DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Waste Tanks Process Engineering	Date April 20, 1995
Project Title/Work Order		EDT No. ~~611648~~
Data Quality Objectives For Tank Farms Waste Compatibility Program		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
W. B. Barton	R2-11				
T. S. Basra	R1-51				
T. M. Brown	R2-12				
K. G. Carothers	R1-51				
R. A. Dodd (3)	S5-05				
S. J. Eberlein	R2-12				
K. D. Fowler (5)	R2-11				
J. M. Jones	S5-13				
N. W. Kirch	R2-11				
G. M. Koreski	R2-11				
C. H. Mulkey	R1-51				
D. A. Reynolds	R2-11				
J. N. Strode	R2-11				
T. C. Trible	S1-57				
T. S. Vail	R2-54				
M. D. Webb	H4-25				
Central Files	L8-04				
O.S.T.I. (2)	L8-07				

MASTER

DISCLAIMER

ENGINEERING CHANGE NOTICE

1. ECN № 623160

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. K. D. Fowler, 71310, R2-11, 373-5930	3a. USQ Required? [] Yes [X] No	4. Date 4/24/95
	5. Project Title/No./Work Order No. Compatibility Program/E15758	6. Bldg./Sys./Fac. No. Tank Farms	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) SD-WM-DQO-001 Rev. 0 SD-WM-OCD-015 Rev. 0A	9. Related ECN No(s). NA	10. Related PO No. NA

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	NA	NA Cog. Engineer Signature & Date	NA Cog. Engineer Signature & Date

12. Description of Change

Total revision for consistency with other updated Tank Farms administrative controls

13a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

Review of the compatibility program showed that revision was necessary for compliance with updated CPS and other administrative control documents.

14. Distribution (include name, MSIN, and no. of copies)

See distribution sheet

RELEASE STAMP

OFFICIAL RELEASE (2)
BY WHC
DATE APR 24 1995
Sta 4

A-7900-013-2 (11/94) GEF095

A-7900-013-1

ENGINEERING CHANGE NOTICE	Page 2 of 4	1. ECN (use no. from pg. 1) 623160

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. See Pages 3 & 4 of this ECN		PE	
Cog. Mgr. See Pages 3 & 4 of this ECN		QA	
QA See Pages 3 & 4 of this ECN		Safety	
Safety See Pages 3 & 4 of this ECN		Design	
Environ.		Environ.	
Other		Other	
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

200

ECN-623160 page 374

~~ENGINEERING DATA TRANSMITTAL~~ 47. 4/24/95	Page ~~1~~ of ~~1~~ 1. EDT ~~Nº 611648~~

2. To: (Receiving Organization) East Tank Farm Plant Engineering	3. From: (Originating Organization) Waste Tanks Process Engineering	4. Related EDT No.: 611649
5. Proj./Prog./Dept./Div.: Tank Farm	6. Cog. Engr.: K. D. Fowler	7. Purchase Order No.:
8. Originator Remarks: Transmitted to document the updated Tank Farm Waste Transfer Compatibility Program		9. Equip./Component No.: 10. System/Bldg./Facility: Tank Farms
11. Receiver Remarks:		12. Major Assm. Dwg. No.: 13. Permit/Permit Application No.: 14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-DQO-001		1	Data Quality Objectives For Tank Farms Waste Compatibility Program	SQ	1,2		

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	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. K. D. Fowler	[signature]	4/20/95	R2-11						
1	1	Cog. Mgr. W. B. Barton	WB Barton	4/24/95		Cog. Eng. J. M. Jones	Joseph M Jones	04-20-95		1	1
1	1	QA T. C. Trible	T.C. Trible	4/20/95							
1	1	Safety M. N. Islam	[signature] Islam	4/20/95							
		Env.									
1	1	R. A. Dodd	RA Dodd	4/20/95							
1	1	T. S. Vail	[signature]	4/20/95							

18.	19.	20.	21. DOE APPROVAL (if required)
K. D. Fowler [signature] 4/20/95 Signature of EDT Originator / Date	R. A. Dodd [signature] 4/24/95 Authorized Representative for Receiving Organization / Date	W. B. Barton [signature] 4/24/95 Cognizant Manager / Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

A-6000-135 (01/93) WEF067

BD-7400-172-1

015

ECN- 623160 page 4 of 4

~~ENGINEERING DATA TRANSMITTAL~~ 4/24/95

~~Page 1 of~~

1. EDT ~~No 611648~~

2. To: (Receiving Organization) East Tank Farm Plant Engineering	3. From: (Originating Organization) Waste Tanks Process Engineering	4. Related EDT No.: 611648
5. Proj./Prog./Dept./Div.: Tank Farm	6. Cog. Engr.: K. D. Fowler	7. Purchase Order No.:
8. Originator Remarks: Transmitted to document the updated Tank Farm Waste Transfer Compatibility Program		9. Equip./Component No.:
		10. System/Bldg./Facility: Tank Farms
11. Receiver Remarks:		12. Major Assm. Dwg. No.:
		13. Permit/Permit Application No.:
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-OCD-015		1	Tank Farm Waste Transfer Compatibility Program	SQ	1,2		

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	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. K. D. Fowler	[signature]	4/20/95	R2-11						
1	1	Cog. Mgr. W. B. Barton	[signature]	4/24/95		J. M. Jones Cog. Eng.	[signature]	04-20-95		1	1
1	1	QA T. C. Trible	[signature]	4/20/95							
1	1	Safety M. N. Islam	[signature]	4/20/95							
		Env.									
1	1	R. A. Dodd	[signature]	4/20/95							
1	1	T. S. Vail	[signature]	4/20/95							

