Jimmy

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

DEC 1 7 2004

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

Dear Mr. Pedde:

SUBJECT: Submittal of Revision 8 of the DWPF Authorization Agreement and Safety Basis Change Package ABD-DW-04-002 to DOE (Your Letter, 11/23/04)

The Department of Energy Savannah River Operations Office (DOE-SR) has completed its review of the Authorization Agreement (AA) and change package submitted in the referenced letter for the installation of a Melter Glass Pump. Based on the review, DOE-SR approves the AA and the submitted change package. These changes will be incorporated into the Documented Safety Analysis in the next annual update. The enclosed Safety Evaluation Report documents the results of the DOE evaluation and provides 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 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 Jean Ridley at 208-1204.

Sincerely,

Jeffrey M. Allison

Jeffrey M. Allison
Manager

WDED-05-17

2 Enclosures
1. Safety Evaluation Report
2. AA for DWPF

cc w/o Enclosures:
W. J. Johnson, WSRC, 730-1B
H. T. Conner, Jr., 730-1B
J. C. DeVine, WSRC, 766-H
W. S. Shingler, WSRC, 730-1B
L. J. Simmons, WSRC, 730-1B

Enclosure 1: Letter, Allison to Pedde, subject: Submittal of Revision 8 of the DWPF Authorization Agreement and Safety Basis Change Package ABD-DW-04-002 to DOE, dated:

DEC 1 7 2004

Safety Evaluation Report
Revision 2, Supplement 2

Installation and Operation of a Melter Glass Pump
Documented Safety Analysis
WSRC-SA-6, Revision 22
Change Package ABD-DW-04-002

December 2004

Prepared by: Jean M Ridley TA
Jean M. Ridley, P.E.

Reviewed by: James A. Guerry
Jimmy A. Guerry

Approved by: [signature]
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

EXECUTIVE SUMMARY

This Safety Evaluation Report (SER) supplement documents the U.S. Department of Energy (DOE) evaluation of the Safety Basis Change Package ABD-DW-04-002 submitted in Reference 1 for the installation and operation of a melter glass pump (MGP) as an optional top head component. This SER was prepared in accordance with Savannah River Implementing Procedure (SRIP) 400, Chapter 421.1, "Nuclear Safety Oversight," (Reference 2).

The scope of the evaluation focused on the Safety Basis Change Form Request and supporting calculation for the installation of a glass pump. Operation of the glass pump is within the current analyzed safety basis thereby eliminating the need for the melter feed loop restrictions in the Justification for Continued Operation (JCO) for melter glass pump 2 (MGP 2) submitted in Reference 3 and supporting SER Supplement 1. Accordingly, this SER serves as a supplement to the DWPF SER, Revision 2 (Reference 4) and documents the basis for approval of the submitted change package. The glass pump will be an optional top head component.

No Conditions of Approval were identified as a result of the review.

DOE has reviewed and determined that a change to the DWPF Authorization Agreement (WSRC-RP-99-00663, Revision 7) is required as a result of the removal of the JCO.

Final approval of the Safety Basis (SB) document revisions and this SER supplement by the DOE Manager is in accordance with Savannah River Manual 300.1.1B, Chapter 1, "Functions, Responsibilities, and Authorities Procedure" (Reference 5).

1.0 INTRODUCTION

This SER supplement documents the DOE evaluation of the Safety Basis Document (SBD) Change Request Form (CRF) ABD-DW-04-002 for the installation and operation of a melter glass pump. A glass pump (i.e., MGP 2) is installed under a JCO as a temporary modification. The glass pump design life is estimated to be 6 months but may be less depending on melter conditions. Replacement of the pump is part of normal operating conditions. Installation of the glass pump is through an existing melter top head penetration which usually houses the center melt pool thermocouples. The glass pump will perform a minimal amount of mixing in the melter which is expected to improve melt rate and reduce pressure spikes. This is accomplished by pumping molten glass to the melt pool surface to reduce cold cap formation and gas retention. The pump will continue to be evaluated as to its effectiveness and is expected to be made permanent based on past performance. However, the pump is considered an optional component of the melter and can therefore be removed if deemed necessary. The SBD CRF will be incorporated into the Documented Safety Analysis (DSA) during the next annual update.

This change documents that the installation and operation of a glass pump would not allow feed rates greater than the currently analyzed rate of 1.5 gallons per minute (GPM).

This SER supplement documents the basis for approval of the submitted SBD CRF, removal of the JCO, and inclusion of the SBD CRF as part of the DWPF SB.

2.0 REVIEW CRITERIA AND SUMMARY OF CHANGES

The change package was reviewed to ensure compliance with appropriate DOE criteria: 10CFR830, DOE Guide 421.1-2 (Reference 6), DWPF DSA requirements, and technical accuracy. In addition, the change package was reviewed for consistency, completeness, adequacy of justification, documentation, and reasonableness.

The documentation submitted for DOE review included the following:

1. The SBD CRF ABU-DW-04-002 documents the proposed changes to the DSA Section 5.2 *Melter Top Head Components* which added the melter glass pump as an optional top head component;
2. Section 11.5.5 *Melter Off Gas Explosion* which references the supporting calculation X-CLC-S-00139 (Reference 7) and;
3. Section 11.8 *References* which updated the listing of references with the above calculation.

3.0 EVALUATION OF DOCUMENT CONTENT AND CONCLUSIONS

The SBD CRF allows the installation and operation of a melter glass pump as an optional top head component in the DWPF melter. The pump is currently installed under a JCO and is being monitored for its effectiveness. Based on the past performance, the glass pump is expected to be made permanent; however, the current safety basis is based on a maximum feed rate of 1.5 GPM to prevent the possibility of an explosion in the melter offgas system. The feed rate directly corresponds to flammable fuel in the offgas system. The current DWPF safety basis relies on the lower melter vapor space temperature interlock to prevent more than 1.5 GPM feed into the melter. As the feed rate approaches 1.5 GPM the temperature in the vapor space decreases to the point that the 493°C low temperature interlock trips the melter feed tank pumps. This temperature interlock includes a safety margin of 33°C for instrument uncertainties. Without the instrument uncertainties, the minimum measured vapor space temperature that must be maintained during feeding is 460°C. Additionally, the safety basis limits the total organic carbon (TOC) content of the melter feed at less than 18,900 ppm after instrument uncertainties are accounted for.

DOE reviewed the documented justification provided in calculation X-CLC-S-00139 (Reference 7) and concurs that an adequate basis exists to accept operation of a glass pump as the melter is protected against overfeeding above 1.5 GPM.

This justification is summarized as follows:

The calculation assessed the impact of the glass pump on the thermal characteristics of both the melt pool and the vapor space by critically reviewing available Melter 1 and Melter 2 operating data along with data collected from the glass pump.

Besides dome heater power, two melter operating variables have an impact on vapor space temperature: the feed rate and the air purge to the backup film cooler. Because the melter has never been operated at feed rates of 1.5 GPM or at a minimum air purge interlock rate of 233 lb/hr, existing data from the operation of the melter with and without the glass pump was used to establish a baseline of steady state melter operation at a constant feed rate. Once this baseline was established, assumptions were made in the estimation of the steady state vapor space temperature with the feed pump at 1.5 GPM and with 233 lb/hr air purge. The resultant calculations show that operation of the glass pump does not inhibit the minimum vapor space interlock and will not allow inadvertent overfeeding of the melter.

The following inputs/assumptions were reviewed:

1. The baseline steady state feed rate was set at 0.55 GPM based on the findings of the power data analysis for the dome heaters and electrodes.
2. A steady state melter operation can be maintained at 1.5 GPM.
3. The true gas temperature in the melter vapor space is estimated from the measured value by a constant correlation.

The calculation asserts that the impact of the glass pump on the radiative heat loss to the vapor space becomes almost negligible at 0.55 GPM; therefore the vapor space can be effectively isolated from the melt pool and the same energy balance equations can be used to determine both vapor space temperatures with and without the glass pump. The calculation only showed a limited number of data points. DOE confirmed that additional data was provided as input to the calculation (CBU-WSE-2004-00250). This additional data was consistent with the values used in the calculation.

DOE evaluated the impact of additional radiant heat on the melter vapor space temperature interlock. The results of this evaluation concluded that there will be no impact on the vapor space interlock when cold cap coverage approaches current steady state levels (i.e. 80% coverage). With the reduced cold cap coverage expected as a result of MGP operation, the situation (i.e. 3X surge) the interlock is protecting against does not exist. As shown in the melter power operating data, the impact of melt surface temperature on the radiative heat loss to the vapor spaces decreases with increasing feed rate or cold cap coverage; however, once the feed rate exceeds 0.55 GPM, minimal difference could be detected in the vapor space temperature with or without the glass pump. Since the vapor space can be effectively isolated from the melt pool, the same energy balance equations used to establish the baseline data without a pump can be applied to the post-pump operation. Consequently, an assumed baseline steady state feed rate of 0.55 GPM is a reasonable baseline data point for determining temperatures against the highest allowed feed rate of 1.5 GPM.

The calculation also assumes that the 1.5 GPM is steady state. The highest feed rate ever achieved in melter 2 was 0.8 GPM. However, the more typical feed rates are less than 0.65 GPM even with the glass pump. Attempts to achieve higher feed rates have been unsuccessful because of the erratic pour stream and pressure, which is usually indicative of too high a cold cap coverage or overfeeding. Based on operating history, it is very unlikely that the feed pumps would ever run at 1.5 GPM indefinitely even with the most ideal feed stream and glass pump operation. Therefore the assumption that the melter feed would be run at steady state of 1.5 GPM is conservative.

The calculation assumes the actual vapor space gas temperature is estimated from the measured temperature in a thermowell and vice versa using the following correlation: $T_{gas} = 0.91685T_{tw} - 128$. The validity of this equation and its conservatism was confirmed earlier under no glass pump condition on Melter 1. Validation of the equation was extended to glass pump operation by estimating steady state operation (0.55 GPM) and comparing the measured vapor space temperature to those of the predicted values using the equation. With the glass pump, the measured vapor space temperature was 697.4°C which equates to a true gas temperature using the equation of 511°C, whereas the off-gas model results showed that the true gas temperature would be closer to 575°C. This means that the equation under-predicts the calculated true gas temperature by 64°C. When compared to melter 1 without a glass pump, the equation is closer to the actual predictions. This confirms that the equation would be more conservative in the prediction of flammability potential with a glass pump.

The equation is not conservative from the standpoint of protecting the melter from inadvertent overfeeding. However, the interlock is not set based on the actual gas temperature, but on the measured temperature from the thermowell. The interlock is currently set at 493°C which includes instrument uncertainties or 460°C without the instrument uncertainties. The interlock will activate if the thermowell reading goes below this value. The interlock setpoint was established based on Reference 9 (off-gas model). To confirm that the glass pump will not cause inadvertent overfeeding, the calculation was set up to determine the maximum feed rate that would result in the lowest vapor space temperature at which the safety basis limits are just met for both normal and seismic operations. Since the current limit is set at 1.5 GPM based on Reference 9, the calculation re-performed the off-gas model (using plant data with the glass pump) to determine what the vapor space temperature would be at this maximum feed rate with a glass pump. If the measured vapor space temperature (extrapolated to 1.5 GPM with the MGP operation) was equal or lower than the minimum limit of 460°C, the operating variables affecting the off-gas flammability calculation remain the same as their current values, thereby confirming that the interlock would trip before the feed rate exceeded 1.5 GPM. The energy balance equation was used to determine the actual gas temperature at 1.5 GPM. Since the interlock is set using the thermowell temperature, the correlated temperature equation can be used in reverse to find this value. The calculated value for the T_{gas} (actual gas temp.) using the overall energy balance equation with the MGP equaled 293.5°C at 1.5 GPM. When this value is placed into the temperature equation and solved for T_{tw}, the resultant value is 459.7°C, virtually the same as the current safety basis interlock setpoint of 460 °C without the instrument uncertainties. Thus, the initial estimate that the feed rate will not exceed 1.5 GPM is still valid with and without a glass pump under the current operating conditions.

DOE has determined that the inputs and assumptions for the calculation are reasonable and conservative.

4.0 DOE COMMENT RESOLUTION AND DOCUMENT STATUS

As a result of the review, DOE did not identify any comments or outstanding issues requiring a revision to the submitted documents.

5.0 CONDITIONS FOR APPROVAL

No Conditions for Approval were identified as a result of this evaluation.

6.0 CONCLUSION

DOE has evaluated the submitted change package for the melter glass pump for enhanced melter performance. The change package and supporting calculation have shown that there is no impact to the current safety basis. DOE approves the SBD CRF ABD-DW-04-002. The JCO is no longer required. The supporting calculation shows there is no impact in the existing safety margin. In addition, no new accident scenarios or initiators are created.

7.0 CONTRIBUTING REVIEWER

None

8.0 REFERENCES

1. Letter, Pedde to Allison, "Submittal of Revision 8 of the DWPF Authorization Agreement and Safety Basis Change Package ABD-DW-04-002," WSR-2004-00235, November 23, 2004.

2. Savannah River Implementing Procedure, "Nuclear Safety Oversight," SRIP 400, Chapter 421.1, Revision 2, dated October 3, 2003.

3. Letter, French to Hansen, "Request for DOE Approval of Justification for Continued Operation Associated with DWPF Melter Glass Pump," CBU-WSD-2004-00019, August 5, 2004.

4. Letter, French to Hansen, "Request for Department of Energy (DOE) Approval of the Defense Waste Processing Facility (DWPF) Technical Safety Requirements (TSR) Revision 29 and Documented Safety Analysis (DSA) Revision 22," CBU-WSD-2004-00018, July 22, 2004.

5. Savannah River Manual 300.1.1B, Chapter 1, "SR Functions, Responsibilities, and Authorities Procedure," dated June 16, 2004.

6. DOE Guide 421.1-2, "Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10CFR830," October 24, 2001.

7. Calculation X-CLC-S-00139, "Maximum Vapor Space Temperature During DWPF Melter Operation with Glass Pump at 1.5 GPM Feed Rate," September 16, 2004.

8. Letter, Allison to Pedde, "Request for DOE Approval of Justification for Continued Operation (JCO) Associated with the DWPF Melter Glass Pump," DC-04-015, February 5, 2004.

9. Calculation X-CLC-S-00096, "Steady State Indicated DWPF Melter Vapor Space Temperature at 1.5 GPM Feed Rate," August 31, 2000.

DEC 1 7 2004

U.S. Department of Energy
Savannah River Operations Office
and
Westinghouse Savannah River Company

Authorization Agreement (AA)
for the
Defense Waste Processing Facility (DWPF)

Enclosure 2: Letter, Allison to Pedde, subject: Submittal of Revision 8 of the DWPF Authorization Agreement and Safety Basis Change Package ABD-DW-04-002 to DOE, dated:

U.S. Department of Energy
Savannah River Operations Office
and
Westinghouse Savannah River Company

Authorization Agreement (AA)
for the
Defense Waste Processing Facility (DWPF)

Section 1 – Facility Name, Function, and Location

This Authorization Agreement (AA) applies to the DWPF, a large radiochemical facility designed to vitrify high-level waste. The DWPF is located within S-Area of the Savannah River Site (SRS) near Aiken, South Carolina. The facility, major functions, subsystems, and support facilities are described in the Safety Basis (SB) documents as defined in Manual WSRC-IM-94-10, and as shown in Attachment 1 to this AA.

Section 2 – Authorized Scope of Operations

The scope of operational activities being authorized by this AA is as described in: (a) the Work Authorization and Change Control process specified in Contract No. DE-AC09-96SR18500, (b) the DWPF SB, as defined in Manual WSRC-IM-94-10, and (c) the Environmental Impact Statements (DOE/EIS-0082, DOE/EIS-0082-S and DOE/EIS-0082-S2) and the associated Records of Decision, except with the following restrictions:

A. Radioactive operation of 512-S (Actinide Removal Process) is not permitted by this AA revision.

Section 3 – Bases

The Department of Energy (DOE) has determined:

A. Through a series of comprehensive reviews under the Technical Assessment Program, the facility will be operated in compliance with the Standards/Requirements Identification Document (S/RID), WSRC-RP-94-1268 as amended, and this AA as specified in Contract No. DE-AC09-96SR18500, between DOE and Westinghouse Savannah River Company (WSRC). The S/RID has a separate review and approval process and may be amended without need to revise and re-approve this AA.

B. The facility hazards have been adequately analyzed and appropriate operational controls have been employed as properly documented by the DWPF SB listed in Attachment 1 to this AA. The basis for this determination is documented in the DOE Safety Evaluation Report (SER), [Allison to Pedde, DC-04-043, July 29, 2004] as supplemented. Each safety document individually has a separate review and approval process, thus each may be amended without need to revise and re-approve this AA. This AA serves to document the complete set of DOE-SRS-approved safety documents tailored for use by the facility and specifically approved by the DOE as the basis for safe operations. The latest revisions to the WSRC and DOE approved SB documents for the DWPF will be identified in Manual WSRC-IM-94-10, as amended.

C. In accordance with the NEPA regulations, the environmental impacts of facility construction and operation have been evaluated. The environmental impacts of facility construction and operation have been documented in the Environmental Impact Statements. DOE has issued Records of Decision, and the scope of the activity contained in this agreement is consistent with the selected alternative. NEPA documentation has a separate review and approval process and may be amended without necessarily requiring revision and re-approval of this AA.

- DOE/EIS-0082, Final Environmental Impact Statement (Record of Decision 47 FR 23801).
- DOE/EIS-0082-S, Final Supplemental Environmental Impact Statement (Record of Decision 60 FR 18589).
- DOE/EIS-0082-S2, Savannah River Site Salt Processing Alternatives Final Supplemental Environmental Impact Statement (Record of Decision 66 FR 52752).

D. Through the performance of an Operational Readiness Review (ORR), there is reasonable assurance that the facility can be operated without endangering the health and safety of the public, the workers, or the environment [Ref., Action Memorandum, Grumbly (EM-1) to Secretary of Energy (S-1), March 5, 1996].

E. Through DOE's adherence to Federal Acquisition Regulations, Department of Energy Acquisition Regulations regarding selection of competent contractors, as well as WSRC's contractual commitment to an Integrated Safety Management System and S/RID requirements for personnel selection, training and qualification, DOE is assured that WSRC is technically qualified to engage in the activities authorized by this AA.

F. Through DOE's review of an approved and current Radioactive Waste Management Basis, as listed in Attachment 2, the facility's handling, documentation and control of radioactive waste ensures compliance with all state, local, and federal radioactive waste regulatory requirements.

G. Through DOE's review of an approved and current Emergency Preparedness Hazards Assessment, the DWPF response and notification of accident conditions ensures adequate protection for public and workers in surrounding facilities.

H. Through DOE's review of the Safeguards and Security Basis per the General Site Security Plan, WSRC-RP-2000-00968, latest revision as amended, the facility meets its applicable safeguards and security requirements.

Section 4 – Requirements and Conditions

Operation of DWPF is subject to the following requirements and conditions:

A. WSRC shall operate the facilities in compliance with the S/RID (latest revision). In accordance with Contract No. DE-AC09-96SR18500, the S/RID identifies the rules, regulations, orders, standards, and directives of DOE and other federal, state, or local agencies that are applicable to the activities associated with DWPF. Authorized deviations shall be documented by WSRC and approved by DOE through Exemption Requests, Compliance Schedule Agreements, Implementation Plans, or modification of the S/RID, as appropriate. New or revised requirements shall be incorporated into the S/RID as directed by DOE. WSRC shall ensure compliance commitments are tracked and completed within established time frames.

B. WSRC shall operate the DWPF in accordance with the operational controls specified in the latest revision of the SB documents as defined in Manual WSRC-IM-94-10, as amended.

C. WSRC shall implement and maintain an Environmental Protection program complying with applicable environmental protection and environmental permit requirements as specified in S/RID Functional Area 20, "Environmental Protection." Permits with general applicability are listed below. Compliance is required with all applicable permits even if not listed herein.

- South Carolina Department of Health and Environmental Control Wastewater Treatment Facility Permits to Operate #16,783, #11,413, #17,424 (LPPP only), as amended.
- South Carolina Department of Health and Environmental Control Wastewater Treatment Facility Permit to Construct #18,793-IW (512-S), as amended.
- South Carolina Department of Health and Environmental Control National Pollutant Discharge Elimination System Permit #SC0000175 for S-Area outfall S-04, as amended.
- South Carolina Department of Health and Environmental Control Part 70 Air Quality Permit # TV-0080-0041 as it pertains to S-Area, as amended.

D. During an emergency, facility personnel may take emergency actions that depart from a requirement in the approved AA when no actions consistent with the AA are immediately apparent, and when these actions are needed to protect workers, the public or the environment from imminent and significant harm. Such action must be approved as a minimum by a qualified Vitrification Control Room Manager or Shift Manager. Reporting of such departure from the AA shall be coincident with the normal reporting (per Procedure Manual 9B) for the emergency that caused the departure to be necessary.

Section 5 – Contractual Citation Effective Dates and Approval Signatures

This AA is subject to the conditions specified in Contract No. DE-AC09-96SR18500 between WSRC and DOE. DOE and WSRC agree to the conditions and limitations contained herein. The conditions and limitations within this Authorization Agreement are effective upon the date both parties have signed this AA, or, if applicable, upon revision of Manual WSRC-IM-94-10 and implementation of this revision, which shall be completed within 5 days from the date both parties have signed this AA. This AA shall expire upon expiration or termination of Contract No. DE-AC09-96SR18500.

Robert A. Pedde, President
Westinghouse Savannah River Company

11/23/04
Date

Jeffrey M. Allison, Manager
Savannah River Operations Office

12/17/04
Date

Attachment 1
DWPF Safety Basis Documents
(The latest effective revision is defined in Manual WSRC-IM-94-10)

1. DWPF Final Safety Analysis Report, WSRC-SA-6, latest revision, as amended.

2. DWPF Technical Safety Requirements, WSRC-TS-95-0019/S-TSR-S-00001, latest revision, as amended.

Attachment 2
DWPF Radioactive Waste Management Basis Documents

1. DWPF Safety Basis Documents, shown in Attachment 1.

2. S-Area Low Level Waste, Mixed Waste and Transuranic Waste Certification Plan, Q-ESR-S-00001, latest revision, as amended.

3. DWPF Waste Form Qualification Report, WSRC-IM-91-116-X (X=1 through 13), latest revision, as amended.

4. Citation Determination and Evaluation of Waste Incidental to Reprocessing, HLW-SUP-99-0060, latest revision, as amended.

5. Closure Business Unit Implementation of DOE Order 435.1 Container Staging, Inspection, and Monitoring Requirements, CBU-ENG-2003-00052, latest revision, as amended.

6. Federal Facility Agreement for the Savannah River Site, Administrative Document Number 89-05-FF, WSRC-OS-94-42, latest revision, as amended.

Distribution:

J. M. Allison, Manager, SR, 730-B
C. E. Anderson, Office of the Manager, 730-B
K. L. Hooker, OESH, 730-B
C. A. Hansen, AMWDP, 704-S
M. A. Mikolanis, WDED, 707-H
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Records Administration, 773-52A

AUG 20 2004

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

Dear Mr. Pedde:

SUBJECT: Request for Department of Energy (DOE) Approval of Justification for Continued Operation (JCO) Associated With the Defense Waste Processing Facility (DWPF) Melter Glass Pump (Letter, French to Hansen, CBU-WSD-2004-00021, 8/5/04)

DOE Savannah River Operations Office (SR) has completed its review of the JCO submitted in the referenced letter for the installation of a Melter Glass Pump. Based on the review, DOE-SR approves the JCO as a safety basis document. The enclosed Safety Evaluation Report documents the results of the DOE evaluation and provides the basis for approval.

Please take the necessary steps to add the JCO to the WSRC-IM-94-10 Manual as a safety basis document prior to the DWPF steam outage in September. It is expected that the JCO will be canceled or appropriate revisions made to DWPF safety basis documents to incorporate the Melter Glass Pump as a permanent design change within 6 months of installation of the pump. This has been discussed with Marshall Miller of your staff.

It should be recognized that an Authorization Agreement revision is needed to support implementation of the JCO.

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 Jean Ridley at 208-1204.

Sincerely,

Original Signed by
Charles E. Anderson

Jeffrey M. Allison
Manager

WDED:JMR:kl

DC-04-051

Enclosure:
DWPF Safety Evaluation Report
Revision 2, Supplement 1

cc w/o encl:
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W. J. Johnson, WSRC, 730-1B
W. S. Elkins, WSRC, 730-1B
W. S. Shingler, WSRC, 730-1B
J. C. DeVine, WSRC, 703-H

bcc w/encl:
J. L. Barnes, WSRC, 704-S
M. D. Miller, WSRC, 704-S
J. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ
J. A. Guerry, WDED
D. J. Blake, WDED
J. M. Ridley, WDED
T. C. Temple, WDED

bcc w/o encl:
WDED Reading File
AMWDP Reading File
Mgr's Reading File
DMC Rdg File
ECATS (MC #041176)

Subject: DOE Approval of JCO
Associated with DWPF
Melter Glass Pump AUG 20 2004

Safety Evaluation Report
Revision 2, Supplement 1

Justification for Continued Operations
For the Installation and Operation of Melter Glass Pump 2
WSRC-TR-2004-00400, Revision 0

August 2004

Prepared by: Jean M Ridley
Jean M. Ridley, P.E.

Reviewed by: Donald J Blake
Donald J. Blake

Approved by: [signature]
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

EXECUTIVE SUMMARY

This Safety Evaluation Report (SER) supplement documents the U.S. Department of Energy (DOE) evaluation of the Justification for Continued Operation (JCO) supporting installation and operation of melter glass pump 2 (MGP 2) submitted in Reference 1. This SER was prepared in accordance with Savannah River Implementing Procedure (SRIP) 400, Chapter 421.1, "Nuclear Safety Oversight" (Reference 2).

The scope of the evaluation focused on the changes made to the DWPF safety basis to support operation of the MGP 2 and re-verification of existing controls. Accordingly, this SER serves as a supplement to the DWPF SER, Revision 2 (Reference 3) and documents the basis for approval of the submitted JCO. The JCO covers the installation, operation and removal of a pump in the melter, as a temporary modification, to improve melt rates and reduce pressure spikes experienced during operations. The JCO will be effective for a limited duration to evaluate the performance of the MGP 2 during Sludge Batch 3. Based on the pump's performance, steps will be taken to make the installation permanent or the pump will be removed.

No Conditions of Approval were identified as a result of the JCO review.

DOE has reviewed and determined that a change to the DWPF Authorization Agreement (WSRC-RP-99-00663, Revision6) is required as a result of the submitted JCO.

Final approval of the Safety Basis (SB) document revisions and this SER supplement by the DOE Manager is in accordance with Savannah River Manual 300.1.1B, Chapter 1, "Functions, Responsibilities, and Authorities Procedure" (Reference 4).

1.0 INTRODUCTION

This SER supplement documents the DOE evaluation of the JCO (WSRC-TR-2004-00400) for the installation and operation of MGP 2. This JCO is basically a duplication of an earlier JCO which covered installation, operation and removal of the first melter glass pump. The earlier JCO was reviewed and approved by DOE in Reference 7. The first glass pump was removed due to premature degradation. MGP 2 will be installed through an existing melter top head penetration which currently houses the center melt pool thermocouples in the same location as MGP 1. MGP 2 will perform a minimal amount of mixing in the melter which is expected to improve melt rate and reduce pressure spikes. This is accomplished by pumping molten glass to the melt pool surface to reduce cold cap formation and gas retention. The pump will be installed and evaluated as another temporary modification as the design of the pump has been modified and its effect on improved melter performance is still unknown.

Should performance lead to increased production, the pump will be made a permanent installation. Any necessary SB changes will be incorporated into the Documented Safety Analysis (DSA) or Technical Safety Requirements (TSR) such that the JCO will not be needed.

With the expected increase in melt rate with the MGP 2 operational, the melter may support feed rates greater than the currently analyzed rate of 1.5 gallons per minute (GPM). As a compensatory measure, the JCO will protect the maximum analyzed feed rate by limiting melter feed pump operation.

This SER supplement documents the basis for approval of the submitted JCO and their inclusion as part of the DWPF SB.

2.0 REVIEW CRITERIA AND SUMMARY OF CHANGES

The JCO was reviewed to ensure compliance with appropriate DOE criteria: 10CFR830, DOE Guide 423.1-1 (Reference 5), DWPF DSA requirements, and technical accuracy. In addition, the JCO was reviewed for consistency, completeness, adequacy of justification, documentation, and reasonableness.

The documentation submitted for DOE review included the following:

1) The JCO (WSRC-TR-2004-00400) adds a compensatory measure on the operation of melter feed pumps such that one feed pump must be physically isolated and administratively controlled to prevent the operations of more than one feed pump, with the MGP 2 installed.
2) The corresponding Unreviewed Safety Question (USQ) Evaluation (USQE-04-03-S) which identified the impact of the MGP installation on the existing safety basis.

