WSRC-TR-2001-00546, Revision 0

Key Words: **PUREX Waste**
Stabilization
Saltstone

Retention: Permanent

Stabilization of Tank 33 and 35 Aqueous PUREX Waste (U)

Authors: Christine A. Langton,[1] Gary M. Iversen[2]

[1] Westinghouse Savannah River Company
Savannah River Technology Center
Aiken, SC 29808

[2] SCUREF
Savannah River Technology Center
Aiken, SC 29808

Report Date: December 4, 2001

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under
Contract Number DE-AC09-96SR18500

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

WSRC-TR-2001-00546, Revision 0
December 4, 2001

Key Words: **PUREX Waste**
Stabilization
Saltstone

Retention: **Permanent**

Stabilization of Tank 33 and 35 Aqueous PUREX Waste (U)

Authors: Christine A. Langton,[1] Gary M. Iversen[2]

[1] Westinghouse Savannah River Company
Savannah River Technology Center
Aiken, SC 29808

[2] SCUREF
Savannah River Technology Center
Aiken, SC 29808

Report Date: December 4, 2001

REVIEWS AND APPROVALS

C. A. Langton, Savannah River Technology Center Date

G. M. Iversen, SCUREF, Savannah River Technology Center Date

B. T. Butcher, Level 4 Manager, SRTC Date

M. G. Looper, Solid Waste Division Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ADS	Analytical Development Section, Savannah River Technology Center
CIF	Consolidated Incinerator Facility
CRF	Code of Federal Register
DOE	Department of Energy
dpm	disintegrations per minute
DSSI	Diversified Scientific Services, Inc.
NSST	New Solvent Storage Tank
PUREX	Plutonium Uranium Extraction
RCRA	Resource Conservation and Recovery Act
SCUREF	South Carolina University Research and Education Foundation
SRS	Savannah River Site
SRS (E-Area)	Savannah River Site E-Area
SRTC	Savannah River Technology Center
SW	Solid Waste
TCLP	Toxicity Characterization Leaching Procedure
UTS	Universal Treatment Standards

1.0 INTRODUCTION

Approximately 38,000 gallons of PUREX waste are currently stored in the New Solvent Storage Tanks (NSST), Tanks 33 and 35. The waste consists of both an organic and aqueous fraction. Solidification is currently being evaluated for the 24,800 gallons of organic PUREX waste [1]. M. Looper, SW, requested that cement stabilization be evaluated for treating the 12,900 gallons of aqueous PUREX waste.

Tanks 33 and 35 were sampled in 2000 and analyzed by ADS/SRTC. Analyses of these samples are provided in Appendix A. Tank 33 contains about 900 gallons of aqueous solution containing less than one weight percent sodium salts and about 8 weight percent dibutylphosphate. The waste has a pH of 9.8 and specific gravity of 1.048. The dibutylphosphate is a breakdown product of tributylphosphate that is a reagent in the PUREX process. Tank 35 contains about 10,800 gallons of aqueous solution with even less dissolved salt and less than 0.5 weight percent dissolved organics. The pH of Tank 35 is 7.7 and the specific gravity is 1.001.

Treatment for the aqueous and organic PUREX waste was identified as thermal destruction in the Consolidated Incineration Facility (CIF). Since the CIF is not currently operational to treat this waste, cement stabilization is being evaluated for the aqueous PUREX. The stabilization alternatives that are currently being considered include:

1) Direct stabilization in a new processing facility. The facility was assumed to be a small in-drum facility or a small auger mixer with drum or B-12/25 box containerization
2) Direct stabilization in the saltstone facility.
3) Transfer to Tank 50 and stabilization of the blended solution in the saltstone facility. Based on the current volume in Tank 50, a 10 : 1 blend of Tank 50 solution to aqueous PUREX waste was selected for testing.

1.1 Objective

Laboratory testing was conducted to evaluate two processing options for the aqueous PUREX waste:

1) Stabilization in a small batch process in a new H-Area facility using the saltstone dry solids reagents,
2) Stabilization of a 10:1 (by volume) blend of the aqueous PUREX waste and the current Tank 50 solution in the Saltstone Facility.

Two simulants were prepared for the blends: 1) reference saltstone feed and 2) simulated Tank 50 solution based on a calculated composition as of November, 2001 [2]. At the time of this testing, actual Tank 50 solution was not available. The reference saltstone dry solids premix was selected as the stabilization reagent. The ingredients and the proportions of the premix ingredients are listed in Table 1.

