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ENGINEERING CHANGE NOTICE

1. ECN 653788

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 []	T. A. Hu, Data Assessment and Interpretation, R2-12, 373-4098	[] Yes [X] No	05/24/99
	6. Project Title/No./Work Order No. Tank 241-U-102	7. Bldg./Sys./Fac. No. 241-U-102	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-618, Rev. 0-B	10. Related ECN No(s). ECNs: 635514, 650103	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: 2-3, 2-4, 4-1 through 4-4, 5-3 and 5-4.

JUN 1999 RECEIVED EDMC

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

MAY 27 1999 DATE

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

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-653788

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. T.A. Hu	[signature]	5-27-99	PE		
Cog. Mgr. K.M. Hall	[signature]	5/27/99	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

S

Tank Characterization Report for Single-Shell Tank 241-U-102

T. A. Hu
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-653788 UC: 2070
Org Code: 74B20 CACN/COA: 102217/EI00
B&R Code: EW 3120074 Total Pages: 258

Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-U-102, Tank U-102, U-102, 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 HNF-SD-WM-ER-618	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-U-102

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 01/24/97 on EDT-613495.	T.A. Hu	K.M. Hall
0-A RS	Incorporate per ECN-635514.	T.A. Hu	K.M. Hall
0-B RS	Incorporate per ECN-650103.	M.J. Kupfer	K.M. Hodgson
0-C RS	Incorporate per ECN-653788.	T.A. Hu	K.M. Hall

A-7320-005 (08/91) WEF168

experienced with non-complexant waste liquids. The reported inductively-coupled plasma spectoscopy (ICP) values seem consistent for a near-saturated salt solution with specific gravities reported in the range of 1.35 to 1.40.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-U-102 for potential safety problems is documented in *Tank Safety Screening Data Quality Objective*, Rev. 2 (Dukelow et al. 1995). These potential safety problems are: exothermic conditions in the waste; flammable gases in the waste and/or tank headspace; and criticality conditions in the waste. Each of these conditions is addressed separately below. Because of the hardness of the waste in the lower regions of the tank, full vertical profiles could not be obtained using push mode core sampling. Approximately the bottom 66 cm (26 in.) of waste below riser 19 and the bottom 61 cm (24 in.) below riser 9 could not be sampled. Although full depth profiles were not obtained, sufficient sample was recovered to resolve safety screening issues for this tank (Reynolds et al. 1999).

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure that insufficient exothermic constituents (organic or ferrocyanide) exist in tank 241-U-102 to cause a safety hazard. Because of this requirement, energetics in the tank 241-U-102 waste were evaluated. The safety screening DQO required that the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine if the energetics exceed the safety threshold limit. The threshold limit for energetics is -480 J/g on a dry weight basis.

The DSC analyses revealed that nearly all samples displayed exothermic behavior. Two samples contained results that exceeded the safety screening notification threshold of -480 J/g; the mean dry weight result from the upper and lower half subsegment of segment two from core 143 had exotherms with enthalpy changes of -534.0 and -617.3 J/g (see Appendix C, Table C1-2), respectively. Because these samples exceeded the threshold, it was necessary to determine whether high TOC or high total cyanide concentrations were causing this higher exothermic behavior. The TOC concentration, adiabatic calorimetry testing, and energy equivalent calculation are discussed in Section 2.2, "Organic Complexant Safety." Because the ferrocyanide issue has been resolved and closed out (Cash 1996b), the following information will support this conclusion. Cyanide analysis was performed for samples that exceeded the DSC limit. The mean cyanide concentrations for these two samples were 30.1 and 21.0 μg/g using the EDTA addition and water distillation methods, respectively.

2.1.2 Flammable Gas

Vapor phase measurements, taken in the tank headspace prior to the push-mode core sampling in May 1996, indicated that no flammable gas was detected (0 percent of the lower flammability limit). Data from these vapor phase measurements are presented in Appendix B.

2.1.3 Criticality

The potential for criticality can be assessed from the total alpha activity data. The safety screening DQO notification limit is 1 g/L (Dukelow et al. 1995). Because the laboratory reported total alpha activity in units of μCi/g, the 1-g/L threshold was converted to 32.7 μCi/g for the solids using the formula of 61.5 (μCi/mL)/solid density (g/mL). The limit for solids was conservatively based on the highest density value for a single sample, 1.88 g/mL. The analytical mean for the solid phase was 0.192 μCi/g. This result, and the one-sided 95 percent confidence interval upper limit, were well below the DQO limits for all samples. (See Appendix C, Table C1-1). Therefore, there are no criticality issue concerns.

