SEP 22 1998

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 624562

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) J. Jo, LMHC	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: TWRS	6. Design Authority/ Design Agent/Cog. Engr.: JO, J	7. Purchase Order No.: NA
8. Originator Remarks: For approval and release.		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks: 11A. Design Baseline Document? ☐ Yes ☒ No		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date:

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designa- tor	Reason for Trans- mittal	Origin- ator Dispo- sition	Receiv- er Dispo- sition
1	HNF-2799	-	0	Application of "Confirm Tank T is an Appropriate Feed Source for Low- Activity Waste Feed Batch X" to Specific Feed Batches	NA	1,2	1	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E. S. Q. D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged	

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
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1	1	Cog.Eng. J. Jo	<i>[Signature]</i>	9/21/98	R2-12	1		P. J. Certa	<i>[Signature]</i>	9/14/98	73
1	1	Cog. Mgr. J. S. Garfield	<i>[Signature]</i>	9/21/98	R3-73						
		QA									
		Safety									
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18. J. Jo Signature of EDT Originator 9/21/98	19. K. M. Hall Authorized Representative Date for Receiving Organization 9/21/98	20. J. S. Garfield Design Authority/Cognizant Manager 9/21/98	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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BD-7400-172-2 (05/96) GEF097

BD-7400-172-1

Application of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" to Specific Feed Batches

J. Jo

Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 624562

UC: 721

Org Code: 8C451

Charge Code: D2D28

B&R Code: EW3130010

Total Pages: 221

Key Words: Data quality objectives, DQO, PSDQO, TWRS

Abstract: This document addresses the characterization needs of tanks as set forth in the "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" Data Quality Objective (Certa and Jo 1998).

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9/22/98
Release Approval Date

Release Stamp

Approved for Public Release

HNF-2799
Revision 0

**APPLICATION OF "CONFIRM
TANK T IS AN APPROPRIATE
FEED SOURCE FOR
LOW-ACTIVITY WASTE FEED
BATCH X" TO SPECIFIC
FEED BATCHES**

September 1998

J. Jo
Lockheed Martin Hanford Corporation
Richland, Washington

Prepared for
U.S. Department of Energy
Richland, Washington

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LIST OF TERMS

DQO	Data Quality Objective
ESP ¹	Environmental Simulation Program
LAW	Low-activity waste
PSDQO	Problem-Specific Data Quality Objectives
TSAP	Tank Sampling and Analysis Plan
TWRS	Tank Waste Remediation System

¹ESP is a trademark of OLI Systems, Inc.

APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE FOR LOW-ACTIVITY WASTE FEED BATCH X" TO SPECIFIC FEED BATCHES

1.0 INTRODUCTION

This document addresses the characterization needs of tanks as set forth in the *"Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" Data Quality Objective (DQO)* (Certa and Jo 1998).

The primary purpose of this document is to collect existing data and identify the data needed to determine whether or not the feed source(s) are appropriate for a specific batch before transfer is made to the feed staging tanks. To answer these questions, the existing tank data must be collected and a detailed review performed.

If the existing data are insufficient to complete a full comparison, additional data must be obtained from the feed source(s). Additional information requirements need to be identified and formally documented, then the source tank waste must be sampled or resampled and analyzed. Once the additional data are obtained, the data shall be incorporated into the existing database for the source tank and a reevaluation of the data against the DQO must be made.

2.0 APPROACH

The Tank Waste Retrieval Division has determined that a strategic and cost-effective way to identify the data needed for low-activity waste (LAW) feed delivery is to define those data needs on a batch-by-batch basis using the DQO process. The overall decision logic is shown schematically in Figure 1.

The first step in identifying the data need is for the Tank Waste Retrieval Division to translate its operating scenario into a series of process steps (essentially a process flowsheet) that clearly defines the waste to which each element of the decision rule applies. Alternatives to the baseline operating scenario may also be addressed.

The second step is to apply the decision rule to each group of operating scenario activities that constitute a source of waste feed going to the waste feed staging tanks.

Figure 1. Overall Decision Logic.

ESP¹ = Environmental Simulation Program
TCR = Tank Characterization Report

¹ESP is a trademark of OLI Systems, Inc.

The third step is to determine if the data needed to address each element can be supplied by or approximated with existing (Best-Basis Inventory) or new characterization data on the waste, statistical evaluations, mathematical or process models such as Environmental Simulation Program (ESP¹), or by process testing on existing or new samples including dissolution/dilution testing.

If the existing data are insufficient to complete a full evaluation, additional data must be obtained from Tank T. The missing information needs to be identified and formally documented in this document. Unless sufficient archived samples can be found, Tank T waste must be sampled and analyzed. Once these data are obtained, they shall be compiled into the existing database for Tank T and a reevaluation of the data must be made and compared to Tables 1, 2, and 3.

¹ESP is a trademark of OLI Systems, Inc.

Table 1. Low-Activity Waste Feed Liquid Phase Chemical Composition.

Chemical	Maximum ratio, analyte (mole) to sodium (mole)		
Analyte	Envelope A	Envelope B	Envelope C
Al	1.9E-01	1.9E-01	1.9E-01
Ba	1.0E-04	1.0E-04	1.0E-04
Ca	4.0E-02	4.0E-02	4.0E-02
Cd	4.0E-03	4.0E-03	4.0E-03
Cl	3.7E-02	8.9E-02	3.7E-02
Cr	6.9E-03	2.0E-02	6.9E-03
F	9.1E-02	2.0E-01	9.1E-02
Fe	1.0E-02	1.0E-02	1.0E-02
Hg	1.4E-05	1.4E-05	1.4E-05
K	1.8E-01	1.8E-01	1.8E-01
La	8.3E-05	8.3E-05	8.3E-05
Ni	3.0E-03	3.0E-03	3.0E-03
NO ₂	3.8E-01	3.8E-01	3.8E-01
NO ₃	8.0E-01	8.0E-01	8.0E-01
OH	7.0E-01	7.0E-01	7.0E-01
Pb	6.8E-04	6.8E-04	6.8E-04
PO ₄	3.8E-02	1.3E-01	3.8E-02
SO ₄	9.7E-03	7.0E-02	2.0E-02
TIC	3.0E-01	3.0E-01	3.0E-01
TOC ¹	6.0E-02	6.0E-02	5.0E-01
U	1.2E-03	1.2E-03	1.2E-03

¹For each atom of Carbon in TOC.

Table 2. Low-Activity Waste Feed Liquid Phase Radionuclide Content.

Radionuclide ¹	Maximum ratio, radionuclide (Bq) to sodium (mole)		
	Envelope A	Envelope B	Envelope C
TRU ²	4.8E+05	4.8E+05	3.0E+06
¹³⁷ Cs	4.3E+09	6.0E+10	4.3E+09
⁹⁰ Sr	4.4E+07	4.4E+07	8.0E+08
⁹⁹ Tc	7.1E+06	7.1E+06	7.1E+06

¹Some radionuclides, such as ⁹⁰Sr and ¹³⁷Cs, have daughters with relatively short half-lives. These daughters have not been listed in this table. However, they are present in concentrations associated with the normal decay chains of the radionuclides.

²Radionuclides contributing to TRU are those alpha-emitting transuranic radionuclides with half-lives greater than 5 years (²³⁶Np, ²³⁷Np, ²³⁸Pu, ²³⁹Pu, ²⁴⁰Pu, ²⁴²Pu, ²⁴⁴Pu, ²⁴¹Am, ^{242m}Am, ²⁴³Am, ²⁴³Cm, ²⁴⁴Cm, ²⁴⁵Cm, ²⁴⁶Cm, and ²⁴⁷Cm). ²³⁸Pu, ²³⁹Pu, ²⁴⁰Pu and ²⁴¹Am are expected to comprise >95 percent of the total measured activity. ^{242m}Am and ²⁴⁴Cm are expected to contribute less than 2 percent of the total measured alpha activity. ²³⁶Np, ²⁴⁵Cm, ²⁴⁶Cm, and ²⁴⁷Cm are not expected to be present in Hanford nuclear waste in measurable quantities. Measurement of total alpha activity may provide an adequate screening for comparison with the TRU envelope limit.

Table 3. Applicable Waste Composition Limits from OSD-T-151-00007 (PHMC 1997).

7.2.1 <u>TANK COMPOSITION</u>	
7.2.1.A Temperatures ($T \leq 212^{\circ}\text{F}$)	
<u>Variable</u>	<u>Specification Limit</u>
For $[\text{NO}_3^-] \leq 1.0\text{M}$:	
$[\text{OH}^-]$	$0.010\text{M} \leq [\text{OH}^-] \leq 5.0\text{M}$
$[\text{NO}_2^-]$	$0.011\text{M} \leq [\text{NO}_2^-] \leq 5.5\text{M}$
$[\text{NO}_3^-]/([\text{OH}^-] + [\text{NO}_2^-])$	< 2.5
(for solutions below 167°F , the $[\text{OH}^-]$ limit is 8.0M)	
For $1.0\text{M} < [\text{NO}_3^-] \leq 3.0\text{M}$:	
$[\text{OH}^-]$	$0.1 ([\text{NO}_3^-]) \leq [\text{OH}^-] < 10\text{M}$
$[\text{OH}^-] + [\text{NO}_2^-]$	$\geq 0.4 ([\text{NO}_3^-])$
For $[\text{NO}_3^-] > 3.0\text{M}$:	
$[\text{OH}^-]$	$0.3\text{M} \leq [\text{OH}^-] < 10\text{M}$
$[\text{OH}^-] + [\text{NO}_2^-]$	$\geq 1.2\text{M}$
$[\text{NO}_3^-]$	$\leq 5.5\text{M}$
7.2.8 <u>HEAT GENERATION RATE</u>	
<u>Variable</u>	<u>Specification Limit*</u>
1) Maximum Heat Generation Rate	70,000 BTU/hr, for 241-AN, AP and AW. 50,000 BTU/hr, for 241-SY.
2) Max. Concentration Cesium-137 (Cs-137)	$5.74 \times 10^5 \mu\text{Ci/L}$ for 241-AN, AP, and AW. $4.10 \times 10^5 \mu\text{Ci/L}$ for 241-SY.
3) Max. Concentration Strontium-90 (Sr-90)	$4.04 \times 10^5 \mu\text{Ci/L}$ for 241-AN, AP, and AW. $2.88 \times 10^5 \mu\text{Ci/L}$ for 241-SY

3.0 REFERENCES

- Certa, P. J., and J. Jo, 1998, *Data Quality Objectives for TWRS Privatization Phase I: Confirm Tank T is an Appropriate Feed source for Low-Activity Waste Feed Batch X*, HNF-1796 Rev. 1, Numatec Hanford Corporation, Richland, Washington.
- PHMC, 1997, *Unclassified Operating Specifications for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*, OSD-T-151-00007, Fluor Daniel Hanford, Richland, Washington.

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ADDENDUM 1

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AN-105 / BATCH 1

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
M	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
USQ	Unreviewed Safety Question
WIT	Waste Disposal Integration Team
WTC	Whole tank composite

**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AN-105 / BATCH 1**

1.0 INTRODUCTION

This addendum applies Revision 0 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" problem-specific data quality objectives (PSDQO) to tank 241-AN-105 / Batch 1.

This application will also serve as a user test for the PSDQO since it is the first time the PSDQO will be applied.

This application of PSDQO-01 is divided into a Base Case Operating Scenario and an Alternative Case Operating Scenario. The Base Case homogenizes the waste in tank 241-AN-105 by mixing prior to transfer to 241-AP-102 and -104. The Alternative Case transfers the tank 241-AN-105 supernate to 241-AP-102 and -104 without mixing followed by subsequent diluent addition and mixing in 241-AN-105 before transfer to 241-AP-102 and -104.

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2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 1:

- Empty, flush, and empty 241-AP-102 and -104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.
- Homogenize the waste in 241-AN-105 using mixer pumps to resuspend the salt slurry.
- Transfer half of the homogenized waste in 241-AN-105 to 241-AP-102 and the remaining half to 241-AP-104, leaving a 0.1 ML (10-in.) heel. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow undissolved solids to settle.

The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) of 241-AN-105 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: there are two nearly identical transfers; they will be treated as one transfer. Transfer requirements apply to a whole tank composite of the waste currently in 241-AN-105 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: the mixing requirement applies to a salt slurry composite of the waste currently in 241-AN-105 over the temperature range of 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 1 composition; the composition and physical properties are that of a whole tank composite of the waste currently

in 241-AN-105 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a “Confirm Tank T...” issue.

Element 5, Miscellaneous Inputs: These inputs apply to the whole tank composition of 241-AN-105 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 6.1 of the PSDQO. For each element, the requirements specific to 241-AN-105 / Batch 1 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

2.2 ALTERNATIVE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 1 are listed below:

- Empty, flush, and empty 241-AP-102 and -104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.
- Decant the supernate in 241-AN-105; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.
- Add diluent to the salt slurry in 241-AN-105 and mix.
- Allow undissolved solids to settle in 241-AN-105.
- Transfer half of the liquid in 241-AN-105 to 241-AP-102 and the remaining to 241-AP-104, leaving a 10-in. heel. No additional diluent is expected to be needed for the transfer.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.

- Allow any undissolved solids that were inadvertently entrained to settle in 241-AP-102 and -104.

The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the tank needs to be is an operational issue, not a “Confirm Tank T...” issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to (a) a supernate composite from 241-AN-105 and (b) a salt slurry composite from 241-AN-105, both over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: out of four transfers, there are two distinct transfers. The transfer requirements applies to (a) supernate composite from 241-AN-105 after addition of the proper amount of diluent and (b) a salt slurry composite from 241-AN-104 after addition of the proper amount of diluent and settling of undissolved solids over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: the dissolution requirements applies to the whole tank composite of the waste currently in 241-AN-105 over the temperature range of 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 1 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AN-105 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a “Confirm Tank T...” issue.

Element 5, Miscellaneous Inputs: these inputs apply to the whole tank composition of 241-AN-105 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 2 contains the evaluation of the alternative case operating scenario for all the elements of the decision rule found in Section 6 of the PSDQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 6.1 of the PSDQO. For each element, the requirements specific to 241-AN-105 / Batch 1 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 3.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A process test was performed (Herting 1997a). The test was conducted in accordance with a test plan (Herting 1997b). The test plan was based on instruction provided by the Disposal Program (Garfield 1997). The whole tank composite (WTC) results of this test apply to the Base case operating scenario. The test determined that the required dilution ratio¹ is 50-75% and that the desired diluent is water.</p> <p>Dilution ratio and Diluent composition established.</p>	No further information is needed.
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	<p>Herting (1997a, Section 5.3.3) found that beyond a dilution ration of 50% for the WTC the supernate is below saturation in major Na salts.</p> <p>Below saturation established.</p>	No further information is needed.
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>Herting (1997a, Section 3.3.1) found that the viscosity of the WTC at a 50% dilution ratio over the temperature range of 28 to 65 °C varies from 2.5 to 6.0 cP. All samples exhibited Newtonian behavior. Continued dilution to 75% is expected to further reduce the viscosity since no additional solids were observed to precipitate.</p> <p>The largest observed quantity of settled solids that Herting (1997a, Table 4-1) observed for WTC dilutions of 50% and 70% at temperatures of 25, 45, and 65 °C at 20 hours after mixing was 15 volume %.</p> <p>Herting (1997a, Section 3.1) found that the liquid phase density for WTC dilutions of 50% and 75% performed at temperatures of 25, 45 and 65 °C ranged from 1.28 to 1.39 g/ml. Bulk densities calculated from the raw data in this section range from 1.30 to 1.39 g/ml. These values are less than the limit by more than 0.05 g/ml. Correction for reference conditions for SpG are not important.</p> <p>Viscosity, SpG, suspended solids no concern.</p>	No further information is needed.

¹In this addendum, a dilution ratio is the volume ratio of diluent to undiluted waste expressed as a percentage.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	<p>Herting (1997a, Section 2.2) did not observe precipitation during extended storage (4-8 weeks) of supernate sub-samples from the WTC dilution tests at 0, 25, 50 and 75% dilution at temperatures of 25, 45 and 65 °C. This covers all practical dilution ratios.</p> <p>Special Consideration: If gibbsite will form, it should form within four weeks. Samples were observed for 4-8 weeks.</p> <p>No precipitation concern.</p>	No further information is needed.
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	<p>The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-105 would dissolve. Herting (1997a, Table 4-5) found that the undissolved solids at 50 and 75% dilution for temperatures of 25, 45 and 65 °C varies from 0.2 - 0.4 true wt% (the undiluted samples ranged from 3.8 - 4.8 true wt%). This is consistent with the Base case operating scenario which has 3 wt% solids in the undiluted waste and 0.5 wt% solids after dilution.</p> <p>Herting (1997a, Section 1.1) found that dissolution kinetic were very fast (dissolution was complete after about 15 seconds).</p> <p>Note: Confirmation that a mixer pump can provide the necessary amount of mixing to dissolve the solids in the tank in a reasonable amount of time is within the scope of the Equipment Design PSDQO.</p> <p>Solids solubility no concern.</p>	No further information is needed.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements (continued)	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	<p>Herting (1997a, Section 3.1) found that the undissolved solids will settle and do so in about 20 hrs.</p> <p>Scale-up calculations for Herting's settling data have not been performed.</p> <p>The base case time allocated in the TWRSO&UP (Kirkbride et al. 1997, Assumption 6.11) for settling is taken by reference from (Certa et al. 1996) and is 30 days.</p> <p>Special Consideration: The dissolved air in the dilution water was salted out when mixed with the undiluted waste. The resulting foam kept a portion of the solids from settling. The foam dispersed and solids settled upon mixing again.</p>	Estimated time to settle undissolved solids at full scale. (See Table 3, Item # 1).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	<p>Tank 241-AN-105 contains about 40% by volume of a salt slurry. The best basis inventory also shows that the salt slurry contains approximately 40% of the total sodium (Jo 1997). The base case operating scenario targets most of the sodium in the salt slurry for feed. The equipment required to mobilize and retrieve the slurry includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).</p> <p>Retrieval equipment to be added to 241-AN-105 will accomplish requirements.</p>	No further information is needed.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>	<p>Only Envelope A limits apply to Batch 1.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3)) compared the point estimates¹ of the composition of the feed from 241-AN-105 to the Envelope limits and "flagged" TOC as requiring further examination. The TOC was at 82% of the maximum limit of 0.06 gmole TOC/gmole Na; All other analytes were below 80% of their maximum limits.</p> <p>Resolution of "flag": (1) TOC was not identified as a problem by Welsh (1997) or by Herting (1997a); (2) RL is negotiating an increase in the TOC limit from 0.06 gmole TOC/gmole Na to 0.5 gmole TOC/gmole Na.</p> <p>Welsh (1997, Section 7.1 and 7.2) calculated the mean concentration and UL² for the bulk tank composition³ using four variations on segment data and two variations on composite data. The means and UL for all analytes and methods were below the maximum envelope limits, with the following exception: In two variations based on segment data that used fusion digest slurry data the means for Ba.icp and La.icp and the UL for Ba.icp, La.icp, Ni.icp.wo, Pb.icp.w and Pb.icp.wo exceeded their respective envelope limits. These are "flagged" for further consideration.</p>	<p>No further information is needed.</p>

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¹These point estimates were based on the best basis inventory for 241-AN-105. A thermodynamic model (ESP) was used to estimate the liquid phase composition of the diluted waste.

²The UL is the upper 95 percent confidence interval for random variability.

³For 241-AN-105, the bulk inventory can be used as a bounding case in estimating the analyte:Na ratios. The quantity of each bulk analyte inventory will be equal to or greater than that in the liquid phase of the diluted waste. The bulk quantity of sodium in the tank will be about the same as the sodium in the liquid phase after dilution with water since nearly all of the sodium has been removed from the solids at a 50% or greater dilution. Any bias in the analyte:Na mole ratios estimated directly from the bulk inventory will tend to be high (that is, conservative for comparison to maximum envelope limits).