Table 1-1. Saltstone reference formulation.

Ingredient	Reference Saltstone Dry Solids Premix Wt. %	Reference Saltstone Wt. %
Portland Cement, Type I	8	54
Slag, Grade 100	46	
Fly Ash, Class F	46	
Reference Salt Solution, 29 wt. % salt	NA	46
Water : Cementitious Solids Ratio	NA	0.605

2.0 EXPERIMENTAL APPROACH AND RESULTS

2.1 Aqueous PUREX Stabilization – New Processing Facility

To evaluate processing small batches and to evaluate a worst case for TCLP leaching, a 1:1 mixture (by volume) of the Tanks 33 and 35 aqueous PUREX waste was prepared and mixed with the Saltstone reagents. The resulting waste forms were evaluated for processing properties and for the RCRA hazard characteristic of toxicity. The ingredients in the simulated waste forms and processing observations are shown in Table 2-1.

Table 2-1. Stabilization of the Aqueous PUREX Waste.

Ingredient	Aqueous PUREX Waste Forms		
	Mix 1	Mix 2	Mix 3
Saltstone Reference Premix Portland Cement, Type I (8 wt.%)	54 g	54 g	54 g
Slag, Grade 100 (46 wt.%)			
Fly Ash, Class F (46 wt.%)			
Tank 33 Aqueous PUREX	50 ml	--	--
Tank 35 Aqueous PUREX	--	35 ml	--
PUREX Waste Mixture Tank 33 : 35* (1:1 by volume)	--	--	65ml
Water : Cementitious Solids Ratio	0.843	0.65	1.144
Processing			
Mixing	v. rapid false set	acceptable	rapid false set
Flow	no flow, thick paste	Thick slurry	no flow, thick paste
Bleed Water	none	Yes after 24 hr.	none
Set Time (hr.)	0.5 hr.	12 hr.	0.5 hr.

* Tank 33 contains about 91 wt. % water and Tank 35 contains about 99 wt. % water. Consequently the 1:1 mixture contains about 95 wt. % water. (46)(0.95) = 43.7 wt. % water in the waste form.

Mixes 1 and 2 were sent to ADS/SRTC for TCLP analyses to determine whether the stabilization treatment removed the RCRA hazardous characteristic of toxicity. (The waste is carrying several "D" codes.) The TCLP extractions and leachate analyses were performed by ADS/SRTC because the samples contained higher levels of radionuclides than GEL, Inc., Charleston, SC. can currently accept. The results are shown in Table 2-2.

Table 2-2. Aqueous PUREX Saltstone TCLP Results.

Analyte	Mix 1 Tank 33 PUREX Saltstone (mg/L)	Mix 2 Tank 35 PUREX Saltstone (mg/L)	Hazardous Limit** (mg/L)	UTS Limit (mg/L)
Ag	0.050	0.050	5	0.14
As	<0.005	<0.005	5	5
Ba	0.827	0.872	100	21
Cd	0.020	0.020	1	0.1
Cr	0.090	0.111	5	0.6
Hg*	<0.01	<0.01	0.2	0.025
Pb	0.460	0.460	5	0.75
Se*	<0.005	<0.005	<1** (total)	5.7
Benzene#	<0.05	<0.05	0.5	10 (total)
Trichloro ethene#	<0.05	<0.05	0.5	6 (total)
Tetrachlo roethene#	<0.05	<0.05	0.7	6 (total)
Be	<0.010	<0.010	-	1.22
Ni	<0.090	<0.090	-	11
Sb	<0.660	<0.660	-	1.15
Tl	<0.02	<0.02	<0.02	0.2
V	0.140	0.140	-	1.6
Zn	<0.030	<0.030	-	4.3

* Reported as ug/g (ppm) rather than mg/L (ppm).
# Reported as mg/kg (ppm) rather than mg/L (ppm).
** Concentration were measured in the TCLP leachates except for selenium which is a total.

Results indicate that the aqueous PUREX waste can be stabilized with the saltstone dry solids premix. The resulting waste forms pass the TCLP requirements for exiting RCRA regulation. Small batch processing is possible provided that the mixer and grout delivery/packaging process is suitable for a thick nonflowable waste form.

