

KEYWORDS:
Sludge Batch
Qualification
DWPF

RETENTION: PERMANENT
CLASSIFICATION: U
Does not contain UCNI

Sludge Batch Qualification Checklist

May 2013

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APPROVAL PAGE

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REVISION HISTORY

Revision 0 (June 2010)	<ul style="list-style-type: none"> - Initial issue
Revision 1 (April 2011)	<ul style="list-style-type: none"> - Separated the checklist into two different sections (one must be completed before sludge is transferred from sludge prep tank to Tank 40H and the other must be completed before processing of the new sludge batch can begin at DWPF) - Removed the TOC $\leq 17,900$ ppm from SME qual run in association with new Melter flammability controls. - Added 11 to determine if a new reportable chemical is present in the sludge batch - Added additional document number line for Steps 1h and 10a - Removed PCCS Desktop Instruction memo prerequisite from Step 12 - Renumbered checklist items
Revision 2 (May 2013)	<ul style="list-style-type: none"> - Added the interim HGR WAC limit for purge modification implementation - Added nepheline glass quality constraint - Moved the Sludge Batch Evaluation Report, DWPF to TF WCP and WCP calculations to the required before transfer from Tank 40H to DWPF to support SB8 schedule. - Removed review of EPHA as the EPHA uses bounding sludge - Added IDP and flammability evaluations for TSR SAC 5.8.2.14 per PISA resolution (S-CLC-S-00147) - Added the statement to place the Tank Farm to DWPF sludge transfer procedures on Admin Hold at the end of the Prerequisite section for Transfers from Tank 51H to 40H - Added the statement to remove the Admin Hold on the Tank Farm to DWPF sludge transfer procedures in the Prerequisite section for Transfers from Tank 40H to DWPF - Added the statement to complete the DWPF DSA Implementation Checklist in the Prerequisite section for Transfers from Tank 40H to DWPF - Added Facility Manager signature prior to transferring new sludge batch to DWPF - Added DWPF WCP implementation - Renumbered checklist items - Added Prerequisite section for transfer from SRAT to SME upon for the new sludge batch

Purpose

This checklist serves as a guideline for the Defense Waste Processing Facility (DWPF) to complete sludge batch qualification. Please initial each item listed below as they are verified and include the document number (where indicated). Once completed and items have been verified and documented, this checklist will be scanned and documented as a SRR memorandum.

Prerequisites for Transfers from Tank 51H to Tank 40H for New Sludge Batch

INITIALS

- | | | |
|---|---|------------|
| 1. Ensure that the following tasks have been completed and evaluated: | | <u>JWR</u> |
| a. Complete variability study | Doc. #: <u>VSL-13R2580-1</u> | <u>JWR</u> |
| b. Complete frit development and selection | Doc. #: <u>SRNL-L3100-2012-00195</u> | <u>JWR</u> |
| c. Complete an evaluation of the melt rate | Doc. #: <u>N/A</u> | <u>N/A</u> |
| d. Complete evaluation of the REDOX equation | Doc. #: <u>SRNL-L3100-2013-00001 (R1)</u> | <u>JWR</u> |
| e. Complete chemical and radionuclide characterizations of qualification sample | Doc. #: <u>SRNL-L310-2012-00179 (R1)</u> Doc. #: <u>SRNL-STI-2012-00775</u> | <u>JWR</u> |
| f. Complete sulfate limit evaluation | Doc. #: <u>VSL-13L2580-3</u> | <u>JWR</u> |
| g. Perform simulant testing of acid requirements and stoichiometry | Doc. #: <u>SRNL-L3100-2013-00008</u> Doc. #: <u>SRNL-STI-2013-00243</u> | <u>JWR</u> |
| h. Perform shielded cells qualification run to determine hydrogen generation and processing parameters for the SRAT and SME | Doc. #: <u>SRNL-L3100-2013-00018</u> Doc. #: <u>SRNL-STI-2013-00116</u> | <u>JWR</u> |
| i. Perform the PCT on the qual run glass sample | Doc. #: <u>SRNL-STI-2013-00116</u> | <u>JWR</u> |
| j. Complete ammonia evaluation on qual run | Doc. #: <u>SRNL-STI-2013-00243</u> | <u>JWR</u> |
| k. Complete verification of DWPF digestion methods | Doc. #: <u>SRNL-STI-2013-00096</u> | <u>JWR</u> |
| l. Determine if a new reportable chemical is present in the sludge batch | Doc. #: <u>N/A</u> | <u>N/A</u> |
| 2. Perform the Melter Flammability Calculation | Doc. #: <u>X-CLC-S-00164 (R8)</u> | <u>JWR</u> |
| a. Determine if revision of the Documented Safety Analysis (DSA) is needed | | <u>JWR</u> |
| b. If so, revise the DSA
(If not, initial as N/A) | Doc. #: <u>SBD-S-13-004</u> | <u>JWR</u> |
| 3. Determine if revision of the procurement specification for frit is necessary (see Step 1b) | | <u>JWR</u> |
| a. If so, revise the procurement specification
(If not, initial as N/A) | Doc. #: <u>X-SPP-S-00018 (R10)</u> | <u>JWR</u> |

