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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN № 625691

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	S. E. Kelly/Characterization Plans, Coordination and Reports/R2-12/373-1027	[] Yes [X] No	09/11/95
	5. Project Title/No./Work Order No. Tank 241-BX-101	6. Bldg./Sys./Fac. No. N/A	7. Approval Designator N/A
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[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Vapor sampling and gas flammability sections are being incorporated into Sections 3 and 4 of this document. Editorial changes to other sections are also being made.

13a. Justification (mark one)

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

13b. Justification Details

Tank vapor flammability assessment is required to satisfy the safety screening requirements for this tank.

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

See attached distribution sheet.

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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
N/A		

20. Approvals

	Signature	Date		Signature	Date
OPERATIONS AND ENGINEERING			ARCHITECT-ENGINEER		
Cog. Eng. S.E. Kelly	S E Kelly	9/18/95	PE		
Cog. Mgr. J.G. Kristofzski	SE Kelly for JK	9/18/95	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		
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EXECUTIVE SUMMARY

Single-shell tank 241-BX-101 is an underground storage tank containing high-level radioactive waste. It is located in the BX Tank Farm in the Hanford Site's 200 East Area. The tank was auger-sampled in June of 1994 and vapor space sampled on August 29, 1995. Analysis was performed in accordance with WHC-SD-WM-SP-004, *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The analysis supports the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-08 (Ecology et al. 1994).

Tank 241-BX-101 went into service in 1948 receiving metal waste (produced in the bismuth phosphate process) from B Plant. Other waste types received by the tank during its service life were uranium recovery waste, Plutonium Uranium Extraction (PUREX) Facility cladding waste, evaporator bottoms, B Plant low-level waste, B Plant ion-exchange waste, PUREX organic wash wastes, and Reduction and Oxidation (REDOX) Facility ion-exchange waste.

Tank 241-BX-101 is the first tank in the 241-BX-101, 241-BX-102, 241-BX-103 cascade series. The tank has a capacity of 2,010 kL (530 kgal) and currently contains 163 kL (43 kgal) of waste, existing primarily as sludge, including 3.79 kL (1 kgal) of supernatant. The tank became a suspected leaker in 1973 and was removed from service. The tank was deactivated and the supernatant was pumped, interim stabilizing the tank in 1978. Intrusion prevention was completed in 1981.

The Safety Screening Data Quality Objective (DQO) (Babad and Redus 1994) is the only current DQO that has been applied to tank 241-BX-101. Therefore, only those analyses required by

that DQO were performed in 1994 on the tank auger sample. The analyses included thermogravimetric analysis, differential scanning calorimetry, and total alpha activity. The analyses revealed that the water content in three of the six major subsamples was below the DQO-required limit of 17 wt%, ranging from 11.3 wt% to 16.1 wt% in those three major subsamples. The three subsamples that satisfied the water content requirement ranged from 18.7 wt% to 26.3 wt%. The one subsample that was excluded contained a rock and had a water content of 1.5 wt%. These water content values may pose a safety concern though no exotherms were observed and all of the total alpha results were below the DQO decision limit (41 μCi/g). However, the total alpha results do exceed the transuranic classification criterion (100 nCi/g). The flammability of the gas in the headspace of the tank is another safety screening consideration; no flammable gases were detected in the tank vapor space.

The current status of tank 241-BX-101 is shown in Table ES-1. A summary of the estimated historical inventory is shown in Table ES-2. The only chemical and radiochemical analytical data for the tank is from a 1976 sampling taken prior to stabilization. These values are based on the historical tank layer model estimates presented in Brevick and Redus (1994).

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LIST OF TERMS

ANOVA	analysis of variance
DQO	data quality objectives
DSC	differential scanning calorimetry
LFL	lower flammability limit
PUREX	Plutonium Uranium Extraction (Facility)
RPD	relative percent difference
TGA	thermogravimetric analysis

TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-BX-101

1.0 INTRODUCTION

This tank characterization report presents an overview of the use and contents of single-shell tank 241-BX-101 and its waste contents based upon an evaluation of historical information and sampling and analysis events.