Alternative processing options include, testing set retarders and blending the aqueous PUREX waste with other wastes that have higher salt contents and higher pH values, or using alternative stabilization reagents. Small amounts of nitrate/nitrate salts (<2 weight percent) act as set accelerators for portland cement hydration. At higher salt concentrations (5 to 10 - 15 wt. %), the effect is reversed and the hydration is retarded.

2.2 Stabilization of Aqueous PUREX – Tank 50 Salt Solution Blends

Stabilization of a 10:1 blend by volume (Tank 50: aqueous PUREX) was evaluated using simulated Tank 50 solution and reference salt solution. (Actual Tank 50 solution was not available in SRTC at the time this work was performed.) Saltstone processing requires a grout that is pumpable, self-leveling and does not generate bleed water.

The compositions of the current calculated Tank 50 solution and the reference salt solution are provided in Tables 2-3 and 2-4, respectively. The sodium salts used to prepare these simulants are also shown in Table 2-4. The simulated waste streams were blended with actual aqueous PUREX waste and then mixed with the saltstone reference dry solids. Mix compositions and processing results are listed in Table 2-5 and 2-6, respectively.

Table 2-3. Calculated Composition of Tank 50 [2].

Analyte	Molar (moles/L)	Concentration (g/L)	Added as Sodium Salt	Concentration of Salt (g/L)
NO_3^-	1.340	83.08	$NaNO_3$	113.90
$NO2^-$	0.040	1.84	$NaNO_2$	2.760
AlO_2^-	0.03		$NaAlO_2H_2O$	3.000
SO_4^{-2}	0.031	2.976	Na_2SO_4	4.402
PO_4^{-3}	0.001	0.095	Na_3PO_3	0.164
$(COO)_2^{-2}$	0.004	0.352	$Na_2C_2O_4$	0.536
CO_3^{-2}	0.04	2.400	$Na_2CO_3H_2O$	4.960
OH^-	1.41	23.97	NaOH	56.400
H_2O				16.4 wt. %

Table 2-4. Reference Saltstone Feed Solution Composition.

Analyte	Molar (moles/L)	Concentration (g/L)	Added as Na Salt	Concentration of Salt (g/L)
NO_3^-	2.04	126.48	$NaNO_3$	173.4
$NO2^-$	0.62	28.52	$NaNO_2$	42.78
AlO_2^-	0.41	17.63	$NaAlO_2H_2O$	41.00
SO_4^{-2}	0.15	14.4	Na_2SO_4	21.3
PO_4^{-3}	0.01	0.95	Na_3PO_3	1.64
$(COO)_2^{-2}$	0.025	2.2	$Na_2C_2O_4$	3.35
CO_3^{-2}	0.15	9.00	$Na_2CO_3H_2O$	18.60
OH^-	1.17	19.89	NaOH	46.80
H_2O				28.5 wt.%

Table 2-5. Saltstone Waste Form Mix Designs for Blends of Aqueous PUREX Waste and Simulated Tank 50 Solution.

	Blended Tank 50 - Aqueous PUREX Waste Forms Based on the Reference Saltstone Formulation									
Mix Design	**Reference Saltstone**	**10:1 Blend Ref. Saltstone : Tank 33 Aqueous Purex**	**10:1 Blend Ref. Saltstone : Tank 35 Aqueous Purex**	**Sim. Tank 50 Saltstone (Ref Mix)**	**10:1 Blend Sim. Tank 50 : Tank 33 Aqueous Purex**	**10:1 Blend Sim. Tank 50 : Tank 33 Aqueous Purex**	**10:1 Blend Sim. Tank 50 : Tank 35 Aqueous Purex**	**10:1 Blend of Tank 33 plus Tank 35 Aqueous Purex**	**9:1 Blend of Tank 35 and Tank 33 Aqueous Purex**	**13:1 Blend of Tank 35 and Tank 33 Aqueous Purex**
Mix Number	**Mix 1-R**	**Mix 2-R-AP**	**Mix 3-R-AP**	**Mix 4-T50**	**Mix 5-T50-AP**	**Adj. Mix 5b-T50-AP**	**Mix 6-T50-AP**	**Mix 7-T50-AP**	**Mix 8-AP (9:1)**	**Mix 8b-AP (13:1)**
Ingredients										
Portland Cement, Type I Slag, Grade 100 Fly Ash, Class F	108 g	108 g	108 g	108 g	108 g		108 g	108 g	108	
Tank 33 Aqueous PUREX (91 wt.% water)	--	7 ml	--	--	6 ml		--	2 ml	5 ml	
Tank 35 Aqueous PUREX (99 wt. % water)	--	--	7 ml	--	--		6 ml	5 ml	45 ml	Added 20 ml of Tank 35 and mixed for a total of 65 ml Tank 35
Tank 50 solution (16 wt. % salt, 84 wt. % water as prepared from calculated composition)	--	--	--	65 ml	59 ml	Added 5 ml and mixed, Added another 5 ml and mixed 69 ml total	70 ml	70 ml	--	
Reference Saltstone Solution (28wt.% salt, 71 wt. % water as prepared)	75	68 ml	68 ml	--	--		--	--	-- -	
Water : Cementitious Solids Ratio	0.50	0.506	0.512	0.506	0.509	0.587	0.600	0.607	0.458	0.638