2.2 ORGANIC COMPLEXANT SAFETY

Based on a tank's fuel and moisture concentrations, the *Organic Complexant Safety Data Quality Objective* (Turner et al. 1995) establishes a set of criteria to categorize the tank as safe, conditionally safe, or unsafe. The criteria are applied to tanks that have or potentially have organic complexant safety issues as mentioned in the beginning of this section. Tank 241-U-102 was recently added to the list of tanks with organic complexant issues (Cash 1996a). According to the organic complexant safety DQO, a minimum fuel concentration to support a propagating reaction is 3 wt% TOC on a dry-weight basis. This criterion can be evaluated by the analytical results of the TOC concentration or the exothermic energy (J/g).

For tank 241-U-102, as discussed earlier in the safety screening section, almost all the samples show exotherms. The dry weight basis TOC concentrations for all analyzed samples and one-sided 95 percent confidence interval upper limits were below this 3 wt% (or 30,000 μg/g) TOC limit. The highest dry weight basis TOC value is 23,600 μg/g and the highest one-sided 95 percent confidence interval upper limit is 27,700 μg/g (see Appendix C, Table C1-4). The exothermic energies for these values are -162 J/g and -189 J/g, respectively (see Appendix C, Table C1-2).

Segments 2 upper and lower half from core 143 have DSC values exceeding the -480-J/g DSC limit. The TOC values in dry-weight basis of these two samples are 15,100 and 16,300 μg C/g with one-sided 95 percent confidence interval upper limits of 19,200 and 22,300 μg C/g (see Appendix C), respectively. The moisture content for those two sample are 51 and 50 percent, respectively.

4.0 SUMMARY AND RECOMMENDATIONS

The waste in tank 241-U-102 was core sampled in April and May 1996. The solids were analyzed in accordance with the safety screening, organic, and historical DQOs, and the drainable liquid was analyzed in accordance with the safety screening, organic, and waste compatibility DQOs. Furthermore, a characterization best-basis inventory was developed for the tank contents.

Regarding the safety evaluation, comparisons were made between the analytical results and the decision criteria thresholds listed in the safety screening and organic DQOs. Two samples contained exothermic reactions with changes in enthalpy above the DQO limit of -480 J/g dry weight. The mean dry weight DSC result for the upper and lower half subsegment of segment two of core 143 were -534.0 and -617.3 J/g dry weight. The moisture contents of these samples were 50.82 and 49.72 wt%, respectively, and the dry TOC concentrations are 15,100 and 16,300 μg C/g, respectively. The RSST test showed weak exothermic reaction and no propagation. Three subsegments had thermogravimetric analysis (TGA) results below the 17 wt% specified by the organic DQO. However, none of these subsegments contained exothermic reactions with changes in enthalpy greater than the -480 J/g dry weight limit. Another six subsegments had 95 percent confidence interval lower limits below 17 percent. None of these samples exhibited exothermic reactions or the upper limit to one-sided 95 percent confidence interval on the mean exceeding the safety screening limit. The organic DQO decision threshold for TOC concentration is 3 wt%, or 30,000 μg C/g dry weight. All TOC results, on a dry weight basis, were below the limit. Cyanide was analyzed on the two subsegments that displayed the high exothermic reactions. The overall cyanide mean of 30.1 μg/g was far below the limit of 39,000 μg/g. This result is consistent with the waste transaction record, which shows no evidence that this tank collects cyanide-containing compound.

The remaining requirements of the safety screening DQO were satisfied. The total alpha activity mean was 0.192 μCi/g for the solids. The single highest one-sided 95 percent confidence interval upper limit was 0.697 μCi/g, far below the decision threshold of 32.7 μCi/g (solids). The decision threshold for flammable gas concentration is 25 percent of the LFL. Combustible gas meter readings registered 0 percent of the LFL.

Based on analytical results, the estimated tank heat load was 2,340 W (8,000 Btu/hr). The Agnew et al. (1996) estimate of the tank heat load was 2,630 W (8,990 Btu/hr), and the estimate based on the headspace temperature was 1,670 W (5,701 Btu/hr) (Kummerer 1995). All three estimates were below the 11,700-W (40,000-Btu/hr) high-heat threshold (Smith 1986).

The historical DQO attempts to quantify the errors associated with predicting tank waste composition based on waste transaction history and waste type compositions. According to the transaction record (Agnew et al. 1995), a sludge layer was predicted to be present in the bottom 28 cm (11 in.) of the tank. Unfortunately, because of the hardness of the waste, no

sample was collected from this region of waste in the tank. The historical DQO gateway analysis was not performed. However, the SMM model prediction for the SMM layer was evaluated by comparing the core composite means with the concentration estimates provided in Agnew et al. (1996). The comparison gave varying results; the means for anions, density, and weight percent water agreed well. Generally, reasonable agreement was found for the remaining analytes.