In June 1994 and August 1995, single-shell tank 241-BX-101 was auger and vapor space sampled respectively to meet safety screening requirements for Hanford Site nuclear waste tanks (Carpenter 1994, Babad and Redus 1994). The analyses of the samples were used to complete this tank characterization report in order to comply with requirements specified in the *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement (Ecology et al. 1994).

The *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004 (Babad and Redus 1994), describes the sampling and analytical requirements used to screen waste tanks with no identified safety issues, tanks such as tank 241-BX-101. Both watch list and non-watch list tanks are to be sampled and evaluated to identify safety conditions related to the ferrocyanide, organic, flammable gas, and criticality safety issues. The analytical requirements for safety screening are designed to identify a common set of primary analytes and waste characteristics; these include energetics, total alpha activity, moisture, and flammable gas concentrations.

This tank characterization report presents an overview of the tank sampling and analysis effort and contains observations regarding waste characteristics. Chemical information associated with tank 241-BX-101, however, is highly contained since the analysis of the waste was governed solely by the Tank Safety Screening Data Quality Objective (DQO) (Babad and Redus 1994), which requires that only limited analyses be performed. As a consequence, the concentration and inventory estimates of individual chemical species are based upon the estimates in WHC-SD-WM-ER-349, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area* (Brevick et al. 1994). The information presented represents the best estimate of the waste composition based on historical knowledge and the 1994 sampling and analysis event.

1.1 PURPOSE

The purpose of this report is to summarize the information about the use and contents of tank 241-BX-101. When possible, this information will be used to assess issues associated with safety, operations, environmental, and process development activities. This report also provides a reference point for more detailed information about tank 241-BX-101.

1.2 SCOPE

This report presents historical information based on process knowledge and early sampling and analysis. The results from the 1994 auger and 1995 vapor space samples analyzed for safety screening are then summarized and presented. The historical information also is compared with the actual waste measurements and recommendations are given based upon the current waste inventory and tank status where possible.

Because the 1994 screening analyses only included differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and total alpha measurements, historical information is used for most chemical and radiochemical tank waste values.

3.0 TANK SAMPLING OVERVIEW

Because of the limited applicability of and information on earlier (1976) sampling and analysis events, this chapter focuses on the 1994 sampling event, the handling of the samples after the sampling event, and the analytical procedures performed on the samples.

Sampling of the tank's vapor space was also performed on August 29, 1995, to measure vapor flammability and satisfy the requirements of the safety screening DQO.

3.1 DESCRIPTION OF 1994 SAMPLING EVENT

Tank 241-BX-101 was sampled on June 20 and 21, 1994, from two widely spaced risers, as specified in WHC-SD-WM-SP-004 (Babad and Redus 1994). Because of the shallow depth of the tank waste, auger sampling was selected as the most appropriate sampling method for tank 241-BX-101. The two auger samples were taken using a 10-in. auger. For a further description of auger sampling procedures, refer to WHC-SD-WM-TI-648, *Tank Characterization Reference Guide* (De Lorenzo et al. 1994). Table 3-1 lists tank farm sample numbers, transport cask numbers, and drill string dose rates for the two samples from tank 241-BX-101.

Table 3-1. Tank 241-BX-101 Sampling Information.

Sample number	Cask serial number	Riser number	Drill string dose rate mSv/h (mR/h)
94-AUG-004	C-1050	1	4.5 (450)
94-AUG-005	C-1052	7	2.0 (200)

3.1.1 Sample Handling

One auger sample was removed from each of two risers, 1 and 7, of tank 241-BX-101. Each 10-in. auger has eight flutes; flute 1 begins at the auger shaft while flute 8 is at the tip of the auger bit. Table 3-2 details the subsample locations and the laboratory numbering system for these samples.

The waste from riser 1 was present on all eight flutes of the auger. The waste from flute 1 was cream colored. The waste form flutes 2 and 4 was a darker brown color. The flute 3 sample was white to cream colored with the consistency of wet peanut butter. The sample combined from flutes 1, 2, and 4 had a similar consistency. However, the material from flutes 5 through 8 was damper but with a consistency similar to the upper flutes. Flutes 5 through 8 appeared dark brown to black on the outside but had some white to cream-colored material inside.