Table 2-6. Processing Properties for Saltstone Waste Forms Made with Blends of Aqueous PUREX Waste and Simulated Tank 50 Solution.

	Blended Tank 50 - Aqueous PUREX Waste Forms Based on the Reference Saltstone Formulation									
Mix Design	**Reference Saltstone**	**10:1 Blend Ref. Saltstone : Tank 33 Aqueous Purex**	**10:1 Blend Ref. Saltstone : Tank 35 Aqueous Purex**	**Sim. Tank 50 Saltstone (Ref Mix)**	**10:1 Blend Sim. Tank 50 : Tank 33 Aqueous Purex**	**10:1 Blend Sim. Tank 50 : Tank 33 Aqueous Purex**	**10:1 Blend Sim. Tank 50 : Tank 35 Aqueous Purex**	**10:1 Blend of Tank 33 plus Tank 35 Aqueous Purex**	**9:1 Blend of Tank 35 and Tank 33 Aqueous Purex**	**13:1 Blend of Tank 35 and Tank 33 Aqueous Purex**
Mix Number	**Mix 1-R**	**Mix 2-R-AP**	**Mix 3-R-AP**	**Mix 4-T50**	**Mix 5-T50-AP**	**Adj. Mix 5b-T50-AP**	**Mix 6-T50-AP**	**Mix 7-T50-AP**	**Mix 8-AP (9:1)**	**Mix 8b-AP (13:1)**
Processing Properties										
Mixing	Easily mixed with spatula	Same as 1R	Same as 1-R	Same as 1-R	Too thick to mix well, Sticky	Easily mixed	Easily mixed	Thick	Too thick to mix with spatula	Easily mixed
Flow	v. fluid, pourable	Sl. thicker than 1-R, pourable	v. fluid, Same as 1-R	v. fluid, Same as 1-R	Not pourable	v. Fluid, Same as 1-R	Fluid, pourable	Sl. thicker but pourable	Not pourable	Fluid, pourable.
Bleed Water	Trace of bleed after 1 hr No Bleed after 18m 24, and 48 hr.	Trace of bleed after 1 hr., No bleed after 18 hr.	Bleed after 1 hr, Trace after 18 hr.	Trace of bleed after 1 hr., None after 18 hr	No Sample	None after 1 hr. None after 18 hr.	Bleed after 1 hr, Trace after 18 hr.	Trace of bleed after 1 hr., None after 18 hr	No Sample	Bleed after 1 hr Bleed after 18m 24, and 48 hr.
Set Time (hr.)	3-5 days	3-5 days	3-5 days	3-5 days	NA	3-5 days	3-5 days	3-5 days	NA	3-5 days

3.0 DISCUSSION

3.1 Regulatory Classification

3.1.1 Direct Stabilization Waste Forms

TCLP analyses were performed on cement stabilized aqueous PUREX waste forms assuming a direct stabilization process. A direct stabilization treatment option would require a new process. The results indicate that direct stabilization using the Saltstone reagents provides the treatment necessary for Tank 33 and Tank 35 waste to exit RCRA regulation and to be disposed of as low-level radioactive solid waste forms. The stabilization reagents consisted of a pre-blended mixture of portland cement, slag, and fly ash.