3.0 EVALUATION OF DOCUMENT CONTENT AND CONCLUSIONS

The JCO allows the installation and operation of a pump in the DWPF melter. The MGP concept has been demonstrated at the melter at Clemson University where it was successfully tested. Additionally, a similar pump has been demonstrated at DWPF but the pump degraded faster than was anticipated, thereby forcing its early removal before complete data on its performance with differing frit compositions could be analyzed. The pump is designed to mix molten glass in the DWPF melter which will limit cold cap development and improve melter performance. The pump will be installed through the center thermowell penetration and extend down into the melt pool surface approximately 24 inches. The pump is a hollow tube with an air or argon supply (30 scfh) which is released at the inner lower end of the tube like a bubbler. The flow of air or argon provides the motive force to lift molten glass from below the melt pool surface up the hollow tube to discharge slits at the pool surface. At the slits, molten glass and air or argon is discharged producing mixing. The mixing promotes improved heat transfer decreasing cold cap formation and supports increased feed rates from the Melter Feed Tank. Reduced cold cap formation is expected to reduce in number and magnitude melter pressure spikes that have historically hindered melter operations. The design of MGP 2 has been changed from MGP 1 to increase strength and corrosion allowance by increasing the thickness of the pump in the area of the melt pool line and reducing the number of slits in order to minimize the probability of failure during the pump design life (4 to 6 months).

The supply of air/argon to the pump is controlled by valve operation (manual) and can be isolated if needed. It is expected that the pump will be operating continuously and therefore not require automatic control. The pump will be installed as part of a temporary modification (DWPF-TMC-04-013) and limited to six months of operation. During this time, DWPF will monitor pump performance and gather data to support permanent installation and incorporation of any necessary changes to the DSA and TSR to replace the JCO. Should MGP 2 not improve melter performance, the temporary modification will be removed and the plant placed back into its original configuration.

With the placement of the MGP 2 into one of the existing thermowell locations, thermocouples were incorporated into the MGP 2 design so that (center) temperature monitoring of the melt pool would not be lost. However, these temperature readings will not be used for electrode control. The electrodes will be controlled from the set of outer melt pool thermocouples, which have historically read lower (conservative) than the center thermowell. MGP 2 installation will not impact the location of the safety related melter vapor space thermocouples.

DOE reviewed the revised risk assessment (Reference 6) performed on MGP 2 which identified sixteen risks for evaluation. The DOE review determined that risks associated with the pump were adequately identified and evaluated. The revised risk assessment appropriately evaluated one change from the previous risk assessment on MGP 1. Based on the observed premature failure of the first pump, a potential increase in risk of separation of the lower section of the pump resulting in its falling into the melt pool was identified; however, after design modifications were applied to the second pump, the risk of separation of the lower section of MGP 2 is no more likely than MGP 1. Additionally, one high risk was identified for MGP 1 and is still applicable to MGP 2 and is described below:

The current safety basis is based on a maximum feed rate of 1.5 GPM to prevent the possibility of an explosion in the melter offgas system. The feed rate directly corresponds to flammable fuel in the offgas system. The current DWPF safety basis relies on the lower melter vapor space temperature interlock to prevent more than 1.5 GPM feed into the melter. As the feed rate approaches 1.5 GPM the temperature in the vapor space decreases to the point that the 493° C low temperature interlock trips the melter feed tank pumps.

With the MGP installed in the melter, efficiencies may be increased to the point that the vapor space interlock will not automatically prevent feed rates in excess of 1.5 GPM. The possibility of the temperature interlock not automatically protecting the feed limit was the high risk identified in the risk assessment. The corresponding USQ Evaluation (included in Reference 1) concluded that operation of the MGP would be a positive USQ. Thus, DOE approval is required prior to operating the MGP. The JCO was submitted in Reference 1 to implement additional controls to maintain risk within previously accepted levels. It should be noted that adjustments in the feed rate to the melter require operator action. While the DCS will maintain a setpoint, manual operator action is required to adjust the feed rate up and down.

To prevent the possibility of operations from exceeding the analyzed feed limit, the JCO establishes a compensatory measure/control to physically isolate and administratively control one of two melter feed loops to protect the 1.5 GPM feed limit. This control shall be established before feed flow is initiated to the melter. Start up testing of the melter feed pumps have shown that one pump is capable of 1.0 GPM flow maximum (Reference 8). This test was performed with water, which is less dense than the melter feed material. The isolation of one feed pump effectively limits maximum flow to the melter to 1.0 GPM and conservatively protects the safety basis assumptions. DWPF Engineering personnel verified that no plant modifications have been made since start-up which would impact maximum feed pump output.

In much the same way as when feeding to the melter is stopped, there is the possibility that the MGP will reduce cold cap formation to the point that more radiant heat from the melt pool will impact thermocouple readings in the vapor space. The difference between actual vapor space temperature and indicated vapor space temperature has been analyzed in several calculations. Certain assumptions have been made relative to the temperature correlation and cold cap coverage that may be modified by MGP operation. The additional radiant heat will tend to make the thermocouples read higher than is assumed which would be non-conservative.

DOE evaluated the impact of additional radiant heat on the melter vapor space temperature interlock. The results of this evaluation concluded that there will be no impact on the vapor space interlock when cold cap coverage approaches current steady state levels (i.e. 80% coverage). With the reduced cold cap coverage expected as a result of MGP operation, the situation (i.e. 3X surge) the interlock is protecting against does not exist. The cold cap is postulated to contain combustibles that are quickly released to the vapor space during a surge event. With minimal cold cap, there would be less available gases for a surge release. The surge event also assumes continuous feed to the melter at 1.5 GPM. Therefore, the accident scenario the vapor space interlock is protecting against does not exist in this case and the interlock setpoint of 493°C would be conservative. In addition, the likelihood of operating temperatures being driven down toward the 493°C interlock (where temperature discrepancies come into play) with a significantly reduced cold cap is judged very unlikely. Melt pool temperatures are approximately 1100°C. As more of the melt pool is exposed, additional heat will be supplied to the vapor space pushing actual temperatures upward. Melter vapor space temperature readings have been relatively consistent above 680°C since Melter 2 operations began in May 2003. With the expectation that the vapor space will be slightly hotter for a given feed rate than current operations, the lower operating band limit is not expected to be challenged. Any impact on the vapor space temperature correlation will not impact facility safety functions or accident analysis assumptions.

A review has been conducted and the MGP will not impact the waste qualification process.

4.0 DOE COMMENT RESOLUTION AND DOCUMENT STATUS

As a result of the review, DOE did not identify any comments or outstanding issues requiring a revision to the submitted documents.

5.0 CONDITIONS FOR APPROVAL

No Conditions for Approval were identified as a result of this evaluation.

6.0 CONCLUSION

DOE has evaluated the submitted JCO to install another melter glass pump for enhanced melter performance. The safety analysis impacts identified by the USQ have been addressed by the JCO and the established compensatory measure. DOE approves the JCO (WSRC-TR-2004-00400, Revision 0) for a period of six months from the time of installation of the pump. The JCO establishes adequate controls to protect safety analysis assumptions for maximum feed flow to the melter. By physically isolating and administratively controlling one of the melter feed pumps, maximum feed to the melter is limited to 1.0 GPM versus the analyzed limit of 1.5 GPM. This compensatory measure/control will prevent the possibility of Operations manually exceeding the 1.5 GPM feed rate. With the compensatory measure in place, there is no reduction in the existing safety margin. In addition, no new accident scenarios or initiators are created.

7.0 CONTRIBUTING REVIEWER

None

8.0 REFERENCES

1. Letter, French to Hansen, "Request for DOE Approval of Justification for Continued Operation Associated with DWPF Melter Glass Pump," CBU-WSD-2004-00019, August 5, 2004.

2. Savannah River Implementing Procedure, "Nuclear Safety Oversight," SRIP 400, Chapter 421.1, Revision 2, dated October 3, 2003.

3. Letter, French to Hansen, "Request for Department of Energy (DOE) Approval of the Defense Waste Processing Facility (DWPF) Technical Safety Requirements (TSR) Revision 29 and Documented Safety Analysis (DSA) Revision 22," CBU-WSD-2004-00018, July 22, 2004.

4. Savannah River Manual 300.1.1B, Chapter 1, "SR Functions, Responsibilities, and Authorities Procedure," dated June 16, 2004.

5. DOE Guide 423.1-1, "Implementation Guide for Use in Developing Technical Safety Requirements," DOE G 423.1-1, dated October 24, 2001.

6. Risk Analysis Report, "Air-Lift Pump," M-RAR-S-00003, August 12, 2004.

7. Letter, Allison to Pedde, "Request for DOE Approval of Justification for Continued Operation (JCO) Associated with the DWPF Melter Glass Pump," DC-04-015, February 5, 2004.

8. WSRC SW4-3.3, DWPF Test Results Report, "MFT Component Operation with Water," DWPF-FA-10.01, Revision 0, January 14, 1993.

JUL 2 9 2004

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

Dear Mr. Pedde:

SUBJECT: Annual Update of Defense Waste Processing Facility (DWPF) Safety Basis Documents and Unreviewed Safety Question Evaluation (USQE) Summary Report (Supplemental) – 2004

References: 1. Letter, French to Hansen, CBU-WSD-2004-00018, 06/24/04
2. Letter, Pedde to Allison, WSR-2004-00143, 07/22/04

The Department of Energy Savannah River Operations Office (DOE-SR) has completed its review of Revision 22 to the DWPF Documented Safety Analysis (DSA) and Revision 29 to the DWPF Technical Safety Requirements (TSR) transmitted in Reference 1. Based on the review, DOE-SR approves the submitted changes as safety basis documents. The enclosed Safety Evaluation Report (SER) (Enclosure 1) documents the results of the DOE evaluation and provides the basis for approval. As a result of the review, two revision issues were generated and are summarized here:

1. Discussion of the hazards associated with the Decontaminated Equipment Storage Area (DESA) is basically limited to Chapter 5, "Facility Design". For better consistency and completeness with the DSA format, discussion of the DESA hazards assessment should be included or moved to Section 9.3.2.
2. Discussion is needed in Section 9.4.2.21 to address why the melter steam explosion is not included in the mitigated dose for the high winds accident scenario.

Please take the necessary steps to resolve the above revision issues no later than the next annual update.

The DWPF Authorization Agreement (AA) revision, to remove reference to the melter glass pump Justification for Continued Operation (Reference 2), has been approved and is also enclosed (Enclosure 2).

The DWPF SER has been issued as a new revision (Revision 2) and replaces the previous Revision 1 and the associated SER supplements. Relevant portions of SER Revision 1 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 2 or be issued as a new SER revision. Therefore, please submit by August 31, 2004, an additional AA revision to recognize SER Revision 2 and this approval letter. Due to the nature of the changes associated with the 2004 annual update, the new AA revision need not be approved prior to implementation of DSA Revision 22 and TSR Revision 29.

It is expected that the DSA and TSR revisions will be added to the WSRC-IM-94-10 Manual as safety basis documents within the next 14 days.

The items in this letter have been discussed with Marshall Miller 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 Jimmy Guerry at 208-1218.

Sincerely,

Original Signed By
Jeffrey M. Allison

Jeffrey M. Allison
Manager

DC-04-043

2 Enclosures:
1. DWPF Safety Evaluation Report, Rev. 2
2. DWPF Authorization Agreement, Rev. 6

cc w/o encls:
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/encls:
J. W. French, WSRC, 704-S
J. L. Barnes, WSRC, 704-S
T. J. Lex, WSRC, 703-H
J. Smartt, SRPD, 730-B
R. J. Hardwick (EH-2), HQ
T. C. Temple, WDED

bcc w/o encls:
J. M. Ridley, WDED
J. A. Guerry, WDED
WDED Rdg File
AMWDP Rdg File
MGR's Rdg File
DMC Rdg File
ECAT 040925

Enclosure 1: Letter Allison to Pedde,
Subject: Annual Update of DWPF USQE
Summary Report Supplement 2004

JUL 2 0 2004

SAFETY EVALUATION REPORT

Revision 2

for the
Savannah River Site

DEFENSE WASTE PROCESSING FACILITY
Operated by WSRC under Contract No. DE-AC09-96SR18500

DOCUMENTED SAFETY ANALYSIS
WSRC-SA-6, Revision 22

TECHNICAL SAFETY REQUIREMENTS
WSRC-TS-95-0019, Revision 29

July 2004

Prepared by: James A Guerry
James A. Guerry

Prepared by: Jean M. Ridley
Jean M. Ridley, P. E.

Reviewed by: Thomas C Temple
Thomas C. Temple

Approved by: TC Temple for MAM
Michael A. Mikolanis, Director
Waste Disposition Project Engineering Division

THE OFFICE OF THE ASSISTANT MANAGER FOR WASTE DISPOSITION PROJECT
SAVANNAH RIVER OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY

201679

Executive Summary

This Safety Evaluation Report (SER) revision documents the basis for the U.S. Department of Energy (DOE) approval of the Defense Waste Processing Facility (DWPF) Documented Safety Analysis (DSA, WSRC-SA-6, Revision 22) and associated DWPF Technical Safety Requirements (TSRs, WSRC-TS-95-0019, Revision 29). This SER revision incorporates appropriate discussion from SER Supplement 2, which is still applicable to the safety basis of DWPF. SER Supplement 1, covering the melter glass pump Justification for Continued Operations (JCO) is no longer applicable since the JCO is deleted from the safety basis with removal of the glass pump. The purpose of the DWPF 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 DWPF. The DWPF 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 DWPF is part of the overall High Level Waste Facilities. The DWPF consists of a group of facilities and support services designed to receive, process, treat, store and safely manage liquid radioactive wastes from the Concentration, Storage, and Transfer Facilities. The DWPF includes the Low Point Pump Pit (LPPP), the Actinide Removal Process (ARP) facility, the main Vitrification Building, the Glass Waste Storage Building (GWSB), as well as various support buildings and interconnecting transfer lines.

The DWPF DSA/TSRs evaluated and described in this SER revision constitute the principle 10 CFR 830 compliant safety basis documents for the systems, structures, and components making up the DWPF described above. The DWPF 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 (Evaluation Guidelines); 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 and surface spills of liquid waste. Based on the radioactive material inventory of the facility and projected worst case accident consequences, the DWPF is classified as a Hazard Category 2 nuclear facility in accordance with the guidelines of DOE-STD-1027-92.

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

DOE approves these documents as the DWPF DSA and 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 DWPF. 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 Order 5480.23 compliant DWPF DSA and TSRs	12/1995
1	Consolidates appropriate and applicable information from SER Rev. 0 and 33 supplements; addresses changes made in the DSA and TSRs for the 2003 annual update; addresses the ARP facility; and addresses elimination of the precipitate processing from the scope of DWPF operations.	10/2003
2	Consolidates appropriate and applicable information from SER Rev. 1 and its supplements; addresses changes made in the DSA and TSRs for 2004 annual update such as deletions from programmatic chapters and the addition of safety grade nitrogen check valve testing.	7/2004

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I. Background and Review Process

A. Introduction

The DWPF DSA and TSRs were initially approved by DOE in SER Revision 0 in December 1995 (Reference 1). SER Revision 1, which incorporated 33 supplements (see Appendix B) against Revision 0, was approved in October 2003 (Reference 2). The scope of changes made in DWPF DSA Rev. 22 and TSRs Rev. 29, described below, make it appropriate to revise the SER to consolidate appropriate discussion from SER Revision 1, and the SER supplement associated with the melter single failure vulnerabilities, as well as to address the new changes made in the DSA and TSRs . The supplement (Revision 1, Supplement 2) which addresses the melter glass pump JCO will be excluded since the glass pump has been removed from the facility. Thus, this SER revision:

a. is prepared per DOE-STD-1104 (format and content)
b. incorporates applicable and appropriate information from SER Rev.1 and the supplement covering melter single failure vulnerabilities
c. documents the results of the DOE evaluation of DSA Rev. 22 and TSR Rev. 29.

The DWPF DSA (Rev. 22) and TSRs (Rev. 29) were submitted to DOE by WSRC for approval by a letter dated June 24, 2004(Reference 3). The scope of changes includes:

a. Incorporation of the following change packages: ABD-DW-03-005, GWSB Ventilation; ABD-DW-03-006, Deletion of Zone 2 Monitoring and 831-S Swirl Cell; ABD-DW-04-001, Melter Offgas Single Failure Vulnerabilities.
b. Deletion of the requirements for Hydrogen sniffing of interarea transfer lines except during excavation.;
c. Deletion of surveillance frequencies from Chapter 11 since they are listed as part of the TSR.;
d. Correction of the earthquake mitigated consequence to include a melter steam explosion.;
e. Revision of the safety grade Nitrogen inventory discussion to include leakage of isolation check valves and new surveillance requirements.;
f. Clarification of traffic control discussion in Chapter 11 to be more aligned to TSR.;
g. Substantial deletion of excess detail in all DSA programmatic chapters (i.e. Chapters 8, 10, 12, and 13). Editorial and clarification changes..
h. Modification to the canister vault ventilation system for the glass waste storage building to use either natural convection or forced air;
i. Addition of a new segment to the facility for the decontaminated equipment storage containers area;
j. Incorporation of revisions as part of the 2004 annual update (e.g., editorials corrections, organization updates, laboratory name change, etc.).

The purpose of the DWPF 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 DWPF. The DWPF DSA/TSRs evaluated and described in this SER revision constitute the Nuclear Safety Rule 10 CFR 830 compliant DSA/TSR.

B. Facility Description

The DWPF is part of the overall High Level Waste Facilities and is located in the S Area of the SRS near Aiken, South Carolina. The DWPF consists of a group of facilities and support services designed to receive, process, treat, store and safely manage liquid radioactive wastes from the Concentration, Storage, and Transfer Facilities (CSTF). The DWPF includes the Low Point Pump Pit (LPPP), the Actinide Removal Process (ARP) facility, the main Vitrification Building, the GWSB, as well as various support buildings and interconnecting transfer lines. The primary purpose of the DWPF is to receive liquid high level waste from the CSTF and convert this waste into a durable, solidified borosilicate glass material contained in stainless steel canisters, which are stored in the GWSB until shipped to a national repository.

Various support systems such as ventilation, plant/instrument air, steam supply, normal electrical supply, as well as standby diesel generators, are provided to support waste receipt, treatment, solidification, and storage operations.

The DWPF receives liquid radioactive waste only from the CSTF. The DWPF has a Waste Acceptance Criteria, which controls the acceptance of this waste stream to ensure it complies with the DWPF safety basis requirements.

C. Document Content and Conclusions

The DWPF 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 Chemical Process Cell (CPC) vessel explosions, sludge spills from interarea transfer lines, and the Seismic event. Based on the radiological inventory and projected worst case accident consequences, the DWPF is classified as a Hazard Category 2 nuclear facility per DOE-STD-1027-92 (Reference 4).

The DWPF DSA also describes the site and design of the DWPF, 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 5). 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 DWPF 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 DWPF.

The DWPF 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 DWPF presents an acceptable level of risk. The DSA is formatted in accordance with Reference 6 but contains the technical content required by DOE-STD-3009-94 (Reference 5).

The DWPF TSRs set forth the operating limits, surveillance requirements, and administrative controls which are used by facility operators to ensure the DWPF 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 7).

D. DOE Review Criteria

Review Criteria used in SER Revision 0 through Supplement 29 –
The DWPF DSA was formatted to meet formal Savannah River Operations office guidance (Reference 6) for Safety Analysis Reports. The DWPF DSA was a mature document when DOE Standard 3009 was issued in July 1994 (i.e., all chapters had been prepared, numerous reviews (internal to SRS as well as from DOE-HQ) and comment resolutions had taken place). WSRC revised the DWPF DSA in subsequent revisions to satisfy the technical content requirements of DOE Standard 3009 but did not reformat the entire document to satisfy the format guidance contained in the Standard. A cross-reference matrix, which correlates DOE Standard 3009 topics with the applicable sections of the DWPF DSA which address those topics, is provided in Chapter 1 of the DWPF DSA.

In applying DOE-STD-3009 to its review of the DWPF DSA, DOE focused on evaluating the technical content of the DSA relative to the Standard, and the logical organization and presentation of this content. DOE did not factor into its evaluation whether the information was organized and presented in conformance with the DSA format guidance contained in the Standard. This strategy was considered by DOE to be fiscally sound and technically justified.

The DWPF TSRs were initially written to meet DOE Order 5480.22, "Technical Safety Requirements," (Reference 8). Thus, the DOE review of the DWPF TSRs was performed against criteria drawn from DOE 5480.22. The intent of the DOE review of the DWPF TSRs was to confirm that the DOE 5480.22 requirements were met in terms of content, and organization. The review evaluated the operating limits, surveillance requirements, administrative controls, use and application instructions, and the bases thereof against Chapters 4, 9, and 11 of the DWPF DSA for accuracy, completeness, adequacy, and clarity.

Review Criteria used in SER Revision 0 Supplement 30 through Supplement 33, SER Revision 1 Supplement 1 through 2, and SER Revision 2 –

The DOE review of the DWPF DSA was performed against the criteria contained in DOE-STD-3009-94 (Reference 5). Specific criteria from DOE STD-3009-94 utilized for this review is identified for Section II.B, "Hazard and Accident Analysis"; Section II.C, "Safety Systems, Structures, Components"; and Section II.D, "Derivation of TSRs". In 2001, the DWPF TSRs were revised to satisfy 10CFR830 and its associated Guide G 423.1-1. Thus, the DOE review of the DWPF TSRs was performed against the criteria contained in DOE Guide G 423.1-1 (Reference 7), which superseded (but is very similar to) DOE Order 5480.22. 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 Guide G 423.1-1 utilized for this review is identified in SER Section III for the TSRs.

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 300.1.1B (Reference 11), the SR Manager is the approval authority for this SER.

E. DOE Review Chronology and Methodology

The DWPF DSA (WSRC-SA-6, Revision 22) and TSRs (S-TSR-S-00001, Revision 29) were submitted to DOE in Reference 3. A DOE Review Team (Appendix A) performed a technical review of the DWPF DSA and TSRs.

As listed in section I.A above, a major portion of the changes made in DSA Revision 22 was the removal of excess detail in the programmatic chapters. DOE conducted a review of the revised programmatic chapters versus the requirements of DOE Standard 3009. DOE verified that the required detail remained in the DSA to support the safety analysis and meet 3009 requirements. Most of the deleted detail discussed site level programs that are more appropriately referenced to site level manuals. Where appropriate, certain details of these site programs were described or certain aspects unique to DWPF were identified. Based on the relevance to the safety analysis, varying degrees of detail exists for DOE-STD-3009 requirements. Due to the fact that the DWPF DSA does not follow the 3009 format, extensive use of the Chapter 1 cross-reference was utilized and thus validated.

This SER revision also consolidates applicable discussion from SER Revision 1 and Supplement 2 which is still applicable to the safety basis of DWPF. The review chronology for SER Revision 0 and 1 will not be stated here but this history is available in References 1 and 2.

Two revision issues have been identified in SER Section II.B.6 and Section II.B.10 as noted below:

1. Revision Issue No.: DWPF-2-0-R1–Discussion of the hazards associated with the Decontaminated Equipment Storage Area is basically limited to Chapter 5, "Facility Design". For better consistency and completeness with the DSA format, discussion of the Decontaminated Equipment Storage Container Area hazards assessment should be included or moved to Section 9.3.2.

2. Revision Issue No.: DWPF-2-0-R2 – Discussion is needed in Section 9.4.2 to address why the melter steam explosion is not included in the mitigated dose for the high winds accident scenario, 9.4.2.21.

These revisions are required to be incorporated no later than the next annual update.

F. DOE Conditions of Approval

None.

G. Summary of DOE Evaluation

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; the mitigated accident consequences are well below the offsite Evaluation Guideline; and that all other major programmatic elements covered in the DSA have been deemed adequate to support safe operation of the DWPF. 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 DWPF is acceptable.

Based on DOE review of the Authorization Agreement (WSRC-RP-99-00663, Revision 5) a change will be required to address removal of the glass pump JCO and recognize issuance of this SER as a revision.

H. References

1. Letter, Fiori to Schwallie, "Approval of the Defense Waste Processing Facility (DWPF) Safety Analysis Report (SAR) (WSRC-SA-6) and Technical Safety Requirements (TSRs) (WSRC-TS-95-0019)," November 21, 1995, MC-96-0015.
2. Letter, Allision to Pedde, "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.," October 17, 2003, DC-04-001
3. Letter, French to Hansen, "Annual Update of DWPF Safety Basis Documents and USQE Summary Report (Supplemental) – 2004," June 24, 2004, CBU-WSD-2004-00018.
4. 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"
5. DOE-STD-3009-94, 7/94 and Change Notice #2, 4/02, "Preparation Guide for Nonreactor Nuclear Facility DSAs"
6. DOE-SR Savannah River Operations Manual, SROM-5480.5-1, Nonreactor Nuclear Facility Safety Analysis Report Format and Content Guide," 2/89
7. DOE Guide G 423.1-1, "Implementation Guide for Use in Developing Technical Safety Requirements," 10/24/2001
8. DOE Order 5480.22, "Technical Safety Requirements," 2/25/2002
9. DOE-STD-1104-96, 2/96 and Change Notice #1, 5/02, "Review and Approval of Nonreactor Nuclear Facility DSAs"
10. DOE-SR SRIP 400, Chapter 421.1, "Nuclear Safety Oversight," 6/12/2003
11. DOE-SR SRM 300.1.1B, "Human Resources Program Management Manual," 6/29/2003

II. Documented Safety Analysis (DSA) Approval Basis

The five DSA approval bases required by DOE-STD-1104-96 are described in Sections II.A through II.E below. [Note, references referred to in the text of Section II are provided at the end of that particular Section.]

A. Base Information (DSA Chapters 1, 2, 3, 5, and 6)

The DSA contains sufficient background and fundamental information to support the review of the technical aspects contained in Chapters 4, 9, and 11, and the TSRs. Most of the base information is contained in the Chapter 1 (Introduction and General Description of the DWPF), Chapter 2 (Summary Safety Analysis), Chapter 3 (Site Characteristics), Chapter 5 (Facility Design), and Chapter 6 (DWPF Process Systems). These chapters were reviewed against the DOE-STD-3009-94 criteria and the results have been summarized below.

Chapters 1 and 2: These chapters describe the mission of the DWPF 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). The DWPF was segmented and categorized overall as Hazard Category (HC) 2, in accordance with DOE-STD-1027-92. The Glass Waste Storage Building Operations Area, the Cold Chemical Feed Storage Facility, Decontaminated Equipment Storage Area, and the Chemical and Industrial Waste Treatment Facility are categorized as Hazard Category 3 segments. The Service Building and Glass Waste Storage Building Office Area are categorized as Non-Radiological segments. The remaining segments, including the Vitrification Building, Low Point Pump Pit, the Actinide Removal Process, and the GWSB Vault area are Hazard Category 2. Chapter 1 briefly describes the facility overview (e.g., geography, demography), provides a facility description (including major process systems), briefly describes the various organizations associated with DWPF, and provides a clear description of the interfaces with the CSTF. A cross walk of the DSA chapters compared to the DOE-STD-3009 format chapters is included in Chapter 1, Section 1.7. Chapter 1 also contains changes to the glass waste storage building canister vault to include natural convection cooling or forced air ventilation. Chapter 2 provides a summary of the safety analysis and its conclusions. Chapter 2 also discusses the Consolidated Hazards Analysis effort on ARP. The major hazards are identified as fires, explosions, uncontrolled chemical releases, and radioactive material spills. The main preventive or mitigative features have been identified as passive primary and secondary containments, ventilation/purge systems, temperature monitors, and pump interlocks.

DOE has determined that the Introduction and General Description and Safety Summary meet the guidance of DOE-STD-3009-94 Chapters 1 and 2.

Chapter 3: The DWPF position relative to the site boundary, waterways, and other facilities, such as the canyons, RTF, reactors, and administrative areas were included. 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 DWPF 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 DWPF 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 risks associated with these other facilities are considered minimal due to being shutdown or distance from S-Area and therefore have no impact on the DWPF. The DWPF safety analysis was reviewed, and it was determined that design features, administrative controls, and safety programs protect onsite workers, including DWPF personnel and pose no significant risk to the DWPF. 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 DWPF DSA and those used in the existing environmental analyses.

DOE has determined that Chapter 3 meets the guidance of DOE-STD-3009-94.

Chapters 5 and 6: Chapter 5 provides a description of the design considerations and criteria utilized to control the hazards within DWPF. The criteria used for structural classification of the facility's systems, structures, and components considered the hazardous material at risk, the credited safety functions during normal and abnormal operations, the consequences to the workers and public due to failure, and the cost of repair/replacement. Confinement of radiological and chemical hazards are provided by passive containment, ventilation, and appropriate treatment or handling of the hazardous material. A discussion is provided regarding human factors studies that have been performed since the initial design of the facility.

DSA Section 5.1.6 discusses Human Factors Engineering (HFE). Section 5.1.6.1 identifies the requirements for new projects or major modifications and cites the SRS Engineering Standards Manual, WSRC-TM-95-1, Revision 18. DOE reviewed Attachment 1, "National Codes and Standards for Engineering/Design Task Matrix" of this Manual to determine what design requirements are specified. The following Standards are identified for HFE applications:

- NUREG-0700, "Human-system Interface Design Review Guidelines",
- IEEE 1023, "Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations",
- IEEE 845, "Guide to Evaluation of Human-system Performance in Nuclear Power Generating Stations", and
- IEEE 1289, "Guide for the Application of Human Factors Engineering in Design of Computer Based Monitoring and Control Displays for Nuclear Power Generating Stations"

DOE has clearly conveyed its expectations to utilize industry codes and standards. DOE Order 252.1, "Technical Standards Program" states one of its objectives is to promote the use of voluntary consensus standards within DOE and requires each organization to select, use and adhere to appropriate voluntary consensus standards. In addition, AB Implementing

Document 001-04 (Reference A.1), endorsed by DOE (Reference A.2), states, "The design codes and standards for other than Safety-Class and Safety-Significant SSCs ... shall be to the applicable industry codes and standards." DOE Handbook 1132-99, "Design Considerations", cities IEEE-1023 for electrical and I&C design considerations. In addition, NUREG-0700 is repeatedly cited in DOE Order 6430.1A (part of original design basis for DWPF) as a source of additional information. The scope of referenced IEEE standards was reviewed and found to be relevant to DWPF. The use of these standards for any major modifications at DWPF is judged to be acceptable.