3.1.2 Sample Analyses

All analyses were performed at the 222-S Laboratory. The samples were received by the 222-S Laboratory on June 22, 1994. Laboratory personnel loaded the samples into the IE-2 hot cell, and the contents were mechanically extruded on June 23 and 28, 1994.

The objectives of the sample analyses are to provide the following: determination of weight percent water by TGA, exothermic activity by DSC, and total alpha content by alpha proportional counting. Procedures used for these analyses are listed in Table A-1 in Appendix A. Additional information on analytical methods can be obtained in WHC-SD-WM-TI-648 (De Lorenzo et al. 1994).

3.2 DESCRIPTION OF VAPOR SAMPLING EVENT (1995)

The tank vapor space was sampled on August 29, 1995, using a combustible gas meter in accordance with work package ES-95-00458. Sampling was performed through riser 7 at approximately 3 ft above the waste surface (37 ft below the top of the riser). Tubing was lowered into the tank vapor space to the specified sampling depth, the tubing was purged, and the combustible gas meter reading was recorded.

3.3 PREVIOUS SAMPLING EFFORTS

A sludge analysis for tank 241-BX-101 was conducted in March 1976. The analysis included chemical and physical property data and a heat generation rate based upon the $^{89/90}Sr$ and ^{137}Cs levels. Table B-1 in Appendix B presents the results of this analysis.

Sample number[a]	Run	First transition			Second transition		
		Range °C	Peak °C	ΔH J/g[b]	Range °C	Peak °C	ΔH J/g
R5738 R1/F3	1	NI	NI	NI	208-335	280	380
	2	NI	NI	NI	200-320	282	396
R5739 R1/F1,2,4	1	NI	NI	NI	210-330	280	344
	2	NI	NI	NI	210-330	283	349
R5740 R1/5,6,7,8	1	NI	NI	NI	NI	NI	NI
	2	NI	NI	NI	NI	NI	NI
R5749 R7/F1	1	40-130	120	492	210-325	284	441
	2	50-130	94.7	274	190-318	282	538
R5746 R7/F2,3,4,5	1	NI	NI	NI	192-310	255	239
	2	NI	NI	NI	195-310	269	297
R5745 R7/F6,7,8	1	NI	NI	NI	200-320	271	198
	2	NI	NI	NI	170-310	265	187
R5750 R7/rock	1	90-120	101	32.0	210-340	300	552
	2	85-120	103	47.1	205-330	298	518

[a] The first number is the laboratory tracking number. The second number is the customer ID number and identifies the riser and the auger flute(s) from which the sample came.

[b] Negative sign denotes exothermic reaction.

NI = not integrated.

[c] Wet weight refers to the raw data seen by the DSC. Comparisons to the DQO are done on a dry weight basis.

4.4 VAPOR FLAMMABILITY

A combustible gas meter reading was taken through riser 7 at approximately 3 ft above the waste surface. The combustible gas meter reading was 0 percent of the lower flammability limit (LFL), indicating no flammability concerns with this tank.

(17 wt%) and the variance too large to confidently conclude that the moisture level in the tank is above 17 wt%. Because the average result is so near the limit, it is unlikely that the variance could be adequately improved through reanalysis. Some drainable or liner liquids were recovered for each auger. The 15 mL of liquid recovered for the riser 1 auger would represent about 12 wt% of the sample recovered assuming a density of 1.0 g/mL. The 5 g of liner liquid in riser 7 represents about 14.5 wt% of the total sample. If these liquid quantities are included with the TGA percent water results, the moisture content would be estimated to be considerably higher.

The heat generation rate based on historical radiochemical estimates is 4.04 kW (2.38×10^4 Btu/h) (decayed to 1995). This is still a factor of two below the high heat classification limit of 11.7 kW (4.0×10^4 Btu/h). In addition, the tank temperature history does not show any signs of excessive heat generation.