3.1.2 Stabilization of Tank 50 – Aqueous Blends

Treating the aqueous PUREX waste by blending it with the contents of Tank 50 can utilize the Saltstone Facility and therefore does not require a new process. Since a 10:1 blend of the current Tank 50 solution and the organic PUREX waste will have lower concentrations of benzene and hazardous metals compared to the initial aqueous PUREX, such blends will also meet the TCLP requirements for exiting RCRA and for disposal as low-level radioactive waste.

3.2 Waste Form Processing

Cement waste forms can be produced from either the Tank 33 and 35 solutions or a blend of these wastes. However, a small-scale batch process in a new facility or vendor treatment is recommended if the waste streams are not blended with Tank 50 solution. Blending with Tank 50 solution increases the salt concentration enough to effectively regulate the gelation and setting properties of the resulting slurry.

Waste forms prepared with Tank 33 waste, and a blend of Tank 33 and tank 35 waste were difficult to mix and displayed rapid setting even at high water to cementitious solids ratios. Given the dissolved salt concentration of Tank 33 (0.1 to 1 wt. %) this was expected. The waste form prepared with just Tank 35 waste also processed as expected based on the waste composition. The slurry was easy to mix, gelled slowly and set in 12 to 24 hours. The neutral pH of the Tank 35 waste (7.7) is responsible for the slow gelation. More alkaline solutions are required to activate the slag hydration. Slow gelation results in solid-liquid phase separation and consequently to bleed water.

A possible processing option for the aqueous PUREX waste is to blend it with the current Tank 50 waste. A 10:1 blend by volume, tank 50 to aqueous PUREX is the convenient and conservative ratio given the relative volumes of the respective waste streams. Since a sample of Tank 50 was not available for this evaluation, blends were prepared for the Z-Area reference solution and a calculated Tank 50 composition. All of the blends prepared were easy to mix, pumpable (visually correlated to rheology, i.e., fluid enough to be pourable), and self-leveling. However, some of the mixes displayed bleed water even after 24 to 48 hours. The presence of bleed water is attributed to: 1) stirring with a spatula rather than mixing in a blender which more closely simulates the saltstone process, 2) use of six month old ingredients versus fresh ingredients and 3) use of Grade 100 slag rather than Grade 120. The reference mix design was based on Grade 120 slag. However, Grade 100 slag was subsequently recommended for the saltstone process. Subsequent saltstone samples will be mixed in a blender per the saltstone preparation procedure.

The dissolved salt concentrations of the calculated Tank 50 solution and the tank 50- aqueous PUREX blends are about 12 wt. % less than the reference case solution. Sodium salt concentrations in the range of 5 to 15 wt. % retard the gelation/hydration reactions in the saltstone process. The result is settling and bleed water formation. Based on the limited testing to date, the proportions of the dry solids in the premix and/or the proportion of the salt solution to dry solids premix will have to be adjusted to compensate for the lower salt loading.

4.0 CONCLUSION

Tank 33 and Tank 35 aqueous PUREX wastes are characteristically hazardous based on previous analysis [3]. Cement waste forms prepared with these aqueous wastes passed the TCLP and UTS leaching requirements. Consequently, based on the testing described in this report, the resulting cement-based waste forms quality to exit RCRA regulation and to be disposed of as low-level radioactive waste. In addition, blends of the Tank 33 and 35 aqueous waste mixed with a higher salt concentration solution, such as the waste currently in Tank 50, also meet the TCLP and UTS limits and qualify to exit RCRA regulation.

Two different processing routes can be used to treat the Tank 33 and 35 wastes by cement stabilization. If just the Tank 33 and 35 wastes require cement stabilization, then a new site facility using a small-scale batch process is needed to treat the waste. Alternately, a vendor facility could be provided onsite for waste treatment. The Tank 33 and 35 can also be cement stabilized at the Saltstone Processing Facility provided the waste is mixed with a higher salt concentration solution.

The low salt content in the aqueous PUREX waste causes accelerated setting of the saltstone formulation. This results in processing issues when pumping the saltstone from the mixing facility to the disposal vault. Once in the vault the saltstone may not be sufficiently fluid to self-level in the vault cell. However, if the aqueous waste is mixed with a waste containing a higher salt concentration, such as low curie salt solution or ETF waste, stabilization of the aqueous waste at the Saltstone Processing Facility is acceptable provided that an appropriate blend ratio is used. The blend ration should result in a mixture with at least 15 to 20 weight percent dissolved sodium salts.