Additionally, DSA section 5.5.1.1 recognizes that the number of available storage locations in the Vitrification Building exceeds the number of canisters considered in the original shielding evaluations. Specifically, the number of canisters considered was changed for the following locations:

1) Canister Decontamination Cell (CDC) was increased from 4 to 6,
2) CDC to Weld Test Cell (WTC) Transfer Tunnel was increased from 1 to 2, and
3) Melt Cell (MC) was increased from 5 to 20.

WSRC Inter-Office Memorandum ESH-HPT-97-0279, "DWPF Shielding Evaluation for Canisters in Additional Storage Locations (U)", was cited as documenting the acceptability of the increased number of stored canisters.

The DSA, Paragraph 5.5.2.1, "Design Considerations", states the shielding design limits the dose rates in areas routinely occupied to a maximum of 0.5 mrem/hr and in intermittently occupied areas (<10% of the normal work year) to a maximum of 5.0 mrem/hr. As stated in the DSA, these design considerations were consistent with DOE Order 5480.11, "Radiation Protection for Occupational Workers." This is also consistent with DOE Order 6430.1A, Section 1300-6.2, "Shielding Design" which states the shielding design basis shall be to limit the maximum exposure to an individual worker to one-fifth of the annual occupational external exposure limits specified in DOE 5480.11.

ESH-HPT-97-0279 was reviewed by DOE to confirm the above criteria were still met with the additional canisters. It summarized the results of Radiological Engineering Calculations NLS0148, "DWPF Shielding Evaluation For Canisters in Additional Storage Locations (U)", and NLS0149, "Neutron and Photon Dose Rates From a DWPF Canister in Air and Through Concrete and Shield Windows." These were also reviewed. These documents adequately demonstrate that the design considerations of the DSA are satisfied with the additional canisters using the design basis glass source term.

Chapter 9, "Accident Analysis" was also reviewed and it was confirmed that the additional canister loading had no significant impact on any Design Basis Accidents. This is based on the position that the form of the glass and its low respirable fraction ensure they are not a significant source term (when compared to other sources within the building) in accidents involving the Vitrification Building.

The effect of the additional canisters on Safety Class equipment was considered to ensure the additional sources did not result in exceeding the applicable equipment radiation design requirements. HLW-DEN-98-0232, "Radiation Environment Effects on Safety Class Equipment with Increased Number of Full Canisters (U)", documented this evaluation. This evaluation was reviewed by DOE and provided adequate justification that the additional canisters did not result in unacceptable dose rates for impacted equipment.

The following discussion addresses specific changes in Chapter 5 as a result of the 2004 annual update.

Incorporated change package ABD-DW-03-006, "Deletion of Zone 2 Monitoring and 831-S Swirl Cell" that resulted in a negative USQ. The swirl cell monitoring system located in the effluent collection line for the service building, cold chemical feed area, and cooling tower system is no longer required. This capability was removed based on discussions with DHEC and the utilization of the remaining swirl cell monitor. This change was incorporated into several sections of the DSA including Chapter 7, 13, and 14. One swirl cell monitor will remain for the cooling tower water return line for contamination detection prior to release of the effluent to the DWPF outfall.

Modified the discussion of the chemical monitoring for the Zone 1 and 2 exhaust to remove two systems no longer in service: the Mercury Monitor and Effluent Airborne Chemical Monitor. These systems are not required to meet any regulatory requirements and process information is utilized to determine chemical releases when required.

Incorporated change package ABD-DW-03-005, "GWSB Ventilation" System that modified the canister storage vault ventilation to include natural convection air cooling and removed the requirement for the exhaust to be filtered through high efficiency particulate air filters (HEPA). Based on 8 years of radioactive operations, use of HEPA filters has been shown to be unnecessary. Additional discussion on the GWSB ventilation is in Section II.C.10 of this SER.

DSA section 5.4.15, Decontaminated Equipment Storage, discusses the addition of engineered containers (SeaLand or equivalent) in an area outside of Building 221-S to store decontaminated equipment from DWPF. This facility segment was determined to be a Hazard Category 3 nuclear facility segment based on radionuclide inventory (discussed further in SER section II.B.3). A bounding consequence analysis showed the potential consequences from the hazards associated with this storage location are minimal and no specific safety class or safety significant controls are warranted for this storage area (discussed further in SER section II.B.6). DOE reviewed the DWPF Storage Container Operating Plan (CBU-WSE-2003-00215) and found it to identify appropriate considerations for the control and placement of the SeaLand containers to minimize the hazards, personnel exposure, and the potential for damage. Considerations such as appropriate radiological controls, heavy rigging/lifting, ventilation, types of internal heaters, drainage of storage area, etc. are identified, as well as the need to perform certain inspections and tests for leak-tightness prior to receipt. Proper implementation of these considerations will ensure storage of decontaminated equipment within the SeaLand (or equivalent) containers as described in DSA section 5.4.15 represents minimal risk to workers and the environment.

Chapter 6 describes how the DWPF, including the LPPP and ARP segments, integrates with the other High Level Waste facilities. The principal product of the DWPF process is identified as borosilicate glass in a sealed container. Major process operations within the scope of the DWPF DSA are described in Chapter 6. These include Actinide Removal, Melter Feed Preparation, Process Vessel Ventilation, Melter Operation, Canister Cleaning, Welding, and Transfer, Mercury Recovery, and Waste Collection and Recycle. The Actinide Sludge Removal Tank (located in the Chemical Process Cell), which was previously called the Precipitate Reactor Bottoms Tank, will receive ARP feed from the Low Point Pump Pit. This feed material will be added to the Sludge Receipt Adjustment Tank (also located in the Chemical Process Cell) and eventually processed into canisters with sludge from H-Area. The basic processes and principal operations performed are illustrated in process flow diagrams. Process support systems and their contribution to plant operation and/or safety are briefly described. It is noted that although the vitrification process is normally controlled from the Central Control Room, the entire process can be controlled from a local field operating station located in an accessible service area of the building. Thus, the control room can be evacuated without affecting the safety of the plant. Process sampling and analytical capability is discussed to support processing the material.

DOE has determined that DSA Chapters 5 and 6 meet the guidance of DOE-STD-3009-94 Chapter 2.

A.1 References

A.1 Letter, Johnson to Tripp, "Authorization Basis Implementation Documents," 11/14/1997 [Enclosure 1 – ABID-004: Safety Class and Safety Significant Design Criteria]

A.2 Letter, Sjostrom to Oakland, "Authorization Basis Implementation Documents," 1/14/1998, VC-98-0044

B. Hazard and Accident Analysis (DSA Chapter 9)

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

The introduction and requirements section of DSA Chapter 9 discusses the process used to identify and assess the hazards associated with the facility. Hazard identification, categorization, hazard evaluation, and accident analyses are discussed. Appropriate requirements are listed as the basis for this evaluation; for example, 10CFR830, STD-3009, STD-1027, STD-5502, and S/RIDs. The chapter organization is discussed and a summary of the accident analysis results are presented. The organization and summary discussed are consistent with the contents of the remaining chapter.

The hazard and accident analysis for DWPF, with the exception of 512-S and the interarea transfer lines, was performed using the Preliminary Hazards Analysis (PHA) process with SSC's functionally classified in accordance with WSRC Manual E7, Procedure 2.25, Revision 3. This methodology was evaluated and approved by DOE in DWPF SER Revision 0 (Reference B.1). A Probabilistic Safety Analysis (PSA), WSRC-TR-95-0198, was performed for quantitative analyses on the initial design of the DWPF and as a design verification to support initial operation in 1996.

In accordance with the DOE approved Safety Basis Strategy for DSA Revision 21 (Reference B.2), the 512-S facility and interarea transfer lines were analyzed using the Consolidated Hazards Analysis (CHA) process with functional classification in accordance with E7/2.25 Revision 13. The methodology used in a PHA and CHA are similar; however, the binning of hazards and EGs are different. DOE has previously reviewed and accepted the new methodology and EGs as evaluated in the CSTF SER Revision 0 (Reference B.3). DOE assessed the results of the re-analyses for DWPF (i.e., all scenarios except for 512-S and the interarea transfer lines) and concluded no new controls would have been identified had the latest EGs (E7/2.25, Rev. 13) been used.

Based on DOE reviews, the criteria to provide objectives and scope and to list relevant requirements documents have 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

Section 9.3.1 discusses the types of hazards identified in the DWPF PHA and CHA, the role of DID and Functional Classification to identify the DBAs and the SSCs that provide protection for the site worker. DBAs were examined for all modes of operation (i.e., Operation, Standby, Shutdown, and Deinventoried) and the bounding accident scenario, based on frequency of occurrence and the onsite/offsite consequences, was included in this DSA. This section also discusses the results of the PHA effort for the DWPF and its related facilities, and provides:

- The implemented methodology.
- The identification of the PHA hazards.
- The evaluation and binning of the PHA postulated accident consequences.
- The selection of the set of postulated accidents from the PHA requiring detailed quantitative analyses as part of this DSA accident analysis development.
- The analyses of the selected DBAs in the DSA considering all modes of operation in which that accident could credibly occur.
- A statement that the DID determined an adequate set of multiple confinement barriers and systems that restrict releases of radioactive material or hazardous chemicals to the environment or into areas normally occupied by plant personnel.
- A brief summary of the safety significant SSCs and plant programs that provide worker safety.

This section states and shows that large releases to the environment are prevented due to multiple confinement barriers (e.g., process tanks and piping, surrounding structures such as the 221-S building and LPPP, and Zone 1 Ventilation with sand filter).

For portions of DWPF other than ARP and the interarea transfer lines, Section 9.3.1 states that the S-Area DWPF PHA (WSRC-TR-94-0586) was used to identify and characterize the DWPF hazards and to perform a systematic evaluation of the postulated accidents. The graded approach was the overall methodology used in the analysis. Detailed walkdowns of the DWPF operation facilities were conducted by a 4-person WSRC/SAIC survey team ~1994-1995. Standard industrial hazards were evaluated only to the degree that they were initiators and/or contributors to accidents in the DWPF process and/or related activities. Hazards were identified from previous process experience, flowsheets, and similar hazards in other facilities. The hazards were grouped under the DOE MORT categories as; Energy Source Hazards, Stored Inventory, Material Processing Inventory, and Chemical Inventory. DBAs were developed for these hazards through many techniques, including Failure Modes and Effects Analysis (FMEA), Event Tree Analysis (ETA), Fault Tree Analysis (FTA), Hazard and Operability Studies (HAZOP). The hazards were evaluated qualitatively to estimate the frequency of occurrence and the onsite/offsite consequences to the public, facility worker, and the environment. The accident scenarios were then ranked to identify the moderate and high risk accidents that required further evaluation in accordance with DOE-STD-3009-94 guidance. The PHA (WSRC-TR-94-0586) has not been revised. Supplemental analyses for new/revised scenarios were incorporated into the DSA directly or by reference and evaluated by DOE in SER supplements subsequent to SER Revision 0.

For the ARP segment of the facility and the interarea transfer lines, DOE reviewed the Consolidated Hazards Analysis (Reference B.4). The methodology used (Hazard and Operability Analysis) for the unmitigated hazard evaluation was based on DOE-STD-3009-94 and the WSRC 11Q manual. A multidisciplinary team binned events based on a frequency/risk rating of the event. No ARP events tripped any offsite guidelines and therefore no ARP events were required for accident analysis. However, for completeness, one ARP scenario (explosion in the LWPT and LWHT) was analyzed using the same methodology as used for explosions within the LPPP. The results of this analysis confirmed the CHA conclusion that no safety class controls were required for offsite protection.

Based on DOE staff reviews, the DSA adequately addresses the criteria outlined in Section 3.3.1, Methodology, of DOE-STD-3009-94. The methodologies described for identifying the types of hazards, identifying the hazard locations, and identifying the release scenario are acceptable.

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

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.

<u>Evaluation</u>

Segments other than ARP and Interarea Transfer Lines –
The DWPF PHA (WSRC-TR-94-0586) identified 31 hazards being required for detailed accident analyses; however, since the precipitate process is longer part of the DWPF flowsheet, the DSA only identifies 19 hazards (related to sludge only operations) in Table 9.3-3 as hazards requiring accident analyses. The DOE staff review judged these hazards to encompass a full range of scenarios were considered when compared to guidance given in DOE/TIC 11603, Rev. 1, DOE 6430.1A, and LA-10294-MS. Four of these accidents were ranked as an 8 (high consequence with an unlikely frequency of occurrence), thirteen were ranked as a 6 (high consequence with an extremely unlikely frequency of occurrence), and two were ranked as a 5 (moderate consequence with an unlikely frequency of occurrence). The DSA identifies the accident scenarios evaluated in the DSA for each hazard. The consequences and frequency of occurrence of the hazards described in Table 9.3-3 are unmitigated.

Natural phenomena accidents [e.g., earthquakes, high winds (includes tornadoes and hurricanes)], although not addressed in the PHA, were considered high risk based upon chemical and radiological inventories and were not evaluated in the PHA because they automatically would be evaluated in the DSA. These hazards were evaluated in the DSA.

The identification and documentation of the hazardous materials found in the DWPF led to the segmentation and hazard categorization per DOE-STD-1027-92. This standard permits the concept of facility segmentation provided the hazardous material in one segment cannot interact with hazardous material in another segment. This could be demonstrated by barriers, independent HVAC systems, and independent piping. An explanation on the segmentation of the DWPF processes into 10 different segments is discussed in Section 9.3.2.1 (ARP and Decontaminated Equipment Storage Area segments are discussed below).

A systematic review of the PHA identified potential accidents that resulted in a moderate or high radiological or chemical consequence to the facility worker, onsite worker, or to the offsite public. The accidents were further evaluated to determine DID with respect to Mitigative and Preventive Functions to identify the number of LOD for protection of the facility worker, onsite worker, the offsite public, and the environment per WSRC Manual E7, Procedure 2.25, Revision 3. DOE staff review found the DID and LOD to be adequate for each accident evaluated. This review used the requirements from WSRC Manual E7 which adequately implements the requirements from DOE-STD-3009-94.

Worker safety design features are discussed in Chapter 4, the DWPF Safety Programs (e.g., Radiation Protection, Industrial Hygiene, Industrial Safety, Criticality Safety, and Fire Safety) are discussed in Chapter 8, Emergency Preparedness is discussed in Chapter 13, and the assessment/audits of these programs are discussed in Chapters 10 and 12. Table 9.3-10 lists the PHA hazards that, if unmitigated, could exceed the EGs for the onsite worker. The safety significant SSCs and administrative controls that mitigate or prevent the scenario from happening and the safety significant function of the SSCs are given. The design and operation features of the DWPF ensure confinement of the hazardous materials, chemical and radiological, present during the operation of the DWPF. Chapter 4 discusses the Safety SSCs for the DWPF.

The DOE staff review of Table 9.3-10 found it consistent with and properly covered in Sections 4.3 and 4.4 for safety class and safety significant features.

To provide the facility with flexibility when handling canisters, DOE assessed moving canisters without the final closure weld into the GWSB. Upon evaluation this activity was determined to be acceptable. This was because the internal plug, which must pass a leak check, will be installed. Also, given the low release fraction, the amount of radioactive material per canister, and atmospheric dispersion, the consequences due to a single glass canister rupture are insignificant (M-CLC-S-00691).

ARP Segment and Interarea Transfer Lines –
Two tables are provided in Chapter 9 for the bounding radiological (9.4-1b) and chemical (9.4-14) concentrations at ARP. These concentrations are controlled via the DWPF Feed Acceptance Criteria and Waste Acceptance Criteria. The volume of material analyzed for the ARP facility is bounded by the storage and processing vessels capacity. DOE judges this quantity to be conservative based on the maximum capacity of the LWPT, the LWHT and the filtrate tank. No explosive or flammable materials are used in the 512-S ARP process. The assumed radionuclide concentrations were found to be consistent with the values in Chapter 9. DOE reviewed calculation S-CLC-S-00126 and –00098 (derived the ARP dose potentials (rem/gal)) and found them reasonable and consistent with the derivation in the CSTF DSA (WSRC-SA-2002-00007). Other key inputs for tank volumes and temperature were found to be consistent with or conservative to actual conditions.

Table 9.3-11 provides the CHA results for the ARP and interarea transfer lines. DOE reviewed Table 9.3-11, as well as the supporting CHA report (Reference B.4) and found it to be comprehensive and thorough. Postulated events and their supporting calculations were found consistent with similar facilities within the CSTF as evaluated by DOE in Reference B.3. The estimated frequency and consequences of the events were judged to be conservative. As stated earlier, none of the ARP-specific events were of a level requiring detailed accident analysis. However, several of the transfer line events were identified for detailed accident analyses and were properly carried into DSA section 9.4.2. Also, for those ARP and transfer line events identified in Table 9.3-11 warranting safety significant controls for worker protection, these controls were found properly identified in Chapter 4 (for SSCs) and Chapter 11 (for administrative controls).

Table 9.3-11 which identifies events and lists safety significant structures, systems, and components and associated controls was modified to credit the transfer line jackets and Leak Detection Boxes for secondary containment following an explosion in a transfer line jacket.

The 512-S ARP facility is a segment of the overall DWPF hazard category analysis. The boundary between the segments is defined with the 512-S facility being physically separate from the remainder of the DWPF facilities. Based solely on inventory of radionuclides, 512-S ARP is classified as Hazard Category 2 facility. Based on the result of the CHA (Reference B.4), 512-S ARP is correctly categorized as a Hazard Category 2 Nonreactor Nuclear facility. From a chemical perspective, 512-S ARP chemical quantities were compared to 29CFR1910, 40CFR68, 40CFR302, and 40CFR355. Based on this analysis, 512-S ARP was categorized as a Low Hazard Chemical Facility (EM-STD-5502).

The Decontaminated Equipment Storage Area is treated as a separate segment based on the physical separation that exists from the remainder of the DWPF facilities. Based solely on inventory of radionuclides, the Decontaminated Equipment Storage Area is classified as a Hazard Category 3 facility. Based on the result of the Hazards Assessment Document Determination (HADD, WSMS-SAE-M-04-0001, Ref 156 in DSA), the decontaminated equipment storage area is correctly categorized as a Hazard Category 3 Nonreactor Nuclear facility. Chemical hazards were assessed and determined to not be a concern from a personnel exposure or environmental standpoint. DOE review of the HADD, and its supporting reference CBU-WSE-2004-0001, concluded the number of SeaLand containers (5) assumed stored, the number/type of equipment stored in these containers, the volume of residual waste assumed to be within this equipment, and the constituency of this waste (concentrated sludge slurry in SRAT), were appropriately conservative. The resulting sum of fractions comparison to Hazard Category 2 (0.07) and Hazard Category 3 (14.1) showed the Decontaminated Equipment Storage segment to be clearly within Hazard Category 3 and have significant margin below Hazard Category 2. To support the volume of residual waste assumed to be within the stored equipment, DSA Section 5.4.15 properly captures the commitment to decontaminate the equipment by appropriate means prior to storage by reference to CBU-WSE-2004-00001 which derived the Decontaminated Equipment Storage Area inventory. Report CBU-WSE-2004-00001 states that in all cases, a water rinse (or high pressure water blast) followed by air drying will be performed. Other techniques are also available (high pressure water, CO_2 blasting, and/or nitric acid cleaning) and will be used as appropriate.

Based on DOE review, the criteria to identify and classify hazards have 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

No future operational safety improvements or design changes were identified, including the 512-S Facility.

Based on DOE review, the criteria to identify planned design and operational safety improvements have 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 9.3.2.1 discusses the defense in depth for the DWPF and Tables 9.3-10 and 9.3-11 show appropriate DID safety significant controls are identified consistent with WSRC Manual E7, Procedure 2.25. Also, in accordance with E7/2.25, DSA Section 9.1.1.2 discusses defense-in-depth evaluation and concludes that non-SC/SS SSCs or administrative controls are not required for defense-in depth since the consequences associated with offsite accidents do not exceed the evaluation guidelines when credit is taken for SC and SS SSCs and/or TSRs.

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

DSA section 9.3.2.1 discusses worker protection and notes the SS controls in Table 9.3-10 as well as key administrative controls identified through the PHA for worker protection (e.g., Radiation Protection, Industrial Hygiene/Safety, Fire Protection, etc.). Chapters 8 and 10 provide details of these administrative controls.

For the ARP facility, a summary of the administrative controls credited to provide worker protection is provided in Section 9.3.2.2 of Chapter 9. The only Safety Significant SSC directly associated with ARP is the Backpulse Vault Structure Design Feature. Its credited worker protection function is to provide shielding and prevent access during normal operations. The Radiation Protection Program is credited with preventing access though the Vault door (e.g., control of high radiation area) during normal operations.

DSA Table 9.3-10 also evaluates the interaction of Sodium Nitrite and acid. The combination of these chemicals has been demonstrated to release Nitrogen Dioxide (calculation S-CLC-S-00086, Rev. 0). Quantities of these chemicals at DWPF represent a potential threat to facility worker safety should the chemicals mix. Acids identified as available for potential interaction with Sodium Nitrite are nitric acid, formic acid, and oxalic acid. New controls and system upgrades were documented to reduce the likelihood or eliminate the possibility of interaction. The Sodium Nitrite Makeup Tank, dike, and piping were qualified to PC-2 for high winds and earthquakes. This tank is located in the Cold Chemical Area contained in a dike. The NPH qualification of the tank maintains the contents such that high winds or an earthquake will not breach the system.

Table 9.3-11 identifies two scenarios from the CHA regarding transfer line explosions which require safety significant controls for worker protection: (1) explosions in the transfer line core pipe, and (2) explosions in the transfer line secondary containment/jacket. For explosions inside the core pipe (above and below ground), calculation T-CLC-H-00662 shows the core pipe will withstand the internal pressure so no core pipe failure occurs and minimal consequences result. Calculation T-CLC-H-00662 is further discussed in Section C.10 of this SER.

For explosions in the secondary containment/jacket, the above ground portion and below ground portion are protected differently based on differences in design. Calculations T-CLC-H-00662 and T-CLC-H-00686 show that the above-ground portion of the core pipe, secondary containment/jacket, and seal plate at the H-Tank Farm valve boxes will withstand the resulting pressures so no core pipe failure occurs and minimal consequences result. The Emergency Response Program provides additional mitigation by evacuating workers from any resulting plume release. Thus, the controls for this scenario are:

1. core pipe credited to prevent leakage (prevents event) and credited to withstand external explosion pressure (prevents spillage, thus mitigates consequences if jacket explosion occurs),
2. jacket/seal plate credited to withstand internal explosion pressure, thus mitigating consequences, and
3. Emergency Response Program credited to mitigate consequences via evacuation.

DOE reviewed calculation T-CLC-H-00686 and noted that the stress analysis performed was based on nominal pipe wall thickness versus minimum wall thickness. However, DOE concluded that sufficient margin existed such that the use of minimum wall thickness would not impact the conclusion that the core pipe and jacket can withstand the explosion pressure.

For the below ground portion, again, calculation T-CLC-H-00662 shows that the core pipe can withstand external pressures from the explosion. Additionally, calculation S-CLC-S-00116 shows that the dose reduction from the secondary containment/jacket (not as robust as above-ground portion, so partially fails) and 3 feet of soil significantly reduces the consequences. Thus, the controls for this scenario are:

1. core pipe credited to prevent leakage (prevents event) and credited to withstand external explosion pressure (prevents spillage , thus mitigates consequences if jacket explosion occurs),

2a. jacket/secondary containment/soil credited to provide significant source term reduction, thus mitigating consequences,

2b. if excavation is to occur within 4 feet of jacket/secondary containment, flammable vapor monitoring program credited to identify flammable vapors in jacket/secondary containment before reaching LFL, and

3. Emergency Response Program credited to mitigate consequences via evacuation.

DOE reviewed calculation S-CLC-S-00116 and concluded this calculation used inputs consistent with transfer line configuration; standard handbook values for parameters such as friction factors, loss coefficients, heats of combustion, etc.; and that the assumptions were reasonable. Additionally, the methodology employed in calculation S-CLC-S-00116 was reviewed and found to appropriately bound the event scenario. Based on this review, DOE concluded that the significant source term reduction derived in calculation S-CLC-S-00116 was reasonable and that providing at least 3 feet of soil coverage was an effective control. Table 9.3-11 identifies the need for the Configuration Management Program to maintain the below ground portion of the secondary containment/jacket covered with earth. DSA section 4.4.39 refers to calculation S-CLC-S-00116 and commits to maintaining 4 feet of soil coverage around the below ground transfer line jackets/secondary containment. Table 9.3-11 also identifies that, should excavations be performed, programmatic controls are needed to periodically sample ("sniff") the secondary containment/jacket vapor space for flammable vapors. Additional discussion of the hydrogen sniffing program control is provided in Section III.D of this SER.

As discussed previously, a new facility segment is being added to allow outside storage of decontaminated equipment within SeaLand (or equivalent) containers. This new segment, the Decontaminated Equipment Storage area, is a Hazard Category 3 nuclear facility. Calculation S-CLC-S-00114 analyzed the potential consequences from a bounding event to ascertain whether any safety basis controls were warranted for protecting onsite or offsite personnel. A bounding event, an earthquake followed by a fire followed by continuing atmospheric entrainment, was evaluated to show the potential onsite and offsite consequences. This event was chosen because the earthquake/fire combination usually bounds other types of events involving containerized contaminated equipment. The reason for this is because both the earthquake and fire affect the entire material at risk, causes the release to occur relatively quickly, and no dilution of the MAR is involved. Thus, events such as tornadoes (which causes much more atmospheric dilution as the released material travels downwind to the receptor) or floods (which dilutes the MAR and occurs more slowly) or spills (which would not involve every Sealand container and occurs more slowly) would all have less resulting consequences than the fire/earthquake scenario. DOE reviewed calculation S-CLC-S-00114 and found:

1. the MAR was consistent with the conservatively derived curie content in the HADD (discussed in section II.B.3 above);
2. the airborne release fractions and respirable fractions were consistent with DOE-HDBK-3010;

3. no credit was given to any source term reduction from the SeaLand containers themselves;
4. the appropriate time-dependent atmospheric dose conversion factors from calculation S-CLC-S-00113 were used; and
5. additional conservatism was employed by increasing the result by a factor of 25.

The resulting consequences were 5 rem at 100 meters and well less than 500 mrem offsite. With these conservatively derived low consequence results, the only required safety basis controls are standard worker safety controls such as the Radiation Protection Program.

DSA Section 9.3 discusses the hazards analyses for DWPF through a PHA and CHA for 512-S and the interarea transfer lines. The methodology of each analysis is explained and results given. The 2004 annual update adds a new facility segment to DWPF, the Decontaminated Equipment Storage Area, as a Hazard Category 3 segment. However, there is no discussion about the Decontaminated Equipment Storage Area or its hazards assessment in Section 9.3. The hazards discussion is limited to Chapter 5, "Facility Design". For better consistency and completeness with the DSA format, discussion of the Decontaminated Equipment Storage Area and its hazards analysis needs to be added to Chapter 9 **(Revision Issue DWPF-2-0-R1)**.

Based on DOE review, the criteria to summarize major worker protection have 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

The controls and operating practices that provide protection for workers and the public also afford protection to the environment. These features include primary confinement barriers (e.g., piping, process vessels, canisters, dikes surrounding chemical vessels); filtered ventilation systems (e.g., process vessel ventilation system); and treatment capabilities prior to discharge (e.g., mercury recovery, neutralization). The DSA states a design objective of the facility is to ensure releases are within applicable limits established through DOE Orders and state a federal laws and regulations. DOE review concludes appropriate consideration has been given to applying controls that will protect the environment.

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

DOE review of DSA section 9.3.2 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

Section 9.4.1 describes the scenario development methodology, the source term analysis methodology (chemical and radiological), the consequence analysis methodology (chemical and radiological), and the acceptance criteria.

The development methodology derived two different types of accident scenarios;

- The Bounding Unmitigated Scenario (BUS) was developed for each DBA class based on insights gained from examination of the bounding credible scenarios discussed in the PSA (WSRC-TR-95-0198). Using credible initiators, the accident progression with the maximum offsite radiological consequences is developed. No credit is taken for any mitigative or preventive systems. This scenario may be used to gauge the upper limit.

- The Safety Class/TSR Mitigated Scenario (SCMS) for each DBA class is developed from an examination of the associated BUS and crediting safety class SSCs and TSR administrative controls. This method assumes all safety class items fulfill their function. The adequacy of the safety class items ability to fulfill their function is discussed in Chapter 4. If all initiators have associated safety class items or TSRs designed to prevent them, then the accident is assumed not to happen (i.e., is prevented).