The waste compatibility DQO has several safety criteria that pertain to the mixing of wastes transferred from different sources. The requirements regarding the exotherm/endotherm ratio, criticality, and corrosion limits were all satisfactorily met. The flammable gas accumulation decision threshold to transfer waste to a double-shell tank required the specific gravity of the source waste to be less than 1.3, or the weighted mean of the commingled wastes to be less than or equal to 1.41. The analytical mean result for tank 241-U-102 was 1.38.

The waste compatibility DQO also requires an operations analysis of non-routine transfers before they are approved, and several decision criteria apply. The analytical mean for TRU elements was below the decision threshold, allowing the waste to be transferred to a non-TRU tank. The heat load level was well below the tank operation specification limit, and the phosphate concentration was below the level that would cause crystallization and plugging of equipment. Three other operations were not comparable to analytical data, and were thus beyond the scope of this report.

Table 4-1 summarizes the status of Project Hanford Management Contractor (PHMC) TWRS Program Office review and acceptance of the sampling and analysis results reported in this tank characterization report. All DQO issues required to be addressed by sampling and analysis are listed in column one of Table 4-1. The second column indicates whether the requirements of the DQO were met by the sampling and analysis activities performed and is answered with a "yes" or a "no." The third column indicates concurrence and acceptance by the program in TWRS that is responsible for the DQO that the sampling and analysis activities performed adequately meet the needs of the DQO. A "yes" or "no" in column three indicates acceptance or disapproval of the sampling and analysis information presented in the TCR. If the results/information have not yet been reviewed, "n/r" is shown in the column. If the results/information have been reviewed, but acceptance or disapproval has not been decided, "n/d" is shown in the column.

Table 4-1. Acceptance of Tank 241-U-102 Sampling and Analysis.

Issue	Evaluation Performed	PHMC TWRS Program Office Acceptance
Safety screening DQO	Yes	Yes
Organic complexant DQO	Partial	Partial
Historical evaluation DQO	Partial	Partial
Waste compatibility DQO	Yes	Yes
Vapor screening	No	n/a

Because of the hardness of the waste, this push-mode core sampling could reach the waste no further than roughly 66 cm (26 in.) and 61 cm (24 in.) from the tank bottom for core 143 and 144, respectively. Consequently, a full evaluation could not be completed for the organic complexant and historical DQOs. According to the waste transaction record and HDW Model (Agnew et al. 1995 and 1996), the bottom 28 cm (11 in.) of waste is expected to be a REDOX sludge layer, and the rest of the 61-cm (24-in.) depth of unsampled segments is expected to be similar to the collected evaporator concentrates waste. Although full depth profiles were not obtained, sufficient sample was recovered to resolve safety screening issues for this tank (Reynolds et al. 1999).

Table 4-2 summarizes the status of TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluations specifically outlined in this report are the gateway analysis and the evaluation to determine whether the tank is safe, conditionally safe, or unsafe. Column one lists the different evaluations performed in this report. Columns two and three are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is also the same as that in Table 4-1.

Overall, the available samples, historical data information, and evaluation of the current analytical results on the various DQOs give no indications that the tank's status is unsafe according to the safety screening DQO.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-U-102.

Issue	Evaluation Performed	PHMC TWRS Program Office Acceptance
Historical "gateway" analysis	No	No
Core composite sample comparison	Yes	n/r
Waste type classification	Yes	Yes
Safety Screening	Yes	Yes

Note:
n/r = Not reviewed

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Reynolds, D. A., 1996, *Samples to Ship to PNNL for Organic Speciation* (internal letter 74A30-96-047 to K. M. Hall, October 28), Lockheed Martin Hanford Corporation, Richland, Washington.

Reynolds, D. A., W. T. Cowley, J. A. Lechelt, B. C. Simpson, 1999, *Evaluation of Tank Data for Safety Screening*, HNF-4217, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Simpson, B. C., and D. J. McCain, 1996, *Historical Model Evaluation Data Requirements*, WHC-SD-WM-DQO-018, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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Steen, F. H., 1996a, *45-Day Safety Screening Results for Tank 241-U-102, Push Mode Cores 143 and 144*, WHC-SD-WM-DP-189, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Steen, F. H., 1996b, *Final Report for Tank 241-U-102, Cores 143 and 144*, WHC-SD-WM-DP-189, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

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