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ENGINEERING CHANGE NOTICE

1. ECN 653810

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Duc M. Nguyen, Data Assessment and Interpretation, R2-12, 372-3042	[] Yes [X] No	05/26/99
	6. Project Title/No./Work Order No. Tank 241-U-107	7. Bldg./Sys./Fac. No. 241-U-107	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-614, Rev. 0-B	10. Related ECN No(s). ECNs: 163506, 650094	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN has been generated in order to update the document to reflect results of recent data/information evaluation.

Replace pages:
ES-7, ES-8, 5-7, 5-8, 6-1, 6-2, 7-3 and 7-4

RECEIVED EDMC JUN 1999

14a. Justification (mark one)

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

14b. Justification Details

A tank characterization report page change revision is required to reflect the results of recent evaluation of data/information pertaining to adequacy of tank sampling for safety screening purposes (Reynolds et al. 1999, Evaluation of Tank Data for Safety Screening, HNF-4217, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington).

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

See attached distribution.

RELEASE STAMP

6-4-99 DATE

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19 ID

A-7900-013-2 (05/96) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-653810

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. 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 13. Enter the affected document number in Block 20.

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	[]		[]

20. 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
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. D.M. Nguyen	Dan M. Nguyen	6/3/99	PE		
Cog. Mgr. K.M. Hall	[signature]	6/3/99	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-U-107

Duc M. Nguyen
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-653810 UC: 2070
Org Code: 74B20 CACN/COA: 102217/EI00
B&R Code: EW 3120074 Total Pages: 233

Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-U-107, Tank U-107, U-107, U Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: N/A

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-614	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-U-107

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) Initially released 9/18/96 on EDT 617551.	J. Jo	J. G. Kristofzski
0A RS	Incorporate per ECN-163506.	M. J. Kupfer 8-29-97	K. M. Hodgson 8-27-97
0B RS	Incorporate per ECN-650094.	M.J. Kupfer 9-16-98	K.M. Hodgson 9-17-98
0-C RS	Incorporate per ECN-653810.	D.M. Nguyen 6/3/99	K. M. Hodgson 6/3/99

A-7320-005 (08/91) WEF168

of the supernate heat load based on analytical data was 189 W (645 Btu/hr), indicating no waste compatibility concerns. The total tank heat load estimate from radionuclide data was 1,017 W (3,470 Btu/hr). The historical tank content estimate (HTCE) prediction was 2,520 W (8,600 Btu/hr) (Agnew et al. 1996a), and an estimate based on the tank headspace temperature was 1,610 W (5,480 Btu/hr) (Kummerer 1994). The average tank temperature between July 1987 and July 1996 was 24.7 °C (76.4 °F), the minimum temperature was 17 °C (62 °F), and the maximum temperature was 32 °C (89 °F). The tank has exhibited an upper temperature extreme in the past, which no longer exhibits, therefore, it may be concluded that any heat generated from radioactive sources is adequately dissipated.

The weight percent water, total alpha, and TOC results met the criteria of the safety screening and organic DQOs. Although only one of the three collected core samples contained waste from the bottom segments, the sampling and analytical results are considered sufficient to address the data needs specified for safety screening (Reynolds et al. 1999).

Table ES-2 shows the results for major analytes and analytes of concern from 1996 core sample and 1995 grab sample. The liquid inventory was calculated by multiplying the supernate mean by the supernate waste volume and dividing by a unit conversion factor of 1E+06. The solid inventory was calculated by multiplying the solid mean by the solid density and the solid waste volume and dividing by a unit conversion factor of 1E+06. The total inventory was the sum of liquid and solid inventories.