18.	19.	20.	21. DOE APPROVAL (if required)
K. D. Fowler [signature] 4/20/95 Signature of EDT Originator / Date	R. A. Dodd [signature] 4/20/95 Authorized Representative for Receiving Organization / Date	W. B. Barton [signature] 4/24/95 Cognizant Manager / Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

A-6000-135 (01/93) WEF067

BD-7400-172-1

Z

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-OCD-015, REV 1
Document Title:	Tank Farm Waste Transfer Compatibility Program
Release Date:	4/24/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz — April 24, 1995

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

SUPPORTING DOCUMENT

SUPPORTING DOCUMENT			1. Total Pages 26
2. Title Tank Farm Waste Transfer Compatibility Program	3. Number WHC-SD-WM-OCD-015	4. Rev No. 1	
5. Key Words Characterization, Compatibility, Criteria, Decision Rules, Double-Shell Tank, Tank Farms, Waste Transfer	6. Author Name: K. D. Fowler Signature Organization/Charge Code 71310/N1F6N/N1208		

7. Abstract

The compatibility program described in this document formalizes the process for determining waste compatibility. The primary goal of the program is to ensure that sufficient controls are in place to prevent the formation of incompatible mixtures during future operations. The formation of incompatible mixtures could possibly result in an unreviewed safety question. Waste transfer decision rules are presented as a process for assessing compatibility of wastes or waste mixtures. The process involves characterizing the waste, comparing waste characteristics with the criteria, resolving potential incompatibilities, and documenting the process.

8. RELEASE STAMP

A-6400-073 (08/94) WEF124

RECORD OF REVISION		(1) Document Number SD-WM-OCD-015	Page A

(2) Title
Tank Farm Waste Transfer Compatibility Program

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT - 131532	NA	NA
RS 1	Total Revision per ECN - 623160	[signature]	[signature] 4/24/95

TANK FARM WASTE TRANSFER COMPATIBILITY PROGRAM

ACRONYMS

BTU/hr	British thermal units per hour
CC	concentrated complexant waste
CP	concentrated phosphate waste
DC	dilute complexant waste
DN	dilute non-complexant waste
DOE	United States Department of Energy
DQO	Data Quality Objectives
DSC	differential scanning calorimetry
DSSF	double-shell slurry feed
DST	double-shell tank
g/gal	grams per gallon
g/L	grams per liter wt
Kg	kilogram
M	molar
nCi/g	nanocuries per gram
N_{Re}	Reynolds number
NCAW	aging waste from PUREX
NCRW	neutralized cladding removal waste
OSD	Operating Specification Document
PD	PUREX neutralized cladding removal waste
PT	TRU solids fraction from PFP operations
SpG	specific gravity
TGA	Thermo-gravimetric analysis
TOC	total organic carbon
TRU	transuranic
WHC	Westinghouse Hanford Company
WVR	waste volume reduction

1.0 INTRODUCTION

Mixed wastes are stored at the Hanford site on an interim basis until they can be treated, as necessary, for final disposal. The Tank Farm Waste Transfer Compatibility Program is implemented to assure continued safe storage and handling of these wastes.

This document describes decision rules relating to waste transfers both into and within the Hanford Site Tank Farm Facilities. In conjunction with the Waste Compatibility DQO (Fowler 1995) and the Waste Analysis Plan (Mulkey and Jones 1994), it provides a plan for applying safety, operational and regulatory criteria and considerations to evaluate waste transfers.

The primary decision is either to allow or not allow a waste transfer. A secondary decision is to determine what mitigation measure(s) would allow a transfer falling outside of normal safety, or operations parameters described by the decision rules.

Transfer decisions are based on:

1) SAFETY DECISION RULES
   - criticality
   - flammable gas accumulation
   - energetics
   - corrosion
   - Watch List tanks
   - chemical compatibility

2) OPERATIONAL DECISION RULES
   - tank waste type
   - separation of transuranic (TRU) from non-TRU waste
   - limited heat generation
   - segregation of complexant waste (high organic content)
   - waste pumpability
   - high phosphate waste

3) REGULATORY REQUIREMENTS

Regulatory requirements for waste transfers are specified in the Waste Analysis Plan (Mulkey and Jones 1994) and are not addressed in this document.

1.1 SCOPE

The decision rules apply to both routine and non-routine transfers. The operations encompassed include 1) combining the wastes from within the double-shell tank (DST) system, 2) transferring waste between the tanks and the evaporator, and 3) acceptance of waste transferred from outside of the DST system.

1.2 TRANSFER ASSESSMENTS

Prior to acceptance of a waste transfer, the proposed transfer shall be assessed by East or West Tank Farms Plant Engineering. The assessment will compare compositions of the proposed waste source(s), waste receiver(s), and transfer conditions to the decision rules given in Section 3. The assessment process is outlined in Figure 1-1.

If it is determined, via the transfer assessment, that a proposed transfer is acceptable, the assessment is documented and signed off by East or West Tank Farms Plant Engineering. Concurrence signatures from Waste Tanks Process Engineering, and from Environmental Engineering are also required to proceed with the transfer.

1.3 EXEMPTIONS

Certain additions to waste tanks are unlikely to cause any waste compatibility problems. This type of addition may occur on a regular basis, thus, conducting detailed waste compatibility assessments each time is neither economically nor technically justified.

Water used to pressure test waste transfer pipelines is one example of such an addition. The water used in a pressure test drains back into DSTs where it mixes with the stored waste. Because all DST wastes are aqueous solutions and slurries of inorganic salts contaminated with minor amounts of radionuclides and organic salts, water additions serve only to dilute the waste and, in most cases, reduce interactions between compounds in the waste.