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	<p>Resolution of "flag": (1) The fusion digest results are overly conservative in that they dissolve essentially all solids while the alternative method (acid digest) dissolves all water soluble solids and most other solids. (2) The fusion digest method results in large "less than" values due to the additional dilution of the sample (about an order of magnitude greater than the acid digest).</p> <p>Herting (1997a, Section 1.0) found that "under all dilution conditions studied, the retrievable waste fell within the feed specification limits established for Envelope A in the Phase I Privatization contracts".</p> <p>Compliance with Envelope A achieved. c Herting (1997a, Table 8-1) found that the [Na] is 7.56 M for a 50% dilution ratio and 6.57 M for 75% dilution.</p> <p>The worst case (for the various statistical models and analytical methods employed) estimate of bulk [Na] is a mean of 12.7 M with a 95% CI around the mean of $10.3 \text{ M} - 15.2 \text{ M}$ (Welsh 1997, Section 7). Dilution of waste with a 15.2 M [Na] at a 50% dilution ration will yield a [Na] of 10.1 M.</p> <p>Compliance with Na molarity achieved.</p>	No further information is needed.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>Herting (1997a, Table 4-1) measured the quantity of solids and expressed the results several different ways. The ranges given below are for WTC dilutions of 50% and 70% at temperatures of 25, 45 and 65 °C at 20 hours after mixing:</p> <p>9-15 volume % settle solids → "Flagged"</p> <p>3-7 volume % centrifuges solids → "Flagged"</p> <p>2.6 to 3.6 weight % centrifuged solids (wet)</p> <p>0.2 to 0.6 weight % true solids.</p> <p>Resolution of "Flag": (1) The PHMC will use the decant system planned for the intermediate feed staging tanks (Britton et al. 1996) for control of solids in the feed delivered to the private contractors, if needed. (2) Issue 19T of ICD 19 (PHMC 1997a) addresses this solids measurement issue. RL is negotiating a change in this limit from volume % to weight percent.</p> <p>Compliance with insoluble fraction will be resolved administratively.</p>	No further information is needed.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 1. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 1, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 1 is 7,820 BTU/hr for Contractor 1 and 7,870 BTU/hr for Contractor 2. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimated the total heat load in 241-AN-105 (Jo 1997) to be 9,840 W (33,600 BTU/hr total, 16,800 per Batch). This estimate is also well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors achieved.</p>	No further information is needed.
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>Using the best basis inventory and reported volume for 241-AN-105 from Jo (1997), the bulk [¹³⁷Cs] is calculated to be 4.7E5 μCi/L and [90Sr] is 7.9E3 μCi/L. These are both well below the OSD limits of 5.74E5 μCi/L and 4.04E5 μCi/L, respectively. This is a conservative comparison since the 50-70% dilution has not been accounted for in the above estimates.</p> <p>Conformance with maximum ¹³⁷Cs concentration achieved.</p>	No further information is needed.

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Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 1 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) ≥ 500 MT Na.	Herting (1997, Table 7-2a) found that 946 MT Na are recoverable at 50% dilution ratio and 1016 MT Na are recoverable at 75% dilution ratio (the difference is mainly due to leaving less sodium behind in the interstitial liquid associated with the settled solids - the sodium concentration is less for the greater dilution). The recoverable sodium is less than 120% of the minimum limit and is “flagged” for further evaluation. Resolution of “flag”: (1) if necessary, the PHMC will blend in additional waste or shim the feed batch to meet the 500 MT Na requirement; (2) The minimum 500 MT size for the first batch is not driven by technical or cost considerations; (3) The PHMC has already identified this as an issue (PHMC 1997, Issue 19H) and (Kirkbride et al. 1997, Section 3.1.3). RL is considering the recommendation to reduce this limit to 300 MT Na. (4) The availability of the engineering solution in number (1) avoids the need for additional tank characterization data. Na quantity requirements will be resolved administratively or by engineering solution.	No further information is needed.
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 500 - 600 MT Na.	Same as above. Na quantity requirements will be resolved administratively or by engineering solution.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 514 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity requirements will be resolved administratively or by engineering solution.	No further information is needed.

Table 1. Base Case Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 5 - Miscellaneous Inputs	Physical form of Tank 241-AN-105 contents	From Jo (1997): 241-AN-105 has a noncontinuous floating crust layer that may be up to 30 cm (1-ft) thick. The layer is easily penetrated and is composed of easily dissolvable salts. There is approximately 6.4 m (21 ft) of supernate which is compositionally homogenous. There are approximately 4 m (13 ft) of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	This is the first batch. Heels remaining from cleanout of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 1	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	(a) As applied to supernate composite:	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 2)
		This information was not obtained and is still needed.	
		(b) As applied to salt slurry composite: A process test was performed (Herting 1997a). The test was conducted in accordance with a test plan (Herting 1997b). The test plan was based on instruction provided by the Disposal Program (Garfield 1997). The settled solids composite results of this test determined that the required dilution ratio ¹ is 80-120% and that the desired diluent is water.	No further information is needed.
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	Dilution and Diluent Composition established.	
		(a) As applied to supernate composite with proper amount of diluent added:	See requirement (See Table 3, Item # 3).
		This information was not obtained and is still needed.	
		(b) As applied to salt slurry composite with proper amount of diluent added:	No further information is needed.
		Analysis of data in Herting (1997a, Section 5.3) found that beyond a dilution ratio of 80% for the settled solids the supernate is below saturation in major Na salts.	
		Below saturation established.	

¹In this addendum, a dilution ratio is the volume ratio of diluent to undiluted waste expressed as a percentage.

Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements are Satisfied (continued)	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: This information was not obtained and is still needed.	See requirement (See Table 3, Item # 4).
		(b) As applied to salt slurry composite with proper amount of diluent added: Herting (1997a, Section 3.3.1) found that the viscosity of the settled solids at a 80% dilution ratio over the temperature range of 28 to 65 °C varies from 2.5 to 7.0 cP. All samples exhibited Newtonian behavior. Continued dilution to 120% is expected to further reduce the viscosity since no additional solids were observed to precipitate. The observed quantity of settled solids that Herting (1997a, Table 4-6) observed for the settled solids dilutions of 80% at temperatures of 25, 45 and 65 °C at 20 hours after mixing ranged from 16 - 27 volume %; at 120% dilution they ranged from 12 - 18 volume %. Herting (1997a, Section 3.1) found that the liquid phase density for salt slurry dilutions of 80% and 120% performed at temperatures of 25, 45 and 65 °C ranged from 1.24 to 1.49 g/ml. Bulk densities calculated from the raw data in this section range from 1.24 to 1.38 g/ml. These values are less than the limit by more than 0.05 g/ml. Correction for reference conditions for SpG are not important. Viscosity, SpG, suspended solids no concern.	No further information is needed.
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	Herting (1997a, Section 2.2) did not observe precipitation during extended storage (4-8 weeks) of supernate sub-samples from the WTC dilution tests at 0, 25, 50 and 75% dilution at temperatures of 25, 45 and 65 °C. This covers all practical dilution ratios. Special Consideration: If gibbsite will form, it should form within four weeks. Samples were observed for 4-8 weeks. No precipitation concern.	No further information is needed.

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Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Dissolution Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	<p>The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-105 would dissolve.</p> <p>Herting (1997a, Table 4-7) found that the undissolved solids at 80 and 120% dilution for temperatures of 25, 45 and 65 °C varies from 4 - 9 volume % centrifuged solids (the undiluted samples ranged from 32 - 40 volume % centrifuged solid). Herting (1997a, Table 4-8) also found that the undissolved solids at 80 and 120% dilution for temperatures of 25, 45 and 65 °C varies from 3.3 - 6.2 wt % centrifuged solids (the undiluted samples ranged from 38.3 - 43.4 wt % centrifuged solid). Most of the solids thought to be soluble are soluble.</p> <p>Herting (1997a, Section 1.1) found that dissolution kinetic were very fast (dissolution was complete after about 15 seconds).</p> <p>Note: Confirmation that a mixer pump can provide the necessary amount of mixing to dissolve the solids in the tank in a reasonable amount of time is within the scope of the Equipment Design PSDQO.</p> <p>Solids solubility no concern.</p>	No further information is needed.
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	<p>Herting (1997a, Section 3.1) found that the undissolved solids will settle and do so in about 20 hrs.</p> <p>Scale-up calculations for Herting's settling data have not been performed.</p> <p>Special Consideration: The dissolved air in the dilution water was salted out when mixed with the undiluted waste. The resulting foam kept a portion of the solids from settling. The foam dispersed and solids settled upon mixing again.</p>	Estimated time to settle undissolved solids at full scale (See Table 3, Item # 5)
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	<p>The alternative case uses the same retrieval equipment as the base case. See base case evaluation for details.</p> <p>Retrieval equipment to be added to AN-105 will accomplish requirements.</p>	No further information is needed.

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Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>	<p>Only Envelope A limits apply to Batch 1.</p> <p>In the alternative case, the composition of the waste staged in 241-AP-102 and -104 is almost identical to that of the base case. There will be differences in absolute concentration due to differences in the total amount of dilution, but this will not affect the [analyte]:[Na] values. There will also be differences due to slightly different extent of solids dissolution, but these are bounded by the evaluation for the Base Case that was based on the Welsh (1997) report.</p> <p>Herting (1997a, Section 1.0) found that "under all dilution conditions studied, the retrievable waste fell within the feed specification limits established for Envelope A in the Phase I Privatization contracts".</p> <p>Compliance with Envelope A achieved.</p>	<p>No further information is needed.</p>
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>Since the supernate dilution ratio was not established, the resulting [Na] in the Batch can not be directly determined. However, a bounding calculation shows that the lower limit will be satisfied: Assume that the dilution ratio required by the supernate layer will be equal to the dilution ratio required by the salt slurry layer. The lowest (95% CI around the mean for the various statistical models and analytical methods employed) estimate of the bulk [Na] was 10.2 M (Welsh 1997, Section 7). The lowest [Na] in the feed batch is the [Na]bulk/(1+120%/100%) to account for 120% dilution). This yields a value of 4.6 M.</p> <p>Another bounding calculation shows that the upper limit will be satisfied: Assume that no dilution is required by the supernate layer. The overall dilution ratio will not exceed $100\% \{1 - [(0.6) + (0.4) * (1 + 80\%/100\%)]\} = 32\%$; The largest (95% CI around the mean for the various statistical models and analytical methods employed) estimate of the bulk [Na] was 15.2 M (Welsh 1997, Section 7). Dilution of waste with a 15.2 M [Na] at a 32% dilution ratio yields a [Na] of 11.5 which is well within the upper limit.</p> <p>In any case, the sodium concentration for the feed batch can be adjusted in the intermediate feed staging tanks.</p> <p>Compliance with Na molarity achieved.</p>	<p>No further information is needed.</p>

Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	In the alternative case, the only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue. Compliance with insoluble fraction will be resolved by case during operations.	No further information is needed.
	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	Mass balances have not been performed on the alternative case operating scenario to estimate the composition of the staged feed batch (these can be done explicitly after the supernate dilution ratio has been determined. Bounding calculations can be performed, however it is simpler to wait for the dilution ratio.	Estimated composition of the staged feed (See Table 3, Item # 6).
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	This limit is equivalent to 1.59E6 μ Ci/L. Using the best basis inventory and reported volume for 241-AN-105 from Jo (1997), the bulk [¹³⁷ Cs] is calculated to be 4.7E5 μ Ci/L. This is well below the maximum limit of 1.59E6 μ Ci/L. This is a conservative comparison since dilution has not been included. Conformance with maximum Cs achieved.	No further information is needed.
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 1 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.

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Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 500 MT Na.	<p>Herting (1997, Table 7-2b) found that 973 MT Na are recoverable at 80% dilution ratio and 1011 MT Na are recoverable at 120% dilution ratio (the difference is mainly due the leaving less sodium behind in the interstitial liquid associated with the settled solids - the sodium concentration is less for the greater dilution). The recoverable sodium is less than 120% of the minimum limit and is "flagged" for further evaluation.</p> <p>Resolution of "flag": (1) if necessary, the PHMC will blend in additional waste or shim the feed batch to meet the 500 MT Na requirement; (2) The minimum 500 MT size for the first batch is not driven by technical or cost considerations; (3) The PHMC has already identified this as an issue (PHMC 1997, Issue 19H) and (Kirkbride et al. 1997, Section 3.1.3). RL is considering the recommendation to reduce this limit to 300 MT Na. (4) The availability of the engineering solution in number (1) avoids the need for additional tank characterization data.</p> <p>Na quantity requirements will be resolved administratively or by shimming.</p>	No further information is needed.
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 500 - 600 MT Na.	<p>Same as above.</p> <p>Na quantity requirements will be resolved administratively or by shimming.</p>	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 514 MT Na (Kirkbride et al. 1997, Table 3.1-5)	<p>Same as above.</p> <p>Na quantity requirements will be resolved administratively or by shimming.</p>	No further information is needed.
Element 5 - Miscellaneous Inputs	Physical form of Tank 241-AN-105 contents	241-AN-105 has a 30-cm (1-ft) crust that is easily penetrated and is composed of easily dissolvable salts. There is 19.3 ft of supernate that is compositionally homogenous. There is 14.8 ft of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	This is the first batch. Heels remaining from cleanout of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed

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Table 2. Alternative Case Operating Scenario Evaluation. (7 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 5 - Miscellaneous Inputs (continued)	Shimming Batch 1	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 3. Information Needs.

Item	Information need	Planned resolution	Sample required
1	Estimate time to settle undissolved solids at full scale	Engineering calculations: no additional tests required	None
2	Desired dilution ratio and diluent composition for a representative sample of supernate.	Calculate from results of Item #3 and ESP. No additional tests required.	None
3	Confirm as-retrieved waste remains below satn in major NA salts during transfer.	Perform lab test: measure %solids vs. temp for supernate at 25 and 65 degrees C under 4 conditions: (1&2) increasing temp. undiluted and diluted 15%, (3&4) decreasing temp. undiluted and diluted 15%.	10 g ¹ solids and 60 mL supernate
4	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	SpG and %Solids already known. Measure viscosity of undiluted supernate at 25 to 65 C, which should be < 10 cP. All dilutions will be lower.	5 g ¹ solids and 20 mL supernate
5	See item #1.	See item #1.	None
6	Estimate composition of staged feed.	Can be calculated from existing data after item #2 is resolved.	None

¹The solids are needed to re-establish the original solid-liquid equilibria that was present in 241-AN-105.

There are six items that have been flagged in Tables 1 and 2 requiring further information. All involve performing a specific process test with specific material from 241-AN-105. There are no other information needs requiring either an analysis of an existing 241-AN-105 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AN-105 is appropriate for Batch 1.

3.0 REFERENCES

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ADDENDUM 2

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AN-104 / BATCH 2

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
<u>M</u>	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
USQ	Unreviewed Safety Question
WIT	Waste Disposal Integration Team
WTC	Whole tank composite

**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AN-104 / BATCH 2**

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" problem-specific data quality objectives (PSDQO) to tank 241-AN-104 / Batch 2.

This application of the DQO is divided into a Base Case Operating Scenario and an Alternative Case Operating Scenario. The Base Case homogenizes the waste in tank 241-AN-104 by mixing prior to transfer to 241-AP-102 and -104. The Alternative Case transfers the tank 241-AN-104 supernate to 241-AP-102 and -104 without mixing followed by subsequent diluent addition and mixing in 241-AN-104 before transfer to 241-AP-102 and -104.

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2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 2:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel behind in each tank.
- Homogenize the waste in 241-AN-104 using mixer pumps to resuspend the salt slurry.
- Transfer half of the homogenized waste in 241-AN-104 to 241-AP-102 and the remaining half to 241-AP-104, leaving a 0.1 ML (10-in.) heel. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow undissolved solids to settle.

The heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; The waste compositions of tank 241-AN-105 and tank 241-AN-104 are very similar.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) of 241-AN-104 over the temperature of 45 °C.

Element 2, Transfer Requirements: there are two nearly identical transfers; they will be treated as one transfer. Transfer requirements apply to a whole tank composite of the waste currently in 241-AN-104 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: the mixing requirement applies to a salt slurry composite of the waste currently in 241-AN-104 over the temperature of 45 °C.

Element 4, Envelope Requirements: there is one unique Batch 2 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AN-104 after addition of the proper amount of diluent over the temperature of 45 °C.

The heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed).

Element 5, Miscellaneous Inputs: These inputs apply to the whole tank composition of 241-AN-104 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-AN-104 / Batch 2 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

2.2 ALTERNATIVE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 2 are listed below:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel behind in each tank.
- Decant the supernate in 241-AN-104; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.
- Add diluent to the salt slurry in 241-AN-104 and mix.
- Allow undissolved solids to settle in 241-AN-104.
- Transfer half of the liquid in 241-AN-104 to 241-AP-102 and the remaining to 241-AP-104, leaving a 10-in. heel. No additional diluent is expected to be needed for the transfer.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow any undissolved solids that were inadvertently entrained to settle in 241-AP-102 and -104.

The heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; The waste compositions of tank 241-AN-105 and tank 241-AN-104 are very similar.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to (a) a supernate composite from 241-AN-104 and (b) a salt slurry composite from 241-AN-104, both over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: out of four transfers, there are two distinct transfers. The transfer requirements applies to (a) supernate composite from 241-AN-104 after addition of the proper amount of diluent and (b) a salt slurry composite from 241-AN-104 after addition of the proper amount of diluent and settling of undissolved solids over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: the dissolution requirements applies to the whole tank composite of the waste currently in 241-AN-104 over the temperature range of 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 2 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AN-104 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed).

Element 5, Miscellaneous Inputs: these inputs apply to the whole tank composition of 241-AN-104 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 2 contains the evaluation of the alternative case operating scenario for all the elements of the decision rule found in Section 6.0 of the PSDQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-AN-104 / Batch 2 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 3.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	A process test is being performed in accordance with a test plan (Herting 1998). The test plan is based on instruction provided by the Disposal Program (Garfield 1997). The whole tank composite (WTC) results of this test apply to the Base case operating scenario. Dilution ratio and Diluent composition will be established.	Desired dilution ratio and diluent composition (See Table 3, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is being performed in accordance with a test plan The test is being performed for WTC and WTC with dilution ratio of 50% (Herting 1998).	Confirm a dilution ratio of 50% for the WTC is below saturation in major Na salts (See Table 3, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	A process test is being performed in accordance with a test plan (Herting 1998). The test will determine viscosity of the undiluted WTC, undiluted supernate from WTC, and at a 50% dilution ratio over the temperatures of 25, 45, and 65 °C. If viscosity of the supernate from WTC is above 5 cP, then WTC supernate will be diluted 20% and viscosity measured. A process test is being performed in accordance with a test plan (Herting 1998). The largest observed quantity of settled solids for WTC and WTC dilution of 50% at temperature of 45 °C at 48 hours after mixing will be determined. A process test is being performed in accordance with a test plan (Herting 1998). The test will determine the liquid phase density for WTC and at a 50% dilution ratio over the temperature of 45 °C.	Determine viscosity, SpG, suspended solids (See Table 3, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at temperature of 45 °C will be observed for solid formation. Special Consideration: If gibbsite will form, it should form within four weeks.	Determine solid formation, if any (See Table 3, Item # 4).

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-104 would dissolve. A process test is being performed in accordance with a test plan (Herting 1998). Amount of undissolved solids is being determined at 50 % dilution for temperature of 45 °C. During the test, amount of time needed to dissolve the sample will be recorded	Amount of undissolved solids and the amount of time needed to dissolve the solids (See Table 3, Item # 5).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test is being performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data will be performed. The base case time allocated in the TWRSO&UP (Kirkbride et al. 1997, Assumption 6.11) for settling is taken by reference from (Certa et al. 1996) and is 30 days.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale. (See Table 3, Item # 6).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-AN-104 contains about 39% by weight of a salt slurry. (Hu 1997). The base case operating scenario targets most of the sodium in the salt slurry for feed. The equipment required to mobilize and retrieve the slurry includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997). Retrieval equipment to be added to 241-AN-104 will accomplish requirements.	No further information is needed.

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>	<p>Only Envelope A limits apply to Batch 2.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3)) compared the point estimates¹ of the composition of the feed from 241-AN-104 to the Envelope limits and "flagged" sulfate as requiring further examination. The sulfate was at 92% of the maximum limit of 0.06 gmole sulfate/gmole Na; All other analytes were below 80% of their maximum limits.</p> <p>Welsh (1998, Section 7.1 and 7.2) calculated the mean concentration and UL² for the bulk tank composition³ using four variations on segment data and two variations on composite data. The means and UL for all analytes and methods were below the maximum envelope limits, with the following exception: In two variations based on segment data that used fusion digest slurry data the means for Ba.icp, La.icp and U.icp and the UL for Ba.icp, La.icp, Pb.icp, sulfate, Total alpha and U.icp exceeded their respective envelope limits. These are "flagged" for further consideration.</p>	<p>Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 7).</p>
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During Herting's process test [Na] will be measured.</p>	<p>[Na] measurement (See Table 3, Item # 8).</p>

¹These point estimates were based on the best basis inventory for 241-AN-104. A thermodynamic model (ESP) was used to estimate the liquid phase composition of the diluted waste.

²The UL is the upper 95 percent confidence interval for random variability.