Table ES-2. Major Analytes and Analytes of Concern.[1,2] (2 sheets)

Analyte	Mean Solid Concentration	Solid RSD (Mean)	Mean Liquid Concentration	Liquid RSD (Mean)	Total[3] Inventory
METALS	**μg/g**	**%**	**μg/mL**	**%**	**kg**
Aluminum	7,620	26.8	23,100	3.5	19,100
Chromium	2,410	36.9	567	35.3	5,270
Phosphorous	2,720	53.1	1,130	3.7	6,000
Potassium	819	16.5	3,150	7.6	2,140
Sodium	2.01E+05	4.1	2.19E+05	1.8	4.60E+05
Sulfur	721	23.5	2,110	14.8	1,810
ANIONS	**μg/g**	**%**	**μg/mL**	**%**	**kg**
Chloride	2,320	19.0	7,900	4.3	5,930
Hydroxide	---	---	26,600	2.9	3,110
Nitrate	4.81E+05	12.4	2.38E+05	14.0	1.07E+06
Nitrite	25,100	18.6	96,200	4.3	65,500
Oxalate	3,120	28.5	1,070	47.3	6,860
Phosphate	12,300	39.5	3,830	15.8	26,900
Sulfate	4,490	27.5	6,390	13.4	10,400
RADIONUCLIDES	**μCi/g**	**%**	**μCi/mL**	**%**	**Ci**
Total alpha	0.102	38.6	< 0.0108	n/a	221
^{137}Cs	76.8	19.4	338	19.0	2.06E+05
CARBON	**μg C/g**	**%**	**μg C/mL**	**%**	**kg**
Total inorganic carbon	2,750	28.7	5,400	12.1	6,570
Total organic carbon	2,070	30.5	4,070	7.9	4,950

Table 5-4. Comparison of Historical Estimates with the 1996 Analytical Results for Tank 241-U-107.[1,2]

Analyte	HTCE Estimate[3]	1996 Analytical Result
METALS	**µg/g**	**µg/g**
Aluminum	57,300	8,230
Calcium	1,280	282
Chromium	1,570	2,270
Iron	1,300	742
Manganese	112	301
Nickel	205	25.8
Potassium	1,140	922
Silicon	1,220	192
Sodium	1.60E+05	1.98E+05
ANIONS	**µg/g**	**µg/g**
Chloride	3,810	2,560
Nitrate	1.72E+05	4.61E+05
Nitrite	60,600	28,200
Phosphate	4,590	11,600
Sulfate	12,300	4,480
Oxalate	1.79	2,960
Acetate	196	5,230[4]
Carbonate	14,700	14,200[5]

Notes:

[1]Agnew et al. (1996a)
[2]Jo (1996b)
[3]The data are not validated and should be used with caution.
[4]Calculated from TOC.
[5]Calculated from TIC.

Comparing the HTCE with the analytical values gives varied results. Some analytes are reasonably close in their estimates, and others are very different. In general, most comparisons were the same order of magnitude.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

The three core samples retrieved from tank 241-U-107 in February and March 1996 were taken to meet the requirements of the safety screening DQO (Dukelow et al. 1995), the organic DQO (Turner et al. 1995), and the waste compatibility DQO (Fowler 1995). In addition, a waste compatibility evaluation was performed on the results of a 1995 grab sampling event. This section discusses the specific requirements of these DQOs and makes a comparison between the analytical results and the defined concentration limits. Section 5.5.1 details the safety evaluations required by the three DQOs, and section 5.5.2 details the pertinent operations decision rules specified in the waste compatibility DQO.

5.5.1 Safety Evaluation

Data criteria in the safety screening DQO are used to assess tank waste safety and to check for unknown safety issues, and the data criteria in the organic DQO are used to assess the possibility of an exothermic reaction between precipitated nitrate or nitrite salts and organic complexants. The waste compatibility DQO establishes criteria to prevent safety or operational problems that could be caused by transferring waste. The set of primary analyses required by the three DQOs include TGA to determine the moisture content, DSC and TOC to evaluate energetics and fuel content, total alpha activity to determine the criticality potential, specific gravity/density measurements to evaluate the potential for flammable gas accumulation within the waste, a visual check of drainable liquid samples for the presence of a separable organic layer, and a measurement of the flammability of tank headspace gases. In addition, the waste compatibility DQO imposes limits on the tank contents to control corrosion. The safety screening DQO indicates two widely spaced vertical cores would be a near optimum sampling scheme. Three core samples were taken because of incomplete recovery. Although only one of the three core samples contained waste from the bottom two to five segments, the sampling and analytical results are considered sufficient to address the data needs specified in the DQO. Basis for the determination that the data needs have been sufficiently addressed is provided in Reynolds et al. (1999). For each required analysis, a decision threshold was established by the DQOs which, if exceeded, may warrant further investigation to assure tank safety. Table 5-5 and 5-6 list applicable safety issues, decision variables, DQO thresholds, and the mean analytical results for the safety, organic complexant and waste compatibility DQOs.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The waste in tank 241-U-107 was core sampled in February and March 1996 in accordance with the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue* (Turner et al. 1995), and *Data Quality Objectives for Tank Farms Waste Compatibility Program* (Fowler 1995). The requirements for these documents were integrated into the *Tank 241-U-107 Push Mode Core Sampling and Analysis Plan* (Jo 1996c). All analyses were performed at the Westinghouse Hanford Company 222-S Laboratory. The tank supernate was grab sampled in April 1995. A waste compatibility evaluation was performed on the analytical results.