Therefore, the following types of waste transfers in the tank farms are exempt from formal waste compatibility assessments:

- Potentially contaminated water (e.g., cooling water, rain water, snow melt, pipeline flush water, pipeline pressure test water, deentrainer flush water, airlift circulator flush water) with no chemicals added except for those required for tank corrosion control (i.e., sodium hydroxide and sodium nitrite).

- Dilute, organic-free waste containing any of the major inorganic salts (i.e., sodium aluminate, sodium nitrate, sodium nitrite, sodium carbonate, sodium sulfate, sodium phosphate, sodium fluoride, and sodium chloride), sodium hydroxide, trace metals, and radionuclides commonly found in Hanford Site wastes at concentrations that would form a waste mixture free of precipitation (i.e., < 1 vol. % solids) when blended with another waste.[1]

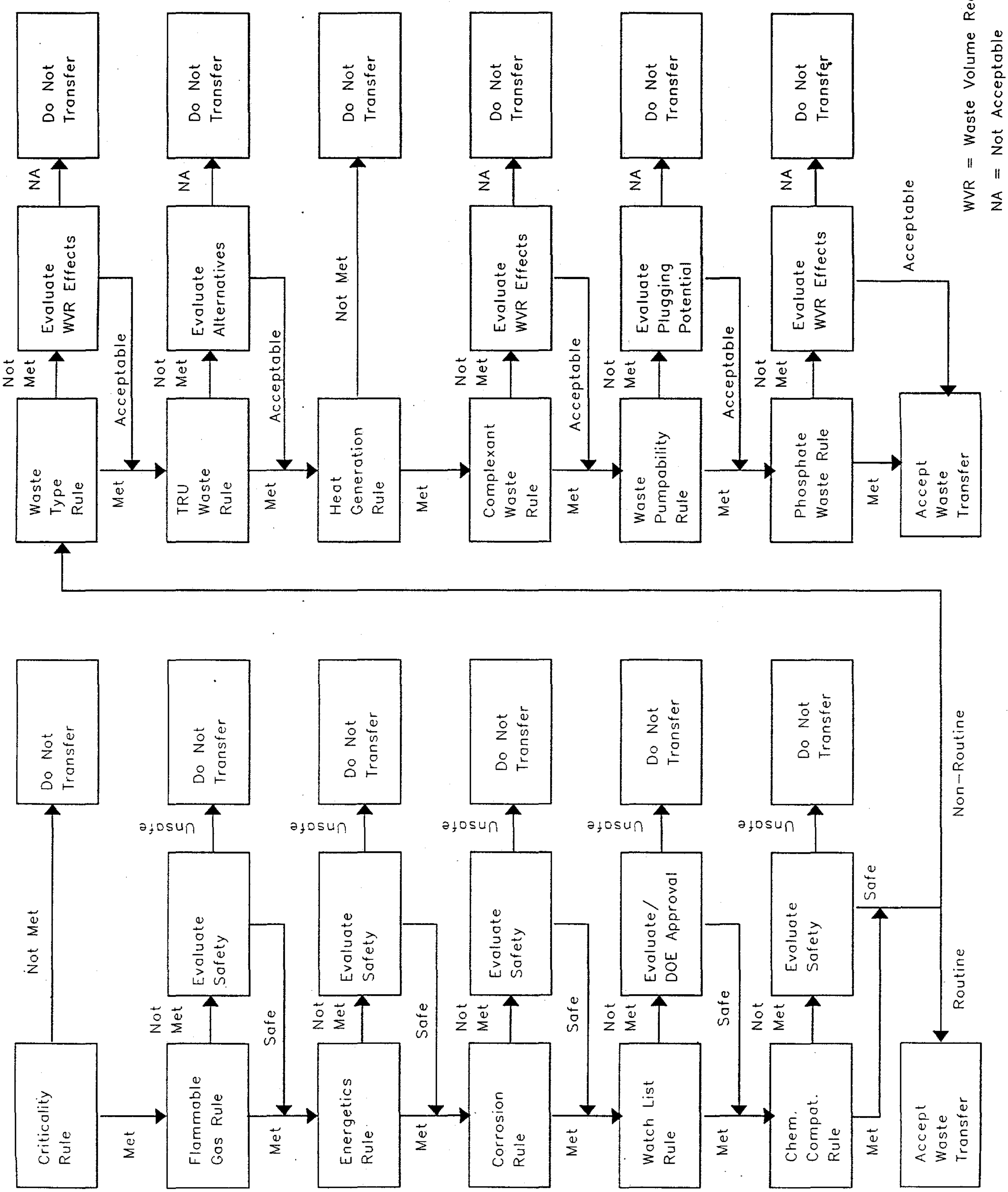
---

[1] Note decision rule 3.2.5 for mixing of high phosphate wastes.

- Small volumes (i.e., 0.1 % of the existing receiver tank volume or 500 gallons, whichever is less) of essentially organic-free waste containing any of the major inorganic salts, trace metals, or radionuclides regardless of precipitation.

Although exempt from detailed compatibility assessments, the wastes described in this section must comply with the safety decision rules described in Section 3.0. To assure compliance with safety decision rules, exempt transfers also require concurrence as specified in Section 1.2.

Figure 1-1 Waste Transfer Assessment



2.0 TRANSFER TYPES

2.1 ROUTINE TRANSFERS

A routine transfer is defined as a type of transfer which has previously occurred in the DST system and for which there is historical data on the analytical and physical characteristics of the waste relevant to the transfer decision rules.

Data collected for routine transfers is reviewed in order to determine the acceptability of the transfer. The process is determined to be acceptable if:

1) limited sampling of each batch of waste falls within the range established through previous analyses of the waste source; and

2) the process complies with safety and regulatory criteria for waste transfers.

