ENGINEERING CHANGE NOTICE	0050768 Page 1 of 2	1. ECN 653811 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 []	Leela M. Sasaki, Data Assessment and Interpretation, R2-12, 373-1027	[] Yes [X] No	05/26/99
	6. Project Title/No./Work Order No. Tank 241-AY-102	7. Bldg./Sys./Fac. No. 241-AY-102	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-454, Rev. 0-C	10. Related ECN No(s). ECNs: 629971, 612298, 644494	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-1 through ES-4, 5-7, 5-8, 6-1, 6-2, and 7-1 through 7-4

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

DATE: 6-4-99

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ID: 19

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

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-653811

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.	L.M. Sasaki *L.M. Sasaki*	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 Double-Shell Tank 241-AY-102

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

EDT/ECN: ECN-653811 UC: 2070
Org Code: 74B20 CACN/COA: 102217/EI00
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Key Words: Waste Characterization, Double-Shell Tank, DST, Tank 241-AY-102, Tank AY-102, AY-102, AY Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: N/A

6/4/99
Release Approval Date

Approved for Public Release

RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-454	Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AY-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 07/06/95 on EDT-612092.	G.W. Ryan	J.G. Kristofzski
RS 0-A	Incorporate per ECN-629971.	L.M. Sasaki	J.G. Kristofzski
		L.M. Sasaki	[signature] 4/15/96
0B RS	Incorporate per ECN-612298	M.J. Kupfer	K.M. Hodgson
		[signature] 8-27-97	K.M. Hodgson 8-27-97
0C RS	Incorporate per ECN-644494.	M. J. Kupfer	K. M. Hodgson
		8-31-98	K.M. Hodgson 9-18-98
0-D RS	Incorporate per ECN-653811.	L.M. Sasaki	K.M. Hall
		L.M. Sasaki	[signature] 6/3/99

A-7320-005 (08/91) WEF168

EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, present status, and sampling and analysis results of waste stored in the double-shell underground storage tank 241-AY-102. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-08 (Ecology et al. 1994).

Tank 241-AY-102 is located in the AY Tank Farm in the Hanford Site's 200 East Area. The tank was designed to provide storage space for high-level aging waste generated at the Plutonium-Uranium Extraction (PUREX) Plant and B Plant. Tank 241-AY-102 began receiving transfers of waste water in 1971. Receipt of aging waste and evaporator slurry return occurred in 1977 and 1978 and double-shell slurry feed in 1980. Since 1980, only dilute, non-complexed waste has been received into tank 241-AY-102. The sources of this dilute, non-complexed waste included B Plant, PUREX Plant, single-shell tanks, 100 Area, 300 and 400 Areas, T Plant, S Plant, and various double-shell tanks. The tank remains in active service to support waste management operations.

A description and status of the tank are summarized in Table ES-1 and Figure ES-1, attached to this executive summary. Because the tank is active and presently receiving or transferring waste, the volume of supernatant is variable. The tank has a design storage capacity of 3,790 kL (1,000 kgal) of waste; however, safety considerations restrict the maximum operating capacity to 3,710 kL (980 kgal) (Hanlon 1995). When last sampled in 1994, it contained 2,740 kL (724 kgal) of supernatant and 121 kL (32 kgal) of sludge.

This report summarizes three sampling and analysis events. Sludge composition and properties are based on a core sample taken from the tank in June 1987 to support development of retrieval, pretreatment, and disposal processes. Supernatant composition is based on grab samples taken in June and December of 1994 to evaluate waste compatibility and process control. The analysis of the waste compatibility samples was governed by the data quality objectives (DQO) included in WHC-SD-WM-DQO-001, *Data Quality Objectives for the Waste Compatibility Program* (Carothers 1994). Since tank 241-AY-102 is a non-watch list tank, there are no specific safety-issue related DQOs associated with its characterization.