Comparisons were made between the analytical results and the decision thresholds in the DQOs. Two liquid samples exhibited exothermic reactions with changes in enthalpy greater than the decision limit of -480 J/g. The mean DSC result of the drainable liquid from core 135, segment 1 was -558.7 J/g. The mean DSC result of the drainable liquid from core 135, segment 1R was -537.6 J/g. The overall solids mean for total alpha activity was 0.102 μCi/g, well below the calculated safety screening threshold of 32.7 μCi/g. The overall liquids mean for total alpha activity was $<$ 0.0108 μCi/mL, well below the waste compatibility threshold of 0.812 μCi/mL.

All TOC results were well below the action limit of 30,000 μg C/g (dry weight basis). The highest reported TOC result for the solids was 16,100 μg C/g, and the highest recorded liquid result was 13,700 μg C/mL (all results dry weight). The overall mean weight percent water for the solid portion of the waste was 22.7 percent. For the solid portion of the tank, six sample means for weight percent water were below the organic complexant DQO threshold of 17 percent. Because no solid DSC result violated the action limit, secondary analyses were not performed. Flammable gas concentration in the tank headspace ranged from 0 to 4 percent of the LFL.

The headspace of tank 241-U-107 was sampled in the February 1995 for gases and vapors to address DQO for flammability and industrial hygiene concerns (Osborne 1994). It was determined that no headspace constituents exceeded the flammability notification limits, but that ammonia, measured to be 453 ppmv in dry air, exceeded the 150 ppmv industrial hygiene notification limit specified in the current Vapor Sampling Analysis Plan (Homi 1995). However, because the ammonia is in the tank headspace and not in the breathing zone, it will not impact worker health. Although the specific gravity mean of 1.43 g/mL exceeded the waste compatibility limit of 1.3 g/mL, no early notification was required according to an agreement with the West Systems Engineering cognizant engineer (Esch 1995). Finally, the concentrations of hydroxide, nitrate, and nitrite were within their prescribed corrosion specifications.

The waste compatibility DQO also requires an operations analysis of nonroutine transfers before they are approved. Several decision criteria apply; all analytical results met the criteria. The concentration of TRU elements in the tank (0.00129 μCi/g) was below the

threshold of 0.1 μCi/g, indicating that the waste may be transferred to a non-TRU classified waste tank. Concerns about the mixing of high phosphate waste with certain other waste types was not an issue because the phosphate result of 0.0403 M was well below the high phosphate threshold of > 0.1 M. The estimate of the supernate heat load based on the analytical data was 189 W (645 Btu/hr), indicating no waste compatibility concerns. The estimate of the tank heat load was 1,017 W (3,470 Btu/hr) and the HTCE estimate was 2,520 W (8,600 Btu/hr). Because the tank exhibits an upper temperature limit, it may be concluded that any heat generated from radioactive sources throughout the year is dissipated.

Because the weight percent water results were greater than 17 percent, the tank may be considered conditionally safe according to the organic DQO (Turner et al. 1995). Although large exothermic reactions were found for two samples, the water contents were well above the minimum required to prevent a propagating exothermic reaction. Core sampling was hindered by very compact and hard areas of the waste. Although only one complete vertical profile of the tank waste was obtained, the sampling and the analytical results from the three core samples are considered sufficient to address the data needs specified in the safety screening DQO (Reynolds et al. 1999).

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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