³For 241-AN-104, the bulk inventory can be used as a bounding case in estimating the analyte:Na ratios. The quantity of each bulk analyte inventory will be equal to or greater than that in the liquid phase of the diluted waste. The bulk quantity of sodium in the tank will be about the same as the sodium in the liquid phase after dilution with water since nearly all of the sodium has been removed from the solids at a 50% or greater dilution. Any bias in the analyte:Na mole ratios estimated directly from the bulk inventory will tend to be high (that is, conservative for comparison to maximum envelope limits).

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>Herting (1998) will measure the quantity of solids for WTC dilution of 50% at temperature of 45 °C.</p>	Insoluble solids measurement (See Table 3, Item # 9).
	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 2. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 2, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 2 is 10,100 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimated the total heat load in 241-AN-104 (Hu 1997) to be 11,500 W (39,150 BTU/hr). This estimate is also well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors achieved.</p>	No further information is needed.

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 $\mu\text{Ci/L}$. The OSD limit of 5.74E5 $\mu\text{Ci/L}$ is more restrictive.</p> <p>Using the best basis inventory and reported volume for 241-AN-104 from Hu (1997), the bulk [¹³⁷Cs] is calculated to be 5.8E5 $\mu\text{Ci/L}$ and [90Sr] is 2.4E4 $\mu\text{Ci/L}$. These are both well below the OSD limits of 5.74E5 $\mu\text{Ci/L}$ and 4.04E5 $\mu\text{Ci/L}$, respectively. This is a conservative comparison since the 50 % dilution has not been accounted for in the above estimates.</p> <p>Conformance with maximum ¹³⁷Cs concentration achieved.</p>	No further information is needed.
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	<p>These discriminators do not apply to Batch 2 (Envelope A).</p> <p>No concern about distinguishing between envelopes.</p>	No further information is needed.
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During Herting's process test, amount of Na recoverable will be measured at 50% dilution ratio	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	Determine Na quantity (See Table 3, Item # 10).
	PHMC desired batch size (from Operating Scenario): 535 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above.	Determine Na quantity (See Table 3, Item # 10).

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hu (1997): 241-AN-104 has a noncontinuous floating crust layer that may be up to 5.1 cm (2 in) thick. The layer is easily penetrated and is composed of easily dissolvable salts. There is approximately 5.5 m (18 ft) of supernate which is compositionally homogenous. There are approximately 4.1 m (13.6 ft) of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 2	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	(a) As applied to supernate composite: A process test is being performed (Herting 1998). The test plan was based on instruction provided by the Disposal Program (Garfield 1997). This information is being obtained per Herting's process test (1998).	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 11)
		(b) As applied to salt slurry composite: A process test is being performed (Herting 1998). The test plan was based on instruction provided by the Disposal Program (Garfield 1997). This information is being obtained per Herting's process test (1998).	Desired dilution ratio and diluent composition for a representative sample of salt slurry (See Table 3, Item # 11)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 12).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 12).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 13).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 13).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	A process test is being performed (Herting 1998).	Precipitation at 0,40, 80, and 120 % dilution (See Table 3, Item # 14).

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Dissolution Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-104 would dissolve. A process test is being performed (Herting 1998).	Amount of soluble solids and amount of time required to dissolve soluble solids (See Table 3, Item # 15).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test is being performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data have not been performed.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale (See Table 3, Item # 16).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	The alternative case uses the same retrieval equipment as the base case. See base case evaluation for details. Retrieval equipment to be added to AN-104 will accomplish requirements.	No further information is needed.
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Only Envelope A limits apply to Batch 2. In the alternative case, the composition of the waste staged in 241-AP-102 and -104 is almost identical to that of the base case. There will be differences in absolute concentration due to differences in the total amount of dilution, but this will not affect the [analyte]:[Na] values. There will also be differences due to slightly different extent of solids dissolution, but these are bounded by the evaluation for the Base Case that was based on the Welsh (1998) report.	Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 7).

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	<p>Since the supernate dilution ratio was not established, the resulting [Na] in the Batch can not be directly determined. However, a bounding calculation shows that the lower limit will be satisfied: Assume that the dilution ratio required by the supernate layer will be equal to the dilution ratio required by the salt slurry layer. The lowest (95% CI around the mean for the various statistical models and analytical methods employed) estimate of the bulk [Na] was 12.1 M (Welsh 1998, Section 7). The lowest [Na] in the feed batch is the [Na] bulk/(1 + 120%/100%) to account for 120% dilution). This yields a value of 5.5 M.</p> <p>The sodium concentration for the feed batch can be adjusted in the intermediate feed staging tanks.</p> <p>Compliance with Na molarity achieved.</p>	No further information is needed.
	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>In the alternative case, the only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue.</p> <p>Compliance with insoluble fraction will be resolved by case during operations.</p>	No further information is needed.
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference).</p> <p>See Section 2.0, Table 3 (in main report).</p>	Mass balances have not been performed on the alternative case operating scenario to estimate the composition of the staged feed batch (these can be done explicitly after the supernate dilution ratio has been determined. Bounding calculations can be performed, however it is simpler to wait for the dilution ratio.	Estimated composition of the staged feed (See Table 3, Item # 16).
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 $\mu\text{Ci/L}$.</p> <p>Using the best basis inventory and reported volume for 241-AN-104 from Hu (1997), the bulk [¹³⁷Cs] is calculated to be 5.8E5 $\mu\text{Ci/L}$. This is well below the OSD limit of 1.59E6 $\mu\text{Ci/L}$. This is a conservative comparison since dilution has not been included.</p> <p>Conformance with maximum Cs achieved.</p>	No further information is needed.

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Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 2 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During Herting's process test, amount of Na recoverable will be measured.	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 535 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity requirements will be resolved administratively or by shimming.	No further information is needed.
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hu (1997): 241-AN-104 has a noncontinuous floating crust layer that may be up to 5.1 cm (2 in) thick. The layer is easily penetrated and is composed of easily dissolvable salts. There is approximately 5.5 m (18 ft) of supernate which is compositionally homogenous. There are approximately 4.1 m (13.6 ft) of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 2	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	A process test is being performed	None
2	Confirm a dilution ratio of 50% for the WTC is below saturation in major Na salts	A process test is being performed	None
3	Determine viscosity, SpG, suspended solids	A process test is being performed	None
4	Determine solid formation, if any	A process test is being performed	None
5	Amount of undissolved solids and the amount of time needed to dissolve the solids	A process test is being performed	None
6	Estimate time to settle undissolved solids at full scale	Engineering calculations: no additional tests required	None
7	Chemical and radionuclide analyses from Herting's test	A process test is being performed	None
8	[Na] measurement	A process test is being performed	None
9	Insoluble solids measurement	A process test is being performed	None
10	Determination of Na quantity	A process test is being performed	None

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
11	Desired dilution ratio and diluent composition for a representative sample of supernate.	Calculate from results of Item #12 and ESP. No additional tests required.	None
12	Confirm as-retrieved waste remains below satn in major NA salts during transfer.	Performing lab test: measure %solids vs. temp for supernate at 25, 45 and 65 °C under 3 conditions: undiluted, 10% diluted and 20% diluted.	None
13	Confirm as-retrieved waste remains <10 cP, <1.5 SpG, and <30% solids during transfer.	SpG, viscosity and %Solids are being measured.	None
14	Precipitation at 0, 40, 80, and 120 % dilutions	Process testing is being performed at these dilutions.	None
15	Amount of soluble solids and amount time needed to dissolve soluble solids.	A process test is being performed.	None
16	Estimate composition of staged feed.	Can be calculated from existing data after item #11 is resolved.	None

There are 16 items that have been flagged in Tables 1 and 2 requiring further information. All items are being addressed by a specific process test with specific material from 241-AN-104. There are no other information needs requiring either an analysis of an existing 241-AN-104 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AN-104 is appropriate for Batch 2.

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ADDENDUM 3

APPLICATION OF

**"CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X"**

TO

241-AW-101 / BATCH 3

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
<u>M</u>	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
USQ	Unreviewed Safety Question
WIT	Waste Disposal Integration Team
WTC	Whole tank composite

**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AW-101 / BATCH 3**

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" problem-specific data quality objectives (PSDQO) to tank 241-AW-101 / Batch 3.

This application of the DQO is divided into a Base Case Operating Scenario and an Alternative Case Operating Scenario. The Base Case homogenizes the waste in tank 241-AW-101 by mixing prior to transfer to 241-AP-102 and -104. The Alternative Case transfers the tank 241-AW-101 supernate to 241-AP-102 and -104 without mixing followed by subsequent diluent addition and mixing in 241-AW-101 before transfer to 241-AP-102 and -104.

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2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 3:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel from Batch 2 behind in each tank.
- Homogenize the waste in 241-AW-101 using mixer pumps to resuspend the salt slurry.
- Transfer half of the homogenized waste in 241-AW-101 to 241-AP-102 and the remaining half to 241-AP-104, leaving a 0.1 ML (10-in.) heel. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow undissolved solids to settle.

The heel remaining in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue. Furthermore, diluted Batch 2 waste will be within Envelope A specifications, and mixing wastes from different tanks/batches within the defined specifications should not have an adverse effect on operations.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) of 241-AW-101 from 25 to 65 °C.

Element 2, Transfer Requirements: there are two nearly identical transfers; they will be treated as one transfer. Transfer requirements apply to a whole tank composite of the waste currently in 241-AW-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: the mixing requirement applies to a salt slurry composite of the waste currently in 241-AW-101 from 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 3 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AW-101 after addition of the proper amount of diluent over the temperature range of 25 to 65°C. The heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed, because the heel will already be within Envelope A specifications); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: These inputs apply to the whole tank composition of 241-AW-101 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 6.1 of the PSDQO. For each element, the requirements specific to 241-AW-101 / Batch 3 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

2.2 ALTERNATIVE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 3 are listed below:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel from Batch 2 behind in each tank.
- Decant the supernate in 241-AW-101; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.
- Add diluent to the salt slurry in 241-AW-101 and mix.
- Allow undissolved solids to settle in 241-AW-101.
- Transfer half of the liquid in 241-AW-101 to 241-AP-102 and the remaining to 241-AP-104, leaving a 10-in. heel. No additional diluent is expected to be needed for the transfer.

- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow any undissolved solids that were inadvertently entrained to settle in 241-AP-102 and -104.

The Batch 2 heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to both (a) a supernate composite from 241-AW-101 and (b) a salt slurry composite from 241-AW-101, over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: out of four transfers, there are two distinct transfers. The transfer requirements applies to (a) supernate composite from 241-AW-101 after addition of the proper amount of diluent and (b) a salt slurry composite from 241-AW-101 after addition of the proper amount of diluent and settling of undissolved solids over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: the dissolution requirements applies to the salt slurry composite of the waste currently in 241-AW-101 over the temperature range of 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 3 composition; the composition and physical properties are that of a blended tank composite of the waste currently in 241-AW-101, after addition of the proper amount of diluent over the temperature range of 25 to 65 °C for both the supernatant and salt slurry composites.

The Batch 2 heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed because the heel will already be within Envelope A specifications); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: these inputs apply to the supernatant and salt slurry composition of 241-AW-101 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 2 contains the evaluation of the alternative case operating scenario for all the elements of the decision rule found in Section 6 of the PSDQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 6.1 of the PSDQO. For each element, the requirements specific to 241-AW-101 / Batch 3 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 3.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	A process test is being performed in accordance with a test plan (Herting 1998). The test plan is based on instruction provided by the Disposal Program (Garfield 1997). The whole tank composite (WTC) results of this test apply to the Base case operating scenario. Dilution ratio and Diluent composition will be established.	Desired dilution ratio and diluent composition (See Table 3, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	The composition will be evaluated to determine if it is similar to previously evaluated tanks. The base case dilution ratio is assumed to be 50% (by volume). If it is not, the planned process test performed in accordance with the current test plan (Herting 1998) will quantify a more appropriate value.	Confirm a dilution ratio of 50% (by volume) for the WTC is below saturation in major Na salts (See Table 3, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	A process test is being performed in accordance with a test plan (Herting 1998). The test will determine viscosity of the undiluted WTC and at a 50% dilution ratio over the temperatures of 25, 45, and 65 °C. A process test is being performed in accordance with a test plan (Herting 1998). The largest observed quantity of settled solids for WTC dilution of 50% at temperatures of 25, 45, and 65 °C at 48 hours after mixing will be determined. A process test is being performed in accordance with a test plan (Herting 1998). The test will determine the liquid phase density for WTC dilution of 50% performed at temperatures of 25, 45, and 65 °C.	Determine viscosity, SpG, suspended solids (See Table 3, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at temperatures of 25, 45, and 65 °C will be observed for solid formation. Special Consideration: If gibbsite will form, it should form within four weeks.	Determine solid formation, if any (See Table 3, Item # 4).

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AW-101 would dissolve. A process test is being performed in accordance with a test plan (Herting 1998). Amount of undissolved solids is being determined at 50 % dilution for temperature of 45 °C. During the test, amount of time needed to dissolve the sample will be recorded	Amount of undissolved solids and the amount of time needed to dissolve the solids (See Table 3, Item # 5).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test is being performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data have not been performed. The base case time allocated in the TWRSO&UP (Kirkbride et al. 1997, Assumption 6.11) for settling is taken by reference from (Certa et al. 1996) and is 30 days.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale. (See Table 3, Item # 6).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-AW-101 contains about 30% by weight of a salt slurry. (Field et al. 1998). The base case operating scenario targets most of the sodium in the salt slurry for feed. The equipment required to mobilize and retrieve the slurry includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997). Retrieval equipment to be added to 241-AW-101 will accomplish requirements.	No further information is needed.

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>	<p>Only Envelope A limits apply to Batch 3.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3)) compared the point estimates¹ of the composition of the feed from 241-AW-101 to the Envelope A limits. All analytes were below 80% of their maximum limits.</p>	<p>Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 7).</p> <p>A statistical evaluation of the data from 241-AW-101 is required to evaluate envelope limits (Table 3, Item #16)</p>
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During Herting's process test [Na] will be measured.</p>	<p>[Na] measurement (See Table 3, Item # 8).</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>Herting (1998) will measure the quantity of solids for WTC dilution of 50% at temperature of 45 °C.</p>	<p>Insoluble solids measurement (See Table 3, Item # 9).</p>

¹These point estimates were based on the best basis inventory for 241-AW-101. Sample data were used to estimate the liquid phase composition of the diluted waste.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements (continued)</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference).</p> <p>See Section 2.0, Tables 3 (in main report).</p>	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 3. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 3, decayed to the estimated time of delivery. The estimated total heat generation rate for Batch 3 from Field et al. (1998) is 33,200 BTU/hr. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch. This value is well within the maximum limit of 70,000 BTU/hr.</p> <p>Conformance with OSD factors achieved.</p>	<p>No further information is needed.</p>
	<p>Maximum ¹³⁷Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).</p>	<p>This limit is equivalent to 1.59E+06 μCi/L. The OSD limit of 5.74E+05 μCi/L is more restrictive.</p> <p>Using the best basis inventory and reported volume for 241-AW-101 from Field et al. (1998), the bulk [¹³⁷Cs] is calculated to be 4.63E+05 μCi/L and [⁹⁰Sr] is 1.26E+03 μCi/L. These are both well below the OSD limits of 5.74E+05 μCi/L and 4.04E+05 μCi/L, respectively. This is a conservative comparison since the dilution has not been accounted for in the above estimates.</p> <p>Conformance with maximum ¹³⁷Cs concentration achieved.</p>	<p>No further information is needed.</p>

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 3 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	Field et al. (1998) estimates the total sodium present in 241-AW-101 to be approximately 1,070 MT. During Herting's process test, amount of Na recoverable will be measured at the quantified dilution ratio, or using the base case 50% dilution.	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	Determine Na quantity (See Table 3, Item # 10).
	PHMC desired batch size (from Operating Scenario): 535 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above.	Determine Na quantity (See Table 3, Item # 10).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Field et al (1998): 241-AW-101 has approximately 7.6 m (24.8 ft) of supernate which is compositionally homogenous. There is an irregular crust volume, however it is anticipated that the crust will dissolve during dilution. There are approximately 2.8 m (9.3 ft) of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining in 241-AP-102 and -104 from previous batches are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 3	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	(a) As applied to supernate composite: This information is being obtained per Herting's process test (1998).	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 11)
		(b) As applied to salt slurry composite: A process test is being performed (Herting 1998). The test plan was based on instruction provided by the Disposal Program (Garfield 1997).	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 11)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 12).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 12).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 13).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test is being performed (Herting 1998).	See requirement (See Table 3, Item # 13).

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements are Satisfied (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	A process test is being performed (Herting 1998).	Precipitation at 0,40, 80, and 120 % dilution (See Table 3, Item # 14).
Element 3, Dissolution Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AW-101 would dissolve. A process test is being performed (Herting 1998).	Amount of soluble solids and amount of time required to dissolve soluble solids (See Table 3, Item # 15).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test is being performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data have not been performed.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale (See Table 3, Item #14).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	The alternative case uses the same retrieval equipment as the base case. See base case evaluation for details. Retrieval equipment to be added to AW-101 will accomplish requirements.	No further information is needed.
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Only Envelope A limits apply to Batch 3. In the alternative case, the composition of the waste staged in 241-AP-102 and -104 is almost identical to that of the base case. There will be differences in absolute concentration due to differences in the total amount of dilution, but this will not affect the [analyte]:[Na] values. There will also be differences due to slightly different extent of solids dissolution, but these will be bounded by the proposed statistical evaluation for the base case.	Chemical and radionuclide analyses from Herting's tests (See Table 3, Items # 7 and #16).

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Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements (Continued)</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>Since the supernate dilution ratio was not established, the resulting [Na] in the Batch cannot be directly determined. A process test is being performed (Herting 1998).</p> <p>The sodium concentration for the feed batch can be adjusted in the intermediate feed staging tanks.</p> <p>Compliance with Na molarity achieved.</p>	<p>Sodium concentration values for the supernate and solids after dilution must be established. (Item #7) Statistical evaluation of data is needed. (Item #16)</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>In the alternative case, the only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue.</p> <p>Compliance with insoluble fraction will be resolved as encountered during operations.</p>	<p>No further information is needed.</p>
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).</p>	<p>Mass balances have not been performed on the alternative case operating scenario to estimate the composition of the staged feed batch (these can be done explicitly after the supernate dilution ratio has been determined. Bounding calculations can be performed, however it is simpler to wait for the dilution ratio.</p>	<p>Estimated composition of the staged feed (See Table 3, Item # 17).</p>
	<p>Maximum ^{137}Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).</p>	<p>This limit is equivalent to $1.59\text{E}+06 \mu\text{Ci/L}$.</p> <p>Using the best basis inventory and reported volume for 241-AW-101 from Field et al. (1998), the bulk ^{137}Cs is calculated to be $4.63\text{E}+05 \mu\text{Ci/L}$. This is well below the OSD limit of $1.59\text{E}+06 \mu\text{Ci/L}$. This is a conservative comparison since dilution has not been included.</p> <p>Conformance with maximum ^{137}Cs achieved.</p>	<p>No further information is needed.</p>
	<p>The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B</p>	<p>These discriminators do not apply to Batch 3 (Envelope A).</p> <p>No concern about distinguishing between envelopes.</p>	<p>No further information is needed.</p>

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	Field et al. (1998) estimates the total sodium present in 241-AW-101 to be approximately 1,070 MT. During Herting's process test, amount of Na recoverable will be measured.	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 535 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity will be resolved administratively or by shimming.	No further information is needed.
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Field et al (1998): 241-AW-101 has approximately 7.6 m (24.8 ft) of supernate which is compositionally homogenous. There are approximately 2.8 m (9.3 ft) of settled solids. There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining in 241-AP-102 and -104 from previous batches are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 3	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3 was developed jointly by TWRs Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis, and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	A process test is being performed	None
2	Confirm a dilution ratio of 50% by volume for the WTC is below saturation in major Na salts	A process test is being performed	None
3	Determine viscosity, SpG, suspended solids	A process test is being performed	None
4	Determine solid formation, if any	A process test is being performed	None
5	Amount of undissolved solids and the amount of time needed to dissolve the solids	A process test is being performed	None
6	Estimate time to settle undissolved solids at full scale	Engineering calculations: no additional tests required	None
7	Chemical and radionuclide analyses from Herting's test	A process test is being performed	None
8	[Na] measurement	A process test is being performed	None
9	Insoluble solids measurement	A process test is being performed	None
10	Determination of Na quantity	A process test is being performed	None

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
11	Desired dilution ratio and diluent composition for a representative sample of supernate.	Calculate from results of Item #12 and ESP. No additional tests required.	None
12	Confirm as-retrieved waste remains below saturation in major NA salts during transfer.	Performing lab test: measure %solids vs. temp for supernate at 25, 45 and 65 °C under 3 conditions: undiluted, 10% diluted and 20% diluted.	None
13	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	SpG, viscosity and %Solids are being measured.	None
14	Precipitation at 0, 40, 80, and 120 % dilutions	Process testing is being performed at these dilutions.	None
15	Amount of soluble solids and amount time needed to dissolve soluble solids.	A process test is being performed.	None
16	Concentrations and uncertainties for diluted supernate and solids.	Statistical analysis of data from dilution studies.	None
17	Estimate composition of staged feed.	Can be calculated from existing data after item #11 is resolved.	None

There are seventeen items that have been flagged in Tables 1 and 2 requiring further information. All items are being addressed by a specific process test with specific material from 241-AW-101. There are no other information needs requiring either an analysis of an existing 241-AW-101 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AW-101 is appropriate for Batch 3.