Source term methodology examined both radiological and chemical source terms. The methodology examined the inventories, the release mechanisms, the phenomenology, and the deposition and filtration of the released material. Note that the source term calculations conservatively assume no deposition internal to the Vitrification building for any scenario. The chemical source term also examined the application of the chemical release mechanisms to accident progressions.

Source term analyses and consequence calculations used recovery times of 4-days (catastrophic events) and 8-hours (non-catastrophic) to conservatively determine the amount of material released to the environment and to calculate the offsite and onsite doses.

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.

The primary computer codes identified in DSA section 9.4.1 are: MACCS (for radiological consequences) and ALOHA (for chemical consequences). These codes and models are accepted industry standards, and have previously been evaluated and found to be appropriate for application at similar facilities (References B.3 and B.5). Additionally, these codes are the preferred methods endorsed by EH-1 for use in DOE applications (Reference B.6).

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 those used in the CSTF DSA analyses approved by DOE in Reference B.3.

Consistent with DOE-STD-3009-94, offsite dose consequences were calculated using 95% meteorology. Consistent with SRS site practices, onsite dose calculations were calculated using 50% meteorology,

DSA section 9.4.1 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. The adequacy of these EGs, given in WSRC Manual E7, Procedure 2.25, Revisions 3 and 13, is previously discussed in section B.1 of this SER. The consequences from the various DWPF accidents were appropriately compared to these EGs, and, where necessary, preventers and mitigators were considered and evaluated to ensure their effectiveness was adequate.

As discussed previously, the existing sludge-only accident scenario consequences were re-calculated using the MACCS computer code and using the dose conversion factors from ICRP-68/72 (versus the original calculations using AXAIR and ICRP-30). Appendix C compares these two methods and shows the new method results in a net reduction in consequences. However, no changes in control selection occurred solely based on these reduced consequence results.

The DOE staff review of the source term and consequence analysis methodologies (chemical and radiological), including the applicable computer codes used, found them to be appropriate, adequately conservative, and consistent with applicable DOE guidance (e.g., DOE-HDBK-3010-94 and DOE-STD-3009).

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 –
DOE staff reviewed the Bounding Unmitigated Scenario (BUS) and the Safety Class Mitigated Scenario (SCMS) discussions in the DSA to ensure:

- they were consistent with referenced source documentation,
- they adequately considered operator action/inaction,
- they properly considered credit for qualified passive SSCs,
- the initiators, source terms, and mitigative and preventive features are clearly and adequately presented,
- the calculated consequences were reasonable and conservative, and
- the scenarios were consistent within the DSA itself.

Section 9.4.2 of the DSA develops the accidents from the PHA (Table 9.3-3) and the CHA that were identified as requiring further consideration because, unmitigated, they could exceed the offsite EGs. Section 9.4.2 also included one bounding scenario for ARP as discussed in section B.2 above as well as the applicable NPH events (seismic, tornado/high wind). Two scenarios, BUS and SCMS were developed for the offsite accidents analyzed. The BUSs take no credit for Safety Class or Safety Significant SSCs (passive or active SSCs). The SCMSs are assumed not to occur (i.e., prevented) if safety class preventors are identified and credited.

The protection of the health and safety of the public, onsite workers, facility workers, and environment is adequately documented and demonstrated in the DSA. All scenarios provide a detailed scenario development, source term analysis, and consequence analysis. Descriptions include equipment failure, operator error (e.g., due to the arrangement of the equipment or to the incorrect use/addition of chemicals), etc. Source terms include the amount of material at risk (MAR) for release (e.g., total inventory of vessel), the release fraction (i.e., the amount released from the vessel), and the total amount released to the environment. Consequences include the onsite and offsite chemical concentration, total curies released to the environment, and the dose to onsite and offsite personnel. Calculations S-CLC-S-00099, -00101, -00102, -00105, and -00106 calculated the unmitigated doses to the onsite and offsite individual (the hypothetical individual located at the plant boundary). For the ARP and transfer line related events, the resulting unmitigated consequences are then compared to the offsite EG given in Manual E7, Procedure 2.25, Revision 13. For the other DWPF events analyzed in DSA section 9.4.2, the controls selected using the previous calculations (N-CLC-S-00028 and N-CLC-S-00044) and the previous EG (E7/2.25, Rev. 3) were maintained. This is conservative since the newly calculated unmitigated offsite doses are lower (see Appendix C) and the new offsite EG is higher.

Inclusion of Non-Safety Class/Safety Significant Defense-in-Depth

In addition to meeting the offsite EG, DOE expectations include that sufficient controls be in place to ensure the potential off-site consequences are "well below" the EG. This expectation has been incorporated into WSRC Manual E7, Procedure 2.25. The evaluation in WSRC-TR-98-00399, "DWPF Non-Safety Class/Safety Significant Defense-In-Depth Evaluation (U)" showed these expectations were met without crediting any additional "non-SC/SS DID" controls, which DOE reviewed and accepted in SER Revision 0, Supplement 25. DOE reviewed the revised mitigated consequences in DSA section 9.4.2 crediting the SC and SS controls and concluded again that no "non-SC/SS DID" controls were necessary to meet the guidance given in E7/2.25, Revision 13.

Individual Design Basis Accident (DBA) Evaluations

DOE reviewed each DBA discussed in DSA section 9.4.2. Many scenarios were revised (in DSA Rev. 21) simply to reflect the new consequence calculation using MACCS and ICRP-68/72. DOE review found these sections consistent with the supporting calculations.

A new scenario, Explosion in 512-S, associated with the ARP facility, was reviewed in detail. Section 9.4.2.17 (Explosion in 512-S) describes the potential for an ARP process vessel explosion due to hydrogen buildup and loss of ventilation. The bounding unmitigated scenario involves a deflagration in the LWPT containing a heel of 1600 gallons of concentrated MST/sludge solids. The offsite dose documented in S-CLC-S-00104 is 0.02 rem, which does not challenge the evaluation guidelines and therefore does not require SC controls. The administrative controls discussed in the TSR section of this SER are credited with providing mitigation for the consequences to the facility and co-located worker. The inputs and assumptions used in the calculation were reviewed and determined to be reasonable and conservative. For example, the LWPT and LWHT vessel volumes used (6400 gallons to overflow; 7050 gallons total volume) were found to be consistent with Drawing W752789. The 1600 gallon heel concentrated to the desired density of 5 wt% solids would yield the maximum activity concentration in the LWPT. The radiolytic hydrogen generation rate equations used in S-CLC-S-00104 are consistent with the equations previously evaluated and accepted in the CSTF DSA SER Revision 0 (Reference B.3). Although the equations allow taking into consideration the scavenger effects of nitrate and nitrite (i.e., lowers the H_2 generation rate), the generation rate used in S-CLC-S-00104 (actually derived in calculation S-CLC-S-00100) conservatively assumed the nitrate and nitrite concentrations were zero. Additionally, the generation rate derived in S-CLC-S-00100 properly adjusted (increased) for temperature effects. Finally, DOE reviewed the source document for the radionuclide decay heat values (Watts/Ci) (DOE/RW-0006) and the sludge stream radionuclide concentration (calculation S-CLC-S-00070) and found these to be consistent. DOE also checked the math for the eight dominant contributors to the sludge stream hydrogen generation rate and derived a value consistent with that in S-CLC-S-00100.

Scenarios associated with transfer lines (i.e., Leaks in Process Cells and LPPP, Overflows/Process Vessel Leaks in the Process Cells and LPPP, Interarea Transfer Line Explosion) were modified using consistent inputs, assumptions, and approaches with similar facilities within the CSTF. As Appendix C shows, the unmitigated consequences for these events, even with the reductions from MACCS and ICRP-68/72, actually increased due to the postulated larger spill sizes and inclusion of the splashing source term. The scenario involving an overflow of the LPPP was replaced with spilling an entire sludge feed tank (1.3 million gallon CSTF Tank 40H or 51H) due to a postulated break in the transfer line between the CSTF and the LPPP. DOE reviewed the calculation deriving the consequences for these events (S-CLC-S-00099 and -00102) and found it to:

a. be consistent with the inputs provided in Input Deck S-CLC-S-00070
b. have used models and assumptions consistent with the similar calculations performed for the CSTF (S-CLC-G-00234 and -00236), which DOE reviewed and accepted in Reference B.3
c. be very conservative regarding the spilling of 1.3 million gallons of sludge given the Transfer Control Program controls within CSTF and DWPF and the interface controls required during transfers between the CSTF and DWPF

Several other highlights from the DOE review of section 9.4.2 are as follows:

<u>Slurry Mix Evaporator Condensate Tank (SMECT) explosion and controls</u>
The DSA properly recognizes the potential for a SMECT deflagration/detonation and derives the necessary controls to prevent it. This possibility was recognized when it was observed that carryover of Slurry Receipt and Adjustment Tank (SRAT) material into the SMECT had exceeded initial predictions. The controls specified for the SMECT explosion (CPC Primary Air Purge, CPC Safety Grade Nitrogen Purge, and the Zone 1 Ventilation System) are the same as those SS controls identified in DSA Chapter 9, Table 9.3-10, "Safety Significant Structures, Systems and Components (SSCs)/Administrative Controls and Functions," for other CPC vessel explosions. These controls provide both preventive and mitigative features for the SMECT explosion scenario and are qualitatively judged to provide adequate worker protection.

<u>Recycle Waste Stream Flammability Hazards</u>
The hazard evaluation discussions of the DSA and the TSR Administrative Control recognize the hazards associated with the recycle waste stream extend to the Recycle Pump Tank (RPT) at the LPPP. Chapter 9, section 9.4.2, of the DSA describes the potential for flammability in the RCT, DWTT and the RPT, and derives the need to control the material transferred to these vessels in order to prevent the flammability hazard. This control is identified in DSA section 11.5.11.2.14 and implemented as TSR Administrative Control 5.8.2.14. In addition, an example of the technical evaluation required by this administrative control, documented in calculation X-CLC-S-00108, Revision 1, was reviewed by DOE. It shows that CLFL cannot be reached in less than 7 days even in worst case conditions (e.g., inclusion of 738 gallons (1430 lbs) pounds of sludge solids, maximum vessel temperature and level, no ventilation, etc.).

<u>Crane Load Drop Scenarios</u>
Section 9.4.2.10, "Crane Load Drops" was found adequate in that:

- the accident discussion includes the potential risks of damaging key jumpers in the vitrification building, the LPPP, and the 512-S building;
- a broad spectrum of initiators are addressed;

- the unmitigated and safety class mitigated accident scenarios provide one-to-one correspondence for each initiator; and
- it recognizes that the unmitigated frequency of Melt Cell crane load drops is actually Anticipated.

The DOE review determined that the description of the risk associated with cranes, the unmitigated and mitigated consequences of these accidents, and basis for the Critical Load Lift Program Administrative Control was accurate and adequate. The basis cited for the unmitigated load drop frequency is S-CLC-S-00076, "DWPF Crane Load Drop Frequency", dated 1/26/95. DOE review found that it clearly defines the basis for the Anticipated frequency and is reasonable.

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

The mitigated consequence of an earthquake was adjusted from 2.09 rem to 3.59 rem to account for a melter steam explosion. The steam explosion was included in the earthquake sequence of events but the dose contribution from this event was mistakenly left out. This correction was also made to Table 9.1-1.

Section 9.4.2.20 accident analysis evaluates the results of an earthquake at DWPF and postulates a melter steam explosion as one of the resulting events in the mitigated scenario. Section 9.4.2.21 evaluates a high winds event that postulates a melter steam explosion in the unmitigated scenario but not in the mitigated scenario. The scenario development is much the same as the earthquake but no explanation is given relative to why the melter steam explosion was prevented. Discussion is needed in Section 9.4.2.21 to address why the melter steam explosion is not included in the mitigated dose for the high winds accident scenario **(Revision Issue DWPF-2-0-R2)**. This issue is considered a revision issue due to the fact that there is no creditable scenario in which a high wind event can cause a melter steam explosion.

Based on the DOE review, DSA section 9.4.2 was found adequate to meet the requirements in DOE-STD-3009, Section 3.4.2.

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
This section states that hundreds of accidents below the credibility threshold of 1E-06/yr were examined and that none exceeded the offsite EGs. DOE staff review of the Beyond Design Basis Accidents (BDBAs) scenarios found they were either bounded by DBAs analyzed in Section 9.4.2 or were sufficiently infrequent so as to not warrant further.

Chemical consequences were examined from a total inventory standpoint, and found to be within the offsite EGs. Since no bounding chemical consequence from these chemical inventories exceeded the EGs in the DBAs, the same would be true when these bounding inventories are associated with BDBA events.

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, Fiori to Schwallie, "Approval of the Defense Waste Processing Facility (DWPF) Safety Analysis Report (SAR) (WSRC-SA-6) and Technical Safety Requirements (TSRs) (WSRC-TS-96-0019)," November 21, 1995, MC-96-0015

B.2 Letter, Anderson to Johnson, "Defense Waste Processing Facility (DWPF) Safety Basis Strategy (SBS)," April 1, 2003, PC-03-020.

B.3 Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) for the 10CFR830 Compliant Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's)," December 20, 2002, PC-03-008

B.4 WSRC-TR-2002-00223, ARP and DWPF Transfer Lines CHA, Revision 1

B.5 Letter, Allison to Pedde, "Submittal of Revision 1 of the Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR) for the Saltstone Facility," August 27, 2003, DC-03-015

B.6 Memorandum, Cook (EH-1) to Beckner and Roberson, "Designation of Initial Safety Analysis 'Tool Box Codes'," March 28, 2003

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

Section 4.1 of the DSA documents the methodology and criteria employed to identify and qualify Safety Class and Safety Significant SSCs, including their functional requirements, for DWPF, and establishes the accident analysis of DSA Sections 9.3 and 9.4 as the basis for identification of Safety Class and Safety Significant SSCs respectively, and administrative controls to protect the offsite public and onsite workers. Safety Class and Safety Significant SSC selection criteria was evaluated and judged by the DOE Staff to be acceptable.

Section 4.2 of the DSA describes the application of applicable Safety Class codes, standards and regulations to DWPF SSCs. Primary Safety Class regulations and guidelines (e.g., DOE 6430.1A and DOE-STD-3009-94) are identified, and the DWPF Safety Class backfit philosophy with respect to compliance to DOE 6430.1A is briefly addressed.

The DWPF code of record consists of the DWPF Basic Data Report (DPSP-80-1033), System Design Descriptions, and Technical Specifications. Addition of new SSCs to provide redundancy used the DWPF code of record for design/installation, even if the SSC was Safety Class. For the case where the new SSC was added to provide additional functionality, the upgrade was performed in accordance with 6430.1A to the extent possible. However, a detailed 6430.1A compliance evaluation was not performed for the overall system. Instead a general assessment against the requirements of 6430.1A, as defined by Table 4.2-4, was performed to determine the overall compliance to safety class criteria. Results of this general assessment are documented within the "System Evaluation" description for each SSC presentation in Section 4.3. DOE Staff have evaluated this general assessment approach to assessing compliance status with DOE 6430.1 A, and has judged the approach to be acceptable.

Early in the design phase, several DWPF safety class systems were designated "Q" items. These items then had a higher level of assurance that what was designed is installed in the facility. The DWPF design calculations for NPH criteria are based on "design", and this is sufficient since there is high confidence that the design is installed. Functional requirements from 6430.1A, (single failure, environmental qualification, redundancy, etc.) are evaluated in Table 4.3-3.

The Technical Baseline and Codes of Record for the DWPF Late Wash Facility (LWF) (Reference C.2) and the Auxiliary Pump Pit Modifications (Reference C.3) were utilized to perform the necessary design modifications for the Building 512-S Actinide Removal Process. The physical modifications required to convert the LWF to ARP were limited. However, a Facility Design Description document (Reference C.4) was developed as well as associated System Design Description Documents to maintain the design and technical baseline for the ARP facility.

Based on the DOE Staff review, Section 4.1 of the DSA adequately addresses the criteria outlined in DOE-STD-3009.

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 DWPF with reasons provided. The safety function of each SC SSC is identified with a reference to the applicable Chapter 9 accident scenario from which the SSC is credited. DOE found Chapter 9 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 9).

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. Appropriate references are made to applicable System Description Documents for additional detail.

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 9.

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

General
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).

DOE staff reviewed the Safety Class SSC descriptions provided (e.g., flow rates, load capacity, volumes, seismic criteria, interlocks, setpoints, redundancy, single-failure tolerance, response times, etc.) to ensure the safety functions and SSC design were adequate to support the safety analysis inputs and assumptions used in Chapter 9.

The DOE Staff reviewed the "Resolution of DWPF's Safety Basis", WSRC-TR-94-0395; the "Defense in Depth Evaluation for the Defense Waste Processing Facility and Late Wash Facility", WSRC-TR-94-0597; and the "Safety Class and Safety- Significant Final Functional Classification Report for the Defense Waste 'Processing Facility (DWPF)", WSRC-TR-95-0189, and found them acceptable and adequate. The information in these documents was properly incorporated into the DSA.

Methodology used for selecting the SC SSCs prescribed for retrofitting SSCs in existing facilities is defined in WSRC Procedure 2.25, Rev. 3 of the E7 Manual (Functional Classification) and in the WSRC Functional Classification Methodology Manual (WSRC-TM-93-9, Rev. 2). For SSCs that do not possess all Safety Class attributes as described in DOE 6430.1A, DOE/TIC-11603-Rev. 1, and DOE-STD-3009-94, these WSRC documents provide a methodology for demonstrating that the Safety Class performance goals of protecting public health and safety can be met. The availability methodology recommended in the E7 Manual was used to analytically demonstrate that the selected SSCs provide for safe operation even when the applicable availability/reliability of these SSCs are taken into account. The availability/reliability of SSCs is addressed in the Probabilistic Safety Analysis (PSA, WSRC-TR-95-0198).

Most of the SSCs designated as SC are passive features such as buildings, vessels, and crane structures. Only three active systems are SC: (1) CPC Safety Grade Nitrogen Purge System; (2) Melter Offgas System Instrumentation and Interlocks, and (3) Melter Vapor Space Temperature Instrumentation and Interlocks. These last two systems are described in Section 4.3 as not satisfying the DOE 6430.1A single failure resistance criteria. DOE assessed this vulnerability below (under "*Specific SC SSC Evaluations*") and found it acceptable.

A key design feature is the separation between the Digital Control System (DCS) and hardwired interlocks with respect to proper isolation. Section 6.5.3.1 states that the vitrification process is normally controlled from the Central Control Room (via DCS). Although the interfaces between DCS and system/interlocks important to safety are not discussed, Section 5.2.3.10, "Distributed Control System" of the DSA states that "each device utilized by the DWPF process has been reviewed to determine if inadvertent operations has the potential for a Process Hazards event. For devices where this potential exists, hardwired interlocks have been provided, which are independent of the DCS." Also, the DCS has neither a Safety Class or Safety Significant function per the discussion of Chapter 4. The DOE staff concludes that the review performed on the impact of inadvertent operations for initiating a process hazards event, and the use of hardwired interlocks, as described in Chapter 4, sufficiently describe and compensate for the impact on the facility in the event of a loss of the DCS.

The Safety Class SSCs described in Chapter 4 are designed to withstand Natural Phenomena Hazards (NPHs) and remain functional during and after such events. The system evaluations of the DWPF design against the NPH design requirements are presented in Section 4.3 for Safety Class SSCs.

To evaluate the potential adverse effects from post-accident environmental conditions, a walkdown was conducted to identify all safety class components in the vicinity of steam, chemical, nitrogen, carbon dioxide, and water lines which could potentially be broken during accident conditions. Those identified were then evaluated to ensure the components functionality. Reports ECS-I01-95-0081, OPS-DTL-95-0034, and WSRC-RP-95-1006 document the results of this effort. DOE staff review of these reports found them adequate to conclude no areas of concern exist. Therefore, the DSA defines the required environmental conditions for the safety class equipment in these areas.

Specific SC SSC Evaluations

The evaluation results from several of the key SC SSCs are provided below.

Vitrification Building and Remote Process Cell (RPC) Walls (Section 4.3.1)

Design Requirement #11 requires safety functions to not be compromised by internal hazards. The Vitrification Building and the RPC Walls have not been qualified for worst possible internal explosions; however, the safety class purge system will prevent the explosion from occurring. This approach is acceptable to the DOE staff.

CPC Vessels (ASRT, SRAT, SME, and MFT) Section 4.3.7

In Sections 4.3.7, CPC Vessels (ASRT (previously called the PRBT), SRAT, SME, and MFT), the safety function of these vessels is stated as to "maintain integrity to contain and support the purging of their contents." One potential failure mechanism could be failure of the main overhead crane. However, Table 4.3-3 refers to a structural qualification calculation which shows the crane is qualified SC for seismic loadings. Additionally, the Vitrification Building is qualified for tornado loadings so the crane inside will not fail. Finally, the Load Lift Program ensures use of the crane is done in a manner which prevents failure of nearby SC equipment. Therefore, this adverse condition (overhead crane failure) is not a consideration for which these vessels must be qualified. The DWPF Structural Integrity Program ensures that the design characteristics for normal operations (e.g. radiation exposure, hydrogen embrittlement, corrosion, etc.) are maintained. Vessel integrity is also evaluated for DBE conditions as summarized in Table 4.3-3. The DOE Staff concludes that the conditions and programs by which vessel integrity is maintained are adequately stated in the DSA.

CPC Purge Systems (Section 4.3.8)

Upgrades to the Safety Class Purge Systems eliminated "active" single failures. The piping, jumpers and Hanford connectors associated with the CPC Safety Grade Nitrogen Purge System do not have full redundancy; however, these "passive" single failures are mechanical in nature and represent minimal risk. This safety system does not rely on electrical power.

WSRC-RP-98-00107, "SMECT Purge Supply Backfit Package (U)", evaluated the purge modifications against the safety class design criteria and HLW-DEN-98-0161, "Design Authority Assessment Of Safety Class Components for Environmental Qualification (EQ) Walkdown for J-DCP-S-97029 (SMECT Safety Class Purge) (U)" evaluated the SMECT safety class purge components with respect to environmental qualification. These documents were reviewed by DOE and found to be acceptable.

The CPC Safety Grade N_2 System was not originally designed against tornado missiles. A modification was made to provide this protection. This modification protects the vaporizers, nitrogen storage tank piping, pressure reducing stations, and piping leading into 221-S.

DOE reviewed the missile shield design, DOE natural phenomenon hazards (NPH) standards 1020, 1021, 1022, site guidance on NPH, structural mechanics calculations for the grading used for missile protection, and nitrogen storage tank design to withstand a Design Basis Tornado (DBT) missile strike.

DOE verified that the required performance category (PC) for the missile shield was PC-3, which matched the Task Requirements and Criteria (TR&C) of the modification. The missile shield and guard posts are designed to protect the Safety Grade Nitrogen System from a 15 pound 2"x4" wooden plank at 100 mph, a 75 pound three inch diameter steel pipe at 50 mph, and a 3000 pound rolling automobile at 19 mph.

DOE observed destructive evaluation of various grating thicknesses. This testing was performed in Central Shops using a wooden 2"x4" and a 3" steel pipe. Since speed requirements could not be met with the test apparatus, additional weight was added to the missiles to ensure equal or greater kinetic energy than that required. DOE reviewed and verified energy calculations used in the test procedure. Based on the test results and recommendations, the 3.5 inch grating specified for the missile shield will protect the Safety Grade Nitrogen system. The specified grating has an approximate space of 1 inch by 4 inches. During grating testing, wooden planks had enough energy to split and penetrate up to 16 inches into the grating before stopping. Current design for the grating has a minimum clearance of three feet between the grating and any protected components.

During the DOE review, a concern was raised about the possibility of objects small enough to penetrate through gaps in the grating. DOE reviewed the basis of the design basis missile selection (Reference C.1). Several arguments can be made (see Reference C.1) relative to small missiles that greatly reduce the likelihood of such missiles damaging the safety grade nitrogen system. First, these missiles can be assumed to tumble as they travel through space. Missiles traveling parallel to their longest dimension (i.e. javelin) are unlikely due to the aerodynamic properties involved. This assumption reduces the longest likely dimension of the missile to just under four inches without some contact with the grating. Any contact with the grating reduces the energy of the object and potential damage. A review of typical tornado missiles reveals that a vast majority are of a size greater than the gaps in the grating. Smaller objects either lack the surface area to be picked up and accelerated to any degree or lack the mass necessary to cause damage for the DBT of category F2 for which the missile shield is designed. Studies have shown that wooden missiles greatly outnumber other missile types and are by nature light. Three hundred wooden missiles were cataloged from three tornadoes in Reference C.1. Only two missiles were found which could fit through the grating space. These two objects were 3 feet and 6.5 feet long and unlikely to penetrate the grating due to the tumbling nature of the objects. Neither object was from a category F2 tornado and therefore required higher wind speeds to fly. Heavier objects such as bolts and nails lack aerodynamic properties to be picked up and carried and are more likely to roll along the ground. Smaller, suspended objects likely to come from buildings again lack the surface area to remain suspended or pick up significant speed. These objects will have a trajectory angled towards the earth (as opposed to straight horizontal) and be unlikely to pass through the grating with significant energy. Based on the explanation given in Reference C.1, DOE considers the risk of small objects damaging the safety grade nitrogen system remote.

DOE reviewed the design of the missile shield (C-DCP-S-99005) to review the method of connecting the grating together and how the nitrogen lines entering 221-S would be protected. All grating is connected together at steel I-beams and fastened. The grating does not completely enclose the nitrogen tanks since they have been shown to be DBT qualified (T-CLC-S-00034). DOE reviewed and verified this calculation for the Safety Grade Nitrogen Tanks. The grating stands approximately 15 feet high to enclose the vaporizers with the minimum 3 foot clearance. A 24-inch schedule 20 pipe cut in half protects the piping entering 221-S. This piping shield completely encloses the nitrogen lines running up the side of 221-S and is fastened to the building. With the nitrogen tanks protruding out of the grating, a one-inch space exists between the tanks and the grating. This one-inch space is addressed in the same manner as the space in the grating, any object that could pass through this area would not have enough force to damage system equipment.

From evaluation of the missile shield design, DOE has reasonable assurance that the Safety Grade Nitrogen system is adequately protected against DBT missiles and winds.

With the Safety Grade Nitrogen system DBT qualified, the TSR administrative control for response to a tornado warning does not require placing the SRAT, SME, and MFT in Standby mode.

Cranes/Structures

Section 4.3.10, "Main Process Cell Crane Structure," properly describe the salient features of the SSCs which enable it to meet its required safety function and clearly emphasize the design features of the SSC that are truly related to meeting the function required by the accident analysis in Chapter 9.

The Melt Cell crane (discussed in DSA section 4.3.44) is not required to be parked away from the melter based on the seismic qualification of the crane. Calculation T-CLC-S-00152 provides the basis for the Melt Cell Crane qualification for a Design Basis Earthquake (DBE). The calculation was reviewed by DOE and found to be satisfactory.

Melter Off-Gas System Controls

The Melter Feed Interlocks are necessary to prevent a Melter off-gas system explosion. The interlocks prevent feeding the melter unless specific conditions (high temperature, adequate airflow), necessary to prevent a flammable atmosphere in the melter vapor space, are met. The DSA recognizes the ability to accomplish this function by:

- installation of steam pressure switches, seismic supports and piping qualifications, MCC contactors to isolate melter feed pump power, etc;
- recognizing DBE qualification of these interlocks and addressing a DBE vulnerability for interlock cabling and the melter vapor space temperature instrumentation jumper;

- identifying the existing Safety Class (SC) Structures, Systems, and Components (SSCs) (e.g., RPC crane and cell covers) and SC SSCs (Melt Cell jumpers over jumpers) which could impact these interlocks from a II over I consideration;
- recognizing DBT qualification of these interlocks and addressing a missile vulnerability for melter feed pump #2 VFD power contactor (on the Vitrification Building roof);
- recognizing single failure vulnerabilities and provide justification for their acceptability;
- recognizing the potential to get to 95% composite lower flammability limit (CLFL) in lieu of 60% CLFL following a seismic event.

Airflow restricting orifices (i.e., melter seal pot and cameras) were credited with the function of limiting air losses from non-seismically qualified piping following a DBE. DOE reviewed calculation X-CLC-S-00086, "Impact of Reduced Air Purges to DWPF Melter on Off-Gas Flammability During a Seismic Event," to ensure it appropriately considered these losses and supported the conclusion that LFL conditions would not develop following a DBE. This calculation clearly demonstrates that, even with these losses following a seismic event, the worst case off-gas flammability concentration is well below 95% (~ 75%) of CLFL during a 3X surge of flammable off-gases. Tables 4.3-1 and 11.6-1 were reviewed and found consistent with the text in sections 4.3.25.

Other items of particular interest during the review were instances where design criteria were not met. These included lack of seismic qualification of interlock cabling and the thermocouple jumper, lack of DBT qualification of these interlocks for melter feed pump #2, and lack of active component single failure resistance. WSRC-RP-98-00108, "Melter Feed Pump Interlocks Backfit Package Revision 1," addressed these items further and was reviewed by DOE.

Reference C.6 addresses why single point failure vulnerabilities (SPFV) are acceptable for the interlocks and instruments that trip the melter feed pumps. The document has been added to the DSA, by reference, for melter vapor space and offgas instruments and interlocks SPFV discussions.