The analysis of tank 241-AY-102 meets the requirements of the safety screening DQO. The fuel content of the supernatant waste has been measured by differential scanning calorimetry (DSC) and no exotherms were found, denoting that the fuel content of the supernatant is low. No DSC analyses were performed on the 1987 sludge samples; however, TOC analyses were performed. Analysis of a more recent (1998) sludge sample indicated an exotherm of only 1.79 J/g, well below the safety screening criterion (Steen 1998). About 96% of the waste is supernatant, and the measured moisture level in the 1987 sludge sample was estimated at 54.4% water, both significantly above the 17% safety screening criterion (Babad and Redus 1994).

The heat generated by radioactivity in the tank is estimated to be 11,587 W (39,546 Btu/h). The temperature of the tank when measured on February 10, 1995, was 25 °C (77 °F). Differences in tank temperature have been noted with seasonal variations. The $^{239/240}Pu$ levels in the sludge were measured to be less than 1.5 x 10^5 Bq/g (4 μCi/g) and only 9.6 x 10^{-1} Bq/g (2.6 x 10^{-5} μCi/g) in the supernatant, both below the criticality safety criteria (Babad and Redus 1994). Based on this information, the waste does not appear to have any safety concerns; however, this report does not include any tank headspace vapor sampling and analysis information for evaluation.

The 1994 supernatant analysis indicates that the liquid also meets compatibility criteria for criticality and corrosion. The supernatant $^{239/240}Pu$ and ^{241}Am are below the transuranic classification limit of 3.7 x 10^3 Bq/g (100 nCi/g). The TOC concentration in the supernatant is 0.082 g/L, well below the organic complexant classification criterion of 10 g TOC/L.

The concentration and tank inventory for the centrifuged, composite sludge and liquid are summarized in Table ES-2. The sludge contained high concentrations of iron, sodium, aluminum, and uranium, as expected from B Plant and PUREX chemical processing wastes and evaporator slurry return. Compared to the supernatant, the sludge contains significantly higher concentrations of chloride, nitrite, and nitrate.

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5.4 EVALUATION OF PROGRAM REQUIREMENTS

Data quality objectives (DQOs) were not developed at the time of the 1987 core sampling but where issued prior to the June 1994 supernatant sampling. Even though DQOs were not written until after the 1987 core sampling and analysis events had occurred, present DQOs are used in the following evaluations.

5.4.1 Safety Evaluation

The data criteria identified in the Safety Screening DQO (Babad and Redus 1994) have been used to assess the waste in tank 241-AY-102. The DQO identifies several primary and secondary factors for consideration: fuel and water content, heat load and temperature, criticality potential, and flammability.

The fuel energy value is normally determined using DSC analysis of the waste material. DSC analyses were performed on the tank 241-AY-102 supernatant wastes sampled in June 1994 and no exotherms were observed. This indicates that the fuel content of the waste is very low in the supernatant phase and is considered to be well below the -125 cal/dry gram of waste criterion established by the organic safety program (Babad et al. 1994). No DSC analyses were performed on samples of the sludge in tank 241-AY-102. However, TOC analyses were performed. The TOC measured in the 1987 sludge sample was 23,100 μg C/g. Analysis of a more recent (1998) sludge sample indicated an exotherm at only 1.79 J/g on a wet weight basis and a TOC concentration of only 3,160 μg C/g (Steen 1998). Analysis of tank 241-AY-102 sludge samples taken during the sluicing of tank 241-C-106 to tank 241-AY-102 confirm the lower TOC values (Esch 1998, 1999a, 1999b, 1999c, 1999d).

Moisture reduces the potential for propagating exothermic reactions in the wastes. Because the supernatant waste in tank 241-AY-102 is 98.5% water, the moisture content of the sludge is expected to be high. Based on the 1987 analysis (Scheele et al. 1990), the composite sludge contained drainable liquid and had a water content of about 54.4% with sludge solids making up the remaining 45.6%. These values are well above the 17% criterion identified in the Safety Screening DQO (Babad and Redus 1994).