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ADDENDUM 4

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AN-103 / BATCH 4

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
M	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
USQ	Unreviewed Safety Question
WIT	Waste Disposal Integration Team
WTC	Whole tank composite

APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AN-103 / BATCH 4

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" problem-specific data quality objectives (PSDQO) to tank 241-AN-103 / Batch 4.

This application of the DQO is divided into a Base Case Operating Scenario and an Alternative Case Operating Scenario. The Base Case homogenizes the waste in tank 241-AN-103 by mixing prior to transfer to 241-AP-102 and -104. The Alternative Case transfers the tank 241-AN-103 supernate to 241-AP-102 and -104 without mixing followed by subsequent diluent addition and mixing in 241-AN-103 before transfer to 241-AP-102 and -104.

2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 4:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel behind in each tank.
- Homogenize the waste in 241-AN-103 using mixer pumps to resuspend the salt slurry.
- Transfer half of the homogenized waste in 241-AN-103 to 241-AP-102 and the remaining half to 241-AP-104, leaving a 0.1 ML (10-in.) heel. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow undissolved solids to settle.

The heel remaining in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue. Furthermore, diluted Batch 3 waste will be within Envelope A specifications, and mixing wastes from different tanks/batches within the defined specifications should not have an adverse effect on operations.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) of 241-AN-103 over the temperature of 45 °C.

Element 2, Transfer Requirements: there are two nearly identical transfers; they will be treated as one transfer. Transfer requirements apply to a whole tank composite of the waste currently in 241-AN-103 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: the mixing requirement applies to a salt slurry composite of the waste currently in 241-AN-103 over the temperature of 45 °C.

Element 4, Envelope Requirements: there is one unique Batch 4 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AN-103 after addition of the proper amount of diluent over the temperature of 45 °C. The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: These inputs apply to the whole tank composition of 241-AN-103 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-AN-103 / Batch 4 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

2.2 ALTERNATIVE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on

consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 4 are listed below:

- Empty 241-AP-102 and -104 (the feed staging tanks) leaving a 0.1 ML (10-in.) heel behind in each tank.
- Decant the supernate in 241-AN-103; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.
- Add diluent to the salt slurry in 241-AN-103 and mix.
- Allow undissolved solids to settle in 241-AN-103.
- Transfer half of the liquid in 241-AN-103 to 241-AP-102 and the remaining to 241-AP-104, leaving a 10-in. heel. No additional diluent is expected to be needed for the transfer.
- Mix the waste in 241-AP-102 and mix the waste in 241-AP-104.
- Allow any undissolved solids that were inadvertently entrained to settle in 241-AP-102 and -104.

The heel remaining in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue. Furthermore, diluted Batch 3 waste will be within Envelope A specifications, and mixing wastes from different tanks/batches within the defined specifications should not have an adverse effect on operations.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to (a) a supernate composite from 241-AN-103 and (b) a salt slurry composite from 241-AN-103, both over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: out of four transfers, there are two distinct transfers. The transfer requirements applies to (a) supernate composite from 241-AN-103 after addition of the proper amount of diluent and (b) a salt slurry composite from 241-AN-103 after addition of the proper amount of diluent and settling of undissolved solids over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: the dissolution requirements applies to the whole tank composite of the waste currently in 241-AN-103 over the temperature range of 25 to 65 °C.

Element 4, Envelope Requirements: there is one unique Batch 4 composition; the composition and physical properties are that of a whole tank composite of the waste currently in 241-AN-103 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: these inputs apply to the whole tank composition of 241-AN-103 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 2 contains the evaluation of the alternative case operating scenario for all the elements of the decision rule found in Section 6 of the DQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 4.0 of the DQO. For each element, the requirements specific to 241-AN-103 / Batch 4 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 3.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A process test will be performed in accordance with a test plan (Herting 1998). The test plan is based on instruction provided by the Disposal Program (Garfield 1997). The whole tank composite (WTC) results of this test apply to the Base case operating scenario. Dilution tests will be limited to one temperature (45 °C), which was the baseline temperature of the 105-AN sample tests.</p> <p>Dilution ration and Diluent composition will be established.</p>	Desired dilution ratio and diluent composition (See Table 3, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test will be performed in accordance with a test plan (Herting 1998).	Confirm a dilution ration of 50 % for the WTC is below saturation in major Na salts (See Table 3, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>A process test will be performed in accordance with a test plan (Herting 1998). The test will determine viscosity of the undiluted WTC and at a 50 % dilution ratio over the temperatures of 25, 45, and 65 °C.</p> <p>A process test will be performed in accordance with a test plan (Herting 1998). The largest observed quantity of settled solids for WTC dilution of 50 % at temperatures of 25, 45, and 65 °C at 48 hours after mixing will be determined.</p> <p>A process test will be performed in accordance with a test plan (Herting 1998). The test will determine the liquid phase density for WTC dilution of 50 % performed at temperatures of 25, 45, and 65 °C.</p>	Determine viscosity, SpG, suspended solids (See Table 3, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	<p>An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at temperatures of 25, 45, and 65 °C will be observed for solid formation.</p> <p>Special Consideration: If gibbsite will form, it should form within four weeks.</p>	Determine solid formation, if any (See Table 3, Item # 4).

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-103 would dissolve. A process test will be performed in accordance with a test plan (Herting 1998). Amount of undissolved solids will be determined at 50 % dilution for temperature of 45 °C. During the test, amount of time needed to dissolve the sample will be recorded	Amount of undissolved solids and the amount of time needed to dissolve the solids (See Table 3, Item # 5).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test will be performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data have not been performed. The base case time allocated in the TWRSO&UP (Kirkbride et al. 1997, Assumption 6.11) for settling is taken by reference from (Certa et al. 1996) and is 30 days.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale. (See Table 3, Item # 6).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-AN-103 contains about 48% by weight of a salt slurry. (Wilkins 1997). The base case operating scenario targets most of the sodium in the salt slurry for feed. The equipment required to mobilize and retrieve the slurry includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997). Retrieval equipment to be added to 241-AN-103 will accomplish requirements.	No further information is needed.

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p>	<p>Only Envelope A limits apply to Batch 4.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3)) compared the point estimates¹ of the composition of the feed from 241-AN-103 to the Envelope limits. All analytes were below 80% of their maximum limits.</p>	<p>Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 7).</p>
	<p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>		
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During Herting's process test [Na] will be measured.</p>	<p>[Na] measurement (See Table 3, Item # 8).</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>Herting (1998) will measure the quantity of solids for WTC dilution of 50% at temperature of 45 °C.</p>	<p>Insoluble solids measurement (See Table 3, Item # 9).</p>

¹These point estimates were based on the best basis inventory for 241-AN-103. A thermodynamic model (ESP) was used to estimate the liquid phase composition of the diluted waste.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (PHMC 1996). See Section 2.0, Table 3 (in main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 4. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 4, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 4 is 11,500 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimated the total heat load in 241-AN-103 (Wilkins 1997) to be 10,600 W (36,300 BTU/hr). This estimate is also well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors achieved.</p>	No further information is needed.
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>Using the best basis inventory and reported volume for 241-AN-103 from Wilkins (1997), the bulk [137Cs] is calculated to be 7.3E5 μCi/L and [90Sr] is 2,540 μCi/L. [90Sr] is well below the OSD limit of 4.04E5 μCi/L. However, [137Cs] is above 5.74E5 μCi/L and is "flagged." This is a conservative comparison since the 50 % dilution has not been accounted for in the above estimates.</p> <p>Conformance with maximum [90Sr] concentration achieved.</p>	Radionuclide analyses from Herting's tests (See Table 3, Item # 7)

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 4 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During Herting's process test, amount of Na recoverable will be measured at 50 % dilution ratio	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	Determine Na quantity (See Table 3, Item # 10).
	PHMC desired batch size (from Operating Scenario): 585 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above.	Determine Na quantity (See Table 3, Item # 10).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Wilkins (1997): 241-AN-103 has a noncontinuous floating crust layer that may be up to 43 cm (17 in) thick. The layer is easily penetrated and is composed of easily dissolvable salts. There is approximately 4.6 m (15 ft) of supernate which is compositionally homogenous. There are approximately 3.8 m (12.4 ft) of settled solids. There could be hard pan at the bottom.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 4	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	(a) As applied to supernate composite: Liquid samples will be diluted 10% and 20% by volume with water. This information will be obtained per Herting's process test (1998).	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 11)
		(b) As applied to salt slurry composite: A process test will be performed (Herting 1998). The test plan was based on instruction provided by the Disposal Program (Garfield 1997). The settled solid samples will be diluted 0, 40, 80, and 120 % by volume with water.	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 3, Item # 11)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test will be performed (Herting 1998).	See requirement (See Table 3, Item # 12).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test will be performed (Herting 1998).	See requirement (See Table 3, Item # 12).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	(a) As applied to supernate composite with proper amount of diluent added: A process test will be performed (Herting 1998).	See requirement (See Table 3, Item # 13).
		(b) As applied to salt slurry composite with proper amount of diluent added: A process test will be performed (Herting 1998).	See requirement (See Table 3, Item # 13).

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements are Satisfied (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	A process test will be performed (Herting 1998).	Precipitation at 0,40, 80, and 120 % dilution (See Table 3, Item # 14).
Element 3, Dissolution Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	The Base case operating scenario (Kirkbride et al. 1997) assumed that the majority of the solids in 241-AN-103 would dissolve. A process test will be performed (Herting 1998).	Amount of soluble solids and amount of time required to dissolve soluble solids (See Table 3, Item # 15).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	A process test will be performed to determine settling rate for the undissolved solids. Scale-up calculations for Herting's settling data have not been performed.	Settling rate for the undissolved solids. Estimated time to settle undissolved solids at full scale (See Table 3, Item # 16).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	The alternative case uses the same retrieval equipment as the base case. See base case evaluation for details. Retrieval equipment to be added to AN-104 will accomplish requirements.	No further information is needed.
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Only Envelope A limits apply to Batch 4. In the alternative case, the composition of the waste staged in 241-AP-102 and -104 is almost identical to that of the base case. There will be differences in absolute concentration due to differences in the total amount of dilution, but this will not affect the [analyte]:[Na] values. There will also be differences due to slightly different extent of solids dissolution.	Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 17).

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Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	During Herting's process test [Na] will be measured.	Chemical and radionuclide analyses from Herting's tests (See Table 3, Item # 17).
	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	In the alternative case, the only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue. Compliance with insoluble fraction will be resolved by case during operations.	No further information is needed.
	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	Mass balances have not been performed on the alternative case operating scenario to estimate the composition of the staged feed batch (these can be done explicitly after the supernate dilution ratio has been determined. Bounding calculations can be performed, however it is simpler to wait for the dilution ratio.	Estimated composition of the staged feed (See Table 3, Item # 18).
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	This limit is equivalent to 1.59E6 $\mu\text{Ci/L}$. The OSD limit of 5.74E5 $\mu\text{Ci/L}$ is more restrictive. Using the best basis inventory and reported volume for 241-AN-103 from Wilkins (1997), the bulk [137Cs] is calculated to be 7.3E5 $\mu\text{Ci/L}$ and [90Sr] is 2,540 $\mu\text{Ci/L}$. [90Sr] is well below the OSD limit of 4.04E5 $\mu\text{Ci/L}$. However, [137Cs] is above 5.74E5 $\mu\text{Ci/L}$ and is "flagged." This is a conservative comparison since the 50 % dilution has not been accounted for in the above estimates. Conformance with maximum [90Sr] concentration achieved.	Radionuclide analyses from Herting's tests (See Table 3, Item # 17)
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 4 (Envelope A). No concern about distinguishing between envelopes.	No further information is needed.

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Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During Herting's process test, amount of Na recoverable will be measured.	Determine Na quantity (See Table 3, Item # 17).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 585 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity requirements will be resolved administratively or by shimming.	No further information is needed.
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Wilkins (1997): 241-AN-103 has a noncontinuous floating crust layer that may be up to 43 cm (17 in) thick. The layer is easily penetrated and is composed of easily dissolvable salts. There is approximately 4.6 m (15 ft) of supernate which is compositionally homogenous. There are approximately 3.8 m (12.4 ft) of settled solids. There could be hard pan at the bottom.	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 4	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed
	Heating and Cooling Curves	Perform a process test (Herting 1998) to generate heating and cooling curves with whole tank composite.	Determine heating and cooling curves (See Table 3, Item # 19).

^aElements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	A process test will be performed	500 mL of 241-AN-103
2	Confirm a dilution ratio of 50% for the WTC is below saturation in major Na salts	A process test will be performed. Sample from Item 1 should be used.	None.
3	Determine viscosity, SpG, suspended solids	A process test will be performed. Samples from Item #1 should be used.	None.
4	Determine solid formation, if any	A process test will be performed	None.
5	Amount of undissolved solids and the amount of time needed to dissolve the solids	A process test will be performed	None
6	Estimate time to settle undissolved solids at full scale	Engineering calculations: no additional tests required	None
7	Chemical and radionuclide analyses from Herting's test	Samples from the process test will be used.	None
8	[Na] measurement	Data from Item #1 should be used.	None
9	Insoluble solids measurement	A process test will be performed. Samples from Item #1 should be used.	None
10	Determination of Na quantity	Data from Item #1 should be used.	None

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
11	Desired dilution ratio and diluent composition for a representative sample of supernate.	Process testing will be performed.	500 mL of 241-AN-103
12	Confirm as-retrieved waste remains below satn in major Na salts during transfer.	Performing lab test: measure %solids vs. temp for supernate at 25, 45 and 65 °C under 3 conditions: undiluted, 10% diluted and 20% diluted. Samples from Item #11 should be used.	None
13	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	SpG, viscosity and %Solids are being measured. Samples from Item #11 should be used.	None
14	Precipitation at 0, 40, 80, and 120 % dilutions	Process testing will be performed at these dilutions.	None
15	Amount of soluble solids and amount time needed to dissolve soluble solids.	A process test will be performed.	None
16	Estimate time to settle undissolved solids at full scale	Engineering calculations: no additional tests required	None
17	Chemical and radionuclide analyses from Herting's test	Samples from the process test will be used.	None
18	Estimate composition of staged feed.	Can be calculated from existing data after item #11 is resolved.	None
19	Establish heating and cooling curve.	Process test (Herting 1998) to generate heating and cooling curves with whole tank composite.	500 mL

There are 19 items that have been flagged in Tables 1 and 2 requiring further information. All items are being addressed by a specific process test with specific material from 241-AN-103. There are no other information needs requiring either an analysis of an existing 241-AN-103 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AN-103 is appropriate for Batch 4.

3.0 REFERENCES

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ADDENDUM 5

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AZ-101 AND 241-AZ-102 / BATCH 5

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
<u>M</u>	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TSC	Tank Supernate Composite
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
USQ	Unreviewed Safety Question
WIT	Waste Disposal Integration Team
WTC	Whole tank composite

**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AZ-101 & 241-AZ-102 /
BATCH 5**

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" problem-specific data quality objectives (PSDQO) to tank 241-AZ-101/241-AZ-102 / Batch 5.

This application of the DQO is divided into a Base Case Operating Scenario and an Alternative Case Operating Scenario. The Base Case evaporates the supernate in tanks 241-AZ-101/241-AZ-102 by in-tank evaporation prior to transferring to tank 241-AY-101. Subsequently, the waste in the tank 241-AY-101 will be transferred to tanks 241-AP-102 and -104. The Alternative Case transfers the supernate in tanks 241-AZ-101/241-AZ-102 to tank 241-AY-101 without in-tank evaporation. Subsequently, the waste in the tank 241-AY-101 will be transferred to tanks 241-AP-102 and -104.

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2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 5:

- Empty, flush, and empty 241-AP-102 and -104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.
- Mixer pump test in tank 241-AZ-101.
- In-tank evaporation of waste in 241-AZ-101/241-AZ-102 to 5M Na.
- Empty supernate from 241-AY-101 leaving supernate heel and sludge behind in each tank.
- Transfer supernate from 241-AZ-101 to 241-AY-101. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Transfer supernate from 241-AZ-102 to 241-AY-101 until 241-AY-101 is full. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Transfer supernate from 241-AY-101 to 241-AP-102 and -104.

The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the tank supernate composite (TSC) after evaporation of 241-AZ-101 and 241-AZ-102 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: There are three transfers; (1) transfer requirements apply to a TSC of the waste (after evaporation) in 241-AZ-101 to 241-AY-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C; (2) transfer requirements apply to a TSC of the waste (after evaporation) in 241-AZ-102 to 241-AY-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C; and (3) transfer requirements apply to blend of 241-AZ-101 and 241-AZ-102 in 241-AY-101 to 241-AP-102 and 241-AP-104 over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: N/A.

Element 4, Envelope and Quantity Requirements: there is one unique Batch 5 composition; the composition and physical properties are that of a whole tank blend of the waste which will be in 241-AY-101 (blend of AZ-101/102 diluted supernate and 241-AY-101 heel/sludge). The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: These inputs apply to the TSC of 241-AZ-101, 241-AZ-102, and blend of 241-AZ-101/102 diluted supernate with 241-AY-101 heel/sludge or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-AZ-101/241-AZ-102 / Batch 5 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

2.2 ALTERNATIVE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 5 are listed below:

- Empty, flush, and empty 241-AP-102 and -104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.

- Mixer pump test in tank 241-AZ-101.
- Empty supernate from 241-AY-101 leaving supernate heel and sludge behind in each tank.
- Transfer supernate from 241-AZ-101 to 241-AY-101. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Transfer supernate from 241-AZ-102 to 241-AY-101 until 241-AY-101 is full . During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Transfer supernate from 241-AY-101 to 241-AP-102 and -104.

The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the tank needs to be is an operational issue, not a “Confirm Tank T...” issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the TSC of 241-AZ-101 and 241-AZ-102 over the temperature of 45 °C.

Element 2, Transfer Requirements: There are three transfers; (1) transfer requirements apply to a TSC of the waste in 241-AZ-101 to 241-AY-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C; (2) transfer requirements apply to a TSC of the waste in 241-AZ-102 to 241-AY-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C; and 3) transfer requirements apply to blend of 241-AZ-101 and 241-AZ-102 in 241-AY-101 to 241-AP-102 and 241-AP-104 over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: N/A.

Element 4, Envelope and Quantity Requirements: there is one unique Batch 5 composition; the composition and physical properties are that of a whole tank blend of the waste which will be in 241-AY-101 (blend of AZ-101/102 diluted supernate and AY-101 heel/sludge). The dilute heel in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that the 241-AP-102 and -104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a “Confirm Tank T...” issue.

Element 5, Miscellaneous Inputs: These inputs apply to the TSC of 241-AZ-101, 241-AZ-102, and blend of 241-AZ-101/102 diluted supernate with 241-AY-101 heel/sludge or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 2 contains the evaluation of the alternative case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO. The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-AZ-101/241-AZ-102 / Batch 5 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 3.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A test plan, based on instruction provided by the Disposal Program (Garfield 1997), is need for process testing. The plan will obtain following information for AZ-101 TSC, AZ-102 TSC and AZ-101/102 TSC blends: a) amount of precipitation during evaporation to 5M Na; b) the minimum dilution ratio after evaporation which satisfies all transfer system requirements except for gibbsite formation; c) the maximum dilution ratio, beyond which gibbsite will form at temperature ranges 25 °C to 65 °C or based on allowable tank storage space consideration.</p> <p>Dilution ration and Diluent composition will be established.</p>	Desired dilution ratio and diluent composition (See Table 3, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	Confirm a dilution ration of 50% for the TSC is below saturation in major Na salts (See Table 3, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>A process test is needed. The test will determine viscosity of the undiluted TSCs, blend and at a 50% dilution ratio over the temperatures of 25, 45, and 65 °C.</p> <p>A process test is needed. The largest observed quantity of settled solids for TSCs and the blend dilution of 50% at temperatures of 25, 45, and 65 °C at 48 hours after mixing will be determined.</p> <p>A process test is needed. The test will determine the liquid phase density for TSCs and the blend dilution of 50% performed at temperatures of 25, 45, and 65 °C.</p>	Determine viscosity, SpG, suspended solids (See Table 3, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	<p>An extended storage (at least one month) of supernate sub-samples from the TSC dilution test at dilution ratio of 0, 40, 80, & 120% and temperatures of 25, 45, & 65 °C should be observed for solid formation.</p> <p>Special Consideration: If gibbsite will form, it should form within four weeks.</p>	Precipitation at 0,40, 80, & 120 % dilution ratios and at temperatures of 25, 45, & 65 °C(See Table 3, Item # 4).