Prerequisites for Transfers from Tank 51H to Tank 40H for New Sludge Batch

INITIALS

- 4. Evaluate the impact of processing the new source term on the following DWPF Radiation Protection programs: Doc. #: N-ESR-S-00006
 - a. Personnel alpha monitoring program JWR
 - b. Continuous Air Monitor (CAM) setpoints JWR
 - c. Bioassay program JWR
 - d. Area and personnel Thermoluminescent Dosimeters (TLDs) JWR
 - e. Photon energy emission spectrum (vs. design basis) JWR

- 5. Determine if changes to the DWPF Waste Acceptance Criteria (WAC) are needed
 - a. If so, revise the DWPF WAC Doc. #: X-SD-G-00008 (R11)
(If not, initial blanks 5a to 5c as N/A) JWR
 - b. Complete Unreviewed Safety Question (USQ) for the WAC revision JWR
 - c. Revise the Tank Farm (TF) WCP to reflect changes to the DWPF WAC JWR

- 6. Ensure that the Tank 40H to LPPP Sludge Tank transfer procedures (SW4-15.87-4.9 and SW4-15.87-4.11) have been placed on Admin Hold following the last SB7b transfer from Tank 40H JEM

Prerequisites for Transfers from Tank 40H to DWPF

INITIALS

7. ^{Approved} ~~Issue~~ ^{DCS 5/10/13} Sludge Batch Evaluation Report Doc. #: X-ESR-S-00136

DCS
DCS
DCS

- a. Ensure all WAC listed in Table 1 are met
- b. Ensure that the WAC LIMITS for Glass Quality and Processability (WAC 5.4.10) are met by:

Taking a sample of sludge and transporting it to SRNL for analysis and processing in the Shielded Cells. The melter feed must be vitrified and the resulting glass tested using the Product Consistency Test (PCT) to confirm that an acceptable glass product can be produced. The vitrified product must be verified to meet the following leach rate limits:

- I. Boron Leach Rate ≤ 16.70 g/L
- II. Lithium Leach Rate ≤ 9.57 g/L
- III. Sodium Leach Rate ≤ 13.35 g/L

DCS
DCS
DCS

The melter feed must also be verified to meet the following predicted properties:

- IV. Liquidus Temperature $\leq 1050^\circ\text{C}$
- V. $20 \text{ poise} \leq \text{Viscosity} \leq 110 \text{ poise}$
- VI. Homogeneity (Alumina/Alkali) Constraint – $\text{Al}_2\text{O}_3 \geq 4 \text{ wt}\%$

DCS
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DCS

OR

$\text{Al}_2\text{O}_3 \geq 3 \text{ wt}\%$ **AND** $\Sigma\text{M}_2\text{O} < 19.3 \text{ wt}\%$
where $\Sigma\text{M}_2\text{O} = \text{Na}_2\text{O} + \text{Li}_2\text{O} + \text{Cs}_2\text{O} + \text{K}_2\text{O} \text{ wt}\%$