DOE reviewed the documented justification and concurs that an adequate basis exists to accept the identified single failure vulnerabilities. This justification is summarized as follows:

A single relay in Local Control Station 251 receives interlock signals from the following devices:

1. Total Melter Air Flow
2. Primary Offgas Film Cooler Pressure (Redundant)
3. Back-up Offgas Film Cooler Pressure (Redundant)
4. Vapor Space Temperature (Redundant)
5. Back-up Offgas Film Cooler Air Flow

The interlocks are electrically fail safe by design. The loss of any input or output signal will initiate the interlock. This design eliminates the need for redundancy in signal and power cables for the relay, feed pump contactors, and switches. In addition, if site power is lost, the melter feed pumps will stop since they are not backed up with emergency power.

Fault tree analysis (Reference C.6) shows the interlock failure probability to be 2.0 E-4 per year. The analysis considered failure of the relay, contactor failure, dome heater failure, plant air failure, steam failure, and interlock switch failure. Considering that loss of compressor cooling, causing a total loss of plant air, (the dominant probability in the analysis) can be excluded from the analysis (i.e. total melter air flow and back-up offgas film cooler air flow come from the same source and their associated interlocks would be redundant under a total loss of air condition), the failure probability becomes extremely unlikely (1.3 E-5 per year).

In addition, the failure of the interlock to stop the feed pumps does not, by itself, cause an explosion in the Offgas Condensate Tank (OGCT). The event which requires safety class devices is a series of three events in combination. First, a flammable concentration of gases must be generated in the OGCT, an ignition source must be present, and the resulting explosion must lead to additional explosions of the other Chemical Process Cell (CPC) vessels. This scenario has been evaluated as beyond extremely unlikely in Reference C.7.

If one assumes the explosion that takes place in the OGCT is a deflagration versus a denotation, the potential for propagation to other process vessels is greatly reduced. Deflagrations are characterized by less energy and occur at lower flammable gas concentration. Deflagrations are a more likely scenario because they will occur before concentrations reach the detonation level. It is considered unlikely that an ignition source would only be present after detonation levels are reached. It is more likely that the ignition source would be present as the flammable gases build up and be ignited as a deflagration. The safety analysis assumption that the denotation process will propagate through each of the six CPC vessels is very conservative. Additionally, the respirable release fraction for a detonation is 15 times higher than a deflagration (Reference C.6).

The accident analysis does not take credit for event mitigation from Zone 1 ventilation. This safety significant system has a minimum decontamination factor of 200 and when factored into reduced release fraction of a deflagration, the overall consequences would be reduced by a factor of 3000. The magnitude of this reduction would result in consequences well below the evaluation guidelines and not require redundancy.

The melter feed pump interlocks, combined with the TSR limit on total organic carbon for feed to the melter, act as the first level of control in the prevention of a melter offgas explosion.

In addition to the melter feed pump interlocks and organic carbon limits, several non-safety defense-in-depth components exist to prevent an offgas explosion.

1. Software interlocks from separate flow transmitters.
2. Software interlocks from separate temperature transmitters.
3. Design and Operating Procedures require these non-safety defense-in-depth components (components 1 and 2) to be operable to run the melter feed system.
4. Melter Pressure Control airflow supplies an additional 500 pounds per hour (pph) of non-safety air to the melter. This additional dilution air flow is not recognized in the safety analysis. [Note, the minimum credited air flow is 900 pph per DSA section 11.5.5.2]
5. Operators actively monitor melter operational parameters.

Additionally, DOE reviewed HLW-DEN-98-0157, "Design Authority Assessment of Safety Class Components For EQ Walkdown For Melter And Melter Off-Gas Safety Class Interlocks of The Melter Feed Pumps (U)," to ensure appropriate potential environmental impacts (per DOE Order 6430.1A, Section 1300-3.4.2) were considered. Chapter 4 was found to be consistent with the analysis in Chapter 9 and is acceptable.

Based on DOE review, the criteria to provide adequate system evaluations 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 SSC 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 DSA Chapter 9 (i.e., from Table 9.3-10, Table 9.3-11, and defense in depth for the DBAs in section 9.4.2). The safety function of each SS SSC is identified. DOE found Chapter 9 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 9).

A number of structures, systems, and components were downgraded based on the removal of the precipitate stream from DWPF. Table C.7-1 below identifies the SSCs that were downgraded from previous DSA revisions based on removing the precipitate stream from the DWPF flow sheet. A brief justification for the change is given for each component. Seven

SSCs from the Low Point Pump Pit and Glass Waste Storage Building, which were previously increased in functional classification to SC at Management's discretion for additional dose reduction, were reclassified as SS. This change is supported by the hazards and accident analyses in DSA chapter 9. With the Safety Significant classification, redundancy that was required when designated as safety class equipment is no longer required. Chapter 4 was revised to relocate the respective discussions of the components that were reclassified from SC to SS or delete the section entirely in accordance to the table below.

Table C.7-1

SSC	*Downgrade*	*Basis for Change*
Zone 1 Ventilation System	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
Diesel Generator System	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
Diesel Fuel Oil System	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
Fan House Structure	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
SPC Vessels (PR, PRFT, OE, OECT, OECD, PRCD, and SCVC)	*SC to Production Support (PS)*	*Process no longer applicable.*
OWST Inner Tank Level Gauge	*SC to PS*	*Process no longer applicable.*
SPC Safety Grade Nitrogen Purge System	*SC to PS*	*Process no longer applicable.*
SPC Sump Level Instrumentation and Associated Interlocks	*SC to PS*	*Process no longer applicable.*
SPC HiHi Pressure Switches and Associated Interlocks	*SC to PS*	*Process no longer applicable.*
Fan House Maintenance Cranes and Structural Support	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
Fire Protection Piping above the Diesel Generator Systems	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
Diesel Generator Room Heater Supports	*SC to SS*	*No precipitate stream, so no SC Zone 1 SPC purge. SS mitigation function only.*
SPC Jumpers Above Safety Class Jumpers	*SC to PS*	*Process no longer applicable.*
SPC Oxygen Analyzers and Associated Interlocks	*SC to PS*	*Process no longer applicable.*

SSC	*Downgrade*	*Basis for Change*
SPC Seismic Switches and Associated Interlocks	*SC to PS*	*Process no longer applicable.*
Low Point Pump Pit Safety Class Interlocks	*SC to PS*	*Process no longer applicable.*
Salt Process Cell Primary Purge System	*SS to PS*	*Process no longer applicable.*
Late Wash Facility Vessels	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
Late Wash Facility Primary Nitrogen System	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
Late Wash Facility Backup Nitrogen System	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
Late Wash Facility Cells and Cell Covers	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
LWF Crane and Structural Support / Superstructure	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
Late Wash Facility Jumpers Above Purge Jumpers	*SS to PS*	*Process no longer applicable, supported by ARP hazards analysis*
OWST Inner and Outer Tanks	*SS to PS*	*Process no longer applicable.*
OWST Primary Inerting System	*SS to PS*	*Process no longer applicable.*
OWST Safety Grade Purge System	*SS to PS*	*Process no longer applicable.*
OWST Inner Tank Pressure Indicators	*SS to PS*	*Process no longer applicable.*
OECT to OWST Transfer Line	*SS to PS*	*Process no longer applicable.*
Low Point Pump Pit Vessels	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Low Point Pump Pit Safety Grade Purge System	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Low Point Pump Pit Cells and Cell Covers	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Low Point Pump Pit Crane Structural Support/Superstructure	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Glass Waste Storage Building Canister Supports	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Glass Waste Storage Building Vaults	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*
Low Point Pump Pit Jumpers Above Safety Class Jumpers	*SC to SS*	*Previously SC based on Management decision to obtain additional dose reduction.*

To address the concerns related to the interaction of Sodium Nitrite and acid (Reference C.5), the Sodium Nitrite Make-up Tank (SNMUT), SNMUT dike, Sodium Nitrite Feed Tank (SNFT) dike, and SNFT dike drain plug were added as safety significant components. The SNFT dike and SNFT dike plug will prevent small leaks and spills of Sodium Nitrite from entering the Floor Drain Catch Tanks (FDCTs) undetected.

Additionally, as discussed in Section II.B.10, accident analyses related to the interarea transfer lines were re-performed. The results of these analyses supported downgrading the interarea transfer lines from SC to SS. The safety significant interarea transfer lines consist of buried pipelines (including the secondary jacket and seal plates), which transport the sludge, salt solution, MST/sludge solids and the ARP filtrate between the Vitrification building, 512-S, LPPP, and H-area facilities. This was properly reflected in Chapter 4.

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. Appropriate references are made to applicable System Description Documents for additional detail.

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 have 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 9.

The DSA identifies each of the safety significant SSCs required for the 512-S ARP. The backpulse vault structure provides shielding and prevents access (except through the door). Access to the door is protected by an administrative control (via the Radiation Protection Program).

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

General

Forty one Safety Significant SSCs are described in Section 4.4 of the DSA. Each Safety Significant SSC description includes a discussion of the safety function, a system description and a system evaluation as suggested in DOE-STD-3009-94. Section 4.4 of the DSA also defines the criteria for establishing Safety Significant functions (evaluated and shown acceptable in section II.B.1), and tabulates Safety Significant functions in Table 4.4-1. Tables 9.3-10 and 9.3-11 provide a listing of the accidents for which the Safety Significant SSCs provide protection. DOE staff reviewed the Safety Significant SSC descriptions provided (e.g., flow rates, load capacity, volumes, seismic criteria, interlocks, setpoints, redundancy, single-failure tolerance, response times, etc.) to ensure the safety functions and SSC design were adequate to support the safety analysis inputs and assumptions used in Chapter 9. The DOE staff reviewed the following support documentation for this chapter and found them to be adequate:

- "Resolution of DWPF's Safety Basis", WSRC-TR-94-0395.
- "DWPF Functional Classification Analysis – Mitigated Chemical Source Term", M-CLC-S-00412.
- "Safety Class and Safety Significant Final Functional Classification Report for the Defense Waste Processing Facility (DWPF)", WSRC-TR-95-0189.
- "Actinide Removal Process (ARP) and Defense Waste Processing Facility Transfer Lines Consolidated Hazard Analysis," WSRC-TR-2002-00223
- New Master Summary calculation S-CLC-S-00107

The SSCs which were previously SC that are now designated SS (shown in Table C.7-1 above) were previously shown to meet the more stringent SC design requirements from Table 4.2-4 of the DSA. This is more than adequate to satisfy the SS design requirements. The only SSC which was downgraded to SS but has a new function/design requirement is the interarea transfer line core pipes. This core piping is now credited to withstand an internal explosion. Calculation T-CLC-H-00662, Evaluation of the High Level Waste Transfer Piping System for Potential Explosion Loads, analyzed the core piping for this new loading condition. DOE reviewed calculation T-CLC-H-00662 for adequacy. The transfer piping was designed per ASME (American Society of Mechanical Engineers) code requirements. The loading exerted by potential hydrogen-air explosion is a one-time event and hence a faulted load condition for structural qualification of the piping. Allowable stresses are computed corresponding to a strain value of 5% as allowed by ASME code for faulted load condition. The allowable stresses are reduced, using a conservative value of 2.0, to simulate the dynamic nature of the shock waves resulting from the potential explosion. The calculated values of stresses resulting from the potential explosion were compared with the reduced allowable stresses and found to be within the reduced allowable stresses.

Thus, DOE found the inputs, methods and equations consistent with standard pipe stress calculation approaches. Additionally, the computer program ABAQUS used for the finite element method for piping analysis is Quality Assurance verified. Sufficient safety margin was shown to confirm that the loads resulting from a potential explosion would not rupture the core pipe of the transfer piping. Hence, DOE concluded that calculation T-CLC-H-00662 was acceptable.

As discussed in section II.C.5, to evaluate the potential adverse effects from post-accident environmental conditions, a walkdown was conducted to identify all safety class components in the vicinity of steam, chemical, nitrogen, carbon dioxide, and water lines which could potentially be broken during accident conditions. Those identified were then evaluated to ensure the components' functionality. Reports ECS-I01-95-0081, OPS-DTL-95-0034, and WSRC-RP-95-1006 document the results of this effort. DOE staff review of these reports found them adequate to conclude no areas of concern exist. Many of the SC components identified in these reports are now SS, and thus the conclusion reached remains valid. Another effort was conducted to evaluate the affects of a loss of ventilation within the electrical rooms in the 292-S Fan House. Originally this was for SC application, but now the components in the 292-S Fan House are only SS. Calculations M-CLC-S-00608, M-CLC-S-00668, and S-CLC-S-00083, show temperatures at 4-days post-accident not exceeding 120°F. Report WSRC-TR-01-0130 shows the calculated temperatures to be within the design limits of the safety significant electrical equipment in 292-S.

Specific SS SSC Evaluations
The evaluation results from several of the key SS SSCs are provided below.

Zone I Ventilation System (Section 4.4.46)
DOE Staff compared the Resolution Safety Basis (RSB, WSRC-TR-94-0395) with the DSA for consistency with respect to the operation of the Zone 1 and Zone 2 supply fan interlocks for maintaining a negative pressure within the vitrification building. Since the Zone 2 supply fans are not required to be interlocked off, the DSA and the RSB are consistent and adequately describe the safety function. Additionally, report "DWPF HVAC System Safety Upgrade Reviews Case Studies for DWPF HVAC Systems Under Postulated Post-Accident Conditions", shows that the continuation of Zone 2 supply fans running with one Zone 1 exhaust fan will not prevent the Zone 1 exhaust fan from maintaining adequate flow or negative pressure within the Zone 1 area.

The DSA states that the Zone 1 ventilation system must be able to re-establish negative building pressure after vessel detonation and/or cell deflagrations. The DOE Staff reviewed the Zone 1 ventilation system operation, including the operation of the Zone 2 and Weld Test Cell (WTC) supply and exhaust fans, and verified that sufficient interlocks are provided to ensure re-establishment of negative building pressure after vessel detonation.

The SS Zone 1 Ventilation System is not required to meet single active failure criteria. However, lack of adequate separation represents a potential vulnerability from a fire event in the 292-S Fan House. DOE staff walked down the 292-S Fan House to determine the level of vulnerability of a common fire event disabling both trains of Zone 1 exhaust fans. As described in the 292-S Fire Hazards Analysis (F-FHA-S-00009, Rev 1), the walkdown confirmed that cable tray loading is light (smaller size cables) in most places. Fire protection systems are provided in areas of potential vulnerability. One area of the 292-S Fan House which represents a potential fire-induced failure of the Zone 1 exhaust fans is Field Operating Station (FOS) Room # 12 which contains Local Control Station (LCS) 272. A fire in this panel could disable the Zone 1 exhaust fans and/or their associated dampers. However, each fan has its own bypass switch on 480V Bus B9 or B10 located on opposite sides of the building which provides manual bypass capability of LCS 272. A fire within LCS 272 would not be expected to propagate throughout FOS Room #12 due to the low combustible loading, the sealant in all panel penetrations, the Halon™ system provided, as well as fire detection in this room. Therefore, the time for manual restoration of the Zone 1 exhaust flow would be available since no other plant upsets (e.g., loss of PVVS flow, loss of offsite power, etc.) should be caused by this event. Based on the DOE staff review, the lack of cable separation is judged to be acceptable.

Engineering Report "NPH Equipment List, DWPF Zone 1 Ventilation", No. T-MEL-S0001 identifies the four Zone 1 exhaust fans, the fan house (292-S), the Vitrification Building (221-S), the underground tunnel, the sand filter (294-S), and the exhaust plenum from the sand filter exit to the "blow-out" port were qualified for the NPH during the design of the DWPF. Calc Note T-CLC-S-00028, "Sand Filter Media Seismic Evaluation", concludes that the effects of entrainment, channeling and sloshing or surface displacement are not a concern for the DWPF sand filter for an earthquake that is less than or equal to the DBE (0.2 g). The "blow-out" port is held in the "close" position by a pneumatic actuator supplied by plant air. If the stack somehow plugged, the Zone 1 Ventilation System will be exhausted via the "blow-out" port. The "blow-out" port will fail "open" upon loss of plant air or power. Additionally, the stack itself is qualified for seismic and tornado requirements. The DOE staff review of these reports and DSA 4.4.46 finds them adequate to conclude a viable NPH qualified exhaust path would be available post earthquake or tornado to meet the SS (PC-2) Zone 1 Ventilation System design requirements.

The potential failure of a Zone 1 Exhaust Fan discharge damper in the open position when its associated fan is secured (or anytime the fan is secured) could impact the ability of the remaining fans to achieve the required Zone 1 exhaust flow. However, the damper is a simple hinged mechanism, reliable, and several operator actions are available should a failure occur (start the associated fan or secure the fan's manually controlled suction damper). DOE considers that the reliability of the equipment and operator actions specified justify accepting this configuration.

The DSA requires the Zone 1 supply fans be shutdown upon high sand filter inlet plenum pressure to ensure the Zone 1 Exhaust system fulfills its required safety significant function. The shutdown of the fans is performed by safety significant hardwired interlocks which the DSA states must be fully NPH qualified.

The starter relays, as part of their associated motor control centers (MCCs), have been evaluated and shown to meet the required seismic criteria. However, this evaluation identified required facility modifications necessary to ensure the MCCs were not unacceptably damaged during a seismic event. Calculation T-CLC-S-00155, "Exhaust/Supply Fan MCC Qualification (U)", was performed to determine the adequacy of MCC B103, B302, B701, B703, B802, and B803 for safety class earthquake criteria. The required upgrades were captured in Required Seismic Upgrades (RSUs) 68, 69, and 70 and were primarily related to providing adequate anchorage and protecting against adjacent equipment interactions. DOE performed a review of facility drawings and confirmed that the MCCs evaluated by this calculation included all the fans tied to this interlock function (14 fans total). The required modifications were completed by design change packages (DCP) C-DCP-S-97004 and C-DCP-S-97007 through C-DCP-S-97012. DOE reviewed the RSUs, DCPs and performed a facility walk-down to obtain objective evidence the required modifications were properly incorporated in the field.

Diesel Generator System (Section 4.4.47)
Two diesel generators (DGs) are provided (only one required to operate by safety analysis) to supply backup power to the Zone 1 exhaust fans in the event that normal offsite power is lost. One DG automatically supplies Load Center B9 and the other supplies B10. Process loads are powered off load Centers B7 and B8, which are fed by B10 and B9, respectively. Load Centers B7 and B8 are automatically transferred onto B10 and B9 upon loss of offsite power. The DCS controls the loads fed by B7 and B8. Additionally, there are other load centers (e.g. B901 and B111) fed from B9 and B10, which have loads controlled by the DCS. Worst accident conditions, as far as DG loading concerns are involved, would be if non-safety loads not "guaranteed" to be shed from safety significant load centers B9 and B10 remained on-line. However, Section 4.4.47 discusses this potential and shows the DG can accept these loads, even if the DCS software run time is assumed to elapse between load sequencing. DOE staff review of E-ESR-S-100165 concluded this assessment to be adequate and complete.

Additionally, the concern of the DG potentially being under "light load" conditions post-accident is evaluated in DSA section 11.5.11.2.28. This evaluation is judged by DOE staff to be adequate. TSR Administrative Control 5.8.2.28 provides the required control for this condition.

Diesel Fuel Oil System (Section 4.4.48)
The diesel fuel oil system comprises of two storage tanks, two day tanks, and two transfer pumps. LCS 210 provides an automatic means (Safety Significant) of transferring diesel fuel oil to the Diesel Generators; however, LCS 210 receives power from DG 200 only. Should DG 200 be unavailable or LCS 210 fail to activate the transfer, manual start switches (for each transfer pump), which do not rely on either LCS 210 or the DCS, are located on the South wall in the Electrical Room of the 292-S Fan House. These manual switches, also Safety Significant, can be used to refill the day tank of each DG. Any time that LCS 210 is not operable (e.g., DG 200 is out of service or LCS 210 is out for maintenance), response procedures for loss of offsite power require an operator to activate these manual switches. Since the day tanks have ~2+ hours of fuel oil, sufficient time exists to accomplish this manual action. This control sequence is acceptable to the DOE Staff.

DOE staff also assessed the fire-induced vulnerability in the diesel fuel oil system identified in the FHA (F-FHA-S-00009, Rev. 1). The scenario described in the FHA involves failure of the fuel oil supply line at one DG breaking and discharging fuel oil on the floor, an ignition source from DG operation causing the fire, and the continued operation of the DG fuel oil pumps (and storage tank fuel oil pumps). The continued pumping of fuel oil spreads from one DG bay to the other, thereby damaging both DG units. However, the fuel oil system, including piping, has been qualified for applicable NPH criteria. Heat-activated (fusible links) isolation valves are provided on the fuel oil lines at each day tank and at the SW corner of DG bay #2. Also, the two DG bays are connected by an open area with an open gate to the outdoors which will allow spilled fuel oil to flow outside the building as well as around the corner. Based on these considerations, the FHA concluded and the DOE concurred that this vulnerability was adequately eliminated.

Fan House and LPPP Cranes
Sections 4.4.50, Fan House Maintenance Crane, and 4.4.55, Low Point Pump Pit Crane, properly describe the salient features of the SSCs which enable it to meet its required safety function and clearly emphasize the design features of the SSC that are truly related to meeting the function required by the accident analysis in Chapter 9.

GWSB
DSA Section 4.4.56.2 system description includes a modification to the GWSB canister storage vault ventilation. Thermal distribution analysis confirmed that natural circulation of air provided sufficient cooling without challenging the structural integrity of the vault. In the event of loss of circulation, vault integrity was evaluated at a steady state temperature of 200°F for an indefinite period and 566°F for two years to evaluate degraded steel and concrete strengths. No detrimental effects were found. DOE reviewed the supporting calculations T-CLC-S-00109, M-CLC-A-00188, and design change form X-DCF-S-00191 and design change package M-DCP-S-01009, and found the assumptions and inputs adequate for the support of natural convection cooling. Removal of the high efficiency particulate air (HEPA) filters was also included in the changes as part of M-DCP-S-01009. DOE reviewed the engineering justification for removal of the HEPAs (HLW-DEN-2000-00200). There are no environmental or regulatory requirements for the filters and process history has shown that no contamination has been found on GWSB #1 HEPA filters. DOE concluded that adequate justification existed to support HEPA removal.

Based on DOE review, the criteria to provide adequate system evaluations 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.

C.12 References

C.1 "Rationale for Wind-Borne Missile Criteria for DOE Facilities," J. R. McDonald, LLNL, 9/1999

C.2 G-FPR-S-00001 (WSRC-TR-92-360-2, "Functional Performance Requirements for DWPF Late Wash Facility," January 1997, with revisions from G-DCF-S-00106, 2/25/97

C.3 G-FDC-S-00006, Rev. 6, "Functional Design Criteria DWPF Late Wash Facility – APP Modifications," 8/22/94

C.4 G-FDD-S-00004, Rev. 1, "Facility Design Description - Actinide Removal Process (ARP) - 512-S Facility," October 2002

C.5 Letter, Piccolo to Anderson, "Transmittal of DWPF Sodium Nitrite USQ Evaluation and Compensatory Measures," HLW-2002-00075, 5/17/2002

C.6 Memo, Buch to Miller, "Revised Justification for Acceptability of the Melter Feed Interlock Single Failure Vulnerabilities," CBU-WSE-2004-00033, March 9, 2004

C.7 "DWPF Mode C Probabilistic Safety Analysis," S. T. Gough, et al, WSRC-TR-95-0198, June 27, 1995

D. Derivation of Technical Safety Requirements (DSA Chapter 11)

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 9, 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 section II.B 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.

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 11.1.1 and 11.1.2 provide the objectives and scope, respectively, for Chapter 11. DOE staff review found these sections adequately meet the requirements of DOE-STD-3009-94, section 5.1. All sections of DOE-STD-3009-94 have been applied to Chapter 11. Chapter 9 evaluates the magnitude of the hazards, the complexity of the facility and/or systems being relied on, and the TSRs necessary to maintain an acceptable level of risk have been identified. The DOE staff found this to be acceptable.

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 11.2 of the chapter and found it adequately meets the requirements of DOE-STD-3009-94, section 11.2. Review of Chapter 11 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 9 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 11.3 covers the summation of those DSA chapters (4 and 9) 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 11.3, "TSR Coverage", 11.3.1, "Safety Limits Coverage", and 11.3.2, "Limiting Conditions of Operations and Surveillance Requirement Coverage". DOE staff review determined the following:

1. 11.3, through use of Table 11.3-1, provides the recommended DOE-STD-3009-94 format for consolidating information from Chapters 4 and 9 which is used to confirm that TSR coverage for the facility is complete. DOE staff reviewed Tables 4.3-1, 4.4-1, 9.3-10, 9.3.11, and the scenario discussions in section 9.4.2, and concludes Table

11.3-1 adequately captures the information required by DOE-STD-3009-94. Section 11.3 references TSR section 6.0 to cover SSCs without TSR coverage (i.e., Design Features) and section 11.5 to provide the specifics of the derivation of TSRs. The DOE staff review found that the information provided adequately meets the requirements of DOE-STD-3009-94.

2. 11.3.1 discusses the philosophy and justification for not imposing Safety Limits, and therefore not imposing Limiting Control Settings (section 11.3.2), on the operation of DWPF. DOE staff review found the justification and the content of this subsection to adequately meet the requirements of DOE-STD-3009-94.

3. 11.3.3 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 9 is maintained and that the SRs chosen provide assurance on a routine basis that the operability requirements detailed in Chapters 4 and 9 are met. DOE staff review found this subsection to adequately meet the requirements of DOE-STD-3009-94.

The DOE staff review concludes that Section 11.3 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 9, "Hazards and Accident Analyses", regarding operational conditions associated with accidents.

Evaluation

Section 11.4 provides the mode definitions used in the derivation of TSRs. Section 11.5, "TSR Derivation" is referenced for derivation of specific numerical values (e.g., temperatures limits), which ties the derivation of modes to Chapter 9. DOE staff review of section 11.5 did not identify any mode that was not included in Section 11.4.

The DOE staff review found this section to adequately meet the requirements of DOE-STD-3009-94, section 5.4.

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.

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

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

Evaluation

The TSRs derived in section 11.5 are organized by major accident scenarios and then by each major facility process area applicable to these scenarios that were analyzed by safety analysis. LCOs and related SRs are numbered, as they will appear in the DWPF 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 staff reviewed Section 11.5 of the DSA to ensure the derivations adequately (1) considered all modes of operation, (2) contained necessary references supporting the statement/value, and (3) considered combination of inoperable equipment (especially with regard to the interface between Zone 1 Ventilation and the electrical power supply). This review involved a vertical slice of various sections within Sections 11.5.1, 11.5.5, 11.5.7, 11.5.8, 11.5.9, and 11.5.10, as well as a general review of the remaining 11.5 sections for the four elements above. This DOE staff review concluded that DSA Section 11.5 adequately satisfied the first three areas above.

As a part of the 2004 annual update, the Surveillance Requirement discussion for each LCO was revised to delete the frequency of SR completion, where applicable. The frequencies will remain in the TSR bases section but will not be specified in Chapter 11. The Chapter 11 discussion will be more generic in nature and changes to TSR SR frequencies will not automatically require a Chapter 11 change. DOE reviewed DOE-STD-3009 and did not identify any requirement for specific SR frequencies to be listed in Chapter 11. DSA Revision 22 included some additional changes to the safety grade nitrogen purge system and nitrogen inventory. These changes are discussed in the appropriate section of the SER.

DSA Section 11.5 concerning the SRAT, SME, SMECT, MFT, LPPP PPT and SPT notes that the purge rates assumed in the accident analysis are conservative though the assumed hydrogen concentration at the LFL has not been compensated for vapor space temperatures exceeding 25°C (i.e., the assumed LFL of hydrogen is 4% by volume.) New Information (NI) was discovered concerning the methodology for calculating the Lower Flammability Limit (LFL) for hydrogen (NI-SITE-2003-001.) Historically, the LFL was calculated using a fla rate of 4% by volume of hydrogen. However, the NI noted that the LFL is reduced when temperature differences are taken into account, the magnitude depending on the increase in temperature above 25°C. DWPF prepared technical report WSRC-TR-2003-00297 as a result of NI-SITE-2003-001 to justify why the current values for the purge rates and time to LFL were still valid. DOE reviewed the technical justification to determine if the compensating factors maintained the margin of safety in the purge rates and time to reach LFL.

Compensating factors that were noted to offset the potential reduction in the safety margin include:

1. catalytic hydrogen generation rate decay – current calculations assume peak rate is constant, but the rate actually decays over time
2. reduced radiolytic hydrogen generation rate – current calculations use "G-value" approach with no credit for hydrogen scavenging from nitrate or nitrite; latest methodology (approved and used in the sending facility (CSTF) DSA) using "NO_{eff}" approach credits scavenging effect from nitrate and nitrites and reduces net hydrogen generation rate
3. steam inerting of vapor space – no credit currently taken; for those tanks where catalytic rate is significant at boiling/near-boiling conditions (i.e., where the change from the "G-value" approach to the "NO_{eff}" approach was not sufficient to compensate for the temperature correction), steam inerting would exist.
4. reduced peak catalytic hydrogen generation rate – current calculations assume vessels are filled to overflow with maximum sludge concentration material

Report WSRC-TR-2003-00397 included spread sheets with the revised calculations for DWPF vessels showing the effects of the above compensating factors regarding purge flow requirements and time to reach LFL upon loss of purge (i.e., recovery time). The results show that the existing purge flow and recovery time calculations are conservative to those that would be calculated if temperature correction of the LFL was made and the above compensatory factors were incorporated. DOE review of report WSRC-TR-2003-00297 determined that the justification provided was adequate and the currently calculated purge flows and recovery times maintain the safety margin for DWPF vessels.