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	N/A	N/A	N/A
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report).	Only Envelope B limits apply to Batch 5. The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates ¹ of the composition of the feed from 241-AZ-101/241-AZ-102 to the Envelope limits and “flagged” sulfate as requiring further examination for 241-AZ-102. The sulfate was at 111 % of the maximum limit of 0.07 gmole sulfate/gmole Na; few other analytes were below 80 % of their maximum limits. Most analytes are missing. The bulk supernate composition is needed.	Chemical and radionuclide analyses from tests (See Table 3, Item # 5).
	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	During a process test [Na] will be measured.	[Na] measurement (See Table 3, Item # 6).
	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	The contracts do not define how the volume percent insoluble solids will be measured. During the process test, measurement will made to measure the quantity of solids for TSC dilution of 50% at temperature of 45 °C.	Insoluble solids measurement (See Table 3, Item # 7).

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¹These point estimates were based on a thermodynamic model (ESP) which was used to estimate the liquid phase composition of the waste.

Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 5. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 5, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 5 is 25,400 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimates the heat load of supernate in 241-AZ-101(Hodgson 1995) to be 89,600 BTU/hr. From the tank characterization report, an estimated heat load in supernate in 241-AZ-102 (Ryan 1995) is 45,000 Btu/hr. Therefore the estimated heat generation rate for Batch 5 is 77,500 Btu/hr (assume only 25% of AZ-102 supernate transferred). This estimate is over the maximum limit. Comparing heat load of the feed from 241-AZ-101/241-AZ-102 to the Envelope limits the heat load is "flagged" as requiring further examination for 241-AZ-101/241-AZ-102. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors is not achieved. During the process testing, full analysis is needed for Envelope B including ¹³⁷Cs.</p>	During the process testing, full analysis is needed for Envelope B including ¹³⁷ Cs (See Table 3, Item # 8).

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of supernate in 241-AZ-101(Hodgson 1995) to be 1.59E6 μCi/L. From the tank characterization report, an estimated ¹³⁷Cs concentration in supernate in 241-AZ-102 (Ryan 1995) 8.6E5 μCi/L. Therefore the estimated ¹³⁷Cs concentration for Batch 5 is 1.42E6 μCi/L. This estimate is over the maximum limit. Comparing ¹³⁷Cs concentration of the feed from 241-AZ-101/241-AZ-102 to the OSD limit the ¹³⁷Cs concentration is "flagged" as requiring further examination for 241-AZ-101/241-AZ-102. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>The tank characterization report estimates the ⁹⁰Sr concentration of supernate in 241-AZ-101(Hodgson 1995) to be 1,200 μCi/L. From the tank characterization report, an estimated ⁹⁰Sr concentration in supernate in 241-AZ-102 (Ryan 1995) 1,450μCi/L. Therefore the estimated ⁹⁰Sr concentration for Batch 5 is 1,260 μCi/L. This estimate is well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors is not achieved. During the process testing, analysis is needed for ¹³⁷Cs.</p>	During the process testing, analysis is needed for ¹³⁷ Cs (See Table 3, Item # 8).
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.		
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	<p>The discriminator is sulfate for Batch 5 (Envelope B).</p> <p>Sulfate concentration is needed.</p>	Determine sulfate concentration (See Table 3, Item # 9).
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During process test, amount of Na recoverable will be measured at 50% dilution ratio	Determine Na quantity (See Table 3, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 250 MT Na.	Same as above.	Determine Na quantity (See Table 3, Item # 10).

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Table 1. Base Case Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements (Continued)	PHMC desired batch size (from Operating Scenario): 118 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above.	Determine Na quantity (See Table 3, Item # 10).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hanlon (1998): 241-AZ-101 has approximately 7.7 m (25.8 ft) of supernate which is compositionally homogenous. There are approximately 43 cm (17 in.) of sludge. 241-AZ-102 has approximately 7.2 m (23.5 ft) of supernate which is compositionally homogenous. There are approximately 96 cm (38 in.) of sludge	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-AY-101 need to be addressed. Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above.	Process test needed (see Table 3, Item #11)
	Shimming Batch 5	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A test plan, based on instruction provided by the Disposal Program (Garfield 1997), is need for process testing. The plan will obtain following information for AZ-101 TSC, AZ-102 TSC and AZ-101/102 TSC blends: a) the minimum dilution ratio which satisfies all transfer system requirements except for gibbsite formation; b) the maximum dilution ratio, beyond which gibbsite will form at temperature ranges 25 °C to 65 °C or based on allowable tank storage space consideration.</p> <p>Dilution ration and Diluent composition will be established.</p>	Desired dilution ratio and diluent composition(See Table 3, Item # 12)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	Confirm a dilution ration of 50% for the TSC is below saturation in major Na salts (See Table 3, Item # 13).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>A process test is needed. The test will determine viscosity of the undiluted TSCs, blend and at a 50% dilution ratio over the temperatures of 25, 45, and 65 °C.</p> <p>A process test is needed. The largest observed quantity of settled solids for TSCs and the blend dilution of 50% at temperatures of 25, 45, and 65 °C at 48 hours after mixing will be determined.</p> <p>A process test is needed. The test will determine the liquid phase density for TSCs and the blend dilution of 50% performed at temperatures of 25, 45, and 65 °C.</p>	Determine viscosity, SpG, suspended solids (See Table 3, Item # 14).

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Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements are Satisfied (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	An extended storage (at least one month) of supernate sub-samples from the TSC dilution test at dilution ratio of 0, 40, 80, & 120% and temperatures of 25, 45, & 65 °C should be observed for solid formation. Special Consideration: If gibbsite will form, it should form within four weeks.	Precipitation at 0,40, 80, & 120 % dilution ratios and at temperatures of 25, 45, & 65 °C (See Table 3, Item # 15).
Element 3, Mixing Requirements	N/A	N/A	N/A
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Only Envelope B limits apply to Batch 5. The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates ¹ of the composition of the feed from 241-AZ-101/241-AZ-102 to the Envelope limits and "flagged" sulfate as requiring further examination for 241-AZ-102. The sulfate was at 111% of the maximum limit of 0.07 gmole sulfate/gmole Na; Few other analytes were below 80% of their maximum limits. Most analytes are missing. The bulk supernate composition is needed.	Chemical and radionuclide analyses from precess testing (See Table 3, Item # 16).
	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	During a process test [Na] will be measured.	[Na] measurement (See Table 3, Item # 16).

¹These point estimates were based on a thermodynamic model (ESP) which was used to estimate the liquid phase composition of the waste.

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>During the process test, measurement will made to measure the quantity of solids for TSC dilution of 50% at temperature of 45 °C.</p>	Insoluble solids measurement (See Table 3, Item # 18).
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).</p>	<p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 5. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 5, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 5 is 25,400 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimates the heat load of supernate in 241-AZ-101(Hodgson 1995) to be 89,600 BTU/hr. From the tank characterization report, an estimated heat load in supernate in 241-AZ-102 (Ryan 1995) is 45,000 Btu/hr. Therefore the estimated heat generation rate for Batch 5 is 77,500 Btu/hr (assume only 25% of 241-AZ-102 supernate transferred). This estimate is over the maximum limit. Comparing heat load of the feed from 241-AZ-101/241-AZ-102 to the Envelope limits the heat load is "flagged" as requiring further examination for 241-AZ-101/241-AZ-102. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors is not achieved. During the process testing, full analysis is needed for Envelope B including ¹³⁷Cs.</p>	<p>During the process testing, full analysis is needed for Envelope B including ¹³⁷Cs.(See Table 3, Item # 19).</p>

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	This limit is equivalent to 1.59E6 μ Ci/L. The OSD limit of 5.74E5 μ Ci/L is more restrictive. The tank characterization report estimates the ¹³⁷ Cs concentration of supernate in 241-AZ-101(Hodgson 1995) to be 1.59E6 μ Ci/L. From the tank characterization report, an estimated ¹³⁷ Cs concentration in supernate in 241-AZ-102 (Ryan 1995) 8.6E5 μ Ci/L. Therefore the estimated ¹³⁷ Cs concentration for Batch 5 is 1.42E6 μ Ci/L. This estimate is over the maximum limit. Comparing ¹³⁷ Cs concentration of the feed from 241-AZ-101/241-AZ-102 to the OSD limit the ¹³⁷ Cs concentration is "flagged" as requiring further examination for 241-AZ-101/241-AZ-102. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.	During the process testing, analysis is needed for ¹³⁷ Cs. (See Table 3, Item #19.)
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.	The tank characterization report estimates the ⁹⁰ Sr concentration of supernate in 241-AZ-101(Hodgson 1995) to be 1,200 μ Ci/L. From the tank characterization report, an estimated ⁹⁰ Sr concentration in supernate in 241-AZ-102 (Ryan 1995) 1,450 μ Ci/L. Therefore the estimated ⁹⁰ Sr concentration for Batch 5 is 1,260 μ Ci/L. This estimate is well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch. Conformance with OSD factors is not achieved. During the process testing, analysis is needed for ¹³⁷ Cs.	
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 5 (Envelope A). No concern about distinguishing between envelopes.	Determine sulfate concentration.
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During the process test, amount of Na recoverable will be measured at 50% dilution ratio.	Determine Na quantity (See Table 3, Item # 17).

Table 2. Alternative Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied (continued)	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 250 MT Na.	Same as above.	Determine Na quantity (See Table 3, Item # 17).
	PHMC desired batch size (from Operating Scenario): 118 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above.	Determine Na quantity (See Table 3, Item # 17).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hanlon (1998): 241-AZ-101 has approximately 7.7 m (25.8 ft) of supernate which is compositionally homogenous. There are approximately 43 cm (17 inches) of sludge. 241-AZ-102 has approximately 7.2 m (23.5 ft) of supernate which is compositionally homogenous. There are approximately 96 cm (38 inches) of sludge.	No further information is needed
	Heel from prior batch remaining in staging tanks	10" supernate heels and sludge remaining in 241-AY-101 need to be addressed. Heels remaining from clean out of 241-AP-102 and -104 are addressed in Section 2.1 above	Process test needed. (See Table 3, Item 20)
	Shimming Batch 5	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	Perform lab test: Measure amount of precipitation during evaporation to 5M Na; measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate
2	Confirm a dilution ratio of 50% for the TSC and blend is below saturation in major Na salts	Perform lab test: to confirm that the as retrieved waste remain below saturation in major Na salts during the transfer to the staging tanks	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate
3	Determine viscosity, SpG, suspended solids	Perform lab test to determine viscosity, SpG, suspended solids	Use sample from Item #2.
4	Determine solid formation, if any	An extended storage of supernate sub-samples from the TSC dilution test at dilution ratio up to 120 % .	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate
5	Chemical and radionuclide analyses.	Measure the analytes in Section 2.0, Tables 1 and 2 (in main report) (Envelope B analytes). Determine the bulk supernate composition.	50 ml of blend
6	[Na] measurement	Measurement of [Na] can be obtained from item #5.	None
7	Confirm insoluble solids fraction limit will not exceed 5 volume %.	Measurement of solid in the blend.	50 ml of blend.
8	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from item #5.	None
9	Determine sulfate concentration as a discriminator for Envelope B.	Perform lab test; Analysis of sulfate can be obtained by results from item #5.	None

Table 3. Information Needs. (2 Sheets)

Item	Information need	Planned resolution	Sample required
10	Determination of Na quantity	Perform lab test; Analysis of Na can be obtained by results from item #5.	None
11	Determine the Chemical and radionuclide analyses of heel in 241-AY-101.	Perform lab test; Analysis of chemical and radionuclides for compatibility test.	50 ml of 241-AY-101 composite waste.
12	Desired dilution ratio and diluent composition for a representative sample of supernate.	Perform lab test: measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate.
13	Confirm as-retrieved waste remains below saturation in major NA salts during transfer.	Perform lab test: to confirm that the as retrieved waste remain below saturation in major Na salts during the transfer to the staging tanks	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate.
14	Confirm as-retrieved waste remains <10 cP, <1.5 SpG, and <30% solids during transfer.	Perform lab test to determine viscosity, SpG, suspended solids	None Use sample from Item 13.
15	Determine solid formation, if any.	An extended storage of supernate sub-samples from the TSC dilution test at dilution ratio up to 120 % .	250 ml 241-AZ-101 TSC, 250 ml 241-AZ-102 TSC, 241-AY-101 sludge, 241-AY-101 supernate.
16	Chemical and radionuclide analyses	Measure the analytes in Section 2.0, Tables 1 and 2 (in main report) (Envelope B analytes). Determine the bulk supernate composition	50 mls of blend.
17	[Na] measurement	Measurement of Na can be obtained from item # 16.	None
18	Confirm insoluble solids fraction limit will not exceed 5 volume %.	Measurement of % solid in the blend.	50 ml of blend.
19	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from item #16.	None
20	Determine the Chemical and radionuclide analyses of heel in 241-AY-101.	Perform lab test; Analysis of chemical and radionuclides from 241-AY-101 heel.	50 ml of 241-AY-101 composite waste

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There are 20 items that have been flagged in Tables 1 and 2 requiring further information. All items will be addressed by a specific process test with specific material from 241-AZ-101/241-AZ-102. There are no other information needs requiring either an analysis of an existing 241-AZ-101/241-AZ-102 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AZ-101/241-AZ-102 is appropriate for Batch 5.

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ADDENDUM 6

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AN-107 / BATCHES 6 AND 7

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
<u>M</u>	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
SC	Supernate Composite
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan

ADDENDUM 6

APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AN-107/BATCHES 6 AND 7

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" (Certa and Jo 1998) problem-specific data quality objectives (PSDQO) to tank 241-AN-107 / Batches 6 and 7.

This application of the DQO applies to transfers of the waste in the tank 241-AN-107 supernate to 241-AP-102 and 241-AP-104 without mixing.

2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This base case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batches 6 and 7 are listed below:

- Empty, flush, and empty 241-AP-102 and 241-AP-104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.
- Decant the supernate in 241-AN-107; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.

The heel remaining in 241-AP-102 and 241-AP-104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to a supernate composite (SC) from 241-AN-107 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements applies to supernate composite from 241-AN-107 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: NA

Element 4, Envelope Requirements: there is one unique composition for batch 6 and for batch 7; the composition and physical properties are that of a SC of the waste currently in 241-AN-107 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The dilute heel in 241-AP-102 and 241-AP-104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and 241-AP-104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: these inputs apply to the SC of 241-AN-107 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rule found in Section 6 of the DQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 4.0 of the DQO. For each element, the requirements specific to 241-AN-107 / Batches 6 and 7 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 2.

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	As applied to supernate composite: Liquid samples will be diluted 10% and 20% by volume with water. This information will be obtained per process test.	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 2, Item # 1)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	As applied to supernate composite with proper amount of diluent added: A process test will be performed.	See requirement (See Table 2, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	As applied to supernate composite with proper amount of diluent added: A process test will be performed.	See requirement (See Table 2, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	A process test will be performed.	Precipitation at 0, 40, 80, and 120 % dilution (See Table 2, Item # 4).
Element 3, Dissolution Requirements	NA	NA	NA
Element 4 - Part 1: Envelope Requirements	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Only Envelope C limits apply to Batches 6 and 7.	Chemical and radionuclide analyses from tests (See Table 2, Item # 5).

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements (continued)</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During process test [Na] will be measured.</p>	<p>Chemical and radionuclide analyses from 's tests (See Table 2, Item # 5).</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>The only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue.</p> <p>Compliance with insoluble fraction will be resolved by case during operations.</p>	<p>No further information is needed.</p>
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).</p>	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and 241-AP-104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batches 6 & 7. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batches 6 & 7, decayed to the estimated time of delivery. The estimated heat generation rate for Batches 6 & 7 are 4,900 and 8,300 BTU/hr, respectively. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimated the total heat load in 241-AN-107 (Jo 1996) to be 8,060 W (27,500 BTU/hr). This estimate is also well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors achieved.</p>	<p>Estimated composition of the staged feed (See Table 2, Item # 6).</p>

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Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 Ei10 Bq/liter (6 Ci/gal).	This limit is equivalent to 1.59E6 μ Ci/L. The OSD limit of 5.74E5 μ Ci/L is more restrictive. Using the best basis inventory and reported volume for 241-AN-107 from Jo (1996), the bulk [137Cs] is calculated to be 3.3E5 μ Ci/L and [90Sr] is 1.2E5 μ Ci/L. They are below the OSD limits of 5.74E5 μ Ci/L and 4.04E5 μ Ci/L, respectively. This is a conservative comparison since the dilution of waste has not been accounted for in the above estimates.	Radionuclide analyses from tests (See Table 2, Item # 5)
		Conformance with maximum [90Sr] concentration achieved.	
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batches 6 & 7 (Envelope C).	No further information is needed.
	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	No concern about distinguishing between envelopes. During process test, amount of Na recoverable will be measured.	Determine Na quantity (See Table 2, Item # 5).
Element 4 - Part 2: Quantity Requirements are Satisfied	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 119 and 272 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity requirements will be resolved administratively or by shimming.	No further information is needed.
	Physical form of Tank T contents	From Jo (1996): There are approximately 1.24 m (4.06 ft) of settled solids and approximately 8.5 m (28 ft).	No further information is needed
Element 5 - Miscellaneous Inputs	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and 241-AP-104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batches 6 and 7	No shimming is anticipated.	No further information is needed

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 5 - Miscellaneous Inputs (continued)	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed
	Decant level	During a sampling event determine the solid liquid interface.	Determine decant level (See Table 2, Item # 7).

^aElements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 2. Information Needs.

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition for a representative sample of supernate.	Process testing will be performed.	360 mL of supernate composite.
2	Confirm as-retrieved waste remains below satn in major Na salts during transfer.	Performing process test: measure %solids vs. temp for supernate at 25, 45, and 65 °C under 3 conditions: undiluted, 10% diluted and 20% diluted.	None. Use samples from Item #1.
3	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	SpG, viscosity and %Solids will be measured during the process test..	None. Use samples from Item #1.
4	Precipitation at 0, 40, 80, and 120 % dilutions	Process testing will be performed at these dilutions.	None. Use samples from Item #1.
5	Chemical and radionuclide analyses from process test	A process test will be performed.	None. Use samples from Item #1.
6	Estimate composition of staged feed.	Can be calculated from existing data after item #1 is resolved.	None. Use samples from Item #1.
7	Determine decant level.	Determine Wt. % solid for each level.	50 mls from each sample level.

There are seven items that have been flagged in Table 1 requiring further information. All items are being addressed by a specific process test with specific material from 241-AN-107. There are no other information needs requiring either an analysis of an existing 241-AN-107 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AN-107 is appropriate for Batches 6 and 7.

3.0 REFERENCES

- Certa, P. J., J. Jo, 1998, *Data Quality Objectives for TWRS Privatization Phase: 1 confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X*, HNF-1796, Rev. 1, Numatec Hanford Corporation, Richland, Washington.
- DOE-RL, 1996, TWRS Privatization, Contract Numbers DE-RP06-96RL13308 and 13309, U.S. Department of Energy, Richland, Washington.
- Jo, J., J. D. Franklin, D. J. Morris, and L. C. Amato, 1996, *Tank Characterization Report for Double-Shell Tank 241-AN-107*, WHC-SD-WM-ER-600, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Kirkbride, R. A., G. K. Allen, P. J. Certa, A. F. Manuel, R. M. Orme, L. W. Shelton, E. J. Slaathaug, R. S. Wittman, G. T. MacLean and D. L. Penwell, 1997, *Tank Waste Remediation System Operation and Utilization Plan*, HNF-SD-WM-SP-012, Rev. 0A, Vol. I and II, Numatec Hanford Corporation, Richland, Washington.
- PHMC, 1996, *Unclassified Operating Specification for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*, OSD-T-151-00007, Rev. H-18, Fluor Daniel Hanford, Richland, Washington.
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ADDENDUM 7

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH X”**

TO

241-AN-102 / BATCH 8

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LIST OF TERMS

DOE	U.S. Department of Energy
ICD	Interface Control Document
LAW	Low-Activity Waste
M	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
SC	Supernate Composite
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan

ADDENDUM 7**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH X" TO 241-AN-102 / BATCH 8****1.0 INTRODUCTION**

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X" (Certa and Jo 1998) problem-specific data quality objectives (PSDQO) to tank 241-AN-102 / Batch 8.