- VII. Nepheline > 0.62

DCS

Prerequisites for Transfers from Tank 40H to DWPF

TABLE 1: DWPF WAC Limits and Targets¹

WAC Section	Topic	Criteria	Criteria Type	INITIALS
5.4.1	NO _x Emissions	≤ 103.52 tons/yr	Target	DCS
5.4.2	Canister Heat Generation	≤ 437 watts/canister	Limit	DCS
5.4.3	Gamma Shielding	≤ 4070 mR/hr-gallon ≤ 3.7 mR/hr-gram insoluble solids	Limit	DCS
5.4.4	Neutron Shielding	Total α ≤ 1.5E-03 Ci/gram insoluble solids	Limit	DCS
5.4.5	Inhalation Dose Potential	Total ≤ 2.47E+08 rem/gallon Cs-137 ≤ 1.34 Ci/gallon	Limit	DCS
5.4.6	Nuclear Criticality Safety	Pu-240 > Pu-241 Concentration Fe: ²³⁹ Pu(eq) ≥ 160:1 * ²³⁹ Pu(eq) ≤ 0.59 g/gallon ** ²³⁵ U(eq _{SLU}) Enrichment ≤ 0.93 wt%	Limit	DCS
5.4.7	Glass Solubility	TiO ₂ ≤ 2.00 wt% in glass Cr ₂ O ₃ ≤ 0.30 wt% in glass PO ₄ ≤ 3.00 wt% in glass NaF ≤ 1.00 wt% in glass NaCl ≤ 1.00 wt% in glass Cu ≤ 0.50 wt% in glass SO ₄ (Na ₂ SO ₄) ≤ 0.60 (0.88) wt% in glass	Limit	DCS
5.4.8	Corrosive Species	SO ₄ ²⁻ ≤ 0.058 M Hg ≤ 21 g/L Slurry	Limit	DCS
5.4.9	Sludge Solids Content	12 – 19 wt% Dry Total Solids	Target	DCS
5.4.11	H ₂ Generation & N ₂ O Concentration	H ₂ SRAT ≤ 0.65 lb/hr for 6000 gal product H ₂ SME ≤ 0.223 lb/hr for 6000 gal product N ₂ O SRAT ≤ 15 vol%	Limit	DCS
5.4.12	Radiolytic Hydrogen Generation	Total HGR ≤ 8.95E-05 ft ³ /hr-gal at 25°C Total HGR ≤ 1.3313E-05 ft ³ /hr-gal at 25°C HGR = Hydrogen Generation Rate	Limit	DCS
5.4.13	Organic Concentration	Organic material contributes < 0.1% to Hydrogen LFL	Limit	DCS
5.4.15	Temperature	Transfers from Tank 40 ≤ 45°C	Limit	DCS
5.4.16	Particle Size	Streams shall have maximum particle size of 80 mesh sieve or equivalent.	Limit	DCS
5.4.17	Fissile Concentration in Glass	(²³³ U + ²³⁵ U + ²³⁹ Pu + ²⁴¹ Pu) Fissile Concentrations ≤ 897 g/m ³ glass	Limit	DCS

* Only Fe from the Tank Farm material shall be included in the calculation of this ratio.

** Only applicable if non-Tank Farm Pu is included in the sludge batch.

Prerequisites for Transfers from Tank 40H to DWPF

INITIALS

- 8. Perform the two DWPF WCP calculations
 - a. Hydrogen Generation / Flammability Doc. #: X-CLC-S-00284 Cke
 - b. Inhalation Dose Potential Doc. #: X-CLC-S-00285 Cke

- 9. Determine if changes to the DWPF WCP are needed
 - a. If so, revise the DWPF WCP Doc. #: X-SD-G-00005 Cke
(If not, initial blanks 9a to 9b as N/A) ccc
 - b. Review/revise applicable WCP-implementing procedures No Revision Required Cke
Cke 5/10/13