Another factor in assessing the safety of the tank waste is heat generation and the temperature of the wastes. Heat is generated in the tanks primarily from radioactive decay. The primary contributors to radioactive decay for tank 241-AY-102 are ^{137}Cs, ^{90}Sr, ^{241}Am, and ^{154}Eu. The amount of heat resulting from radioactivity in the tank is calculated in Table 5-5. The estimated total curies for each analyte are listed in column 2 (from Table 4-2), and the number of watts is listed in column 3. The reported heat load for the tank is 11,587 W (39,546 Btu/h). This is far below the 4,000,000 Btu/h design limit for the tank (Bergmann 1989).

Table 5-5. Tank 241-AY-102 Projected Heat Load.

Radionuclide	Ci[a]	Watts
^{241}Am	992	33
^{137}Cs	27,196	129
^{154}Eu	2,800	25
^{90}Sr	1.7 E+06	11,400
	Total Watts	11,587

NOTE: 1 Ci = 3.7 E+10 Bq.
[a]Analyte values from the liquid portion of the tank were added to the sludge portion. Therefore, the total tank inventory is based on 1987 sludge and 1994 liquid grab sample results.

The temperature of the tank from January 1994 to February 1995 has ranged between 25 °C (77 °F) and 31 °C (87 °F). This slight variance can be attributed to seasonal changes in the environment.

The potential for criticality is assessed from either total alpha analysis or from plutonium analysis; here it is calculated by the latter. Criticality specifications for double-shell storage tanks are defined in CPS-T-149-00010, *Waste Storage in Double-Shell Tanks and Associated Equipment* (Vail 1994). The safety screening criterion for criticality is 1 g/L. This is equivalent to 1.27 x 10^6 Bq (34.2 μCi) ^{239}Pu/g of waste assuming the density of the settled sludge is 1.80 g/mL. The 1987 centrifuged sludge $^{239/240}$Pu concentration was 1.33 x 10^5 Bq (3.6 μCi/g) (Scheele et al. 1990). The criticality specifications also require the pH of the waste to be greater than 8.0 when the plutonium inventory exceeds 10 kg and the depth of the supernatant liquid exceeds 30 cm. The supernatant depth in tank 241-AY-102 exceeds 30 cm, the plutonium inventory is approximately 3.1 kg (conservatively assuming all ^{239}Pu), and the pH of the supernatant is 11.1. Since the plutonium inventory does not exceed 10 kg, the criticality specification does not apply.

The flammability of the gas in the headspace of a tank is another safety screening consideration. Hydrogen monitoring of the tank vapor space showed an average concentration of 29 ppm hydrogen with a maximum concentration of 320 ppm (McCain and Bauer 1998).

The analysis of tank 241-AY-102 meets the safety screening requirements. Historical and analytical information do not show that the waste composition exceeds the safety criteria for fuel and water content, heat, criticality, or tank headspace flammability.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The sampling and analysis of tank 241-AY-102 meets the safety screening requirements (Reynolds et al. 1999). Historical and analytical information do not show that the waste composition exceeds the safety criteria for fuel and water content, heat, criticality, or tank headspace flammability.

The sludge contains large quantities of sodium, aluminum, iron, silicon, and uranium, as expected from B Plant and PUREX chemical processing wastes and from the deposition of concentrated evaporator wastes (high concentrations of sodium aluminate). Higher than normal concentrations of lanthanum, neodymium, silver, chromium, chloride, and TOC are also found. Since the bulk of ^{137}Cs is in the sludge, an insoluble cesium compound is indicated. Relatively high silicon could promote mineralization that is holding the ^{137}Cs. Compared to the supernatant, the sludge contains significantly higher concentrations of nitrite, phosphate, fluoride, sulfate, and chloride (Table 4-2).

The major radioactive constituents in the waste are ^{137}Cs, $^{90}Sr/Y$, and ^{154}Eu. The sludge concentrations of ^{241}Am and $^{239/240}Pu$ exceed the transuranic classification limit whereas the supernatant does not. The estimated heat load of this tank waste is far below the 4,000,000 Btu/h design limit for the tank (Bergmann 1989).

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