This application of the DQO applies to transfers of the waste in the tank 241-AN-102 supernate to 241-AP-102 and 241-AP-104 without mixing.

2.0 EVALUATION**2.1 BASE CASE OPERATING SCENARIO**

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This base case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 8 are listed below:

- Empty 241-AP-102 and 241-AP-104 (the feed staging tanks) leaving a dilute, 0.1 ML (10-in.) heel behind in each tank.
- Decant the supernate in 241-AN-102; transfer half of the supernate to 241-AP-102 and the remainder to 241-AP-104, leaving a 10-in. heel above the salt slurry. During these transfers diluent will be added to the waste at the pump inlet.

The heel remaining in 241-AP-102 and -104 can be neglected for the purposes of this PSDQO; how clean the staging tank needs to be is an operational issue, not a "Confirm Tank T..." issue. Furthermore, diluted Batch 8 waste will be within Envelope C specifications, and mixing wastes from different tanks/batches within the defined specifications should not have an adverse effect on operations.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to a supernate composite (SC) from 241-AN-102 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements applies to supernate composite from 241-AN-102 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Dissolution Requirements: NA

Element 4, Envelope Requirements: there is one unique composition for Batch 8 ; the composition and physical properties are that of a SC of the waste currently in 241-AN-102 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C. The dilute heel in 241-AP-102 and 241-AP-104 can be neglected for the purposes of this PSDQO (all current data strongly indicate that 241-AP-102 and 241-AP-104 heel will not interfere with staging the compositionally correct feed); how clean the tank needs to be is an operational issue, not a "Confirm Tank T..." issue.

Element 5, Miscellaneous Inputs: these inputs apply to the SC of 241-AN-102 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rule found in Section 6 of the DQO for Confirm Tank T. The table lists each element of the decision rule taken from Section 4.0 of the DQO. For each element, the requirements specific to 241-AN-102 / Batch 8 are listed. Each requirement is evaluated against existing data and remaining information needs are identified. The information needs are developed more fully in Table 2.

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	As applied to supernate composite: Liquid samples will be diluted 10% and 20% by volume with water. This information will be obtained per process test.	Desired dilution ratio and diluent composition for a representative sample of supernate (See Table 2, Item # 1)
Element 2, Transfer Requirements are Satisfied	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	As applied to supernate composite with proper amount of diluent added: A process test will be performed.	See requirement (See Table 2, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	As applied to supernate composite with proper amount of diluent added: A process test will be performed.	See requirement (See Table 2, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	A process test will be performed.	Precipitation at 0,40, 80, and 120 % dilution (See Table 2, Item # 4).
Element 3, Dissolution Requirements	NA	NA	NA

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>	<p>Only Envelope C limits apply to Batch 8.</p>	<p>Chemical and radionuclide analyses from tests (See Table 2, Item # 5).</p>
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During process test [Na] will be measured.</p>	<p>Chemical and radionuclide analyses from tests (See Table 2, Item # 5).</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>The only solids that should end up in the feed batch are those solids that are inadvertently entrained during the decant transfers. This is an operational issue, not a "Confirm Tank T..." issue.</p> <p>Compliance with insoluble fraction will be resolved by case during operations.</p>	<p>No further information is needed.</p>

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (in main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (in main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and 241-AP-104 with the Tank Composition (Tank Corrosion) specifications. All limits were not satisfied and adjustment is needed to satisfy the [OH] limit for Batch 8. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 8, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 8 is 7,600 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>The tank characterization report estimated the total heat load in 241-AN-102 (Jo 1996) to be 9,890 W (33,800 BTU/hr). This estimate is also well below the maximum limit. This estimate is conservative since it does not take into account the additional decay that will take place before delivery of the feed Batch.</p> <p>Conformance with OSD factors achieved.</p>	<p>Estimated composition of the staged feed (See Table 2, Item # 6).</p> <p>Determine amount of NaOH addition (See Table 2, Item # 7).</p>
	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>Using the best basis inventory and reported volume for 241-AN-102 from Jo (1996), the bulk [¹³⁷Cs] is calculated to be 3.8E5 μCi/L and [90Sr] is 7.4E4 μCi/L. They are below the OSD limits of 5.74E5 μCi/L and 4.04E5 μCi/L, respectively. This is a conservative comparison since the dilution of waste has not been accounted for in the above estimates.</p> <p>Conformance with maximum [90Sr] concentration achieved.</p>	Radionuclide analyses from tests (See Table 2, Item # 5)

Table 1. Base Case Operating Scenario Evaluation. (4 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	These discriminators do not apply to Batch 8 (Envelope C). No concern about distinguishing between envelopes.	No further information is needed.
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) $\geq$ 100 MT Na.	During process test, amount of Na recoverable will be measured.	Determine Na quantity (See Table 2, Item # 5).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 250 - 600 MT Na.	Same as above.	No further information is needed.
	PHMC desired batch size (from Operating Scenario): 477 MT Na (Kirkbride et al. 1997, Table 3.1-5)	Same as above. Na quantity requirements will be resolved administratively or by shimming.	No further information is needed.
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Jo (1996): There are approximately 0.82 m (2.7 ft) of settled solids and approximately 9.2 m (30 ft).	No further information is needed
	Heel from prior batch remaining in staging tanks	Heels remaining from clean out of 241-AP-102 and 241-AP-104 are addressed in Section 2.1 above.	No further information is needed
	Shimming Batch 8	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed
	Decant level	During a sampling event determine the solid liquid interface.	Determine decant level (See Table 2, Item # 8).

^aElements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 2. Information Needs.

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition for a representative sample of supernate.	Process testing will be performed.	350 mL of supernate composite.
2	Confirm as-retrieved waste remains below satn in major Na salts during transfer.	Performing process test: measure %solids vs. temp for supernate at 25, 45 and 65 °C under 3 conditions: undiluted, 10% diluted and 20% diluted.	None. Use samples from Item #1.
3	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	SpG, viscosity and %Solids will be measured during the process test..	None. Use samples from Item #1.
4	Precipitation at 0, 40, 80, and 120 % dilutions	Process testing will be performed at these dilutions.	None. Use samples from Item #1.
5	Chemical and radionuclide analyses from process test	A process test will be performed.	None. Use samples from Item #1.
6	Estimate composition of staged feed.	Can be calculated from existing data after item #1 is resolved.	None. Use samples from Item #1.
7	Determine amount of NaOH addition.	A process test will be performed.	50 mls supernate composite
8	Determine decant level.	Determine Wt. % solid for each level.	35 mls from each sample level.

There are eight items that have been flagged in Table 1 requiring further information. All items are being addressed by a specific process test with specific material from 241-AN-102. There are no other information needs requiring either an analysis of an existing 241-AN-102 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-AN-102 is appropriate for Batch 8.

3.0 REFERENCES

- Certa, P. J., J. Jo, 1998, *Data Quality Objectives for TWRS Privatization Phase: 1 confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X*, HNF-1796, Rev 1, Numatec Hanford Corporation, Richland, Washington.
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- Jo, J., J. G. Douglas, L. C. Amato, J. D. Franklin, and T. T. Tran, 1996, *Tank Characterization Report for Double-Shell Tank 241-AN-102*, WHC-SD-WM-ER-545, Rev 0, Westinghouse Hanford Company, Richland, Washington.
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- PHMC, 1996, *Unclassified Operating Specification for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*, OSD-T-151-00007, Rev H-18, Fluor Daniel Hanford, Richland, Washington.
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ADDENDUM 8

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH 10”**

TO

241-SY-101 / BATCH 10

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LIST OF TERMS

DOE	U.S. Department of Energy
DQO	Data quality objective
ICD	Interface Control Document
LAW	Low-Activity Waste
M	Molar (gmoles/liter)
M&I	Management and Integration
OSD	Operating Specification Document
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TRU	Transuranic
TSC	Tank Supernate Composite
TSCC	Tank Saltcake Composite
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
WTC	Whole tank composite

ADDENDUM 8

APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE FOR LOW-ACTIVITY WASTE FEED BATCH " TO 241-SY-101 / BATCH 10

1.0 INTRODUCTION

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch 10" problem-specific data quality objectives (PSDQO) to tank 241-SY-101 / Batch 10.

This application of the data quality objective (DQO) is divided into a Base Case Operating Scenario and two alternative case operating scenarios. The Base Case homogenizes the waste in tank 241-SY-101 by mixing prior to transfer to tank 241-SY-102. Alternative Case 1 transfers supernate from tank 241-SY-101 without mixing followed by diluent addition, mixing, and settling of any remaining solids prior to transfer to tank 241-SY-102. Alternative Case 2 involves mixing the waste from tank 241-SY-101 with waste from tank 241-SY-103 in tank 241-SY-102. The waste from each tank would be a well-mixed, and diluted to allow transfer within operational limits. In all three cases, compatibility with the transuranic solids in tank 241-SY-102 must be evaluated.

2.0 EVALUATION

2.1 BASE CASE OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 10:

- Empty supernate from 241-SY-102, leaving a 0.1-ML (10-in.) layer of supernate over the residual sludge layer. The supernate will be transferred cross-site into either tank 241-AN-102 or 241-AN-107 for eventual processing in 200 East Area.
- Homogenize the waste in 241-SY-101 using mixer pumps to resuspend the salt slurry.

- Transfer the homogenized waste in 241-SY-101 to 241-SY-102 until the receiver tank is full. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Repeat the above three steps as necessary until tank 241-SY-101 has been emptied.

Compatibility of the waste with the residual liquid in 241-SY-102 may need to be evaluated for the first transfer from 241-SY-101. Compatibility of 241-SY-101 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: There are several nearly identical transfers. They will be treated as one transfer. Transfer requirements apply to a WTC of the waste currently in 241-SY-101 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: Two sets of mixing requirements apply. The first mixing requirement apply to blend of the diluted WTC for 241-SY-101 with the initial supernate layer and the sludge in 241-SY-102 over the temperature range of 25 to 65 °C. After the first transfer, the residual supernate is assumed to be the diluted WTC from 241-SY-101. Therefore the second mixing requirement applies to the diluted WTC for 241-SY-101 and the sludge in 241-SY-102 over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 10 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-101. The two composites from the mixing study (element 3) should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the WTC of 241-SY-101 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo 1998). The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to 241-SY-101 Batch 10 are listed. Each requirement is evaluated against existing data and the

remaining information needs are identified. The information needs are summarized in Table 4.

2.2 ALTERNATIVE CASE 1 OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 10 are listed below:

- Empty supernate from 241-SY-102, leaving a 0.1-ML (10-in.) layer of supernate over the residual sludge layer. The supernate will be transferred cross-site into either tank 241-AN-102 or 241-AN-107 for eventual processing in 200 East Area.
- Decant supernate from tank 241-SY-101 to 241-SY-102. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Repeat the above two steps until all supernate has been pumped from 241-SY-101.
- Add diluent to the salt slurry in 241-SY-101 and mix.
- Allow undissolved solids to settle in 241-SY-101.
- Transfer the liquid to 241-SY-102, leaving a 10-in heel in 241-SY-101. No additional diluent is expected to be needed for the transfer. It may be necessary to periodically transfer waste cross-site from 241-SY-102 to create space for the transfer.

Compatibility of the waste with the residual liquid in 241-SY-102 may need to be evaluated for the first transfer from 241-SY-101. Compatibility of 241-SY-101 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the supernate composite and salt slurry composite of 241-SY-101 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: There are two types of transfers, supernate and salt slurry. The transfers should be evaluated over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: Two mixing scenarios must be evaluated. The first is the mixing of supernate with the liquid and the sludge remaining in 241-SY-102. The second is the mixing of diluted salt slurry with the sludge in 241-SY-102. Mixing studies should be carried out over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 10 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-101. The two composites from the mixing study above should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the supernate and salt slurry composites for 241-SY-101 or to changes in the operating scenario that may be imposed in the future.

Table 2 contains the evaluation of the alternative case 1 operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo). The table lists each element taken from Section 4.0 of the PSDQO (Certa and Jo). For each element, the requirements specific to 241-SY-101/Batch 10 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 4.

2.3 ALTERNATIVE CASE 2 OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 10 are listed below:

- Empty supernate from 241-SY-102, leaving a concentrated, 0.1-ML (10-in.) layer of supernate over the residual sludge layer. The supernate will be transferred cross-site into either tank 241-AN-102 or 241-AN-107 for eventual processing in 200 East Area.
- Homogenize the waste that is left in 241-SY-101 using mixer pumps to resuspend the salt slurry.
- Transfer the homogenized waste in 241-SY-101 to 241-SY-102. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.

- Homogenize the waste that is left in 241-SY-103 using mixer pumps to resuspend the salt slurry.
- Transfer the homogenized waste in 241-SY-103 to top off the tank 241-SY-102. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Pump the mixture of supernate waste from 241-SY-102 cross-site to 241-AN-102 or 241-AN-107, leaving a 0.1-ML (10-in) heel of supernate over the sludge in 241-SY-102.

Compatibility of the waste with the waste from 241-SY-101 to be evaluated for the first transfer from 241-SY-103. Compatibility of 241-SY-101 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the WTC of 241-SY-101 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: Two transfers need to be evaluated. The first is the transfer of the WTC of the waste in 241-SY-101 to SY-102. The second is the transfer of the WTC of the waste in 241-SY-103 to SY-102 when it contains 241-SY-101 waste. The transfers should be evaluated after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: The two transfer scenarios need to be evaluated while mixing with the sludge in 241-SY-102 over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 10 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-101 and 241-SY-103. The two composites from the mixing evaluation (Element 3) should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the WTC of 241-SY-101 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 3 contains the evaluation of the alternative case 2 operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo). The table lists each element taken from Section 4.0 of the PSDQO (Certa and Jo). For each element, the requirements specific to 241-SY-101/Batch 10 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 4.

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	A test plan, based on instruction provided by the Disposal Program (e.g. Garfield 1997), is needed for process testing. The plan will obtain the following information for the 241-SY-101 WTC. Required dilution ratio to prevent precipitation over the temperature range of 25 °C to 65 °C. Dilution ratio and diluent composition will be established.	Desired dilution ratio and diluent composition (See Table 4, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	Confirm that the diluted WTC is below saturation in major Na salts (See Table 4, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	A process test is needed. The test will determine viscosity, density, and quantity of settled solids for the undiluted WTC and various dilutions of the WTC at temperatures of 25, 45, and 65 °C.	Determine viscosity, SpG, suspended solids (See Table 4, Item # 3).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at various dilution ratios and temperatures of 25, 45, & 65 °C should be observed for solid formation. Special Consideration: If gibbsite will form, it should form within four weeks.	Precipitation at various dilution ratios and at temperatures of 25, 45, & 65 °C (See Table 4, Item # 4).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	Dissolution kinetics at various dilutions and temperatures needs to be measured.	Determine percent solids at various dilutions and temperatures as a function of time while mixing. (See Table 4, Item # 3).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	Observation of settling times at various dilutions and temperatures is needed.	Determine settling times at various dilutions and temperatures. (See Table 4, Item # 3).
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-SY-101 contains crust, convective, and non-convective layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).	No further information needed.

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p> <p>See Section 2.0 (Tables 1 and 2) of main report for the limits.</p>	<p>Either Envelope A or C limits will apply to Batch 10. The limits are identical except that the Envelope C limits for TOC, SO₄, TRU, and ⁹⁰Sr are higher.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates³ of the composition of the feed from 241-SY-101 to the Envelope C limits and indicate that the tank waste meets all criteria.</p>	<p>Chemical and radionuclide analyses from tests (See Table 4, Item # 5).</p>
	<p>Concentration limit for the sodium concentration of the feed: $3 \text{ M} \geq [\text{Na}] \geq 14 \text{ M}$ (DOE-RL 1996, Section C.6).</p>	<p>During process testing [Na] will be measured.</p>	<p>[Na] measurement (See Table 4, Item # 6).</p>
	<p>Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).</p>	<p>During the process test, the quantity of solids for various WTC dilutions will be measured over the temperature range of 25 to 65 °C.</p>	<p>Insoluble solids measurement (See Table 4, Item # 7).</p>

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (of main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0, Table 3 (of main report).</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 10. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 10, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 10 is approximately 5,500 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>Conformance with OSD factors is achieved for all known factors.</p>	During the process testing, full analysis is needed for Envelopes A and C, including ¹³⁷ Cs (See Table 4, Item # 8).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of 342 μCi/g (Herting et al. 1995). Clearly, the ¹³⁷Cs concentration will be well below the limit for this waste.</p> <p>The tank characterization report estimates the ⁹⁰Sr concentration in 241-SY-101 (Herting et. al. 1995) to be 19.3 μCi/L. Clearly, the ⁹⁰Sr concentration is well below the limit for this waste.</p> <p>Conformance with OSD factors is achieved.</p>	<p>Samples should be analyzed during process testing, but all indications are that the levels of ¹³⁷Cs and ⁹⁰Sr are well below the applicable limits (See Table 4, Item # 5).</p> <p>Determine SO₄, TOC, TRU, and ⁹⁰Sr concentrations (See Table 4, Item # 9).</p>
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.		
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	The discriminators for Envelopes A and C are SO ₄ , TOC, TRU, and ⁹⁰ Sr.	

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements	<p>Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.</p> <p>PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.</p> <p>PHMC desired batch 10 size (from Operating Scenario): 1,230 MT Na (Kirkbride et al. 1997, Table 3.1-5)</p>	During process testing, the amount of recoverable Na should be measured. The TCR puts the inventory of Na at $1.38\text{E}+\text{E}6$ kg. Note that some 241-SY-101 waste is planned for batch 11 as well.	Determine Na quantity (See Table 4, Item # 10).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Herting et al. (1995): 241-SY-101 has a crust layer of 0.54 m (1.76 ft). The convective layer is approximately 5.61 m (18.4 ft), and the non-convective layer is approximately 4.08 m (13.4 ft).	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area staging tanks may also need to be addressed.	Process test needed. (See Table 4, Item # 11).
	Shimming Batch 10	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed.

a. Elements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	Process testing of the supernate composite and of diluted salt slurry composite is needed at various dilutions over the temperature range of 25 °C to 65 °C.	Desired dilution ratio and diluent composition (See Table 4, Item # 12)
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste streams (including dilution water or caustic) remain below saturation in major Na salts during the transfer to the staging tank. The two streams are the supernate and salt slurry from the tank. Testing should be conducted at various dilutions and temperatures.	Confirm that the two streams are below saturation in major Na salts (See Table 4, Item # 13).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	Process testing of the supernate and salt slurry at various dilutions and temperatures is needed. Viscosity, specific gravity, and volume percent solids data are needed.	Determine viscosity, SpG, suspended solids (See Table 4, Item # 14).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	An extended storage (at least one month) of supernate and salt slurry subsamples from the dilution should be observed for solid formation over the temperature range of 25 to 65 °C. Special Consideration: If gibbsite will form, it should form within four weeks.	Precipitation at various dilution ratios over the temperature range of 25 to 65 °C (See Table 4, Item # 15).

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	Dissolution kinetics at various dilutions and temperatures needs to be measured. Note: Confirmation that a mixer pump can provide the necessary amount of mixing to dissolve the solids in the tank in a reasonable amount of time is within the scope of the Equipment Design PSDQO.	Determine percent solids at various dilutions and temperatures as a function of time while mixing (See Table 4, Item # 15).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	Observation of settling times at various dilutions and temperatures is needed.	Determine settling times at various dilutions and temperatures. See Table 4, Item # 15)
	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-SY-101 contains crust, convective, and non-convective layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).	No further information needed.