Although a compatibility assessment is required, operations criteria are not normally applied to routine transfers because a historical precedent exists for receiving these transfers without operational problems.

2.2 NON-ROUTINE TRANSFERS

A non-routine transfer involves waste that has unique chemical and/or physical properties for which no historical data exists to determine compliance with transfer decision rules. Waste received from facilities which do not regularly send waste to the tank farms may also comprise a non-routine transfer.

A formal assessment of non-routine transfers is required before the transfers are accepted. The need for a statistically based sampling regime for non-routine transfers will be evaluated on a case-by-case basis. Development of the sampling regime will be in accordance with the Compatibility DQO (Fowler 1995) and will consider:

1) the potential consequences of decision errors for that transfer event;

2) the constraints on sampling and analysis;

3) the perceived variability in the source and receiving tanks; and

4) the values of the data used in waste transfer decision rules.

3.0 DECISION RULES

3.1 SAFETY DECISION RULES:

3.1.1 Criticality

Only transfers in compliance with Criticality Prevention Specification limits (Vail 1994) shall be allowed.

If a DST will contain less than 10 Kg of plutonium (Pu) after completion of a transfer, the following limits may be used.

1. Transfer may be made without consideration of the solids content provided at least one of the following conditions is met:

   - Total Pu in the transfer < 15 g.
   - Pu concentration in source waste < 0.013 g/L (0.05 g/gal).
   - An air lift circulator is operating in the receiver tank and the transfer contains ≤ 200 g Pu.
   - The transfer is made through a slurry distributor and the total Pu added to the waste at any single position does not exceed 200 g.

2. If at least one of the requirements above is not met, transfers may be made in accordance with the requirements for tanks containing greater than 10 Kg Pu (below).

If a DST will contain greater than 10 Kg Pu after completion of the transfer, the solids/Pu mass ratio for the receiver tank contents shall be shown to be at least 1,000 before additional Pu may be added. The ratio is an average value determined by dividing the total solids mass by the total Pu mass.

Also, for waste transfers to a DST, <u>one</u> of the following sets of limits (Set 1, <u>or</u> Set 2, <u>or</u> Set 3) shall apply:

Set 1. The solids/Pu mass ratio for the waste already in the receiver tank exceeds 1,000, and the incoming waste:

a. contains less than 15 g of Pu,

<u>or</u>

b. has a Pu concentration less than 0.013 g/L (0.05 g/gal),

<u>or</u>

c. is received by a tank that has an operating air lift circulator and the transfer contains not more than 200 g Pu, and

<u>or</u>

d. is added through a slurry distributor and the total Pu added to the waste at any single position does not exceed 200 g.

Set 2. The incoming waste:

a. has a solids/Pu mass ratio of at least 1,000 as determined by analysis or predictive calculation
<u>and</u>
b. has an averaged Pu concentration (both liquid and solids volume per batch included) not exceeding 0.033 g/L (0.125 g/gal).

Set 3. Cadmium (Cd) may be added to the waste and a transfer continued under the following conditions:

a. Transfer is made to tank 102-SY or 105-AW only.
<u>and</u>
b. Before transfer, the solids/Pu mass ratio in the receiver tank is at least 1,000.
<u>and</u>
c. The Cd/Pu mass ratio is at least 0.33. (i.e., there is at least one gram of Cd for every three grams of Pu).
<u>and</u>
d. The Pu concentration does not exceed 30 g/L in the precipitated (settled) solids.

3.1.2 Flammable Gas Accumulation

Only transfers in compliance with the flammable gas accumulation decision rule shall be accepted.

A. If the specific gravity (SpG) of the source is < 1.3, then the transfer may be allowed; otherwise, determine the weighted mean SpG of the commingled waste.

B. If the weighted mean SpG ≤ 1.41 for the commingled waste, the transfer may be allowed. If the weighted mean SpG > 1.41, perform a detailed technical evaluation of potential for flammable gas accumulation in the commingled waste to determine whether the waste may be transferred and stored safely.

3.1.3 Energetics

If the source waste has no separable organic and the source and receiving wastes (individually) have an absolute value of the exotherm/endotherm ratio < 1.0 (i.e., no net exotherms) as evaluated from laboratory thermal analysis (DSC and TGA) conducted up to 500 °C, then the transfer may be allowed. Otherwise, prior to accepting the waste, a technical evaluation will be required to determine the conditions needed for safely receiving and storing the waste.

3.1.4 Corrosion

The waste to be transferred must meet the following conditions.
NOTE: Square brackets, [], signify the mean concentration in moles per liter (M).

- For normal operating temperatures: T ≤ 100 °C (212 °F)
  - For $[NO_3^-] \le 1.0$ M:
    - $0.010\ M \le [OH^-] \le 5.0\ M$ and
    - $0.011\ M \le [NO_2^-] \le 5.5\ M$
    - (for solutions below 75 °C (167 °F) the $[OH^-]$ limit is 8.0 M)
  - For $1.0\ M < [NO_3^-] \le 3.0\ M$:
    - $0.1 * [NO_3^-] \le [OH^-] < 10\ M$
    - $[OH^-] + [NO_2^-] \ge 0.4 * [NO_3^-]$
  - For $[NO_3^-] > 3.0\ M$:
    - $0.3 \le [OH^-] < 10\ M$
    - $[OH^-] + [NO_2^-] \ge 1.2\ M$
    - $[NO_3^-] \le 5.5\ M$
- If the operating temperature of the receiving tank is greater than 100 °C (212 °F), the same limits apply with the exception that $[OH^-] < 4.0$ M in all cases.

If the waste does not meet these conditions, it must be brought into compliance during transfer through the 204-AR Waste Unloading Facility OR it must be verified, prior to transfer, that composition limits in the receiving tank will not be violated.