DOE reviewed Section 11.5.1.6.20, Leak Test of CPC Safety Grade Nitrogen Purge Isolation Check Valves and Section 11.5.7.5.8, Leak Test of LPPP Safety Grade Nitrogen Purge Isolation Check Valves. These sections were added to ensure that the Safety Grade Nitrogen Purge System would maintain the required 96 hours purge inventory for the CPC and LPPP vessels following failure of the Primary Air Purge System. The redundant check valves for each system must provide isolation with minimal leakage to maintain the required 4 day supply. The effect of the new leak test on the nitrogen inventory is discussed below. DOE review and WSRC implementation of the testing of the valves resulted in two new surveillance requirements being added to the TSRs. The surveillance frequency for testing of these check valves was based on Nuclear Power Plant guidance for testing of check valves (discussed in CBU-WSE-2004-00091). DOE reviewed report CBU-WSE-2004-00091 along with the Nuclear Regulatory Commission's inspection procedures (NRC Inspection Procedure 73756) and other industry data to determine that the 2 year test frequency was adequate.

The derivation of several the key LCOs are evaluated below:

LCO 3.1.3 and 3.1.4 – SMECT Flammability Control – Operation, Standby, and Shutdown
Calculation X-CLC-S-00085, "SMECT Purge Flow Requirements" was reviewed to confirm the acceptability of the specified purge value. The calculation was found to use methods and inputs consistent with that documented in the DSA for derivation of SRAT purge requirements. The bounding set of conditions considered credible was 7,500 gallons of SRAT material at 50°C. This would be a conservatively large carryover event for the SMECT. It was concluded that this set of conditions represents a conservative bounding condition and the required purge value was appropriately (conservatively) determined. In addition, calculation X-CLC-S-00087, "SMECT Recovery Times", which determined the recovery times included in the TSRs revision, was reviewed by DOE and was found to use inputs and assumptions consistent with Chapter 11 discussions, previous calculations for determining recovery times, and appropriately conservative. Based on the above, these calculations were determined to be acceptable.

LCO 3.1.6 – CPC Purge Sources
The CPC safety grade nitrogen inventory calculation (M-CLC-S-00698, Rev. 2) was reviewed and found to appropriately consider differences between conditions when the flowpath is setup and conditions when actual system actuation occurs (e.g., temperature could be at 80°C but safety grade nitrogen flow could reduce temperature to 20°C due to cold N_2; pressure control valve (PCV) setting at setup could be 63 psig, but PCV actuation point could be at 68 psig). Additionally, the supporting calculation deriving the maximum flows to the CPC vessels (M-CLC-S-00692, Rev. 0) appropriately considered jumper leakage. Finally, since the required inventory in the CPC N_2 storage tanks is sufficient only to provide Standby purge flowrates to the SRAT and SME (other CPC tanks have the same flowrate needs in all modes) for 4 days, DSA section 11.5.1.6 properly identifies the need to take operator action within 24 hours to conserve the N_2 usage rate.

LCO 3.1.6, CPC Purge Source, was revised as a result of a correction to the flowrate and the leakage rates assumed through the nitrogen check valves. The original flowrate was based on standard conditions of 1 atm and 70°F. Calculation M-CLC-S-00698, Rev. 3, adjusted the flowrate based on bounding temperatures of 20°F and 80°F. Engineering judgment added an additional 4 scfm leakage rate for the check valves. DOE finds this rate to be conservative based on the actual leak rates observed in field tests. The combined total flowrate slightly increases the required minimum inventory from 2,515,277 scf (716 in wc) to 2,538,317 scf (723 in wc).

The CPC purge system originally used automatic modulating flow control valves to control the purge flow. These valves provided adequate flow control, but resulted in inadequate flow readings. These valves were converted to manual valves, and additional needle valves are in parallel for redundant control. Both types of valves are manually set in a fixed position based on the flow indication from the Kurz and manual flow meters. Procedures require two surveillances per shift (4x/day) of the CPC purge flow indication devices to verify the CPC purge flow conditions are being met. The valves can be manually adjusted by the operator (open/close) to bring the flow into the required range.

Purge flow rates for the CPC vessels were conservatively derived based on flammable gas production at boiling conditions.

LCO 3.3.1 – Melter Off-Gas Flammability

An explosion can occur in the melter plenum or off-gas system if combustible gases from the melter are not oxidized in the melter plenum. The combustible gases are aromatic organic compounds from the melter feed and hydrocarbons released from the cold cap reaction. This source is characterized by the quantity of total organic carbon in the melter feed. One of the possible initiators of the explosion is low melter vapor space temperature, which provides inadequate combustion temperature for the gases. Melter vapor space temperature is maintained above 460°C (excluding instrument uncertainty) to ensure combustion of these gases in the melter vapor space, thus preventing concentrations of combustible gases above 60% of the lower flammability limit (LFL) in the melter vapor space or off-gas system.

Total organic carbon compounds in the melter feed contribute to combustion gases in the melter offgas system by release of hydrocarbons from the melt pool cold cap. A deflagration in the melter offgas system is prevented by limiting total organic carbon content of the feed (LCO 3.1.8), limiting feed flow, maintaining sufficient temperature in the vapor space to destroy combustibles, maintaining sufficient combustion air flow to destroy combustibles, and maintaining sufficient dilution air flow to dilute combustibles. Should plant operating parameters fall below the settings for the temperature or air flowrates, the melter feed pumps would be tripped offline to prevent waste feeding which would generate additional flammable vapors. The melter feed forms a "cold cap" on top of the melter glass pool. Some of the combustibles are destroyed in calcination reactions there. Additional combustibles are destroyed in the melter vapor space, depending on the vapor space temperature. Calculation X-CLC-S-00096 (Reference D.4) was reviewed. This calculation determined that the melter is automatically protected against extended accidental overfeeding at rates above 1.5 gpm at the new input conditions. This means that sustained feeding above 1.5 gpm will trip the melter vapor space temperature interlock, securing feeding to the melter.

Minimum temperature requirements in the melter vapor space ensure the adequate destruction of combustible gasses generated during operations. By keeping the vapor space temperature sufficiently high and maintaining proper airflow, flammable gasses are kept below 60% composite lower flammability limit (CLFL) during normal operations and below 95% CLFL following a design basis seismic event.

A four stage cold cap computer model is used to predict gases leaving the cold cap and provides input to the Melter Offgas (MOG) dynamic computer model, which predicts flammability. Data gathered and modeling to support the vapor space temperature reduction have identified that a lower temperature limit of 460°C is sufficient to ensure adequate destruction of organic vapors exiting the melt pool.

DOE reviewed the technical report, "Validation of the DWPF Melter Off-gas Combustion Model" (Reference D.1) which assessed data taken from two research melters. This data was compared to the DWPF combustion model and was shown to be bounded by the model. This technical report provided the justification to support 460°C.

The temperature correlation equation is used to determine the true gas temperature of the vapor space. Due to shine from the melt pool, lid heaters, and refractory the vapor space thermowells see higher temperatures than actual. DOE noted the lack of data at the lower temperature range to support extending the temperature correlation equation below 570°C. DOE reviewed calculation X-CLC-S-00104 (Reference D.2) that graphed indicated temperature versus the temperature determined by a mass-energy balance and predicted actual temperature as determined by the temperature correlation equation. In all cases, the temperature predicted by the temperature correlation was lower (a minimum of approximately 40 degrees conservative) than the temperature determined by the mass energy balance. Since the temperature correlation is a straight line through the available higher temperature data, the lower temperature correlation will continue to be conservative. Calculation X-CLC-S-00104 adequately supports extending the temperature correlation to 460°C measured vapor space temperature.

Melter vapor space temperature is measured with three redundant thermocouples. DOE evaluated the possibility of drift in the thermocouples used to measure vapor space temperature and trigger associated interlocks. DOE reviewed several engineering standards (e.g., ASTM E 230) that discussed the prevalence of drift in thermocouple readings. The facility periodically checks the calibration of the thermocouple transmitters but this does not validate the signal coming from the thermocouple itself. Significant drift was not observed in the 7-8 years of run time with the type-B thermocouples. The temperature correlation equation was found to conservatively predict actual temperature. Large errors in the temperature indication would be seen in adjustments to melter heater power requirements. No such adjustments were necessary. There is no reason to expect different behavior from the new type S thermocouples that were recently installed. Based on the information reviewed, DOE concluded that thermocouple drift is within the analyzed tolerances and acceptable to protect the new lower temperature limit of 460°C.

Calculation X-CLC-S-00097 (Reference D.3) shows that the off-gas safety basis flammability limits for normal and seismic cases at a temperature of 460°C are met. This calculation is based on the previously approved modeling programs. Off-gas surges can impact flammability and are factored into the analysis. Normal melter off-gas flow can be increased, by surges, due to water coming in contact with the melt pool or the sudden release of calcine gases from the cold cap. For a 3X (i.e., three times normal) off-gas surge at a feed rate of 1.5 gpm, total organic carbon of 14,000ppm, a vapor space temperature of 460°C, total melter flow of 900 pph, and backup film cooler flow of 233 pph the resultant % LFL is less than 60%. For the seismic case, with the same inputs but assuming some loss of airflow due to line leaks, the % LFL was less than 70%. These values for LFL are as calculated in the Off-gas Condensate Tank (OGCT).

To determine the sensitivity of flammability to the vapor space temperature, the melter off-gas model was run with a 3X surge with the same input parameters without an allowance for combustion. A revision to X-CLC-S-00097 was issued and showed that OGCT % LFL remains below 70% for the normal operating condition. For the seismic case without combustion, the % LFL remained under 80% in the OGCT. Since no combustion was allowed in either run, the results are invariant with vapor space temperature. Based on DOE's review of the calculation and the results of the conservative non-combustive runs, DOE is satisfied that LFL will not be reached.

LCO 3.4.5 – LPPP Purge Sources
No changes were made to the minimum LPPP nitrogen inventory as a conservative value for the nitrogen check valves (10 scfm leak rate) was already included in calculation M-CLC-S-00733. DOE finds this leak rate to be conservative based on actual values observed in field tests. The inventory for the LPPP safety grade nitrogen is considered adequate to meet the 96 hour requirement for purge flow.

LCO 3.9.1 – Standby Electrical Power
An area reviewed by the DOE staff involved the interface between the safety significant DG/Electrical Distribution System and the non-safety DCS (see Section II.C.10 of this SER). Sections 4.4.47 and 11.5.10.2 of the DSA describe two important elements of this interface: (1) the DCS load sequencing (even under worst credible failure conditions) will not overload the DG, and (2) faults on non-safety loads will not prevent the DG supply nor its safety significant loads from functioning properly.

DSA sections 4.4.47, 11.5.10.2, and the TSR Bases for LCO 3.9.1 state the DG output breaker closes after the DG achieves voltage and speed. The Basis for SR 4.9.1.17 (loss of offsite power test) identifies the specific DG output voltage (95% of rated, 456 VAC) and frequency (90% of rated, 54 Hz) which must be obtained before its respective output breaker closed. This specific voltage/frequency condition is necessary to ensure (1) sufficient voltage (thus amperage) was available to be supplied to any faulted non-safety load to ensure the protective devices (fuses/breakers) protected the DG's ability to supply power to safety significant loads, and (2) that if DCS prematurely caused non-safety loads to be added onto the safety significant busses B9 or B10 (possible since DCS has Uninterruptible Power Supply for at least two minutes after loss of AC power), the DG would accept these loads and still supply required power to the safety significant loads. Additionally, a DG dynamic stability study (ECS-IO1-95-0087, November 10, 1995) was performed to show that worst case load sequencing errors within DCS would not prevent the DG from properly supplying power to the required loads in the required time frame. DOE staff review of this study found it to be adequate.

As a part of the 2004 annual update, the discussion on the inoperability of both diesel generators was corrected to require immediate response upon entering this condition to be consistent with the TSR. Previously, Chapter 11 discussed a 2 hour duration to restore a diesel to operable status.

Another area reviewed by the DOE staff involved the criteria at which the diesel fuel oil should be considered unusable and therefore affect DG operability. NUREG 1431, as well as other nuclear industry standards, recommend and/or use a limit of 10 mg/l of particulates. Section 11.5.10.2 of the DSA identifies 20 mg/l as the limit and discusses this difference. The justification provided in Chapter 11 was reviewed by DOE staff and found adequate due to site experience, the DOE Diesel Fuel Oil Working Group Handbook (EFR-RMT-95-0068, July 1995), and the commitment for DWPF to ensure a program is in place to take action if the fuel oil particulate level exceeds 10 mg/l (action being to increase the SR frequency per the SR 4.9.1.23 Bases, and track and trend particulate level above 10 mg/l to ensure continued operability of the DGs).

The DOE review concludes that DSA sections 11.5.1-11.5.10 adequately meet 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 11.3, "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 review of DSA section 11.5.11 found that the safety programs identified in chapters 5, 8, 10, 12, and 13 (e.g., Radiation Protection, Fire Protection, QA, Emergency Preparedness, etc.) were properly captured. Additionally, the administrative controls providing safety significant functions from DSA Tables 9.3-10 and 9.3-11 were captured. Likewise, key assumptions from the ARP/Interarea Transfer Line CHA were captured. Finally, certain specific administrative controls specified within individual DBAs in DSA section 9.4.2 were found to be included in the section of Chapter 11 for these events (e.g., 11.5.1.9, 11.5.5.3, 11.5.7.7). Thus, DOE staff review found section 11.5 to adequately meet the requirements of DOE-STD-3009-94 for content.

The Chemical Control program was appropriately revised to include Administrative Controls for Sodium Nitrite transfers to the Waste & Chemical Waste Treatment Building (980-S). In addition, the Administrative Control prevents acid addition to the Caustic Waste Neutralization Tanks (CWNT) when the CWNT contains Sodium Nitrite.

A few key Administrative Controls credited with preventing and/or mitigating events associated with the ARP include:

- Radiation Protection Program – This program ensures that the radiation exposure of onsite and offsite individuals in maintained within applicable DOE limits and is As Low As Reasonably Achievable (ALARA). This program also ensures administrative control on the backpulse vault door to prevent any entry that could expose an individual to radiation.
- Nuclear Criticality Safety Program – this program recognizes that the NCSEs referenced in Chapter 8 of the DSA are the bases document for nuclear criticality safety control.
- DWPF Feed Acceptance Criteria – This program ensures that programmatic controls are implemented to ensure that sludge and salt solution transfers to DWPF comply with the safety requirements of the DWPF WAC. These controls will ensure that the compositions of the sludge and salt streams received are within analyzed limits. Critical attributes of the program are identified as inhalation dose, gamma and neutron

shielding, nuclear criticality safety, canister heat generation, and hydrogen generation rate.

- Transfer Control Program – key elements of this program are identified as independent verification that transfers are stopped, preventing a siphon, monitoring transfers and ability to stop transfer if material is unaccounted for, monitor supply tank level, continuous communication with sending facility, and evaluation of maintenance and excavation activities for transfer lines.

Minimum Shift Staffing

The minimum shift crew derived consists of 1 Control Manager, 1 Control Room Operator qualified on all stations, 1 Balance of Plant (BOP) operator, and 1 Vitrification Support (VS) Operator. DOE staff reviewed the operator actions required by the DSA and the TSR to verify that sufficient BOP/VS operators will be available to complete the tasks in the specified times. Actions to verify adequate CPC vessel purge flow, performed on the 3rd level in the Vitrification Building are required. Actions by operators with respect to restoration of the Diesel Generators (LCO 3.9.1) and the Zone 1 Exhaust System (LCO 3.7.1), both located in the 292-S Fan House, are also required. The BOP/VS operators are sufficient to complete these immediate actions. DOE concluded that the minimum staffing is sufficient.

Hanford Connector Torque Requirements

Section 11.5.11.2.19, "Hanford Connector Torque Program", identifies the required torque necessary to satisfy the Administrative Control function as 550 ft-lbs. Section 11.5.11.2.19 refers to calculation T-CLC-S-00062, "DWPF Purge Gas System Seismic Review," Revision 3. This document, via an internal reference (i.e., T-ESR-S-00003, "3-inch Hanford Connector Test Results"), states the basis for seismically qualifying the Hanford connectors for DWPF was based on a minimum torque value of 312 ft-lbs. The value of 550 ft-lb provides sufficient margin to accommodate the performance of the impact wrench and the ability to measure the impact time. DOE found this margin adequate.

Traffic Control Program

The Traffic Control Program Administrative Control derivation was revised to be consistent with DSA Section 9.4.2.22, Table 9.3-10 and TSR 5.8.2.21. The discussion originally did not identify which facilities and SSCs were covered under this administrative control. Therefore, the AC was revised to include discussion of the nitrogen supply lines at the LPPP and to identify the SSCs for the vessels in 980-S and 422-S shown in Table 9.3-10. Programmatic controls are implemented to ensure that all vehicle movements are controlled near safety class and safety significant SSCs to prevent vehicle impacts to vulnerable SSCs. DOE facility walkdowns determined that all vulnerable safety related SSCs are now consistently identified in the DSA and TSR.

As discussed in II.B.6, the Flammable Vapor Sampling Program was revised to require hydrogen sniffing only during excavation within a 4 foot halo around inter-area transfer lines. This requirement protects the assumption of 3 foot of soil coverage to minimize any release following a transfer line detonation.

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. Reference Chapter 2, "Facility Description", if that chapter contains the desired information.

Evaluation

Design Features are identified specifically in the TSRs, section 6.0, per DOE Guide G 423.1-1, and are evaluated in section III of this SER. Thus, DSA chapter 11 does not cover these features.

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 DWPF's interface with other facilities from the facility interface, as well as the specific TSR controls. Subsection 11.7.1 provides the facility interface overview. Subsection 11.7.2 provides the TSR interface which is further divided into subsection 11.7.2.1 for coverage of Waste Acceptance Criteria interface and subsection 11.7.2.2 for coverage of Interarea Transfer Accidents interface. DOE staff review found this section to adequately meet the requirements of DOE-STD-3009-94, section 5.7.

Conclusion

Chapter 11 of the DSA is acceptable. Based on the DOE review, the purpose and required elements of section II.D of this SER have been satisfied.

D.3 References

D.1 WSRC-TR-2000-00100-TL, "Validation of the DWPF Melter Off-Gas Combustion Model," 6/27/2000

D.2 X-CLC-S-00104, "Melter Vapor Space Temperature Comparison to Thermocouple Readings," 5/3/2001

D.3 X-CLC-S-00097, "Impact of Lower Vapor Space Temperature on DWPF Melter Off-Gas Flammability During Sludge-Only Operation," 4/19/2001

D.4 X-CLC-S-00096, "Steady State Indicated Temperature of DWPF Melter Vapor Space at 1.5 GPM Feed Rate," 9/1/2000

E. Programmatic Control (DSA Chapters 7, 8, 10, 12, and 13)

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:

- Waste Confinement and Management (Chapter 7)
- Facility Safety Programs (Chapter 8)
- Conduct of Operations (Chapter 10)
- Quality Assurance (Chapter 12)
- Emergency Preparedness (Chapter 13)

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 7, Waste Confinement and Management

Chapter 7 was revised in 2003 to include 512-S operations. The Chemical and Industrial Waste Treatment section recognizes the ability to send the 422-S sump to Sanitary Waste to minimize the potential of Sodium Nitrite and acid mixing in 980-S. Neutralized wastes are discharged through permitted outfall S-04. As evaluated earlier, the 831-S swirl cell has been removed from the DSA and HEPA filters will no longer be used in the GWSB.

Chapter 8, Facility Safety Programs

8.5 Nuclear Criticality Safety Program:

The Nuclear Criticality Safety Program description was revised to address changes in organizational titles, responsibilities, procedures, and program requirements. The Nuclear Criticality Safety Program section was also updated to address the removal of precipitate operations and add ARP. With the addition of ARP several Nuclear Criticality Safety Evaluations (NCSE) were generated to verify a criticality event at DWPF is incredible. These NCSEs were reviewed by DOE criticality experts and evaluated for adequacy. A summary of the review is included below:

Criticality safety in the DWPF process has been based on low concentration of fissile materials in waste feed solution and the high abundance of neutron absorbers in the sludge. Basically, this approach is continued. However, for DSA Revision 21, new Nuclear Criticality Safety Evaluations (NCSEs) have been performed to update this basis to credit uranium-238 poisoning, evaluate Sludge Batch 3 and to evaluate the use of oxalic acid in the Actinide Removal Process. The three NCSEs were:

- N-NCS-S-00004, "Sludge Batch 3 Processing at DWPF",
- N-NCS-S-00003, "DWPF Chemical Process Cell for Sludge Batch 3", and
- N-NCS-S-00005, "Actinide Removal Process."

The results of these evaluations are briefly summarized in the submitted DSA changes.

The DOE review team (specifically an individual specializing in criticality safety) reviewed the NCSEs using criteria developed from DOE-STD-3007, "Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-reactor Nuclear Facilities" and DOE-STD-1134, "Review Guide For Criticality Safety Evaluations". The specific review criteria included:

1. The NCSE identifies the authors, Review Team (if applicable), and reviewers/approvers. Appropriate WSMS and WSRC personnel approve NCSE. NCSE has been independently reviewed by WSMS.
2. The purpose of the NCSE is clearly identified.
3. Sufficient information is provided to understand and reconstruct system and process being analyzed and this information accurately reflects as-found or as-built system and process or as designed.
4. Any special requirements applicable to the evaluation are identified.
5. Adequate methodologies for determining the acceptable sub-critical values and/or for evaluating processes and determining credible/incredible scenarios and appropriate controls or elements, are identified and utilized to perform the evaluation(s).
6. Reasonable normal and abnormal operations are reviewed to determine credible/incredible scenarios.
7. Credible scenarios have two robust and independent controls identified and any common mode failure identified is acceptable. Incredible scenarios meet the minimum acceptable requirements.

The NCSEs were found to meet these review criteria.

Ultimately, criticality safety is provided by the physical characteristics of the waste and the nature of the operations being conducted. In the insoluble waste forms, criticality safety is assured by the low uranium enrichment (i.e., U-238 serves as the neutron poison) and by the high iron to plutonium ratio where iron serves as the neutron poison. There are no operations performed at DWPF that can alter the enrichment of the uranium. Operations which could have an adverse effect of the required iron to Pu ratio (i.e., inadvertent oxalic acid additions) have been evaluated and shown not to represent a credible criticality hazard due to the large surplus of iron in sludge batches 2 and 3. Likewise, in soluble waste forms, criticality safety is assured by the low concentration of fissile materials. Operations that could affect solubility of the isotopes were evaluated and it was shown that those operations would also equally effect the solubility of the credited neutron poisons (i.e., U-238 or iron). After considering all normal operations and credible abnormal events, the Contractor concluded that there were no credible scenarios that could result in a criticality. DOE considers that this conclusion is based on an acceptably rigorous evaluation, is reasonable and is adequately justified.

As a part of the 2004 annual update, two of the referenced Nuclear Criticality Safety Evaluations (NCSEs) have been revised to recognize additional plutonium in sludge batch 3 and to update processing steps in the Actinide Removal Process. In addition, a new NCSE addressing neptunium (Np) 237 processing in the Chemical Processing Cell (CPC) was referenced. The three NCSEs were:

- N-NCS-S-00003, "DWPF Chemical Process Cell for Sludge Batch 3", Rev. 1,
- N-NCS-S-00005, "Actinide Removal Process", Rev. 1, and
- N-NCS-S-00006, "Np Materials Processing in the DWPF Chemical Process Cell as Part of Sludge Batch 3," Rev. 0.

DOE conducted assessments of these WSRC evaluations. The DOE review team (specifically an individual qualified in criticality safety) reviewed the NCSEs using the same criteria listed above. The NCSEs were found to meet these review criteria. The detailed results of these assessments are documented as DOE Technical Assessments 201464, 201419, and 201483.

A new NCSE recognized the addition of neptunium to the process. In order for Np-237 to fission, the incident neutron must have significant energy. ANS Standard 8.15, "American National Standard for Nuclear Criticality Control of Special Actinide Elements", indicates that the energy threshold is around 600 keV. As a result, the presence of virtually any moderating materials (e.g., water) will prohibit fission. For this reason, criticality of solutions containing Np-237 is not possible. The evaluation performed looked at "bounding" type conditions that, while are not physically achievable, demonstrate that no achievable physical scenario could challenge criticality safety. These bounding type evaluations postulate scenarios where the Np is accumulated in regions of a CPC vessel with no interdispersed moderator (clearly bounding and unachievable). Also factored into the evaluation is the potential interaction between the Np-237 and the Pu present in the sludge (Uranium is not an issue due to its low enrichment).

Based on these new NCSEs, it was concluded that no credible criticality hazard exists for the defined DWPF operations. DOE considers that this conclusion is based on an acceptably rigorous evaluation, is reasonable and is adequately justified. In addition, the supplemental information added to Section 8.5 of the DSA is consistent with the underlying NCSEs and was determined to be acceptable.

8.1.4 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 DWPF. As a part of the 2004 annual update, programmatic detail was deleted; however, the requirements of DOE-STD-3009 were maintained as was previously discussed in Section I.E.

Chapter 10, Conduct of Operations

As a part of the 2004 annual update, programmatic detail was deleted; however, the requirements of DOE-STD-3009 were maintained as was previously discussed in Section I.E. Certification is no longer required for any position at DWPF. Previously, the Vitrification Control Room Operators and Managers required certification. The certification requirements were reviewed and determined to not be necessary by DOE.

Chapter 12, Quality Assurance

Chapter 12 properly recognizes the additional quality assurance requirements related to the glass form produced by the DWPF (given in DOE/RW-0333P). As a part of the 2004 annual update, programmatic detail was deleted; however, the requirements of DOE-STD-3009 were maintained as was previously discussed in Section I.E.

Chapter 13, Emergency Preparedness

This chapter summarizes the facility Emergency Response Organization (ERO). The DWPF Shift Manager or Vitrification Control Room Manager on shift is identified as the individual responsible for directing the emergency response (i.e., the AEC). 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. The authority to initially declare a facility emergency is identified as a non-delegable duty and rests with the DWPF AEC. Once the Emergency Operating Center is activated, the Emergency Director is responsible for any changes in classification or declaration of emergency classifications. DOE review of this chapter found it to accurately reflect the facility ERO titles, functions, and plans. As a part of the 2004 annual update, programmatic detail was deleted; however, the requirements of DOE-STD-3009 were maintained as was previously discussed in Section I.E.

III. Technical Safety Requirements (TSR) 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 DWPF.

Section 1.6, Modes, was found to contain all the appropriate location-specific limitations for the CPC vessels (SME, SRAT, ASRT, MFT) and LPPP vessels (PPT and SPT). The

Operation process mode was revised to remove the requirement to perform a USQE prior to adding Formic Acid to the MFT. This requirement is not appropriate here and is already covered by a note in LCO 3.1.8, Melter Feed Contents and AC 5.8.2.23, Chemical Controls.

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 DWPF. This section references DWPF DSA Chapter 11 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 describe, 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 DWPF, 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 11 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.

DOE found the general LCOs and SRs (3.0.x and 4.0.x) consistent with the guidance in DOE Guide G 423.1-1 as well as the CSTF TSRs approved in Reference III.1. Additionally, DOE found the individual LCOs to describe the possible conditions related to inoperable systems or equipment as well as parameters being outside the stated limits.

The results of the DOE review of several key LCOs and SRs are documented below.

LCO 3.1.3 – SRAT, SME, and SMECT Flammability Control - Operation
A clarifying note was added to LCO 3.1.3 covering the requirement to purge the SMECT vapor space following the loss of purge. The 12 vapor space turnover requirement is consistent with the handling of purge requirements in CSTF TSR and other CPC vessels. The 12 vapor space turnover requirement will ensure the vapor space in the SMECT does not reach a flammable concentration. A similar change was made to LCO 3.1.4, SRAT, SME, and SMECT Flammability Control – Standby and Shutdown also for the SMECT.

The minimum purge flows for the SRAT, SME and MFT are based upon uncertainty calculations J-CLC-S-00005, Rev. 4 for the SME flow, J-CLC-S-00003, Rev. 4 for the SRAT flow, and J-CLC-S-00002, Rev. 5 for the MFT flow. The flows are provided in LCO's 3.1.3, 3.1.4, 3.1.5, 3.1.6 and the Bases. Additionally, Required Action A.3 of LCO 3.1.3 requires establishing STANDBY purge flows immediately if the SRAT or SME experiences a low flow condition while in the Operations Mode. Concurrently, the action statements require the vessel be taken to STANDBY MODE. The standby purge flows are sufficient to maintain the SRAT and SME less than 95% of LFL at the bounding hydrogen generation rate and temperatures (i.e., in the short interim period until STANDBY conditions are achieved).

The TSRs recognize that it is safe to add decontamination frit to the SME while it is in Standby mode. Sections that clarify this include the Mode Definition for the SME process area and CPC Flammability Monitoring (LCO 3.1.1 and its Bases). The justification provided states decontamination frit cannot contain Formic Acid and thus will not increase hydrogen generation rates in the SME. Flammability (hydrogen) controls for the SME while in Standby Mode are therefore deemed adequate for the decontamination frit additions.