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 – Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).</p>	<p>Either Envelope A or C limits will apply to Batch 10. The limits are identical except that the Envelope C limits for TOC, SO₄, TRU, and ⁹⁰Sr are higher.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates¹ of the composition of the feed from 241-SY-101 to the Envelope C limits and indicate that the tank waste meets all criteria.</p>	<p>Chemical and radionuclide analyses from process testing (See Table 4, Item # 16).</p>
	<p>See Section 2.0, Tables 1 and 2 (in main report) for the limits.</p>		
	<p>Concentration limit for the sodium concentration of the feed: $3M \geq [Na] \leq 14M$ (DOE-RL 1996, Section C.6)</p>	<p>During process testing [Na] will be measured.</p>	<p>[Na] measurement (See Table 4, Item 17.)</p>
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (of main report).</p>	<p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the corrosion, criticality, TRU, heat generation, and flammable gas SpG specifications. All limits were satisfied for Batch 10. Nevertheless, the envelope analytes should be analyzed to confirm this prediction.</p> <p>Conformance with OSD factors is expected to be achieved.</p>	<p>During the process testing, full analysis is needed for Envelope A and C. (See Table 4, Item # 18).</p>

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¹These point estimates were based on a thermodynamic model (ESP) that was used to estimate the liquid phase composition of the waste.

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of 342 μCi/g (Herting et al. 1995). Clearly, the ¹³⁷Cs concentration will be well below the limit for this waste.</p>	<p>Samples should be analyzed during the process testing, but all indications are that the levels of ¹³⁷Cs and ⁹⁰Sr are well below applicable limits. (See Table 4, Item # 16).</p>
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.	<p>The tank characterization report estimates the ⁹⁰Sr concentration in 241-SY-101 (Herting et. al. 1995) to be 19.3 μCi/L. Clearly, the ⁹⁰Sr concentration is well below the limit for this waste.</p> <p>Conformance with OSD factors is achieved.</p>	
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	The discriminators for Envelopes A and C are SO ₄ , TOC, TRU, and ⁹⁰ Sr.	<p>Determine are SO₄, TOC, TRU, and ⁹⁰Sr concentrations. (See Table 4, Item # 16).</p>

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Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.	During process testing, the amount of recoverable Na should be measured. The TCR (Herting et al. 1995) puts the inventory of Na at $1.38\text{E}+ \text{E6}$ kg. Note that some 241-SY-101 waste is planned for batch 11 as well.	Determine Na quantity (See Table 4, Item # 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.		
	PHMC desired batch 10 size (from Operating Scenario): 1,230 MT Na (Kirkbride et al. 1997, Table 3.1-5)		
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Herting et al. (1995): 241-SY-101 has a crust layer of 0.54 m (1.76 ft). The convective layer is approximately 5.61 m (18.4 ft), and the non-convective layer is approximately 4.08 m (13.4 ft).	No further information is needed
	Heel from prior batch remaining in staging tanks	10" supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area tanks may also need to be addressed.	Process test needed (See Table 4, Item # 11).
	Shimming Batch 10	No shimming is anticipated.	No further information is needed

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 5 - Miscellaneous Inputs (continued)	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.0 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A test plan, based on instruction provided by the Disposal Program (e.g. Garfield 1997), is needed for process testing. The plan will obtain the following information for the 241-SY-101 WTC. Required dilution ratio to prevent precipitation over the temperature range of 25 °C to 65 °C.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Desired dilution ratio and diluent composition (See Table 4, Item # 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	<p>A process test is needed to confirm that the as-retrieved waste (WTC including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Confirm that the diluted WTC is below saturation in major Na salts (See Table 4, Item # 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>A process test is needed. The test will determine viscosity, density, and quantity of settled solids for the undiluted WTC and various dilutions of the WTC at temperatures of 25, 45, and 65 °C.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Determine viscosity, SpG, suspended solids (See Table 4, Item # 3).

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	<p>An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at various dilution ratios and temperatures of 25, 45, and 65 °C should be observed for solid formation.</p> <p>Special Consideration: If gibbsite will form, it should form within four weeks.</p>	Precipitation at various dilution ratios and at temperatures of 25, 45, & 65 °C (See Table 4, Item # 4).
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	<p>Dissolution kinetics at various dilutions and temperatures needs to be measured.</p> <p>Note: Confirmation that a mixer pump can provide the necessary amount of mixing to dissolve the solids in the tank in a reasonable amount of time is within the scope of the Equipment Design PSDQO.</p> <p>For this alternative, the waste will be combined with waste from 241-SY-103. Therefore, compatibility with the 241-SY-101 WTC is necessary.</p>	<p>Determine percent solids at various dilutions and temperatures as a function of time while mixing (See Table 4, Item # 19).</p> <p>Confirm compatibility with 241-SY-101 WTC (See Table 4, Item # 20).</p>

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	<p>Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.</p>	<p>Observation of settling times at various dilutions and temperatures is needed.</p>	<p>Determine settling times at various dilutions and temperatures (See Table 4, Item # 21).</p>
	<p>Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.</p>	<p>Tank 241-SY-101 contains crust, supernate, and salt slurry/sludge layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).</p>	<p>No further information needed.</p>

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).	<p>Either Envelope A or C limits will apply to Batch 10. The limits are identical except that the Envelope C limits for TOC, SO₄, TRU, and ⁹⁰Sr are higher.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates¹ of the composition of the feed from 241-SY-101 to the Envelope C limits and indicate that the tank waste meets all criteria.</p>	Chemical and radionuclide analyses from tests (See Table 4, Item # 22).
	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \geq [\text{Na}] \geq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	During process testing [Na] will be measured.	[Na] measurement (See Table 4, Item # 22).
	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>During the process test, the quantity of solids for various WTC dilutions will be measured over the temperature range of 25 to 65 °C.</p>	Insoluble solids measurement (See Table 4, Item # 21).

¹These point estimates were based on a thermodynamic model (ESP) that was used to estimate the liquid phase composition of the waste.

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference). See Section 2.0, Table 3 (of main report).	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0 (Table 3) of main report.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 10. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 10, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 10 is approximately 5,500 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>Conformance with OSD factors is achieved for all known factors.</p>	During the process testing, full analysis is needed for Envelopes A and C, including ¹³⁷ Cs (See Table 4, Item # 22).

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of 342 μCi/g (Herting et al. 1995). Clearly, the ¹³⁷Cs concentration will be well below the limit for this waste.</p> <p>The tank characterization report estimates the ⁹⁰Sr concentration in 241-SY-101 (Herting et. al. 1995) to be 19.3 μCi/L. Clearly, the ⁹⁰Sr concentration is well below the limit for this waste.</p> <p>Conformance with OSD factors is achieved.</p>	Samples should be analyzed during process testing, but all indications are that the levels of ¹³⁷ Cs and ⁹⁰ Sr are well below the applicable limits (See Table 4, Item # 22).
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.		
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B.	The discriminators for Envelopes A and C are SO ₄ , TOC, TRU, and ⁹⁰ Sr.	
			Determine SO ₄ , TOC, TRU, and ⁹⁰ Sr concentrations (See Table 4, Item # 22).

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements (continued)	Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.	During process testing, the amount of recoverable Na should be measured. The TCR puts the inventory of Na at $1.38\text{E} + \text{E}6$ kg. Note that some 241-SY-101 waste is planned for Batch 11 as well.	Determine Na quantity (See Table 4, Item # 22).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.		
	PHMC desired batch 10 size (from Operating Scenario): 1,230 MT Na (Kirkbride et al. 1997, Table 3.1-5)		
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Herting et al. (1995): 241-SY-101 has a crust layer of 0.54 m (1.76 ft). The convective layer is approximately 5.61 m (18.4 ft), and the non-convective layer is approximately 4.08 m (13.4 ft).	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area staging tanks may also need to be addressed.	None, process test needed (See Table 4, Item # 11).
	Shimming Batch 10	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 4 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	Perform lab test: measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	300 ml SY-101 WTC.
2	Confirm a dilution ratio of 50% for the TCS and blend is below saturation in major Na salts	Perform lab test: to confirm that the as retrieved waste remain below saturation in major Na salts during the transfer to the staging tanks	None, sample from Item 1 can be used.
3	Determine viscosity, SpG, suspended solids	Perform lab test to determine viscosity, SpG, suspended solids	300 ml SY-101 WTC.
4	Determine solid formation, if any	An extended storage of supernate sub-samples from the Tank Supernate Composite (TSC) dilution test at dilution ratio up to 120%.	None, sample from Item 3 can be used.
5	Chemical and radionuclide analyses.	Measure the analytes in Section 2.0, Tables 1 and 2 (in main report) (Envelope C analytes). Determine the bulk supernate composition.	None, sample from Item 1 can be used.
6	[Na] measurement	Measurement of [Na] can be obtained from item #5.	None.
7	Confirm insoluble solids fraction limit will not exceed 5 volume %.	Measurement of solid in the blend. This data will be obtained during Item 1 testing.	None.
8	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from item #5.	None

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
9	Determine sulfate concentration as a discriminator for Envelope C.	Perform lab test; Analysis of sulfate can be obtained by results from item #5.	None
10	Determination of Na quantity	Perform lab test; Analysis of Na can be obtained by results from item #5.	None
11	Determine the Chemical and radionuclide analyses of heel in 241-SY-102.	Perform lab test; Analysis of chemical and radionuclides.	100 ml of SY-102 heel.
12	Desired dilution ratio and diluent composition for a representative sample of supernate and salt slurry.	Perform lab test: measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	300 ml SY-101 Tank Supernate Composite (TSC). 300 ml SY-101 tank saltcake composite (TSCC)
13	Confirm as-retrieved waste remains below satn in major NA salts during transfer.	Perform lab test: to confirm that the as retrieved waste remain below saturation in major Na salts during the transfer to the staging tanks. Will be determined in Item 12.	None.
14	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	Perform lab test to determine viscosity, SpG, suspended solids. Use sample from Item 12.	None.
15	Determine solid formation and solid settling time, if any.	An extended storage of supernate sub-samples from the TSC dilution test at dilution ratio up to 120 %. Use sample from Item 12	None.
16	Chemical and radionuclide analyses	Measure the analytes in Section 2.0 (Tables 1 and 2) of main report (Envelope C analytes). Determine the bulk supernate and diluted salt slurry composition.	None.
17	[Na] measurement	Measurement of Na can be obtained from item # 16.	None

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
18	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from item #16.	None.
19	Determine percent solids at various dilutions and temperatures as a function of time while mixing.	Perform lab test on mixed diluted SY-101 and SY-103 waste.	150 ml diluted SY-101 WTC and 150 ml diluted SY-103 WTC.
20	Confirm compatibility with SY-101	Perform process test; Mix diluted SY-101 with SY-103 WTC. During the lab test in Item # 19 confirm compatibility.	None.
21	Determine settling times.	During the lab test in Item # 19 confirm compatibility.	None.
22	Determine the Chemical and radionuclide analyses of dilute mixture of SY-101 and SY-103.	Measure the analytes in Section 2.0 (Tables 1 and 2) of main report (Envelope C analytes). Determine the bulk supernate and diluted salt slurry composition. Waste from Item 19 should be used.	None.

There are 22 items that have been flagged in Tables 1, 2, and 3 requiring further information. All items will be addressed by a specific process test with specific material from 241-SY-101. There are no other information needs requiring either an analysis of an existing 241-SY-101 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-SY-101 is appropriate for Batch 10.

3.0 REFERENCES

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ADDENDUM 9

APPLICATION OF

**“CONFIRM TANK T IS AN
APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE
FEED BATCH 11”**

TO

241-SY-103 / BATCH 11

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LIST OF TERMS

DOE	U.S. Department of Energy
DQO	Data quality objective
ICD	Interface Control Document
LAW	Low-Activity Waste
<u>M</u>	Molar (gmoles/liter)
PHMC	Project Hanford Management Contract(or)
PMBS	Project Master Baseline Schedule
PSDQO	Problem-Specific Data Quality Objectives
RL	U.S. Department of Energy-Richland Operations
TANK T	Refers to the contents from one tank, multiple tanks, or portions of one or more tanks that will be used to prepare a feed batch
TOC	Total Organic Carbon
TSC	Tank Supernate Composite
TWRS	Tank Waste Remediation System
TWRSO&UP	Tank Waste Remediation System Operation and Utilization Plan
WTC	Whole tank composite

ADDENDUM 9**APPLICATION OF "CONFIRM TANK T IS AN APPROPRIATE FEED SOURCE
FOR LOW-ACTIVITY WASTE FEED BATCH " TO 241-SY-103 / BATCH 11****1.0 INTRODUCTION**

This addendum applies Revision 1 of "Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch 11" problem-specific data quality objectives (PSDQO) to tank 241-SY-103 / Batch 11.

This application of the data quality objective (DQO) is divided into a Base Case Operating Scenario and two alternative case operating scenarios. The Base Case homogenizes the waste in tank 241-SY-103 by mixing prior to transfer to tank 241-SY-102. Alternative Case 1 transfers supernate from tank 241-SY-103 without mixing followed by diluent addition, mixing, and settling of any remaining solids prior to transfer to tank 241-SY-102. Alternative Case 2 involves mixing the waste from tank 241-SY-103 with waste from tank 241-SY-101 in tank 241-SY-102. The waste from each tank would be a well-mixed, and diluted to allow transfer within operational limits. In all three cases, compatibility with the transuranic solids in tank 241-SY-102 must be evaluated.

2.0 EVALUATION**2.1 BASE CASE OPERATING SCENARIO**

Translate the operating scenario into a series of process steps.

The base case operating scenario from the *Tank Waste Remediation System Operation and Utilization Plan* (TWRSO&UP) (Kirkbride et al. 1997) includes the following steps to make up Batch 11:

- Empty supernate from 241-SY-102, leaving a 0.1-ML (10-in.) layer of supernate over the residual sludge layer. The supernate will be transferred cross-site into either tank 241-AN-102 or 241-AN-107 for eventual processing in 200 East Area.
- Homogenize the waste in 241-SY-103 using mixer pumps to resuspend the salt slurry.
- Transfer the homogenized waste in 241-SY-103 to 241-SY-102 until the receiver

tank is full. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.

- Repeat the above three steps as necessary until tank 241-SY-103 has been emptied.

Compatibility of the waste with the residual liquid in 241-SY-102 may need to be evaluated for the first transfer from 241-SY-103. Compatibility of 241-SY-103 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the whole tank composite (WTC) over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: There are several nearly identical transfers. They will be treated as one transfer. Transfer requirements apply to a whole tank composite of the waste currently in 241-SY-103 after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: The first transfer will involve mixing with the liquid waste residual over the sludge in 241-SY-102. Subsequent transfers will involve mixing of the WTC with the residual concentrated waste from the previous transfer over the sludge in 241-SY-102. Two sets of mixing requirements apply. The first mixing requirement apply to blend of the diluted WTC for 241-SY-103 with the initial supernate layer and the sludge in 241-SY-102 over the temperature range of 25 to 65 °C. After the first transfer, the residual supernate is assumed to be the diluted WTC from 241-SY-101. Therefore the second mixing requirement applies to the diluted WTC for 241-SY-103 and the sludge in 241-SY-102 over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 11 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-103. The two composites from the mixing study above should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the WTC of 241-SY-103 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 1 contains the evaluation of the base case operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo 1998). The table lists each element taken from Section 4.0 of the PSDQO. For each element, the requirements specific to

241-SY-103 Batch 11 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 4.

2.2 ALTERNATIVE CASE 1 OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 11 are listed below:

- Empty supernate from 241-SY-102, leaving a 0.1-ML (10-in.) layer of supernate over the residual sludge layer. The supernate will be transferred cross-site into either tank 241-AN-102 or 241-AN-107 for eventual processing in 200 East Area.
- Decant supernate from tank 241-SY-103 to 241-SY-102. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Repeat the above two steps until all supernate has been pumped from 241-SY-103.
- Add diluent to the salt slurry in 241-SY-103 and mix.
- Allow undissolved solids to settle in 241-SY-103.
- Transfer the liquid to 241-SY-102, leaving a 10-in heel in 241-SY-103. No additional diluent is expected to be needed for the transfer. It may be necessary to periodically transfer waste cross-site from 241-SY-102 to create space for the transfer.

Compatibility of the waste with the residual liquid in 241-SY-102 may need to be evaluated for the first transfer from 241-SY-103. Compatibility of 241-SY-103 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the supernate composite and salt slurry composite of 241-SY-103 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: There are two types of transfers, supernate and salt slurry. The transfers should be evaluated over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: Two mixing scenarios must be evaluated. The first is the mixing of supernate with the liquid and the sludge remaining in 241-SY-102. The second is the mixing of diluted salt slurry with the sludge in 241-SY-102. Mixing studies should be carried out over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 11 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-103. The two composites from the mixing study above should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the supernate and salt slurry composites for 241-SY-103 or to changes in the operating scenario that may be imposed in the future.

Table 2 contains the evaluation of the alternative case 1 operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo). The table lists each element taken from Section 4.0 of the PSDQO (Certa and Jo). For each element, the requirements specific to 241-SY-103/Batch 11 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 4.

2.3 ALTERNATIVE CASE 2 OPERATING SCENARIO

Translate the operating scenario into a series of process steps.

The TWRSO&UP (Kirkbride et al. 1997) recommended that process control issues be taken into account. This alternative case operating scenario was developed based on consideration of process control issues and is currently being evaluated and incorporated into the project master baseline schedule and corresponding logic diagrams. The steps that directly affect the composition of Batch 11 are listed below:

- Homogenized, diluted waste from 241-SY-101 is assumed to reside in 241-SY-102. The volume of this waste is not known.
- Homogenize the waste in 241-SY-103 using mixer pumps to resuspend the salt slurry.
- Transfer the homogenized waste in 241-SY-103 to 241-SY-102 until the receiver tank is full. During the transfer, the proper amount of diluent will be added to the waste at the transfer pump inlet.
- Pump the mixture of supernate waste from 241-SY-102 cross-site to 241-AN-102 or 241-AN-107, leaving a 0.1-ML (10-in) heel of supernate over the sludge in 241-SY-102.

- Resume transferring homogenized waste from 241-SY-103 to 241-SY-102, adding the proper amount of diluent at the pump inlet.
- Repeat the above two steps until tank 241-SY-103 is emptied.

Compatibility of the waste with the waste from 241-SY-101 may need to be evaluated for the first transfer from 241-SY-103. Compatibility of 241-SY-103 waste with the transuranic sludge in 241-SY-102 is extremely important to ensure that envelope limits are not exceeded.

Define the waste that applies to each element in the decision rule.

Element 1, Dilution Ratio and Diluent Composition: this applies to the WTC of 241-SY-103 over the temperature range of 25 to 65 °C.

Element 2, Transfer Requirements: Two transfers need to be evaluated. The first is the transfer of the WTC of the waste in 241-SY-103 to 241-SY-102 when it is partially filled with waste from 241-SY-101. The second is the transfer of the WTC of the waste in 241-SY-103 to 241-SY-102 when it contains a small heel of waste over sludge. The heel is assumed to be the same as the WTC of 241-SY-103. The transfers should be evaluated after addition of the proper amount of diluent over the temperature range of 25 to 65 °C.

Element 3, Mixing Requirements: The two transfer scenarios need to be evaluated while mixing with the sludge in 241-SY-102 over the temperature range of 25 to 65 °C.

Element 4, Envelope and Quantity Requirements: the ultimate composition of Batch 11 will depend somewhat upon the residual supernate in 241-SY-102 and on any reactions between the sludge in 241-SY-102 and the WTC from 241-SY-103. The two composites from the mixing study above should be analyzed and evaluated against the Envelope A and C limits.

Element 5, Miscellaneous Inputs: These inputs apply to the WTC of 241-SY-103 or to changes in the operating scenario that may be imposed in the future.

Evaluate existing data and determine information needs.

Table 3 contains the evaluation of the alternative case 2 operating scenario for all the elements of the decision rules found in Section 6 of the PSDQO (Certa and Jo). The table lists each element taken from Section 4.0 of the PSDQO (Certa and Jo). For each element, the requirements specific to 241-SY-103/Batch 11 are listed. Each requirement is evaluated against existing data and the remaining information needs are identified. The information needs are summarized in Table 4.