For waste transfers received at the 204-AR Facility the following limits apply:

- $7 < pH < 14$
- $[Cl^-] < 0.01$ M (rail tank car)
- $[Cl^-] < 0.035$ M (tank trailer)

3.1.5 Watch List Tanks

No high-level waste[2] will be accepted for transfer to a tank identified as a Watch List tank without prior approval from the Department of Energy.

Transfers to a Watch List tank shall have been reviewed prior to acceptance, to assure the potential for release of high-level waste is not increased.

3.1.6 Chemical Compatibility

Source wastes shall be categorized according to Figure 3-1 (USEPA 1994) and potential chemical compatibility hazards identified prior to acceptance into a DST. Reactivity groups are to be identified by waste generators as a part of the waste profile sheet. If no potential hazard is identified for mixing of wastes in the identified reactivity groups with the receiver tank waste, the transfer may be allowed.

If a potential hazard is identified, a technical justification explaining how the waste may be safely transferred and stored in light of the potential hazard will be required before allowing the transfer.

3.2 OPERATIONS DECISION RULES:

The operations decision rules are intended to segregate waste into broad categories (e.g., TRU, and complexant) and to ensure operability of the transfer event and future operations in the tank farms.

3.2.1 Tank Waste Type

Wastes in the tank farms have already been categorized as one of the types listed with the compatibility matrix for tank wastes, Figure 3-2. Mixing of waste types shall be in accordance with the compatibility matrix, Figure 3-2, to the extent practicable.

Waste types for DSTs are given in the most recent Waste Tank Summary Report (WHC-EP-0182-XX). This report is issued monthly by Tank Stabilization and Engineering Support.

---

[2] High-level waste is defined as the highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations requiring permanent isolation.

Reactivity Group No.	Reactivity Group Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Acids, Mineral, Nonoxidizing	1																			
2	Acids, Mineral, Oxidizing		2																		
3	Acids, Organic		I,H	3																	
4	Alcohols and Glycols	H	H,F	H,P	4																
5	Aldehydes	H,P	H,F	H,P		5															
6	Amides	H	H,T				6														
7	Amines, Aliphatic ;and Aromatic	H	H,T	H		H		7													
8	Azo, Diazo Compounds, and Hydrazines	H,I	H,T	H,I	H,I	H			8												
9	Carbamates	H,I	H,T						I,H	9											
10	Caustics	H	H	H		H				H,I	10										
11	Cyanides	T,G	T,G	T,G					I			11									
12	Dithiocarbamates	H,G,F	H,G,F	H,G,T		G,T		U	H,I				12								
13	Esters	H	H,F						H,I		H			13							
14	Ethers	H	H,F												14						
15	Fluorides, Inorganic	T	T	T												15					
16	Hydrocarbons, Aromatic		H,F														16				
17	Halogenated Organics	H,T	H,F,T					H,T	H,I		H,F	H						17			
18	Isocyanates	H,I	H,F,T	H,I	H,P			H,P	H,I		H,P,I	H,I	U						18		
19	Keytones	H	H,F						H,I		H	H								19	
20	Mercaptans and Other Organic Sulfides	T,G	H,F,T						H,I									H	H	H	20
21	Metals, Alkali and Alkaline Earth, Elemental	G,H,F	G,H,F	G,H,F	G,H,F	G,H,F	G,H	G,H	G,H	G,H	G,H	G,H	G,T,H	G,H				H,E	G,H	G,H	G,H
22	Metals, as Powders, Vapors or Sponges	G,H,F	G,H,F	I,F					H,F,T	U	G,H							H,E	G,H		H,G,F
23	Metals, as Sheets, Rods, Moldings, etc.	G,H,F	G,H,F						H,F,I									H,F			
24	Metals and Metal Compounds, Toxic	S	S	S			S	S			S										
25	Nitrides	G,H,F	H,F	H,G	G,H,E	G,H			U	H,I	U	G,H	G,H	G,H				G,H	U	G,H	G,H
26	Nitriles	H,T,G	H,F,T	H							U										
27	Nitro Compounds, Organic		H,F,T			H					H,E										
28	Hydrocarbons, Aliphatic Unsaturated	H	H,F			H															
29	Hydrocarbons, Aliphatic Saturated		H,F																		
30	Peroxides and Hydroperoxides, Organic	H,I	H,E		H,P	H,I		H,T	H,F,E	H,F,T		H,E,T	H,E,T					H,E	H	E	H,F,T
31	Phenols and Cresols	H	H,F						H,I										H,F		
32	Organophosphates, Phosphothioates, Phosphodithioates	H,T	H,T						U		H,E										
33	Sulfides, Inorganic	T,G	H,F,T	T		H			E										H		
34	Epoxides	H,P	H,P	H,P	H,P	U		H,P	H,P		H,P	H,P	U								H,F
101	Combustibles,Flammable Materials, Misc.	H,I	H,F,T																		
102	Explosives	H,E	H,E	H,E					H,E		H,E			H,E							
103	Polymerizable Compounds	P,H	P,H						P,H		P,H	P,H	U								
104	Oxidizing Agents, Strong	H,T		H,T	H,F	H,F	H,F,T	H,F,T	H,E	H,F,T		H,E,T	H,F,T	H,F	H,F		H,F	H,T	H,F,T	H,F	H,F,T
105	Reducing Agents, Strong	H,G	H,F,T	H,G	H,G,F	G,H,F	G,H	H,G	H,I				H,T	H,F				H,E	G,H	G,H	G,H
106	Water and Mixtures Containing Water	H	H						I										H,I		
107	Water Reactive Substances																				