DOE reviewed the justification for this allowance. The DSA, and in particular Chapters 6 & 11, clearly states hydrogen generation in the SME is the result of "dehydrogenation of formic acid catalyzed by noble metals." Chapter 6 clearly distinguishes between the makeup of process frit (which may contain formic acid) and decontamination frit (which consists of only dry frit and water). System piping drawings were reviewed to confirm that piping that would have allowed formic acid addition to the decontamination frit slurry feed tank has been removed. DOE concluded the allowance to add frit to the SME in the Standby mode is adequately justified and correctly incorporated into the TSRs and DSA.

As a part of the 2004 annual update, the flow instrument numbers were deleted from LCO 3.1.3, 3.1.4 (SRAT, SME, and SMECT Flammability Control – Standby and Shutdown), and 3.1.5 (ASRT and MFT Flammability Control) Statements, Conditions and Surveillance Requirements. Each of these three LCOs list the purge flow required but no longer refers to specific instrumentation used to read the flow (instrumentation is identified in Table 3.1.6-1 and the bases section of the TSR). Each vessel has a minimum of 2 flow indicating instruments. Only one of the instruments must be operable (for each vessel) to continue with normal operations (assuming inoperable equipment is restored within 7 days). Operability of the instruments used to verify vessel purge flow is covered under LCO 3.1.6, CPC Purge Source. Inoperable instrumentation must be restored within 7 days or the affected process vessel must be placed in standby. No change in LCO requirements were made as a result of removal of the instrument numbers from LCOs. This change corrects the TSR from potential misinterpretation between the purge flows and the multiple instrumentation that can be used to verify the purge flows.

The Bases for LCOs 3.1.3, 3.1.4, 3.1.5 were also edited to include the purge flow instrumentation which measures each vessel, clarifies that the flow is measured by an "operable" flow instrument, and adds that if a flow instrument is inoperable, LCO 3.1.6 applies.

DOE reviewed these clarifications and changes and found them to be acceptable.

LCO 3.1.4 – SRAT, SME, and SMECT Flammability Control – Standby and Shutdown

The SMECT Recovery Time Table in LCO 3.1.4 includes different SMECT vessel solids concentrations to allow the flexibility of performing maintenance. Additionally, this discussion is included in the corresponding Bases section. The basis for the SMECT recovery times is provided by calculation X-CLC-S-00087, "SMECT Recovery Times". The calculation was reviewed by DOE and found to use inputs, methods, and assumptions consistent with DSA Chapter 11 discussions and previous calculations for determining recovery times. It was determined that it is appropriately conservative and provides a sound basis for the recovery times given in the TSR.

LCO 3.1.5 – ASRT and MFT Flammability Control

LCO 3.1.5 was revised to include the ASRT for flammability control to support receipt of ARP feed material. The required purge has been set at 1.0 standard cubic feet per minute (scfm) to maintain the vessel's gases to below 25% of the lower flammability limit (LFL). The 1.0 scfm protects the required value of 0.544 scfm and allows for instrument uncertainty. The LCO requirements for the ASRT duplicate (except for the rate of flow) those of the MFT that existed previously. Local flow gauges are used to verify required flow on a shiftly basis during Operations, Standby, and Shutdown modes – consistent with the requirements for the MFT. Upon loss of ASRT purge, Operations is directed to restore purge through any of the available purge sources by the Recovery Time indicated on Table 3.1.5-1. Due to the low hydrogen generation rate in the ASRT, purge flow requirements and Recovery Times are not as restrictive as the MFT. In support of the LCO, the following calculations were reviewed: S-CLC-S-00100, "Radiolytic and Catalytic Hydrogen Generation Rate for DWPF Sludge Only and ARP Waste Streams"; N-CLC-S-00083, "Purge Requirement Calculations for ARP"; and J-CLC-S-00116, "Instrument Uncertainty Evaluation". It was noted in the uncertainty analysis that the analysis is only valid for flows between 1.0 and 3.0 scfm. The uncertainty became too great below 1.0 scfm for the instrument to be useable. Should observed purge flow drop below 1.0 scfm, the low flow condition would be entered and the flow indicator would not be usable until purge flow was established above 1.0 scfm. The instrument is not declared inoperable unless damage is expected. Should purge flows reach greater than 100% flow (>3.0 scfm), Engineering will perform an evaluation to determine if instrument calibration has been impacted.

The hydrogen generation rate used for the ASRT was based on "diluted MST/Sludge Solids". DOE verified that the value used to determine the purge requirements is consistent with the expected ARP feed stream. Condition statements, required actions, completion times, and Surveillance Requirements which were added to address the ASRT were judged to be consistent with the requirements for previously existing tanks.

LCO 3.1.6 – CPC Purge Source

LCO 3.1.6 was revised to include the ASRT as a vessel requiring purge from the safety grade nitrogen purge system. The safety grade purge system provides a back-up to the primary air purge system should that system fail. The flow indicating loops for the ASRT were added to the LCO condition statements and related tables. The safety grade system was evaluated for adequate capacity, with the additional load of the ASRT, while maintaining the required four day inventory of nitrogen supply. DOE reviewed calculation M-CLC-S-00698 that derived the required nitrogen inventory assuming worst case temperature and pressure for both purge system set up and actuation. The required inventory was bounded by the previous analysis (calculation M-CLC-S-00631). Condition statements, required actions, completion times, and surveillance requirements, which were added to the LCO to address the ASRT, were judged to be consistent with other vessels in the CPC.

If the one nitrogen tank level indicator on the CPC Safety Grade Nitrogen Supply system is inoperable, the LCO requires it to be restored within 7 days. If it is not restored in 7 days, the LCO requires that the system be declared inoperable, providing 3 more days before the facility must be placed in the defined safe condition. Loss of a single indicator means a second indicator for the tank is still available. The safety function in question is an indication of the available nitrogen inventory present in the five safety grade tanks. This function can still be met with the single indicator. The additional risk, if any, of operating in this condition for three additional days is minimal. DOE concluded this LCO structure was acceptable.

LCO 3.1.6 and its Bases section specify that the Safety Grade Nitrogen System must supply the Standby Purge Flows versus the Operations Mode purge flows. This reduces the required amount of nitrogen used. The standby purge flows are sufficient to maintain the SRAT and SME less than 95% of LFL at the bounding hydrogen generation rate and temperatures and 25% of LFL at STANDBY conditions. The standby purge rates are sufficient to protect the safety analysis. In this abnormal condition (i.e., loss of primary purge sources and having to transition from Operation to Standby conditions while on the safety grade nitrogen purge source), explosive conditions are prevented and TSR actions require reestablishing conditions which are in accordance with the NFPA requirements for normal operations (25% LFL for an unmonitored process). Additionally, SR 4.1.6.16 and the Basis specify Standby purge flows versus Operation Mode purge flows.

SR's 4.1.6.4, 4.1.6.5, and 4.1.6.6 specify the frequency of the instrument loop calibration of the electronic portion of the flow instruments as annually. The uncertainty calculations (J-CLC-S-00005, Rev. 3 for the SME flow, J-CLC-S-00003, Rev. 3 for the SRAT flow, and J-CLC-S-00002, Rev. 3 for the MFT flow) were reviewed by DOE. These calculations contain the technical basis for the calibration frequency of annually for the electronic portion of the flow instrumentation. The frequency is based on information provided by the vendor and the uncertainty calculations have factored the duration into the determined instrument uncertainties.

SR 4.1.6.25, MFT purge flow loop calibration, was revised to show the correct instrument numbers to be consistent with Table 3.1.6-1 and its bases.

SR's 4.1.6.23, 4.1.6.24, and 4.1.6.25 are provided to calibrate the purge flow sensors every 5 years. Calibration of the purge flow sensors was previously only conducted prior to initial installation in the purge system. Periodic calibrations were identified as necessary during the Contractor's comprehensive review of uncertainty calculations, based on the recommendation of the instrument vendor Kurz®. The surveillance frequency is based on information provided by the vendor and the uncertainty calculations, reviewed by DOE, have factored the increased duration into the determined instrument uncertainties.

As a result of past issues with instrument uncertainty calculations, the Contractor performed a comprehensive review of these calculations for instruments that support sludge only operations. As a result, revised uncertainty calculations and revised controls were incorporated into the DSA and TSR. These controls ensure the 96 hour nitrogen inventory is preserved by requiring operator action within 24 hours to reduce nitrogen flows to standby levels. DOE verified that these actions would be adequate to ensure the TSR protected nitrogen inventory would be adequate to last at least 96 hours. DOE reviewed calculation M-CLC-S-00698, "CPC Safety Grade Nitrogen System Setup" in detail. This calculation determines the required nitrogen flow set-points that ensure adequate flow is provided to protect the vessels from reaching LFL and preserve the nitrogen inventory. The inputs, such as required nitrogen flows and instrument uncertainties, were found to be consistent with appropriate sources. The methodology employed is similar to previously accepted calculations and technically sound. The calculation was found to be acceptable. In addition, DOE reviewed several of the revised instrument uncertainty calculations. Again, the inputs were found to be consistent with appropriate sources and assumptions were reasonable. The methodology employed is the same as previously reviewed and accepted and is consistent with industry standard ISA-S67.04-1994 and recommended practice ISA-RP67.04 Part II. DOE also evaluated the credited operator actions and has determined that 24 hours is a reasonable amount of time to accomplish the adjustment of nitrogen purge flow to the SRAT and SME. DOE considered the need for this operator action, as well as other actions required by the DSA, during its evaluation of the reduced manning requirements and found there to be adequate personnel available.

LCO 3.1.6 was revised (TSR Rev 29) to include a new condition that if one or more of the safety grade nitrogen check valves is inoperable, it must be restored to operable status within 72 hours. Inability to meet the 72 hour requirement will force the affected vessel to standby. As discussed and evaluated in paragraph II.D of this SER, the redundant check valves for the system must provide isolation with minimal leakage (4 scfm) to maintain the required 4 day supply of nitrogen. SR 4.1.6.26 was also added to perform a leak test on the individual valves every 2 years. DOE concluded the 72 hour restoration time and surveillance requirements were adequate to ensure availability and functionality of the CPC safety grade nitrogen system. The TSR Bases section was revised to recognize the additional test requirements.

Table 3.1.6-1 was revised to include "components" in the title and the addition of flow elements for each flow instrument loop. The flow elements for the purge flow instrumentation were added for completeness and to match up with existing surveillance requirements.

Additionally, under the SRAT, SME, MFT and ASRT process area, the safety grade nitrogen level indicators logic was changed from "or" to "and" to clarify that both instruments in each redundant pair are required to be operable. There were no changes to the Conditions or Actions as a result of this logic change.

Table 3.1.6-1 was also revised to include the safety grade nitrogen purge isolation check valves with a leakage limit of less than or equal to 4 scfm and a reference to LCO 3.1.6 Condition B. This change is consistent with the new surveillance requirements to support minimum nitrogen inventory requirements.

DOE reviewed the changes and determined that the changes were appropriate.

LCO 3.1.8 - Melter Feed Contents

LCO 3.1.8 was revised to increase the allowable concentration of Total Organic Carbon (TOC) in the Melter Feed Tank (MFT) from 13,300 to 17,900 ppm. TOC is one of several factors that play a role in the flammability of the Melter and Melter offgas system. The 17,900 limit protects the actual limit of 18,900 and accounts for error in laboratory analysis. Should TOC levels exceed the LCO value, Operations is instructed to secure melter feed pumps to prevent continued generation of flammable gases. Calculation X-CLC-S-00124, "DWPF Melter Offgas Flammability Assessment for Sludge Batch 3" was reviewed and provided the basis for increasing the allowable TOC content in the waste feed while maintaining the LFL in the melter offgas below 60% and below 95% after a seismic event. The increase is based on a validation of the melter offgas model for the sludge batch 3 flow sheet. The model was shown to be accurate down to an iron valence ratio (Fe^{+2}/Fe total) of 0.13. The iron ratio of Sludge Batch 3 is expected to be 0.2. The melter offgas model has been used throughout the life of DWPF to predict operational parameters. The model was successfully used to reduce the required melter vapor space temperature in 2000 (SER Supplement 29, May 15, 2001). The proposed change is supported with an adequate technical basis. Another associated change was to the process area applicability, which was revised to drop the SME. DOE has determined that adequate controls are in place to control TOC in the MFT such that LCO applicability in the SME is not necessary.

LCO 3.3.1 - Melter Off-Gas Flammability Control –

LCO 3.3.1 requires the melter vapor space temperature to be greater than or equal to 493°C. The temperature is measured by three redundant thermocouples, any two of which are required to be functional. DOE reviewed the instrument uncertainty calculation (J-CLC-S-00029) that supports the temperature value. The calculation adequately documents the factors affecting the accuracy of the thermocouple reading and is specific to the application in the melter. Reasonable assumptions are documented in the calculation. Both maximum negative (conservative) and maximum positive (non-conservative) uncertainty readings were calculated. The calculation was based on maximum temperature differentials for the various junction points between the sensing instrument and temperature transmitter. Results indicate a possible error of –55°C to +33°C between the indicated and actual temperature (for example, an indicated value of 500°C would result in an actual temperature between 467°C – 555°C). This error includes an additional uncertainty margin of ±6.5°C above the calculated value to provide additional safety assurance. The uncertainty calculation is valid between the temperatures of 400 – 1050°C - a band that adequately covers the DWPF operating temperature range. The melter feed pump hard-wire interlocks are also set to trip the pump if the temperature decreases below 493°C to protect the 460°C limit for destruction of flammable gases with 33°C of uncertainty. With the melter feed pumps offline, the source of flammable vapors (sludge feed to the melter) is eliminated.

DOE reviewed the Instrumentation Society of America (ISA) technical standard, "Temperature Measurement Thermocouples" (ISA-MC96.1-1982). The ISA standard identifies a nominal operating range of –50 to 1768°C for Type S thermocouples. This temperature range easily encompasses the temperatures produced in the melter. Extension wires used as a part of the design change to install the Type S thermocouples were also consistent with the standard.

The other control in place to maintain the Melter offgas concentration below CLFL levels is to maintain minimum airflow to the Melter and Back-up Offgas (BUOG) Film Cooler. This airflow is measured as differential pressure from FISL-3221A & FISL-3221B (Safety Class). If minimum airflow is not maintained, seismically qualified switches trip off the Melter feed pumps to prevent the continued generation of flammable gases. The differential pressure (dP) instruments were replaced with a similar type from a different manufacturer. The new gauges have a calibration frequency of one year. The longer calibration frequency is based on the performance of similar devices installed in the nitrogen and melter offgas systems.

DOE performed an independent review of the associated uncertainty calculations (J-CLC-S-00101 and -00102) for the new instrumentation to verify that the minimum air flow requirements would be maintained and protected.

DOE reviewed the results of the contractor uncertainty calculation review for a similar device made by the same manufacturer (SMECT Air Purge Flow Indicator). Recommendations and improvements noted in the review were compared to calculations J-CLC-S-00101 and -00102. All relevant recommendations were verified to be incorporated into the new instrument uncertainty analysis.

DOE reviewed the calculation input data and verified the uncertainties calculated for the gauges. Ranges were given for process temperature and pressure that the gauges are expected to experience. A range is also given for normal and off-normal ambient conditions as specified in HLW-DEN-98-0329, dated 9/9/98. These ambient values are used to provide consistency in uncertainty calculations. The uncertainty analysis assumes worst case (post-DBE) conditions of high temperature (104°F) and low pressure (20 psig). These figures are considered reasonable given that Melter feeding will be immediately secured by loss of air (hardwire interlock) or secured in a brief time by operator action. It is reasonable to assume that process conditions will remain at these assumed values in the short time before the required operator action is performed.

DOE reviewed the Commercial Grade Dedication (CGD) Package (J-CGD-S-00238) and confirmed it verifies those design attributes relied upon in the uncertainty analysis. This is performed by a combination of visual inspections (to include instrument range and number of divisions) and calibration tests (to include accuracy of switch and indicator).

During review of the uncertainty calculations, DOE staff contacted the vendor in order to verify the information supplied with the TSR Revision 16 and used in the uncertainty analysis was the most current. The accuracies used in the uncertainty calculations matched the information supplied by the vendor with one exception. The repeatability of the switch was listed as 0.25% of full scale in the vendor information but 0.2% in the uncertainty calculations. Switch repeatability is part of the sensor calibration accuracy term of the uncertainty. The discrepancy had no impact on the instrument uncertainty since the calculation was based on a value of 1.0% for this term (as limited by the measurement and test equipment that will be used to calibrate the device). Further review determined that the CGD package listed the correct value for switch repeatability.

Actual process values were called up on the Process Information Management System (PIMS) to verify the appropriate scale range specified for the instruments. The values recorded for Melter and BUOG flow would have been mid-range of the gauges.

Based on the review, DOE verified that the minimum airflow required to prevent the build-up of flammable gases in the Melter and offgas system will be supplied.

LCO 3.4.3 - Low Point Pump Pit (LPPP) Flammability Control

DOE reviewed the DSA and confirmed the safety functions associated with the LPPP purge systems. The nitrogen purge systems prevent the LPPP-SPT and LPPP-PPT from reaching a combustible hydrogen concentration of 25% of the LFL during normal operations by diluting evolved hydrogen. The safety analysis requires a minimum purge flow to perform this function. This minimum flow of 1.0 scfm (for the SPT) and 0.704 scfm (for the PPT) is to be protected by the TSR.

LCO 3.4.3 requires a minimum flow to the SPT of at least 25% indicated on the flow indicator. This ensures as least 1.0 scfm is flowing to the SPT accounting for uncertainties. DOE reviewed the instrument uncertainty calculations (J-CLC-S-00014 and -00015). The initial calculations did not properly account for pressure fluctuations in the system when calculating a correction factor for actual process conditions. The calculation assumed that the system pressure would be maintained at 10 $\pm$ 0.5 psig by the Pressure Control Valve. Also, the calculation assumed a system temperature of 60 to 80°F. The uncertainty for the flowmeters was re-calculated using a minimum system pressure of 1.0 psig and a system temperature of 125°F to calculate the correction factor. The resulting uncertainty for the flowmeters required increasing the LCO indicated purge rate from $\geq$ 1.2 to $\geq$ 1.4 scfm. This was converted to a value of 25% reading on the flow gauge since the flow meter reads in % flow.

DOE reviewed the revised instrument uncertainty calculations (J-CLC-S-00014 and -00015) and concludes that the system pressure of 1.0 psig and temperature of 125°F used to determine the correction factor for the flowmeter are conservative and are based on reasonable assumptions; and that the revised minimum flow in LCO 3.4.3 is appropriate, based on the revised instrument uncertainty. DOE also performed a system walkdown and confirmed that the flowmeter type and specifications were consistent with the uncertainty calculation assumptions. Additionally, increasing the required flow does not affect the minimum required nitrogen inventory (LCO 3.4.5), since the calculations which derived the inventory requirement are based on maximum flow conditions. Therefore, these changes are acceptable.

LCO 3.4.3 provides a recovery time graph for completion of required actions upon loss of SPT purge flow or indication. LCO 3.4.3 helps prevent explosions in the SPT by ensuring that radiolytic hydrogen does not reach 25% of the LFL. A Recovery Time graph (Table 3.4.3-1) is added which is based on the radiolytic hydrogen generation rate to allow completion times for the Required Actions. The Required Action for SPT purge rate below the minimum required purge rate (LCO 3.4.3, Condition B) is to restore the minimum purge flow within the Recovery Time. The Required Action for both SPT purge flow indicating loops inoperable (LCO 3.4.3, Condition D) is to restore inoperable equipment to operable status <u>or</u> to fully open a SPT purge needle valve to maximize purge flow and to place the SPT in Standby, within the Recovery Time.

The Recovery Time graph (calculated by X-CLC-S-00074) indicates the time to reach 100% of LFL in the SPT upon loss of purge, based on sludge volume in the SPT. The Recovery Time graph and calculation was reviewed by DOE, and determined to be conservative since the times to 100% LFL are calculated on bounding hydrogen generation rates, and all hydrogen is assumed to remain in the vapor space (i.e., no purge flow, no process vessel ventilation, and no air in-leakage). Additionally, the methodology for calculation of the SPT Recovery Times is consistent with the calculation of the radiolytic portion of the Recovery Time consistent with the SRAT and SME (X-CLC-S-00013). Completion of Required Actions within the Recovery Time will ensure that the SPT remains below LFL, while allowing operational flexibility. Even though conservative, Recovery Times are sufficiently long to allow completion of Required Actions, ranging, for example, from 20 hours at 5600 gallons to 100 hours at 3000 gallons.

The uncertainty of the SPT level detectors is not factored into the calculation for recovery times. DSA section 11.5.7.3 discusses and justifies this approach based on the conservatisms in the calculation and the operating procedures assuring verification of tank quantities during transfers. Reference is made to OPS-DTP-970050, which DOE reviewed and found adequate. Based on this, DOE concludes that this approach is acceptable.

LCO 3.4.3 was revised to recognize the installation of new flow indicators that measure in percent of flow for the Precipitate Pump Tank (PPT) purges. With the elimination of the precipitate feed stream (and benzene potential), the required action statements and completion times, for the PPT, were modified to give additional flexibility to Operations. Purge flow requirements have been reduced from 5.1 scfm in the PPT to 1.3 scfm due to the lack of benzene potential. Calculation N-CLC-S-00083 was reviewed in support of the modified purge requirements. A recovery time chart was developed for the PPT and provides the basis for several condition completion times. Where previously completion times for the PPT was immediate, now completion times are no less than 50 hours (from PPT recovery time chart at overflow) based on hydrogen generation only. Examples of the additional flexibility include the primary nitrogen purge <20% and loss of both purge flow loops must be corrected within the recovery time versus immediately.

A note was added to the SPT and PPT LCO to require the completion of 12 vapor space turnovers before exiting the condition statement for primary purge flow requirements. DOE reviewed the uncertainty calculation J-CLC-S-00114 for PPT purge flow and found it supported flows down to 20% only. Because the gauge only displays divisions down to 20% the instrument is not usable below 20% flow. The issue that was identified for the ASRT purge flow in LCO 3.1.5 (discussed above) also applies here due to the limited range in the uncertainty analysis. Should purge flow drop below 20% the low flow condition will be entered. As long as flows do not exceed 100% of range, the instrument will be usable upon return of flows in the normal range. Any flow of greater than 100% will require Engineering evaluation to determine any impact instrument calibration.

LCO 3.4.3 contains the appropriate required action to stop transfers into the SPT and PPT upon loss of nitrogen purge from the Primary Nitrogen Supply system. The justification provided states no additional material should be transferred into the tank as it shortens the applicable recovery time and adds to the material at risk.

LCO 3.4.5 – LPPP Purge Sources –

The LPPP Safety Grade nitrogen supply system (backup) is required by the safety analysis to provide a 96 hour nitrogen reserve. Calculation M-CLC-S-00677, Revision 1, derived the maximum possible flow through the pressure regulators supplying the PPT and SPT and supplied to the level instrument bubblers. The maximum total flow was 24 scfm. Calculation M-CLC-S-00733, Revision 0, then added 10 scfm for possible leakage through system check valves and another 11 scfm for margin, and derived the needed volume (259,200 scf at 175 psi) to supply nitrogen for 96 hours. Calculation M-CLC-S-00733 then converts this volume to a level reading (74 in wc) using the conversion factor of 73.47 scf/gal for liquid nitrogen. The LCO value of 89 in wc accounts for instrument uncertainty in the level gauge.

As discussed in section II.C of this SER, the LPPP Safety Grade Nitrogen system was downgraded to SS. With the SS classification, redundancy that was required for the safety class equipment is no longer required. Thus, LCO 3.4.5 was revised to protect a single train of the LPPP Safety Grade Nitrogen System.

LCO 3.4.5 was revised (TSR Rev 29) to include a new condition that if both of the safety grade nitrogen check valves are inoperable, they must be restored to operable status within 72 hours. Inability to meet the 72 hour requirement will require entry into LCO 3.0.3. SR 4.4.5.8 was also added to perform a leak test on the valves every 2 years. As discussed in paragraph II.D of this SER, the redundant check valves for each system must provide isolation with minimal leakage (10 scfm) to maintain the required 4 day supply of nitrogen. DOE concluded the 72 hour restoration time and surveillance requirements were adequate to ensure availability and functionality of the LPPP purge system. Similar changes were made to the Bases section to address the new test requirements.

Table 3.4.5-1 was revised to include the safety grade nitrogen isolation check valves with a leakage limit of less than or equal to 10 scfm and a reference to LCO 3.4.5 Condition A.

DOE reviewed these clarifications, corrections, and additions and found them to be acceptable.

LCO 3.7.1 - Zone 1 Ventilation

The required inlet plenum pressure reflects the actual values determined by test FA 2.08 referred to in Chapter 11 of the DWPF DSA. Maintaining the inlet plenum pressure to a value below -1.1" wc will provide the necessary flow to ensure the canyon is at a negative pressure sufficient to pull any airborne radioactive particulates through the sand filter. However, due to instrument uncertainty, this value was reduced to -1.36" wc. DOE reviewed FA 2.08 test data and concurs that maintaining the plenum pressure at the sand filter inlet at a value of $\leq$ -1.36" wc will provide the required airflow.

LCO 3.7.1 was revised to recognize the downgrade of the Zone 1 Ventilation system. To support precipitate operations, the Zone 1 Ventilation system was functionally classified as a safety class system to purge benzene vapors from the salt cell. With the elimination of the benzene bearing stream, the Zone 1 system was reclassified as a safety significant system to mitigate any radiological release in the DWPF canyon. With the downgrade, the LCO requirement to maintain 3 out of 4 Zone 1 exhaust fans running was revised to require one fan operable on an operable diesel generator bus. One fan has been shown to provide adequate ventilation to maintain a minimum vacuum of –1.36" wc in the Sand Filter inlet plenum. In addition, a statement was added to the LCO to require that the Sand Filter shall be operable. This new statement was implied in the previous revision of the TSR and has been brought forward to more clearly state the operability requirement. With the Safety Significant classification, redundancy that was required for the safety class instruments are no longer required. The LCO condition statements were revised to address the need to have one fan operable and aligned to an operable diesel bus, to have one of two pressure transmitters operable, and to have one of two pressure interlocks operable. The surveillance requirements support the operability requirements and the completion times were judged to be acceptable to maintain safe operations.

LCO 3.9.1 - Standby Electrical Power

The LCO operability requirements and Surveillance Requirements were reviewed and found to have the proper equipment and limits specified. For example,

a. 4-day fuel supply
b. lube oil makeup tank inventory
c. new fuel oil specifications
d. battery bank specifications
e. air starter pressure

DOE review found the Condition statements, Actions, and Completion Times appropriate and consistent with those of the Zone 1 Ventilation System (which is the system supported by the DGs). Several specific areas of review are discussed below.

LCO 3.9.1 was revised to recognize the elimination of the precipitate stream and the resulting downgrade in functional classification of the Diesel Generators (DG). In the previous revision, the DGs were safety class based on their support of the safety class Zone 1 ventilation system. When the Zone 1 ventilation system was downgraded based on the elimination of precipitate operations (benzene potential) the DG could be downgraded as well. As a safety significant system providing back up power for Zone 1 ventilation, only one of the two DGs is required to be operable. However, it is expected that Operations will maintain both DGs in operable status to maintain operational flexibility. The LCO and condition statements were revised to match the new safety significant requirements. The LCO was revised to require 9318 gallons of fuel oil inventory to run one DG for 4 days. The condition related to fuel oil inventory dropping below a 4 day supply but greater than a 3 days was also revised for one required DG. Should fuel oil inventory drop below a 3 day supply, the associated DG must be declared inoperable. Two conditions previously included in the LCO were moved to the surveillance requirements section to simplify the LCO. These are the DG lube oil level and the fuel oil particulate contamination level. Should either of these surveillances fail, the associated DG will be declared inoperable. The same level of control will be maintained for these parameters as the previous TSR and DOE concurs with the change. The LCO condition covering one failed air receiver pressure indicator or switch was deleted because redundancy is no longer required for these instruments; however, Operations is expected to keep all these instruments operable for flexibility purposes.

Another result of downgrading the DG system to safety significant impacted the automatic DG fuel oil transfer system inoperable condition. As discussed in section II.C.10 of this SER, the fuel oil automatic transfer system (LCS 210) is only powered from DG 200. The existing LCO 3.9.1 contains an Action to immediately station an operator in the 292-S building such that manual refilling of the day tank on DG 100 or 200 can occur if LCS 210 is lost (due to postulated single failure since existing DG system is safety class). Additionally, LCS 210 had to be restored in 14 days (consistent with restoration time required for a DG). These actions were necessary since the Zone 1 Ventilation system, and thus the supporting DG system, was the first level of control to prevent a Salt Cell explosion. As discussed previously in this SER revision, the DG system is now only required to meet safety significant requirements. Thus, only one DG system is necessary. However, only DG 200 can meet its safety significant function only relying on engineered features since, if DG 200 were out of service, DG 100 would have to rely on operator action to manually transfer fuel oil from its storage tank to its day tank. In keeping with the control selection hierarchy in DOE-STD-3009 of engineered features over administrative controls, LCO 3.9.1 maintains the requirement to have LCS 210 operable. The required action was adjusted to require an operator to be stationed in 292-S only after an automatic start of the diesel generator(s). The completion time for returning LCS 210 to operable status was extended to 3 months based on having the required functionality with manual fuel oil transfers. These changes in Actions and Completion Time were found adequate given the fact that the DG system is safety significant and the supported system (Zone 1 Ventilation system) is only credited as the 2nd or 3rd level of control (i.e., the Zone 1 Ventilation system is not credited, even as SS, as the 1st level of control for any events in DSA Chapter 9). Additionally, the periodic Surveillance Requirement for LCS 210 was changed from every 3 months to every 6 months. This was found acceptable because Surveillance Requirement 4.9.1.2 ensures the day tank level is proper every 7 days and within 24 hours after each DG shutdown. Surveillance Requirement 4.9.1.11 performs a startup test on the DG(s) every month, so each month the combination of Surveillances 4.9.1.11 and 4.9.1.2 should ensure the automatic fuel oil transfer system has functioned properly.