5.0 QUALITY ASSURANCE

Samples were prepared using calibrated balances and standard volumetric cylinders. The error on the proportioning is +/- 0.05g for the solid materials and +/- 1ml for the liquid portion. The TCLP leaching was performed by ADS/SRTC in accordance with their QA procedures.

6.0 REFERENCES

1. C. A. Langton, et al., PUREX Waste Solidification (U), WSRC-TR-2001-00526, Rev.0, November, 14, 2001, Savannah River Technology Center, Westinghouse Savannah River Company, Inc., Aiken, SC 29801.

2. HLW-STE-2001-00508, Westinghouse Savannah River Company, Inc., Aiken, SC 29801.

3. SRS Site Treatment Plan, WSRC-TR-94-0608, Rev.9, March 2001, Volume II, P. 3-6, Westinghouse Savannah River Company, Aiken, SC 29801.

7.0 ACKNOWLEDGEMENTS

This task was supported by the DOE Mixed Waste Focus Area as TTP-SR18MW44 and by the SRS Solid Waste Division.

Sample analyses were performed by S. L. Crump, D. P. Diprete, J. E. Young, C. J. Coleman, ADS/SRTC. L. M. G. Looper, P&T/SW, coordinated sampling of Tanks 33 and 35.

8.0 APPENDIX A. ANALYSIS OF THE AQUEOUS PUREX WASTE

		Tank 33 Aqueous		Tank 35 Aqueous
Volume		900 gallons		12,800 gallons
Specific Gravity		1.0478		1.0008
pH		9.83		7.66

Chemical Analysis Results

Volatiles				
	Units	**mg/L**		**mg/L**
Aliphatic Hydrocarbons		1.3		2
Aromatic Hydrocarbons		28		31
Butanol		18		1.8
Benzene		<1		<1
Trichloroethylene		<1		<1
Semi-volatiles				
Aliphatic Hydrocarbons		130		34
Aromatic Hydrocarbons		580		56
Tributyl Phosphate		1600		130
Aliphatic Amines		19		3
Anions	**Units**	**ug/mL**	Molar	**ug/mL**
Chloride		73		35
Nitrate		2786	0.0449	<100
Nitrite		1686		<100
Oxalate		764		87
Sulfate		<50		<50
Phosphate		<100		<100
Formate		1397		<100
Fluoride		<20		<20
Cations				
Ammonium ion		<100		<100
Sodium		23,103		1621.46
Dibutyl Phosphate		85,465		3769

Metal Analysis Results					**Tank 33 Aqueous**	**Tank 35 Aqueous**
Metals	**Original Haz Codes**	**D Code UHC**	**UTS ppm**	**Haz Limit ppm**	**ppm**	**ppm**
As	X		5	**5**	1.092	1.05
Se	X		5.7	**<1***	0.401	0.352
Hg	X		0.025	**0.2**	<10.49	<10.49
Ag	X		0.14	**5**	<6	<6
Ba	X		21	**100**	<2	<2
Be			1.22		<1	<1
Cd	X		0.1	**1**	<3	<3
Cr	X		0.6	**5**	**38**	<7
Ni		X	11		126	26
Pb	X		0.75	**5**	<27	<27
Sb		X	1.15		<63	<64
Tl		X	0.2		<128	392
V					<3	<3
Zn					117	80
Zr					<4	<4

* Under Part 261, if waste is 1 ppm or greater, it is hazardous and carries a D code and must be disposed of in a RCRA Subtitle C landfill.