Reactivity Group No.	Reactivity Group Name	21	22	23	24	25	26	27	28	29	30	31	32	33	34	101	102	103	104	105	106	107
21	Metals, Alkali and Alkaline Earth, Elemental	21																				
22	Metals, as Powders, Vapors or Sponges		22																			
23	Metals, as Sheets, Rods, Moldings, etc.			23																		
24	Metals and Metal Compounds, Toxic				24																	
25	Nitrides	E				25																
26	Nitriles	H,F			S	G,H	26															
27	Nitro Compounds, Organic	H,G,F				H,G,F		27														
28	Hydrocarbons, Aliphatic Unsaturated		H,E						28													
29	Hydrocarbons, Aliphatic Saturated									29												
30	Peroxides and Hydroperoxides, Organic	H,E	H,I		H,I	H,G,F	H,F,T		H,F		30											
31	Phenols and Cresols	G,H				G,H					H	31										
32	Organophosphates, Phosphothioates, Phosphodithioates	H									U		32									
33	Sulfides, Inorganic										H,T			33								
34	Epoxides	H,F	H,F		H,F	H,F					H,F	H,F	U	H,F	34							
101	Combustibles,Flammable Materials, Misc.	H,I,F				H,G,F					H,F,T					101						
102	Explosives	H,E	H,E	H,E	E	E					H,E	H,E		H,E	H,E	H,E	102					
103	Polymerizable Compounds	F,H	F,H	F,H	F,H	F,H					F,H	F,H		F,H			H,E	103				
104	Oxidizing Agents, Strong	H,F,E	H,F,E	H,F		H,F,E	H,F,T	H,E	H,F	H,F	H,I	H,F	H,F,T	H,F,T	H,F,I	H,F,I	H,E	H,P,T	104			
105	Reducing Agents, Strong						H,G	H,E			H,E	G,H	T,G,H		H	G,H	H,E	H,P,G	H,F,E	105		
106	Water and Mixtures Containing Water	G,H	G,H		S	G,H								T,G						G,T	106	
107	Water Reactive Substances																					107

Reactivity Code	Consequences
H	Heat generation
F	Fire
I	Innocuous
T	Toxic gas generation
G	Flammable gas generation
E	Explosion
P	Violent polymerization
S	Solubilization of toxic substances
U	May be hazardous but unknown

Figure 3-1 Waste Reactivity Group Compatibility Matrix

Figure 3-2. COMPATIBILITY MATRIX FOR TANK WASTES

SOURCE WASTE TYPE	RECEIVER WASTE TYPE: DN	DSSF	DC	CC	NCRW (PD)	PT	NCAW	CP
DN	X	X	X	X	X	X	X	X
DSSF	X	X						
DC			X	X*				
CC			X*	X				
NCRW SOLIDS (PD)	X				X	X		
PFP SOLIDS (PT)	X				X	X		
NCAW							X	
CP								X

DN dilute non-complexant waste
DSSF double-shell slurry feed
DC dilute complexant waste
CC concentrated complexant waste
PD PUREX neutralized cladding removal waste
PT TRU solids fraction from PFP Plant operations
NCAW aging waste from PUREX
CP concentrated phosphate waste

X Indicated waste type mixing which has occured historically without adverse effects.

* Adding CC to DC is permitted but would not ordinarily be done. The volume of combined waste which would need to be evaporated would be increased, resulting in increased evaporation costs.

3.2.2 TRU Waste Segregation

TRU waste shall be segregated, to the extent practicable, in the DST system.

If the waste source [TRU] ≥ 100 nCi/g, then transfer waste to a TRU storage tank. If the waste source [TRU] < 100 nCi/g, transfer to a non-TRU tank or perform a technical evaluation demonstrating that TRU segregation in a TRU storage tank will not be jeopardized.

3.2.3 Heat Generation Rate Limit

If the sum of the receiving tank waste and the source waste heat generation rates (usually estimated from the mean ^{90}Sr and ^{137}Cs concentrations) is ≤ OSD limit for the receiving tank, the transfer may be allowed; otherwise, select a different tank. The OSD limits for tank heat generation rate are given in Table 3-1.

Table 3-1 Tank Farm Heat Generation Rate Limits

Tank Farm	Maximum Heat Generation Rate Per Tank (Btu/hr)
241-AN 241-AP 241-AW	70,000
241-AY 241-AZ	700,000
241-SY	50,000

3.2.4 Complexant Waste Segregation

If the mean [TOC] is > 10 g/L at double-shell slurry feed (DSSF) composition[3], then transfer to a complexant waste tank. The PREDICT model for the evaporator (Allison 1984) is generally used to determine [TOC] at DSSF concentration for waste streams containing major inorganic salts (i.e., sodium hydroxide, sodium aluminate, sodium nitrate, sodium nitrite, sodium carbonate, sodium sulfate, sodium phosphate, and sodium fluoride).

[3] DSSF waste composition is defined in the monthly Tank Farms Waste Status Summary, WHC-EP-0182.

A more definitive method of determining if a stream is complexant waste is to perform a boildown of the waste. A waste is complexant if either of the following complexant waste behaviors is observed:

1) rapid viscosity increase upon crystallization, or

2) formation of small non-settling crystals.

3.2.5 Waste Pumpability

The waste pumpability rule is based on the Reynolds number (N_{Re}) for the transfer event.

If the $N_{Re} = \rho D v/\mu$ (calculated using density (ρ), viscosity (μ), pipe diameter (D), and velocity (v)) at the conditions of transfer is ≥ 20,000, and the volume percent solids is ≤ 30, then the transfer may be allowed; otherwise, a technical evaluation to show that the transfer can occur without plugging should be completed.

Volume percent solids (measured or estimated) and the cooling curve verification of precipitating solids as a function of temperature may also be used to aid in the determination of waste pumpability.