Several DG surveillance requirement frequencies were extended to 2 years from the current 18 months. These changes are supported by industry standards and DG operational history at DWPF. The battery performance discharge test and DG breaker maintenance was determined to not be necessary based on existing surveillance requirements that proves system operability and function. These activities will continue to be performed under the preventative maintenance program. DOE has reviewed and is satisfied with the changes submitted for this LCO.

DOE found that the specific diesel fuel properties which are important to DG operability have been provided in LCO 3.9.1 consistent with the DOE Backup Power Working Group (BPWG) Handbook for Fuel Quality and WSRC Engineering Requirements (ER) 15591-01-R. Compliance with this Handbook and ER reduces the overall probability of the DG's failure to start.

The minimum day tank level was specified as 5/8 level to reduce the number of times that the tanks would have to be topped off (operator flexibility). DWPF DSA Chapter 4 and 11 describe that each D/G will supply their own bus (i.e., will not be cross-connected). Thus, each DG would only be loaded to 50%. Calculation M-CLC-S-00585 indicates that fuel consumption for 50% load conditions is 93.2 gal/hr. Using tank geometry, the 5/8 level equates to 296 gal. Thus, 296 gallons will ensure the day tank will provide > 2 hours of automatic fuel oil such that the manual action to per DSA section 11.5.10.2 to transfer additional fuel from the makeup tanks can be performed.

The minimum Lube Oil Sump capacity is 110 gallons, which provides a usable capacity of 57 gallons (the amount from the full to the low level mark). Adding the Lube Oil Makeup Tank capacity of 25% provides an additional 67.5 gallons of available lube oil. Thus, the total capacity of the Lube Oil Sump and 25 % of the Lube Oil Makeup Tank is 124.5 gallons. Based on the manufacturer's specified lube oil consumption rate of 0.85 gallons/hr, this will provide a total DG run time of approximately 6 days, which exceeds the minimum 4 day requirement by a sufficient margin to cover instrument uncertainty. (Calculations for the lube oil consumptions and inventories are contained in calculation M-CLC-S-00585.) To support taking credit for the Lube Oil Makeup Tank inventory, the Lube Oil Makeup Tank, including valve and piping, for each DG was upgraded to Safety Class (which is more than adequate to meet its current safety significant functions). Design Change Form No. X-DCF-S-00131 documents that the lube oil components were procured and installed to the same requirements as the Diesel Generator System, and references the seismic calculations for the Lube Oil Makeup Tanks and piping (T-CLC-S-00021 and -00027, respectively), suspect parts evaluation (OPS-DTP-96-0171), and the procurement specification (Technical Specification M-6, Rev. 6). DOE verified that the Lube Oil Makeup Tanks and piping are included within the scope of these documents. The tanks were determined initially not to be seismically adequate; however, the recommended upgrades of T-CLC-S-00021 were added by Design Change Package C-DCP-S-95002 (Design Change Notice C-001) Revision 0. DOE performed a system walkdown to confirm that the required seismic upgrades had been installed on the tanks.

Note b of Table 3.9.1-1 specifies a charging current of <2 amps (in lieu of specific gravity) is an accurate indication of the state of the battery when a charge has been conducted following a deep discharge. The note allows the use of charging current for 30 days (versus 7) following a discharge/charge evolution since the specific gravity readings may not be accurate due to stratification of the electrolyte. DOE reviewed E-ESR-S-00183, "DWPF-Engineering Technical Report: Electrolyte Stratification in Battery Banks." This report analyzed a performance test conducted on a DWPF battery bank following a discharge/charge cycle. The data collected indicates that the specific gravity does not indicate the actual state of battery bank charge for 21 days. Additionally, DOE reviewed WSRC-TM-95-G185-0010, "Technical Manual for GNB Stationary Batteries." Section 11.1 states that when recharging a lead-calcium cell, the specific gravity reading lags behind the ampere hour input due mainly to the very low end of charge currents. Electrolyte mixing is slow due to the small amount of gas generated, so the specific gravity readings do not reflect the actual state of charge. Therefore, meaningful specific gravity readings can only be obtained at the top of the cell after six weeks on float. DWPF measures specific gravity at the top of the cell. NUREG 1431, "Standard Technical Specifications for Westinghouse Plants", Rev. 1, gives an example of using a charging current of <2 amps for a period of [7] days following a discharge/charge evolution. However, the 7 days is a generic period of time. The NUREG recognizes that each facility should specify the length based on their configuration. DOE has concluded the frequency of 30 days (versus 7 days) is acceptable based on the technical bases contained in E-ESR-S-00183 and WSRC-TM-95-G185-0010.

The Basis section for Surveillance Requirement 4.9.1.17 does not contain the criteria related to the voltage and frequency values which must be met before the Diesel Generator output breaker closes. Because non-safety class loads are not isolated from the emergency bus while the DG is developing the necessary frequency and voltage, a concern was raised during the DOE review that deletion of these criteria may not ensure that the DG reaches the required output voltage and frequency needed to isolate any faulted equipment prior to connecting the DG to the emergency bus. Meetings with Contractor technical personnel and review of supporting information (i.e., the DWPF Emergency Diesel Generator Technical Manual and the Instruction Manual for the Kato Pilot Exciter), DOE concluded sufficient technical basis exists to support this position. Specifically, the design of the DG and electrical distribution systems protect the DG from adverse interaction by non-safety loads. The DG system response is sufficient to ensure that the required loads are supported by DG power following a loss of offsite power, even if the DG output breaker prematurely closes. This is based on the credible errors in the load sequencing, the timing for the loading of the SC loads, and the design and operation of the DWPF generator (namely the exciter). The exciter (Permanent Magnet Generator – PMG) is independent of the generator output voltage and requires only diesel shaft rotation to provide voltage to the voltage regulator. A speed switch ensures the necessary shaft speed is achieved prior to energizing the voltage regulator. Review of strip chart recorder tracings made during startup testing showed that once the voltage regulator was energized, nominal output voltage was achieved in milliseconds. This enables sufficient fault current to be developed to trip faulted loads. These design attributes of the DG system are protected by design change control and USQ processes.

As required by applicable IEEE standards, it has been shown that the diesel generator is capable of supplying the necessary fault current to ensure the proper coordination for design faults without loss of function of safety class loads. To ensure coordination, the generator short circuit characteristics (decrement curve, available generator fault current plotted over time) were obtained from the manufacturer. Coordination was evaluated by comparing protective device characteristics at design fault values using the generator decrement curves. To ensure coordination for the design fault values, the generator decrement curve was used to verify that the overcurrent protective device nearest the fault location isolates the fault prior to actuating any upstream overcurrent protective devices. This evaluation is documented in Bechtel Calculation E13 for the DWPF diesel generators. DSA Chapter 4 discusses the load sequencing and coordination of the DG system and electrical distribution system. Reference to calculation E13 has been added in Chapter 4 to identify the basis for the discussion.

Based on the DOE review above, the DWPF 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 staff review found this section to adequately meet the requirements of DOE Guide G 423.1-1. The administrative controls identified in Chapter 11, as well as those specifically required by DOE Guide G 423.1-1, were included in Section 5.0 of the TSRs. Additionally, DOE assessed each TSR AC description against the guidance from EM-1 in Reference III.2 and concluded the level of detail provided was adequate. The results of the DOE review for several key administrative controls are discussed below.

AC 5.2.2, Facility staff, was revised to specify a set crew requirement of at least one Control Room Manager, one Control Room Operator qualified on all stations, one Balance of Plant Operator, and one Vitrification Support Operator. The Control Room Operator, the Balance of Plant Operator, and the Vitrification Support Operator shall remain in the vicinity of S-Area facilities. This is the crew requirement regardless of facility operational mode and includes 512-S.

Consistent with DOE Guide G 423.1-1, TSR AC 5.7 requires any change to the TSRs, including Bases section changes, to be approved by DOE prior to implementation.

AC 5.8.2.11, DWPF Feed Acceptance Criteria, was revised to call out specific requirements in the DWPF Waste Acceptance Criteria (WAC) for incoming waste receipts. These requirements include inhalation dose, gamma and neutron shielding, nuclear criticality safety, canister heat generation, and hydrogen generation rates. In addition, waste streams that do not meet the bounding isotopic and chemical inventory assumptions must be processed through a USQ before being received.

AC 5.8.2.23, Chemical Controls, was revised and expanded to address the interaction of Sodium Nitrite and acid. The control also specifically discusses limitations in chemical additions to CPC vessels resulting in hydrogen generation and salt concentration in melter feed to prevent salt build up in the melter cold cap (leading to a steam explosion). Sampling and/or process knowledge will be used to ensure compatibility of chemical transfers. Specifically, transfers of Sodium Nitrite are prohibited to 980-S when the Caustic Waste Neutralization Tanks contain acid. Facility inventories of chemicals are required to be within assumed limits in the safety analyses. A review of the controls indicates that appropriate steps have been taken to address the mixing of incompatible chemicals including the interaction of Sodium Nitrite and acid.

The TSR administrative control for DWPF generated waste (5.8.2.25) discusses the programmatic controls to ensure compliance with the DWPF Waste Compliance Plan (WCP). The WCP ensures compliance with the receiving facility's Waste Acceptance Criteria. The DWPF TSR contains the additional requirement that controls will also ensure compliance with the requirements identified in the interface section of the receiving facility's (e.g., Tank Farm) DSA. These requirements are not specifically described in the DWPF DSA. By not specifically listing the requirements, the receiving facility (e.g., Tank Farm) can revise their transfer requirements and not impact the DWPF DSA/TSR. The basis for the interface requirements are described in the CSTF DSA (WSRC-SA-2002-00007) and were previously reviewed and approved by DOE in the CSTF SER.

AC 5.8.2.28, Diesel Low Power Operations, was revised to define "light load operations" as running more than 4.5 hours at a load less than 20% of rated capacity. This clarification makes the administrative control more user friendly and helps protect the diesel generators from excessive wear and tear.

AC 5.8.2.29, Flammable Vapor Sampling Program, was revised to only require this programmatic control when excavating near an inter-area transfer line. This requirement protects the minimum of 3 feet of soil coverage required to mitigate any release from a line rupture below those requiring controls. DOE verified adequate soil coverage by walking down portions of the transfer lines and reviewing drawing W761609 Rev. 10, "Interarea Pipeline Details", which requires a minimum of 4.5 feet of soil coverage. Any area that cannot meet this design requirement must provide a concrete slab a minimum of 12" thick and 6 feet in width over the transfer line. Reviews by DOE determined that each of the sludge transfer lines (i.e., SDP-1 and SDP-2) had adequate soil coverage to not require concrete slab pours. Additional discussion of the transfer line administrative control is contained in Section II.B.6.

The administrative controls identified in Chapter 11 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 Design Features section of the TSR was revised to support ARP and address the Sodium Nitrite and acid interaction. The Sodium Nitrite Makeup Tank and Makeup Tank Dike, Sodium Nitrite Feed Tank Dike and Dike Drain Plug were added to the Design Features table. The feed tank dike and dike plug will contain any leak at the feed tank and prevent undetectable quantities from entering the Floor Drain Catch Tank (FDCT). Undetected Sodium Nitrite in the FDCT could be inadvertently transferred to the CWNTs leading to the generation of Nitrogen Dioxide. The tank, dikes, and plug contain leakage of any Sodium Nitrite and prevent its interaction with acid.

The passive credited portion of the transfer line was broadened to include the transfer line jacket and seal plate as well as the core pipe. This change was reflected in Table 6.1.2-1 and is supported by calculations reviewed by DOE. See Section II.B.6 for additional details.

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.

F. References

III.1 Letter, Allison to Pedde, "Concentration, Storage, and Transfer Facilities (CSTF) Safety Evaluation Report (SER) for the 10CFR830 Compliant Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR's)," 12/20/2002

III.2 Memorandum, Roberson (EM-1) to Distribution, "Environmental Management Guidelines and Lessons Learned for Nuclear Facility Safety Control Selection and Implementation," 5/20/2003

APPENDIX A

DWPF DSA/TSR DOE REVIEW TEAM
[for SER Revision 2]

Name	Responsibility
Jimmy Guerry	Lead Reviewer
Jean Ridley	Contributing Reviewer
Glenn Christenbury	Contributing Reviewer
Mike Dholakia	Contributing Reviewer
Tom Temple	Technical Reviewer

APPENDIX B

DISPOSITION OF DOE DWPF SER, REVISION 0 & 1, SUPPLEMENTS

DWPF SER Revision 0 Supplement Disposition

DOE SER	Approval Letter/Date	Subject	Included in SER Rev. 1[A]	Rationale for Not Including in SER Rev. 1
DWPF SER, Rev. 0, Supplement 1	Fiori to Schwallie, 12/8/95, MC-96-0021	TSR changes to reflect CPC purge flow changes due to orifice removal and OWST level instruments read in inches rather than gallons	YES	
DWPF SER, Rev. 0, Supplement 2	Watkins to Scott, 1/29/96, MC-96-0032	Miscellaneous DSA/TSR changes	YES	
DWPF SER, Rev. 0, Supplement 3	Watkins to Scott, 3/7/96, MC-96-0036	Miscellaneous DSA/TSR changes	YES	
DWPF SER, Rev. 0, Supplement 4	Fiori to Schwallie, 4/12/96, MC-96-0043	Authorize performance of CPC Safety Grade N2 System Capacity Test	NO	Test Complete – SER Supplement 4 no longer applicable
DWPF SER, Rev. 0, Supplement 5	Watkins to Scott, 4/19/96, MC-96-0044	JCO and TSR changes for Discovery USQ from CPC N2 Capacity Test	YES	
DWPF SER, Rev. 0, Supplement 6	Watkins to Scott, 6/28/96, MC-96-0056	Response Plan for Inoperable CPC N2 systems	NO	CPC N2 systems returned to operable status and Response Plan exited. SER Supplement 6 no longer applicable
DWPF SER, Rev. 0, Supplement 7	Watkins to Scott, 7/8/96, PC-96-0001	Miscellaneous DSA and TSR changes	YES	
DWPF SER, Rev. 0, Supplement 8	Watkins to Scott, 8/8/96, PC-96-0007	JCO revisions to support lack of tornado qualification of portions of the Zone 1 ventilation system	NO	Zone 1 no longer SC and SS SSCs do not require tornado missile qualification. JCO superseded and no longer effective once DSA Rev. 21 and TSR Rev. are implemented. SER Supplement 8 no longer applicable.
DWPF SER, Rev. 0, Supplement 9	Watkins to Scott, 10/8/96, PC-97-0001	Miscellaneous DSA/TSR changes to support DG operation	YES	
DWPF SER, Rev. 0, Supplement 10	Fiori to Schwallie, 10/11/96, PC-97-0003	JCO change due to lack of tornado missile protection for the CPC purge systems	NO	JCO superseded and no longer in effect once DSA Rev. 21 and TSR Rev. are implemented. SER Supplement 10 no longer applicable.
DWPF SER, Rev. 0, Supplement 11	Watkins to Scott, 11/15/96, PC-97-0011	Miscellaneous DSA, TSR, and JCO changes	YES	
DWPF SER, Rev. 0, Supplement 12	Watkins to Scott, 1/28/97, PC-97-0004	OWST Outage Response Plan	NO	OWST now empty and Response Plan no longer in effect. SER Supplement 12 no longer applicable.
DWPF SER, Rev. 0, Supplement 13	Watkins to Scott, 3/18/97, PC-97-0033	DSA/TSR Annual Update	YES	
DWPF SER, Rev. 0, Supplement 14	Watkins to Scott, 4/4/97, PC-97-0039	DSA/TSR changes for SRAT and LPPP-SPT purge flow, correction of DG fuel oil cloud point.	YES	
DWPF SER, Rev. 0, Supplement 15	Fiori to Schwallie, 8/8/97, PC-97-0080	JCO revisions due to lack of NPH qualification of high-high sand filter pressure interlock and the melter feed interlocks	NO	JCO superseded and no longer in effect once DSA Rev. 21 and TSR Rev. are implemented. SER Supplement 15 no longer applicable.

DOE SER	Approval Letter/Date	Subject	Included in SER Rev. 1[A]	Rationale for Not Including in SER Rev. 1
DWPF SER, Rev. 0, Supplement 16	Rudy to Schwallie, 10/23/97, PC-98-004	Miscellaneous DSA, and TSR changes	YES	
DWPF SER, Rev. 0, Supplement 17	Watkins to Scott, 4/28/98, PC-98-0034	Miscellaneous DSA, TSR, and JCO changes for annual update	YES	
DWPF SER, Rev. 0, Supplement 18	Schepens to Scott, 6/19/98. PC-98-0046	Miscellaneous changes to support Sludge Batch1B	YES	
DWPF SER, Rev. 0, Supplement 19	Schepens to Scott, 8/6/98. PC-98-0058	DSA/TSR changes to correct errors in derivation of LPPP-SPT purge flow requirements	YES	
DWPF SER, Rev. 0, Supplement 20	Schepens to Scott, 10/7/98. PC-99-0001	JCO compensatory measures addressing design deficiency in OWST N2 system	NO	OWST now empty and no longer permitted to store benzene. SER Supplement 20 no longer applicable.
DWPF SER, Rev. 0, Supplement 21	Schepens to Scott, 10/14/98. PC-99-002	Response Plan for pumping out OWST	NO	OWST now empty and Response Plan no longer in effect. SER Supplement 21 no longer applicable.
DWPF SER, Rev. 0, Supplement 22	Schepens to Scott, 4/23/99. PC-99-033	JCO revision to ensure adequate CPC vessel purge flows	NO	JCO superseded and no longer in effect once DSA Rev. 21 and TSR Rev. are implemented
DWPF SER, Rev. 0, Supplement 23	Schepens to Scott, 4/30/99. PC-99-035	Replacement of BUOGFC and Melter air flow instruments	YES	
DWPF SER, Rev. 0, Supplement 24	Schepens to Poulson, 9/2/99, PC-99-052	Response Plan for CPC Purge Header modifications	NO	Response Plan no longer in effect and modification completed. SER Supplement 24 no longer applicable.
DWPF SER, Rev. 0, Supplement 25	Rudy to Buggy, 2/1/2000, PC-00-015	Annual update to DSA, TSR, and JCO	YES	
DWPF SER, Rev. 0, Supplement 26	Schepens to Poulson, 2/25/00, PC-00-021	Temporary modifications for battery bank.	NO	Permanent modifications resolved degraded bank D41. SER Supplement 26 no longer applicable.
DWPF SER, Rev. 0, Supplement 27	Schepens to Poulson, 4/27/00, PC-00-029	Temporary modifications for battery bank.	NO	Permanent modifications resolved degraded bank D41. SER Supplement 27 no longer applicable.
DWPF SER, Rev. 0, Supplement 28	Erickson to Poulson, 8/18/00 PC-00-051	Missile Shield around Safety Grade N2 System; battery cell parameter changes	YES	
DWPF SER Rev. 0, Supplement 29	Anderson to Piccolo, 5/15/01, PD-01-033	DSA annual update, lowered melter vapor space temperature limit, increased melter feed rate, adjusted melter air flow requirements.	YES	
DWPF SER Rev. 0, Supplement 30	Anderson to Piccolo, 8/29/01, PC-01-054	DSA and TSR changes for compliance with 10CFR830.	YES	
DWPF SER Rev. 0, Supplement 31	Rudy to Pedde, 3/14/02, PC-02-023	Approves design change to eliminate single failure vulnerability in UPS Y61.	NO	Zone 1 no longer SC, thus single failure design no longer required. SER Supplement 31 no longer applicable.
DWPF SER Rev. 0, Supplement 32	Allison to Pedde, 2/13/03, PC-03-012	Change out of Melter TC with Type S	YES	
DWPF SER Rev. 0, Supplement 33	Allison to Pedde, 3/12/03, PC-03-017	Revise DSA and TSR to modify controls required to protect transfers from DWPF to CSTF per the new 10CFR830-compliant DSA	YES	

DWPF SER Revision 1 Supplement Disposition

DOE SER	Approval Letter/Date	Subject	Included in SER Rev. 2[A]	Rationale for Not Including in SER Rev. 2
DWPF SER Rev. 1, Supplement 1	Allison to Pedde, 2/5/04, DC-04-015	JCO for installation of a melter glass pump temp mod	NO	Temp Mod (Pump) removed
DWPF SER Rev. 1, Supplement 2	Allison to Pedde, 3/26/04, DC-04-027	Address OA assessment – Melter Single Failure Vulnerabilities	YES	

NOTE A: Appropriate information which is still applicable to the DWPF safety basis is included from SER supplements marked "YES". Some information in these SER supplements are no longer applicable or the discussion was at a level of detail not warranted to be included into SER Revision. However, by virtue of being marked "YES", the reviews documented in these SER supplements still provide the DOE bases for acceptance.

APPENDIX C

Dose Consequence from Facility Accident Scenarios (Offsite)

DWPF Accident Scenario	Previous Unmitigated Offsite Dose (accounting for Material Balance Issue)	New Unmitigated Offsite Dose	Previous Mitigated Offsite Dose	New Mitigated Offsite Dose	Major Rationale for Difference
SPC Cell Explosion	99 rem	N/A	0 rem	N/A	Benzene hazard eliminated
SPC Vessel Explosion	99 rem	N/A	0 rem	N/A	Benzene hazard eliminated
PRBT Explosion	99 rem	N/A	0 rem	N/A	Benzene hazard eliminated
ASRT Explosion	N/A	9.2 rem	N/A	9.2 rem[1]	ASRT replaced the PRBT. Scenario postulated is the same as other CPC vessel explosions
SME Explosion	99 rem	9.2 rem	0 rem	9.2 rem[1]	MACCS and ICRP-68/72
SRAT Explosion	99 rem	9.2 rem	0 rem	9.2 rem[1]	MACCS and ICRP-68/72
MFT Explosion	99 rem	9.2 rem	0 rem	9.2 rem[1]	MACCS and ICRP-68/72
Steam Explosion in Melter	5 rem	1.5 rem	5 rem	1.5 rem	MACCS and ICRP-68/72
OWST Explosion	0.001 rem	N/A	0.001 rem	N/A	Benzene hazard eliminated
Fire in Cold Feeds	3.2 ppm Formic Acid	0.23 mg/m^3 Formic Acid	3.2 ppm Formic Acid	0.23 mg/m^3 Formic Acid	No actual change in consequences. Units were simply converted.
Crane Drop – Breach of Process Vessel	99 rem (Vit Bldg) 1.6 rem (LPPP)	9.2 rem (Vit Bldg) 1.01 rem (LPPP)	0 rem (Vit Bldg) 1.6 rem (LPPP)	9.2 rem (Vit Bldg)[1] 1.01 rem (LPPP)	MACCS and ICRP-68/72
Leaks in Process Cells	99 rem (Vit Bldg) <0.001 rem (SRAT)	0.013 rem	0 rem <0.001 rem	0.013 rem	Previous Vit Bldg event postulated leak in SPC leading to benzene explosion which involved all vessels in SPC/CPC. New single vessel leak result in >10x's increase due to much larger spill volume and splashing term.
Leaks in LPPP	<0.001 rem	0.007 rem	<0.001 rem	0.007 rem	New vessel leak result in >7x's increase due to much larger spill volume and splashing term.
Overflows in Process Cells	99 rem (Vit Bldg) <0.002 rem (SRAT)	0.08 rem	<0.002 rem	0.08 rem	Previous Vit Bldg event postulated leak in SPC leading to benzene explosion which involved all vessels in SPC/CPC. New single vessel leak result in >80x's increase due to much larger spill volume and splashing term.
Overflows in LPPP	<0.001 rem	0.06 rem	<0.001 rem	0.06 rem	New single vessel leak result in >60x's increase due to much larger spill volume and splashing term.
Overflows in Melt Cell	0.5 rem	0.005 rem	0.5 rem	0.005 rem	Airborne source term decrease due to hardening of spilled glass
Uncontrolled Reactions in Process Cells	0.26 rem	0.027 rem	0.26 rem	0.027 rem	MACCS and ICRP-68/72
Explosion in LWF	0.12 rem	N/A	0.12 rem	N/A	Benzene hazard eliminated
Explosion in 512-S (ARP)	N/A	0.02 rem	N/A	0.02 rem	ARP replaced LWF
Interarea Transfer Line Accident	Jacket Expl – 9.5 rem LPPP Overflow - >25 rem	18.72 rem	Jacket Expl - 9.5 rem LPPP Overflow - 0.001 rem	18.72 rem	Scenario changed to postulate spilling an entire waste tank between ESP tank and LPPP.
Criticality					Incredible

DWPF Accident Scenario	Previous Unmitigated Offsite Dose (accounting for Material Balance Issue)	New Unmitigated Offsite Dose	Previous Mitigated Offsite Dose	New Mitigated Offsite Dose	Major Rationale for Difference
Earthquake	Total – 102 rem Vit Bldg – 99 rem LPPP – 1.53 rem FESV – 0.04 rem GWSB – 1 rem	Total - 30.97 rem Vit Bldg – 10.4 rem LPPP – 1.01 rem FESV – 0.01 rem GWSB – 0.81 rem ARP – 0.02 rem Transfer Line Break – 18.72 rem	Total - 6.6 rem Vit Bldg (steam explosion) – 5.0 rem LPPP – 1.53 rem FESV – 0.04 rem	Total – 3.59 rem Vit Bldg (steam explosion) – 1.5 rem LPPP – 1.01 rem FESV – 0.01 rem GWSB – 0.81 rem ARP – 0.02 rem Transfer Line – 0.25 rem	MACCS and ICRP-68/72 FESV – The impact (reduction) of MACCS and ICRP-68/72 was lessened due to an increase in the volume of glass in spent melters GWSB – The impact (reduction) of MACCS and ICRP-68/72 was lessened due to an increase in source material.
High Winds	Total – 102 rem Vit Bldg – 99 rem LPPP – 1.53 rem FESV – 0.04 rem GWSB – 1 rem	Total - 30.97 rem Vit Bldg – 10.4 rem LPPP – 1.01 rem FESV – 0.01 rem GWSB – 0.81 rem ARP – 0.02 rem Transfer Line Break – 18.72 rem	Total – 1.6 rem LPPP – 1.53 rem FESV – 0.04 rem	Total – 2.09 rem LPPP – 1.01 rem FESV – 0.01 rem GWSB – 0.81 rem ARP – 0.02 rem Transfer Line – 0.25 rem	MACCS and ICRP-68/72 FESV – The impact (reduction) of MACCS and ICRP-68/72 was lessened due to an increase in the volume of glass in spent melters GWSB – The impact (reduction) of MACCS and ICRP-68/72 was lessened due to an increase in source material.
Vehicle Crash	<0.001 rem	Defer to LPPP vessel explosion	<0.001 rem	Defer to LPPP vessel explosion	Re-evaluated event; only credible vehicle crash now postulated is damaging LPPP N_2 supply, leading to PPT and SPT explosion
Melter Offgas Explosion	99 rem	9.2 rem	0 rem	9.2 rem[1]	MACCS and ICRP-68/72
LPPP PPT or SPT Explosion	1.6 rem	1.01 rem	1.6 rem	1.01 rem	The impact (reduction) of MACCS and ICRP-68/72 was lessened due to a tank volume increase and source term increase.
SMECT Explosion	99 rem	9.2 rem	0 rem	9.2 rem[1]	MACCS and ICRP-68/72

Note 1: The new unmitigated consequence of 9.2 rem for these events is due to the loss of purge leading to an explosion in one CPC vessel (or in the Melter Offgas), then propagation of this explosion to the other CPC vessels due to debris/shrapnel. This scenario is called the "Bounding Unmitigated Scenario" and is categorized as "beyond extremely unlikely" in the applicable subsections of DSA section 9.4.2. For comparison to the EG, these unmitigated events were categorized as "extremely unlikely" (see DSA Table 9.1-1), thus the EG is 25 rem. Although the new mitigated dose is shown as 9.2 rem (implying there is no credited safety class controls to prevent/mitigate), each of these events is actually prevented with safety class /TSR controls due to the cumulative effect in the Seismic Event and High Wind Event.

1. CPC vessels (ASRT, SME, SRAT, MFT, SMECT) – CPC Safety Grade N2 System is SC
2. Melter Offgas Explosion – Total Organic Carbon (TOC) control on melter feed; high temperature interlocks, low air flow interlocks
3. Crane Drop – TSR Administrative Control on Load Lift

Thus, although the reported mitigated doses increased, the actual mitigate doses crediting existing SC controls have not changed.