The potential for criticality is assessed using either total alpha or plutonium analyses. The safety screening criterion is 1 g/L of plutonium, which is equivalent to 41 μCi/g, assuming the waste has a density of 1.5 g/mL. The highest total alpha result (1.4 μCi/g) for any subsegment was well below the limit of concern. In addition, the total alpha also contains activity from ^{241}Am. Historical $^{239/240}$Pu estimates (0.58 μCi/g) also indicate that the plutonium should be well below this criterion. Even though some of the total alpha spike and duplicate results exceeded the desired criterion, their magnitude was not large enough to affect the criticality assessments.

Vapor sampling was perfomed to determine the flammability of the vapor space gases. The combustible gas meter reading was 0% of the lower flammability limit (LFL), indicating no flammability concerns with this tank. Although the safety screening DQO at the time of sampling specified the determination of gas composition to estimate the percent of LFL, the Safety Program has since determined that a combustible gas meter reading will satisfy the requirements of the DQO for concentrations less than 10 percent of the LFL (Dukelow et al. 1995).

6.0 CONCLUSIONS AND RECOMMENDATIONS

The sludge in tank 241-BX-101 was sampled and analyzed in 1976 and in 1994. The vapor space of tank 241-BX-101 was sampled in 1995 for combustible gases. The 1976 results may no longer be accurate because of subsequent salt well pumping and drying effects. Because the 1994 sampling event focused only on safety screening criteria, the chemical and radiochemical compositions of the waste must be estimated from historical information (Brevick et al. 1994). The tank is excepted to be mostly sludge with high concentrations of sodium, iron, and uranium phosphate and nitrate. The analysis of 1994 auger samples indicated that the plutonium concentration was well below criticality levels. No exotherms were observed for the DSC analyses. The average percent moisture results for the tank were very near the safety screening criterion of 17 wt%.

The 1994 sampling and analysis event for tank 241-BX-101 did not meet all of the requirements for the safety screening DQO (Babad and Redus 1994). Subsamples from the lower and upper areas of the auger samples from the two risers were analyzed, however waste recovery for the auger samples was lower than expected. Limited samples and data from different risers and waste depths make it difficult to determine accurately the variability of the waste composition in the tank. Variability for some of the TGA percent water and total alpha results were greater than desired, but did not have a significant impact on the assessment of the data. Historical information on the heat generation and tank temperature records does not indicate that excessive heat is being generated. Data and historical information do not indicate that tank 241-BX-101 has any immediate safety problems. The flammable gas concentration measurement, from August 1995, in the tank vapor space was 0 percent of the lower flammability limit, which satisfies the safety screening criterion.

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Department of Ecology

A. B. Stone	B5-18	X

Department of Energy - Richland Operations

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M. L. Dexter	R1-51	X	
R. A. Dodd	S5-07	X	
G. L. Dunford	S7-81	X	
S. J. Eberlein	R2-12	X	
D. B. Engelman	R1-49	X	
K. O. Fein	H4-65		X
G. D. Forehand	S7-21	X	
J. S. Garfield	H5-49	X	
J. D. Guberski	R2-06		X
R. D. Gustavson	R1-51	X	
D. L. Herting	T6-09	X	
B. A. Higley	H5-27	X	
G. Jansen	H6-33	X	
L. Jensen	T6-07	X	
G. D. Johnson	S7-15	X	
K. K. Kawabata	S7-55	X	
T. J. Kelley	S7-21	X	
N. W. Kirch	R2-11	X	
J. G. Kristofzski	R2-12	X	
M. J. Kupfer	H5-49	X	
D. L. McGrew	R3-25	X	
W. C. Miller	R1-30	X	
C. T. Narquis	T6-16	X	
D. E. Place	H5-27	X	
D. A. Reynolds	R2-11	X	
L. M. Sasaki (10)	R2-12	X	
F. A. Schmittroth	H0-35	X	
N. J. Scott-Proctor	S5-01	X	
L. W. Shelton, Jr.	H5-49	X	
B. C. Simpson	R2-12	X	
G. L. Smith	H4-62		X
G. L. Troyer	T6-50	X	
D. A. Turner	S7-15	X	
D. J. Washenfelder	H5-27	X	
M. S. Waters	S6-30	X	
W. I. Winters ~~(3)~~	T6-50	X	
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