3.2.6 High Phosphate Waste

If the $[PO_4^{-3}]$ > 0.1 M, the waste is not to be mixed with:

- waste with $[Na^+]$ > 8 M or
- neutralized cladding removal waste (NCRW)[4].

[4] NCRW is the solids portion of the PUREX Plant neutralized cladding removal waste stream; received in tank farms as a slurry. NCRW solids are classified as TRU waste.

Table 3-2 Analytical Data Needs for Compatibility	
Parameter	Needed for:
Aluminum	PREDICT model for the 242-A Evaporator
Americium-241	TRU concentration determination
Carbonate	PREDICT model for the 242-A Evaporator
Cesium-137	Heat generation rate determination
Chloride	Corrosion rule for 204-AR Facility
Cooling Curve	Waste pumpability determination
Exotherm/Endotherm Ratio	Energetics rule determination
Fluoride	PREDICT model for the 242-A Evaporator
Hydroxide	Corrosion rule determination PREDICT model for the 242-A Evaporator
Nitrate	Corrosion rule determination PREDICT model for the 242-A Evaporator
Nitrite	Corrosion rule determination PREDICT model for the 242-A Evaporator
Organic Carbon	Complexant waste determination PREDICT model for the 242-A Evaporator
Organic, Separable	Energetics rule determination
pH	Corrosion rule determination
Phosphate	PREDICT model for the 242-A Evaporator
Plutonium-239/240	Criticality rule determination TRU concentration determination
Solids, Vol.%	Criticality rule determination Waste pumpability determination
Specific Gravity	Flammable gas rule determination Waste pumpability determination
Strontium-90	Heat generation rate determination
Sulfate	PREDICT model for the 242-A Evaporator
Uranium	Criticality rule determination
Viscosity	Waste pumpability determination

4.0 TECHNICAL BASES

4.1 SAFETY DECISION RULES

4.1.1 Criticality

The criticality decision rules are given in detail in the Criticality Prevention Specification (Vail 1994). Limits are given for receiver tanks containing more than 10 Kg of Pu and for receiver tanks containing less than 10 Kg of Pu.

The margin of subcriticality is based on control of the form and distribution of waste components. The alkalinity of waste streams ensures insolubility of Pu.

4.1.2 Flammable Gas

Concerns with flammable gas are centered on generation combined with retention in a waste matrix followed by episodic release. The premise of the current approach is that specific gravity of the source and receiving wastes may aid in identifying transfers that may lead to flammable gas generation and retention.

The flammable gas strategy is under review and practical alternatives to specific gravity measurement are being investigated.

4.1.3 Energetics

Wastes that exhibit exotherms indicate the potential for self-heating and could enter into a propagating chemical reaction. The net energy available for heating the waste from an exothermic chemical reaction is greatly diminished by endotherms resulting from water losses, phase changes, and other competing reactions. Where the endotherms are greater, a propagating reaction would be inhibited. If exotherms are in excess, the potential for propagating self-heating must be assumed until demonstrated otherwise. There is some conservatism in comparing endotherms and exotherms because the heat capacity of the material in the endothermic regions is not accounted for. Additional heat must be absorbed by the material to raise its temperature to the exothermic reaction temperature.

If separable organics were allowed into the waste storage tanks and temperatures in the tanks exceeded 75 °C (167 °F), organic vapors or distillates could accumulate in the tanks, in overhead systems or in condensate collection tanks. An organic liquid fire or vapor explosion could result from the accumulations.

4.1.4 Corrosion

The nitrate, nitrite, and hydroxide concentrations are limited to inhibit corrosion and stress corrosion cracking. If corrosion is not controlled, deterioration of the primary tank will occur at a faster rate. Failure of the tanks could occur under prolonged conditions that are out of specifications.

Chloride concentration limits are placed on waste shipments received at the 204-AR Facility to inhibit corrosion of the stainless steel transfer piping within the facility.

Corrosion rules are based on limits specified in Operating Specification Documents for Tank Farms (WHC 1994a, and 1994b).

4.1.5 Watch List Tanks

Public Law 101-510, Section 3137, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," requires that no additional high-level waste be added to a tank identified as having a serious potential for release of waste caused by uncontrolled increases in temperature or pressure. The Watch List tanks have been so identified.

A listing of Watch List tanks is contained in the latest Waste Tank Summary (WHC-EP-0182-XX) which is issued monthly by Tank Stabilization and Engineering Support.

4.1.6 Chemical Compatibility

Use of Figure 3-1 to screen waste transfers is a consistent method of identifying potential chemical incompatibilities. The DST Waste Analysis Plan requires that applicable waste reactivity groups be identified by the waste generator(s) prior to waste transfer (Mulkey and Jones 1994).

4.2 OPERATIONS DECISION RULES

4.2.1 Tank Waste Types

Wastes in the tank farms have already been categorized as one of the types listed with the compatibility matrix for tank wastes, Figure 3-2. Mixing of waste types not included in the matrix could jeopardize complexant and TRU waste segregation, and/or result in decreased waste volume reduction potential, increased costs for waste evaporation, retrieval, pretreatment and disposal.

4.2.2 TRU Separation

In accordance with DOE Order 5820.2A (DOE 1988), TRU waste in the DSTs shall be segregated, to the extent practical. Additionally, gross volumes of generated TRU wastes are to be reduced. Dissolving precipitated TRU constituents increases the mobility of the TRU and, therefore, increases the concerns associated with interim storage. Also, costs for final disposal of the wastes would likely increase because the TRU waste volumes requiring disposal may increase and/or additional waste pretreatment steps may be needed to prepare the wastes for final disposal processes.