- 10. Perform Recycle Inhalation Dose Potential evaluation per TSR SAC 5.8.2.14 compared with Engineering calculation S-CLC-S-00147 Doc. #: X-CLC-S-00286 Ckc
 - a. Review/revise applicable implementing procedures Cke

- 11. Perform Recycle Flammability evaluation per TSR SAC 5.8.2.14 compared with Engineering calculation S-CLC-S-00147 Doc. #: X-CLC-S-00283 Cke
 - a. Review/revise applicable implementing procedures No Revision Required Cke
5/10/13

- 12. Determine if there is a new reportable chemical (see Step 11)
 - a. If so, develop strategy for reporting new chemical Doc. #: N/A Ckc
(If not, initial as N/A) N/A

- 13. Determine if changes to the Product Composition Control System (PCCS) are needed
 - a. If so, revise the PCCS and/or develop interim strategy Doc. #: N/A Cke
(If not, initial as N/A) N/A

- 14. Issue the PCCS protocol memorandum Doc. #: X-ESR-S-00125 Cke
 - a. If necessary, revise SW4-16.2-3.8, "SME Product Sampling" See step 25
(If not, initial as N/A)

- 15. Review the DWPF sample schedule and determine if revision is needed
 - a. If so, revise the DWPF sample schedule Doc. #: N/A Ckc
(If not, initial as N/A) N/A

- 16. Develop interim strategy to measure and track fissile loading in glass Ckc
Doc. #: X-ESR-S-00134

Prerequisites for Transfers from Tank 40H to DWPF

INITIALS

17. Issue the Sludge Batch Operating strategy Doc. #: SRR-WSE-2013-00057

DCS

18. Issue the Macrobatch notification letter Doc. #: SRR-WSE-2013-00056

CKC

19. Ensure the DWPF Implementation Checklist for Melter Feed Content Control Changes Due to Sludge Batch 8 has been completed

CKC

20. Ensure the DWPF WCP has been implemented

CKC

All above prerequisites are complete for DWPF to receive transfer of new sludge batch:

DCS for M.N. Borders @ 1052

5/11/13

M. N. Borders, DWPF/Saltstone Facility Project Manager

Date

21. Ensure the SRAT Transfer to the SME procedure (SW4-16.2-3.2) and Transfer from PRFT to the SRAT procedure (SW4-16.2-2.14) have been placed on Admin Hold

DES

22. Request the Tank 40H to LPPP Sludge Tank transfer procedures (SW4-15.87-4.9 and SW4-15.87-4.11) be removed from Admin Hold

DES

Prerequisites for SRAT Transfer to the SME

INITIALS

23. Issue the Salt Solubility Implementation strategy

Doc. #: SRR-WSE-2013-00057

JWR

24. Develop interim Calcine to Iron Ratio for Sludge Batch 8

JWR

Doc. #: X-ESR-S-00147 (R0)

25. Revise SME Product Sampling procedure (SW4-16.2-3.8)

JWR

26. Ensure SO₄²⁻, Na, and Ti are tracked for PRFT addition for Sludge Batch 8

JWR

27. Request the SRAT Transfer to the SME procedure (SW4-16.2-3.2) and Transfer from PRFT to the SRAT procedure (SW4-16.2-2.14) be removed from Admin Hold

JWR

The post-processing requirements listed below will be incorporated into the Sludge Batch / DWPF POW schedule logic and are included here for completeness.

Post-Processing Requirements (after first waste transfer to DWPF)

1. Take Waste Acceptance Product Specifications (WAPS) sample
2. Complete the solid waste radionuclide calculation
3. Complete the solid waste chemical calculation
4. Develop the Waste Characterization Form (WCF)
5. Perform elementals on the first ten (10) SRAT receipt batches
6. Complete pour stream sample analysis for each of the following:
 - a. Chemical
 - b. Radionuclide
 - c. PCT

REFERENCES

1. Ray, J. W., "Waste Acceptance Criteria for Sludge, ARP, and MCU Process Transfers to 512-S and DWPF (U)," X-SD-G-00008, Rev. 11, April 2013.

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