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A test plan, based on instruction provided by the Disposal Program (e.g. Garfield 1997), is need for process testing. The plan will obtain the following information for the 241-SY-103 WTC. Required dilution ratio to prevent precipitation over the temperature range of 25 °C to 65 °C.</p> <p>Dilution ratio and diluent composition will be established.</p>	Desired dilution ratio and diluent composition (See Table 4, Item 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	Confirm that the diluted WTC is below saturation in major Na salts (See Table 4, Item 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	A process test is needed. The test will determine viscosity, density, and quantity of settled solids for the undiluted WTC and various dilutions of the WTC at temperatures of 25, 45, and 65 °C.	Determine viscosity, SpG, suspended solids (See Table 4, Item 3).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at various dilution ratios and temperatures of 25, 45, & 65 °C should be observed for solid formation. Special Consideration: If gibbsite will form, it should form within four weeks.	Precipitation at various dilution ratios and at temperatures of 25, 45, & 65 °C (See Table 4, Item 4).
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	Dissolution kinetics at various dilutions and temperatures needs to be measured.	Determine percent solids at various dilutions and temperatures as a function of time while mixing. (See Table 4, Item 3).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	Observation of settling times at various dilutions and temperatures is needed.	Determine settling times at various dilutions and temperatures. (See Table 4, Item 3).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements (continued)	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-SY-103 contains crust, supernate, and salt slurry/sludge layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).	No further information needed.
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6).	Either Envelope A or C limits will apply to Batch 11. The limits are identical except that the Envelope C limits for TOC, SO ₄ , TRU, and ⁹⁰ Sr are higher.	Chemical and radionuclide analyses from tests (See Table 4, Item 5).
	See Section 2.0, Tables 1 and 2 (in main report).	The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates ^a of the composition of the feed from 241-SY-103 to the Envelope A limits and indicate that the tank waste meets all criteria except for TOC. If the TOC limit is not relaxed, then the waste will be classified as Envelope C.	
	Concentration limit for the sodium concentration of the feed: $3 M \geq [Na] \geq 14 M$ (DOE-RL 1996, Section C.6).	During process testing [Na] will be measured.	[Na] measurement (See Table 4, Item 6).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	<p>The contracts do not define how the volume percent insoluble solids will be measured.</p> <p>During the process test, the quantity of solids for various WTC dilutions will be measured over the temperature range of 25 to 65 °C.</p>	Insoluble solids measurement (See Table 4, Item 7).
	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference).</p> <p>See Section 2.0, Table 3 (in main report).</p>	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0 (Table 3) of the main report.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 11. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 11, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 11 is approximately 3,500 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>Conformance with OSD factors is achieved for all known factors.</p>	During the process testing, full analysis is needed for Envelopes A and C, including ¹³⁷ Cs (See Table 4, Item 8).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of supernate in 241-SY-103 (Hansen et al. 1996) to be 4.23E2 μCi/L. The solids concentration is between 1.34E2 and 2.50E2 μCi/g. Clearly, the ¹³⁷Cs concentration will be well below the limit for this waste.</p>	Samples should be analyzed during process testing, but all indications are that the levels of ¹³⁷ Cs and ⁹⁰ Sr are well below the applicable limits.
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.	<p>The tank characterization report estimates the ⁹⁰Sr concentration of supernate in 241-SY-103 (Hansen 1996) to be 2.98 μCi/L. The solids concentration is between 1.12 and 34.8 μCi/g. Clearly, the ⁹⁰Sr concentration is well below the limit for this waste.</p> <p>Conformance with OSD factors is achieved.</p>	
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	The discriminators for Envelopes A and C are SO ₄ , TOC, TRU, and ⁹⁰ Sr.	Determine SO ₄ , TOC, TRU, and ⁹⁰ Sr concentrations (See Table 4, Item 9).

Table 1. Base Case Operating Scenario Evaluation. (8 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements	Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.	During process testing, the amount of recoverable Na should be measured. The TCR puts the inventory of Na at $3.17\text{E}+5$ kg for the convective layer and $4.02\text{E}+5$ for the non-convective layer, for a total of $7.19\text{E}+5$ kg or 719 MT. Note that some 241-SY-101 waste is planned for batch 11 as well.	Determine Na quantity (See Table 4, Item 10).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.		
	PHMC desired batch 11 size (from Operating Scenario): 789 MT Na (Kirkbride et al. 1997, Table 3.1-5)		
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hansen et al. (1996): 241-SY-103 has a crust layer of unknown depth- the historical estimate is less than 2 inches. The supernate layer is approximately 3.51 m (11.5 ft), and the solids layer is approximately 3.34 m (11.0 ft). There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area staging tanks may also need to be addressed.	Process test needed. (See Table 4, Item 10).
	Shimming Batch 11	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

a. Elements are taken from the Decision Rule statement in Section 4.0 of PSDQO-01.

b. Requirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	Process testing of the supernate composite and of diluted salt slurry composite is needed at various dilutions over the temperature range of 25 °C to 65 °C.	Desired dilution ratio and diluent composition (See Table 4, Item 12)
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	A process test is needed to confirm that the as-retrieved waste streams (including dilution water or caustic) remain below saturation in major Na salts during the transfer to the staging tank. The two streams are the supernate and salt slurry from the tank. Testing should be conducted at various dilutions and temperatures.	Confirm that the two streams are below saturation in major Na salts (See Table 4, Item 13).
	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate.	An extended storage (at least one month) of supernate and salt slurry subsamples from the dilution should be observed for solid formation over the temperature range of 25 to 65 °C. Special Consideration: If gibbsite will form, it should form within four weeks.	Precipitation at various dilution ratios over the temperature range of 25 to 65 °C (See Table 4, Item 14).
	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	Observation of settling times at various dilutions and temperatures is needed.	Determine settling times at various dilutions and temperatures. See Table 4, Item 15)

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 2, Transfer Requirements (continued)	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-SY-103 contains crust, supernate, and salt slurry/sludge layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).	No further information needed.
Element 4 - Part 1: Envelope Requirements These limits apply to the feed actually delivered to the private contractors.	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report) for the limits.	Either Envelope A or C limits will apply to Batch 11. The limits are identical except that the Envelope C limits for TOC, SO ₄ , TRU, and ⁹⁰ Sr are higher. The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates ¹ of the composition of the feed from 241-SY-103 to the Envelope A limits and indicate that the tank waste meets all criteria except for TOC. If the TOC limit is not relaxed,, then the waste will be classified as Envelope C.	Chemical and radionuclide analyses from process testing (See Table 4, Item 16).

¹These point estimates were based on a thermodynamic model (ESP) which was used to estimate the liquid phase composition of the waste.

Table 2. Alternative Case 1 Operating Scenario Evaluation. (6 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements are Satisfied	Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.	During process testing, the amount of recoverable Na should be measured. The TCR puts the inventory of Na at $3.17\text{E}+5$ kg for the convective layer and $4.02\text{E}+5$ for the non-convective layer, for a total of $7.19\text{E}+5$ kg or 719 MT. Note that some 241-SY-101 waste is planned for batch 11 as well.	Determine Na quantity (See Table 4, Items 17 and 18).
	PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.		
	PHMC desired batch 11 size (from Operating Scenario): 789 MT Na (Kirkbride et al. 1997, Table 3.1-5)		
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hansen et al. (1996): 241-SY-103 has a crust layer of unknown depth- the historical estimate is less than 2 inches. The supernate layer is approximately 3.51 m (11.5 ft), and the solids layer is approximately 3.34 m (11.0 ft). There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area tanks may also need to be addressed.	Process test needed.
	Shimming Batch 11	No shimming is anticipated.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.

^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 1, Dilution Ratio and Diluent Composition	Determine the desired dilution ratio and diluent composition for each waste transfer.	<p>A test plan, based on instruction provided by the Disposal Program (e.g. Garfield 1997), is need for process testing. The plan will obtain the following information for the 241-SY-103 WTC. Required dilution ratio to prevent precipitation over the temperature range of 25 °C to 65 °C.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Desired dilution ratio and diluent composition (See Table 4, Item 1).
Element 2, Transfer Requirements	Confirm that the as-retrieved waste (including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.	<p>A process test is needed to confirm that the as-retrieved waste (WTC including dilution water or caustic) remains below saturation in major Na salts during the transfer to the staging tank.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Confirm that the diluted WTC is below saturation in major Na salts (See Table 4, Item 2).
	Confirm that the as-retrieved waste (including dilution water or caustic) remain at or below viscosity of 10 cP, at or below a 1.5 SpG, and at or below 30 percent solids by volume during the transfer to the staging tank.	<p>A process test is needed. The test will determine viscosity, density, and quantity of settled solids for the undiluted WTC and various dilutions of the WTC at temperatures of 25, 45, and 65 °C.</p> <p>Process testing for 241-SY-101 WTC will be completed per 241-SY-101 addendum.</p>	Determine viscosity, SpG, suspended solids (See Table 4, Item 3).
Element 2, Transfer Requirements (continued)	Confirm that the dilution ratio, diluent composition, and waste composition are balanced so gibbsite or high viscosity slurries do not precipitate	<p>An extended storage (at least one month) of supernate sub-samples from the WTC dilution test at various dilution ratios and temperatures of 25, 45, and 65 °C should be observed for solid formation.</p> <p>Special Consideration: If gibbsite will form, it should form within four weeks.</p>	Precipitation at various dilution ratios and at temperatures of 25, 45, and 65 °C (See Table 4, Item 4).

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 3, Mixing Requirements	Confirm that the portion of the solids thought to be soluble are soluble and that they dissolve in a reasonable amount of time.	<p>Dissolution kinetics at various dilutions and temperatures needs to be measured.</p> <p>Note: Confirmation that a mixer pump can provide the necessary amount of mixing to dissolve the solids in the tank in a reasonable amount of time is within the scope of the Equipment Design PSDQO.</p> <p>For this alternative, the waste will be combined with waste from 241-SY-101. Therefore, compatibility with the 241-SY-101 WTC is necessary.</p>	<p>Determine percent solids at various dilutions and temperatures as a function of time while mixing (See Table 4, Item 19).</p> <p>Confirm compatibility with 241-SY-101 WTC (See Table 4, Item 20).</p>
<p>Element 4 - Part 1: Envelope Requirements</p> <p>These limits apply to the feed actually delivered to the private contractors.</p>	Confirm that the undissolved solids settle and that they settle in a reasonable amount of time.	Observation of settling times at various dilutions and temperatures is needed.	Determine settling times at various dilutions and temperatures (See Table 4, Item 21).

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	Confirm that the baseline retrieval equipment that will be used to mobilize and transfer the waste is consistent with the operating scenario.	Tank 241-SY-103 contains crust, supernate, and salt slurry/sludge layers. The equipment required to mobilize and retrieve the waste includes mixer pumps and a transfer pump with water (and caustic) dilution capability (Boston 1997). This is consistent with the equipment identified in the base case operating scenario (Kirkbride et al. 1997).	No further information needed.
	Concentration limits for the chemical and radionuclide content of the feed (DOE-RL 1996, Section C.6). See Section 2.0, Tables 1 and 2 (in main report).	Either Envelope A or C limits will apply to Batch 11. The limits are identical except that the Envelope C limits for TOC, SO ₄ , TRU, and ⁹⁰ Sr are higher. The TWRSO&UP (Kirkbride et al. 1997, Tables I-1 and I-3) compared the point estimates ¹ of the composition of the feed from 241-SY-103 to the Envelope C limits and indicate that the tank waste meets all criteria.	Chemical and radionuclide analyses from tests (See Table 4, Item 22).
	Concentration limit for the sodium concentration of the feed: $3 \text{ M} \leq [\text{Na}] \leq 14 \text{ M}$ (DOE-RL 1996, Section C.6).	During process testing [Na] will be measured.	[Na] measurement (See Table 4, Item 22).
	Insoluble solids fraction limit will not exceed 5 volume % (DOE-RL 1996, Section C.6).	The contracts do not define how the volume percent insoluble solids will be measured. During the process test, the quantity of solids for various WTC dilutions will be measured over the temperature range of 25 to 65 °C.	Insoluble solids measurement (See Table 4, Item 21).

¹These point estimates were based on a thermodynamic model (ESP) that was used to estimate the liquid phase composition of the waste.

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 1: Envelope Requirements (continued)	<p>Operating Specifications from OSD-T-151-00007 (DOE-RL 1996, Section C.6 invokes the OSD by reference).</p> <p>See Section 2.0 (Table 3) of the main report.</p>	<p>The contract does not explicitly state which specifications from the OSD apply to the waste. The PHMC assumes that the Tank Composition (7.2.1) and Heat Generation Rate (7.2.8) limits apply to the waste. These limits are shown in Section 2.0 (Table 3) of the main report.</p> <p>The TWRSO&UP (Kirkbride et al. 1997, Section 3.1.1.6) compared the point estimates of the composition of the waste as staged in 241-AP-102 and -104 with the Tank Composition (Tank Corrosion) specifications. All limits were satisfied for Batch 11. Uncertainty is not an issue since the [OH], [NO₂] and [NO₃] in the staging tanks can be adjusted if needed before the feed qualification samples are taken.</p> <p>The TWRSO&UP (Section 3.1.1.6) also evaluated the heat generation rate rule and found that all limits were satisfied for Batch 11, decayed to the estimated time of delivery. The estimated heat generation rate for Batch 11 is approximately 3,500 BTU/hr. This is well within the maximum limit of 70,000 BTU/hr.</p> <p>Conformance with OSD factors is achieved for all known factors.</p>	<p>During the process testing, full analysis is needed for Envelopes A and C, including ¹³⁷Cs (See Table 4, Item 22).</p>

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements	Maximum ¹³⁷ Cs concentration of 5.86 E10 Bq/liter (6 Ci/gal).	<p>This limit is equivalent to 1.59E6 μCi/L. The OSD limit of 5.74E5 μCi/L is more restrictive.</p> <p>The tank characterization report estimates the ¹³⁷Cs concentration of supernate in 241-SY-103 (Hansen et al. 1996) to be 4.23E2 μCi/L. The solids concentration is between 1.34E2 and 2.50E2 μCi/g. Clearly, the ¹³⁷Cs concentration will be well below the limit for this waste.</p>	<p>Samples should be analyzed during process testing, but all indications are that the levels of ¹³⁷Cs and ⁹⁰Sr are well below the applicable limits (See Table 4, Item 22).</p>
	Maximum ⁹⁰ Sr concentration of 4.04E5 μ Ci/L.	<p>The tank characterization report estimates the ⁹⁰Sr concentration of supernate in 241-SY-103 (Hansen 1996) to be 2.98 μCi/L. The solids concentration is between 1.12 and 34.8 μCi/g. Clearly, the ⁹⁰Sr concentration is well below the limit for this waste.</p> <p>Conformance with OSD factors is achieved.</p>	
	The PHMC assumed minimum limits to distinguish between Envelope A and C and between Envelopes A and B	The discriminators for Envelopes A and C are SO ₄ , TOC, TRU, and ⁹⁰ Sr.	

Table 3. Alternative Case 2 Operating Scenario Evaluation. (9 Sheets)

Elements ^a	Requirements ^b	Discussion/evaluation	Information needs
Element 4 - Part 2: Quantity Requirements (continued)	<p>Batch size (mass of sodium) constraints (from the contracts) ≥ 100 MT Na.</p> <p>PHMC targeted batch size range (from the ICD (PHMC 1997, Table 3D): 100 - 600 MT Na.</p> <p>PHMC desired batch 11 size (from Operating Scenario): 789 MT Na (Kirkbride et al. 1997, Table 3.1-5)</p>	During process testing, the amount of recoverable Na should be measured. The TCR puts the inventory of Na at $3.17\text{E}+5$ kg for the convective layer and $4.02\text{E}+5$ for the non-convective layer, for a total of $7.19\text{E}+5$ kg or 719 MT. Note that some 241-SY-101 waste is planned for batch 11 as well.	Determine Na quantity (See Table 4, Item 22).
Element 5 - Miscellaneous Inputs	Physical form of Tank T contents	From Hansen et al. (1996): 241-SY-103 has a crust layer of unknown depth- the historical estimate is less than 2 inches. The supernate layer is approximately 3.51 m (11.5 ft), and the solids layer is approximately 3.34 m (11.0 ft). There is no hard pan.	No further information is needed
	Heel from prior batch remaining in staging tanks	10-in. supernate heels and sludge remaining in 241-SY-102 need to be addressed. Heels remaining in East Area staging tanks may also need to be addressed.	None, process test needed (See Table 4, Item 11).
	Shimming Batch 11	No shimming is anticipated.	No further information is needed
	RL direction	No changes to applicable M&I ICD requirements have been made to date.	No further information is needed

^aElements are taken from the Decision Rule statement in Section 6.1 of PSDQO-01.^bRequirements are taken from Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of PSDQO-01.

Table 4 was developed jointly by TWRS Characterization and Tank Waste Retrieval. It is intended to show what information is still needed, what can be obtained by calculations with existing data, what requires new (or existing) samples, analysis and/or process testing. Where samples are required, the amount and "representativeness" of the sample will be stated. Where analysis is needed, the specific analytes and QA requirements will be stated. If process testing is needed, the amount of sample and goals of the process test will be stated. Appropriate level of end description of QA requirements will be covered in the specific work plan for these limited process tests.

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
1	Desired dilution ratio and diluent composition	Perform lab test: measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	300 ml 241-SY-103 WTC.
2	Confirm a dilution ratio of 50% for the TCS and blend is below saturation in major Na salts	Perform lab test: to confirm that the as retrieved waste remain below saturation in major Na salts during the transfer to the staging tanks	None, sample from Item 1 can be used.
3	Determine viscosity, SpG, suspended solids	Perform lab test to determine viscosity, SpG, suspended solids	300 ml 241-SY-103 WTC.
4	Determine solid formation, if any	An extended storage of supernate sub-samples from the Tank Supernate Composite (TSC) dilution test at dilution ratio up to 120 % .	None, sample from Item 3 can be used.
5	Chemical and radionuclide analyses.	Measure the analytes in Section 2.0 (Tables 1 and 2) of main report (Envelope C analytes). Determine the bulk supernate composition.	None, sample from Item 1 can be used.
6	[Na] measurement	Measurement of [Na] can be obtained from Item 5.	None.
7	Confirm insoluble solids fraction limit will not exceed 5 volume %.	Measurement of solid in the blend. This data will be obtained during Item 1 testing.	None.
8	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from Item 5.	None

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
9	Determine sulfate concentration as a discriminator for Envelope C.	Perform lab test; Analysis of sulfate can be obtained by results from Item 5.	None
10	Determination of Na quantity	Perform lab test; Analysis of Na can be obtained by results from Item 5.	None
11	Determine the Chemical and radionuclide analyses of heel in 241-SY-102.	Perform lab test; Analysis of chemical and radionuclides.	100 ml of 241-SY-102 heel.
12	Desired dilution ratio and diluent composition for a representative sample of supernate and salt slurry.	Perform lab test: measure minimum dilution ratio which satisfies all transfer system; measure maximum dilution ratio where gibbsite will not become a problem. Determine desired dilution ratio and diluent.	300 ml 241-SY-103 Tank Supernate Composite (TSC). 300 ml 241-SY-103 tank saltcake composite (TSCC)
13	Confirm as-retrieved waste remains below satn in major Na salts during transfer.	Perform lab test: to confirm that the as-retrieved waste remains below saturation in major Na salts during the transfer to the staging tanks. Will be determined in Item 12.	None.
14	Confirm as-retrieved waste remains < 10 cP, < 1.5 SpG, and < 30% solids during transfer.	Perform lab test to determine viscosity, SpG, suspended solids. Use sample from Item 12.	None.
15	Determine solid formation and solid settling time, if any.	An extended storage of supernate sub-samples from the TSC dilution test at dilution ratio up to 120 %. Use sample from Item 12	None.
16	Chemical and radionuclide analyses	Measure the analytes in Section 2.0, Tables 1 and 2 (in main report) (Envelope C analytes). Determine the bulk supernate and diluted salt slurry composition from Item 12.	None.
17	[Na] measurement	Measurement of Na can be obtained from Item 16.	None

Table 4. Information Needs. (3 Sheets)

Item	Information need	Planned resolution	Sample required
18	Operating Specification requirements	Perform lab test; Analysis of chemical and radionuclides can be obtained by results from Item 16.	None.
19	Determine percent solids at various dilutions and temperatures as a function of time while mixing.	Perform lab test on mixed diluted 241-SY-101 and 241-SY-103 waste.	150 ml diluted 241-SY-101 WTC and 150 ml diluted 241-SY-103 WTC.
20	Confirm compatibility with 241-SY-101	Perform process test; Mix diluted 241-SY-101 with 241-SY-103 WTC. During the lab test in Item 19 confirm compatibility.	None.
21	Determine settling times.	During the lab test in Item 19 confirm compatibility.	None.
22	Determine the Chemical and radionuclide analyses of dilute mixture of 241-SY-101 and 241-SY-103.	Measure the analytes in Section 2.0, Tables 1 and 2 (in main report) (Envelope C analytes). Determine the bulk supernate and diluted salt slurry composition. Waste from Item 19 should be used.	None.

There are 22 items that have been flagged in Tables 1, 2, and 3 requiring further information. All items will be addressed by a specific process test with specific material from 241-SY-103. There are no other information needs requiring either an analysis of an existing 241-SY-103 sample or the collection of additional sample followed by analysis in order to confirm that tank 241-SY-103 is appropriate for Batch 11.

3.0 REFERENCES

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