Radioactive Analysis Results		Tank 33		Tank 35	
		Aqueous		Aqueous	
Radioactive Constituents	**Units**	**dpm/mL**		**dpm/mL**	
Pu-238		1.11E+05		1.51E+04	
Pu-239		1.95E+03		2.95E+02	
Pu-240		5.50E+02		7.38E+01	
Pu-241		2.36E+04		2.93E+03	
Pu-242		<9.78E+01		<9.78E+01	
U-233		<2.40E+02		<2.40E+02	
U-234		1.93E+02		<1.55E+02	
U-235		1.14E+00		6.79E-01	
U-236		1.92E+00		<1.61E+00	
U-238		7.44E+01		4.45E+01	
Am-241		3.62E+02		1.55E+03	
Am-243		<3.37E+02		9.12E+01	
Cm-244		9.01E+03		3.17E+02	
Cm-245		<4.27E+03		<4.27E+03	
Cm-246		<7.6E+03		<7.6E+03	
Np-237		<1.75E+01		<1.75E+01	
Np-239		<3.37E+02		4.77E+01	
Th-232		6.16E-03		3.08E-03	
Ni-59		<4.44E+01		<4.73E+02	UL
Ni-63		<1.70E+02		<1.08E+03	UL
Tc-99		<1.46E+03	UL	<3.84E+02	UL
Sr-90		1.16E+02		1.81E+03	
Co-60		2.21E+02		7.37E+01	
Ru-106		<4.04E+02		3.53E+01	
Sb-125		<2.06E+02		2.26E+02	
Cs-134		<1.48E+01		7.08E+00	
Cs-137		5.48E+04		2.29E+04	
Eu-154		3.57E+02		2.51E+02	
Eu-155		<7.79E+01		5.64E+01	
Ra-226		<9.00E+02		6.46E+02	UL
Pa-234m/U238		<9.21E+01		6.35E+01	
Se-79		<1.26E+02		<4.79E+02	
I-129		5.13E+02		3.39E+01	
C-14		2.05E+02		<1.31E+02	
Tritium		4.66E+04		4.44E+04	
Alpha		1.24E+05		3.03E+04	
Beta		1.11E+05		6.06E+04	
Gamma		5.57E+04		2.60E+04	

UL Denotes sample results as upper limits because of the evidence of other species or x-ray interferences that were close to the x-ray energy and biased the fitting of the x-ray region.
< Indicates detection limit values.
N/A Not Available (Organic not analyzed for Se-79)

9.0 APPENDIX B. TCLP RESULTS FOR THE AQUEOUS PUREX WASTE FORMS

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172052 LANGTON			
SAMPLE ID:	**Tank 33#1** (1.0381/20			
ANALYSIS DATE/TIME:	11/7/01	1:56:58 PM		
ANALYTE:	RESULTS:			
Ag		<	0.050	mg/L
Ba			0.827	mg/L
Cd		<	0.020	mg/L
Cr		<	0.090	mg/L
Pb		<	0.460	mg/L

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172052 LANGTON-TCLP			
SAMPLE ID:	**Tank 33#1** (1.0381/20)			
ANALYSIS DATE/TIME:	12/3/01	2:26:56 PM		
Data Source: T75_337_01.DAT				
ANALYTE:	RESULTS:			
Be		<	0.010	mg/L
Ni		<	0.090	mg/L
Sb		<	0.660	mg/L
Zn		<	0.030	mg/L

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172052 Langton-TCLP			
SAMPLE ID:	**Tank 33#1** (1.0381/20)			
ANALYSIS DATE/TIME:	12/4/01	7:35:56 AM		
Data Source: T76_338_01.DAT				
ANALYTE:	RESULTS:			
Tl		<	1.341	mg/L
V			0.170	mg/L

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172053 LANGTON			
SAMPLE ID:	**Tank 35#2** (1.0289/20			
ANALYSIS DATE/TIME:	11/7/01	2:02:24 PM		
ANALYTE:	RESULTS:			
Ag		<	0.050	mg/L
Ba			0.872	mg/L
Cd		<	0.020	mg/L
Cr			0.111	mg/L
Pb		<	0.460	mg/L

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172053 LANGTON-TCLP			
SAMPLE ID:	**Tank 35#2** (1.0289/20)			
ANALYSIS DATE/TIME:	12/3/01	2:31:40 PM		
Data Source: T75_337_01.DAT				
ANALYTE:	RESULTS:			
Be		<	0.010	mg/L
Ni		<	0.090	mg/L
Sb		<	0.660	mg/L
Zn		<	0.030	mg/L

ICPES Results from B-151 ARL 3580

Analytical Development Section, SRTC, 5-5523

LIMS#, CUSTOMER:	172053 Langton- TCLP			
SAMPLE ID:	**Tank 35#2** (1.0289/20)			
ANALYSIS DATE/TIME:	12/4/01	7:44:44 AM		
Data Source: T76_338_01.DAT				
ANALYTE:	RESULTS:			
Tl		<	1.341	mg/L
V			0.140	mg/L