4.2.3 Heat Generation

The heat generation rate in tanks is limited to prevent localized boiling from occurring. The ventilation systems for AN, AP, AW, and, SY Tank Farms were not designed for boiling. Boiling could possibly cause a release of contamination.

The heat generation rule is based on limits for tanks in the 241-AN, 241-AP, 241-AW, and 241-SY tank farms given in OSD-T-151-00007 (WHC 1994a); and on limits for tanks in the 241-AY, and 241-AZ tank farms given in WHC 1993.

4.2.4 Complexant Waste Separation

For screening purposes, complexant wastes are generally described as wastes with a TOC concentration > 10 g carbon/L at DSSF concentration. The PREDICT model is used to estimate TOC concentration if the waste were evaporated to DSSF product composition.

Some very dilute waste stream compositions, when evaluated using PREDICT, indicate that the streams meet requirements for complexant waste. This occurs because concentration of the dilute streams, essentially to dryness, leaves all of the organic carbon in the small amount of residue. In general, the model has proved to be a useful tool for evaluating whether tank wastes should be segregated as complexant. PREDICT, however, was designed to provide a time-saving method of predicting evaporator operating conditions and product composition.

A more definitive method of determining whether a stream is complexant waste is to perform a boildown of the waste. A rapid viscosity increase upon crystallization or the formation of small non-settling crystals indicates that the stream is indeed complexant waste.

Segregating waste as complexant ensures that it is stored with a high water content, nominally > 50% water. A complexant waste is concentrated only to the saturation level of the major soluble salt (normally a nitrate), and formation of solid crystals is avoided. When complexant waste is concentrated to a point where solids form, the viscosity increases rapidly. A thick waste matrix with the consistency of petroleum jelly may be formed.

There is also concern that forming organic-TRU complexes in the liquid phase could make the TRU more mobile. (See Section 4.2.1, TRU Separation.)

4.2.5 Waste Pumpability

The minimum N_{Re} of 20,000 was chosen as an indication that waste may be transferred without plugging based on an evaluation of transferring neutralized decladding slurry from PUREX Plant to the 241-AW tank farm (Tulberg 1983). The neutralized decladding slurry contained approximately 50% solids suspended in solution.

Flow appeared to be impeded significantly as the Reynolds number dropped below 20,000. The hindrance is believed to have been caused by settling solids in the transfer line. It was demonstrated that flow in the turbulent region, above a 20,000 N_{Re}, was sufficient to eliminate settling and plugging in transfer lines.

4.2.6 High Phosphate Waste

Studies on the solubility of sodium phosphate (Na_3PO_4) in simulated tank wastes display the formation of needle shaped crystals of $Na_3PO_4 \cdot 12H_2O$ (Herting 1987). These crystals increase the viscosity of the waste and can cause the waste to form a gel-like matrix. This will reduce the ability of pumps to transfer the waste and could make future retrieval more difficult.

Mixing studies performed with PUREX Plant waste types (Herting and Patterson 1982) indicate that the mixing of NCRW or the concentrate of NCRW supernate with concentrated waste from 100-N Area causes the waste mixture to solidify to a hard mass when it cools. This could increase the time and cost involved with the retrieval and treatment of this waste material.

5.0 DATA QUALITY

All sampling and analyses generated by this Tank Farms Waste Transfer Compatibility Program will conform to applicable Quality Assurance and Quality Control requirements as set forth in WHC 1995, Whelan 1994, and in the Waste Compatibility DQO (Fowler 1995), and in specific laboratory procedures.

6.0 REFERENCES

Allison, J. M., 1984, "Computer Prediction of Evaporator Operation," SD-WM-ADP-004, Rev. 0, Rockwell Hanford Operations, Richland, Washington.

DOE, 1988, *Radioactive Waste Management*, DOE Order 5820.2A, U. S. Department of Energy, Washington, D.C.

Fowler, K. D., 1995, *Data Quality Objectives for the Waste Compatibility Program*,. WHC-SD-WM-DQO-001, Westinghouse Hanford Company, Richland, Washington.

Herting, D. L., and K. J, Patterson, 1982, "Effects of Mixing Waste Types - Concentrated Streams," Internal Memo, Rockwell Hanford Operations, August 26, 1982, Richland, Washington.

Herting, D. L., 1987, "Phosphate Solubility in Simulated Defense Waste," Internal Memo, Rockwell Hanford Operations, March 6, 1987, Richland, Washington.

Mulkey, C. H., and J. M. Jones, 1994, *Double-Shell Tank Waste Analysis Plan*, WHC-SD-EV-053 Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Tulberg, D. M, 1983, "Zirflex Decladding Sludge Flowsheet - Reverse Strike," PFD-T-200-00002, Rev. A-0, Rockwell Hanford Operations, Richland, Washington.

USEPA, 1994, *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual*, PB94-963603, OSWER 9938.4-03, April 1994

Vail, T. S., 1994, *Criticality Prevention Specification*, CPS-T-149-00010, Rev. E-0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, *Aging Waste Facility Interim operational Safety Requirements, Rev. A, Draft*, WHC-SD-WM-OSR-004, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994a, *Operating Specifications for 241-AN, AP, AW, AY, AZ, & SY Tank Farms*, OSD-T-151-00007, Rev. H-8, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994b, *Operating Specifications for the 204-AR Waste Unloading Facility*, OSD-T-151-00008, Rev. E-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1995, *Quality Assurance Manual*, WHC-CM-4-2, Release 77, Westinghouse Hanford Comopany, Richland, Washington.

Whelan, T. E., 1994, *TWRS Characterization Program Quality Assurance Program Plan*, WHC-SD-WM-QAPP-025, Rev. 0, Westinghouse Hanford Company, Richland, Washington.