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K BASINS SLUDGE INVENTORY COMPOSITION

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Abstract: This document defines the sludge feed streams from the K East and K West Basins that are expected to be fed to the sludge conditioning system(s) for disposal. The most recent data are used to provide chemical and physical parameters for the individual feed streams based on characterization data, computer code calculations (i.e., ORIGEN code), and process knowledge. Both nominal and upper bound or "working bound" values are defined depending on data available. It is expected this document will be revised with current information as more data is obtained and analyses completed.

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K BASINS SLUDGE INVENTORY COMPOSITION

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LIST OF TERMS

DD	Dropout Drum
gmol	(gram) moles
i	Component or sample index
j	Isotope index
KE	105-K East (Basin)
KW	105-K West (Basin)
$t_{1/2}$	Half-life (seconds)
v/v%	Volume percent
w/w%	Weight percent
ρ_{dry}	Density of dry sludge, g/cc
ρ_{wet}	Density of (wet) as-settled sludge, g/cc

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K BASINS SLUDGE INVENTORY COMPOSITION

1.0 PURPOSE AND SCOPE

The purpose of this document is to define the baseline K East (KE) Basin and K West (KW) Basin sludge process streams expected to be fed to the sludge conditioning system(s) for disposal. This document shall replace, in its entirety, the previously documented K Basin sludge disposal evaluation (Pearce 1997). Evaluations being conducted in support of the K Basins sludge disposal project require characterization data for the various process streams. The streams will be defined as to a mean or nominal value and an upper bound or "working bound" value depending on available data.

The design bases feed compositions for all sludge locations (i.e., KE Basin canister/floor/pit/fuel wash and KW Basin canister/pit) have been determined with the most recent data available and are presented in this document. This document is a collection of the most recently released sludge data results from various separate documents including ORIGEN run data, and will be continually revised as more data is required and released. Information not currently available but expected in future revisions to this document is listed in Table 1.

The scope of this document is to define the individual process streams expected to be fed to the sludge conditioning system. Figures 1 and 2 show the KE and KW Basins sludge locations and respective as-settled volumes, expected storage or separation locations, and eventual process feed streams. The individual process streams include the following:

KE Basin Process Streams (Figure 1)

- **Stream 1:** KE Basin Weasel Pit as-settled sludge retrieved from the various KE Basin pits and floor areas. This stream will also include canister and fuel wash sludge particles less than or equal to 250 μm in diameter (as documented in Erikson 1997).

- **Stream 2:** KE drop-out drum sludge [less than or equal to 0.25 in. (6350 μm) and greater than 250 μm in diameter] collected from the canister removal and fuel wash activities.

KW Basin Process Streams (Figure 2)

- **Stream 1:** KW Basin storage as-settled sludge retrieved from the various KW Basin pit and floor areas.

- **Stream 2:** KW drop-out drum sludge [less than or equal to 0.25 in. (6350 μm) and greater than 500 μm in diameter] collected from the canister removal and fuel wash activities.

- **Stream 3:** KW settler tanks sludge [approximately 100 v/v% of canister sludge (Makenas 1997) less than or equal to 500 μm diameter] collected from the drop-out drum filter system (as documented in Drawings H-1-83320 and H-1-83323).

Figure 1. K East Basin Sludge Locations, Volumes, and Feed Streams.

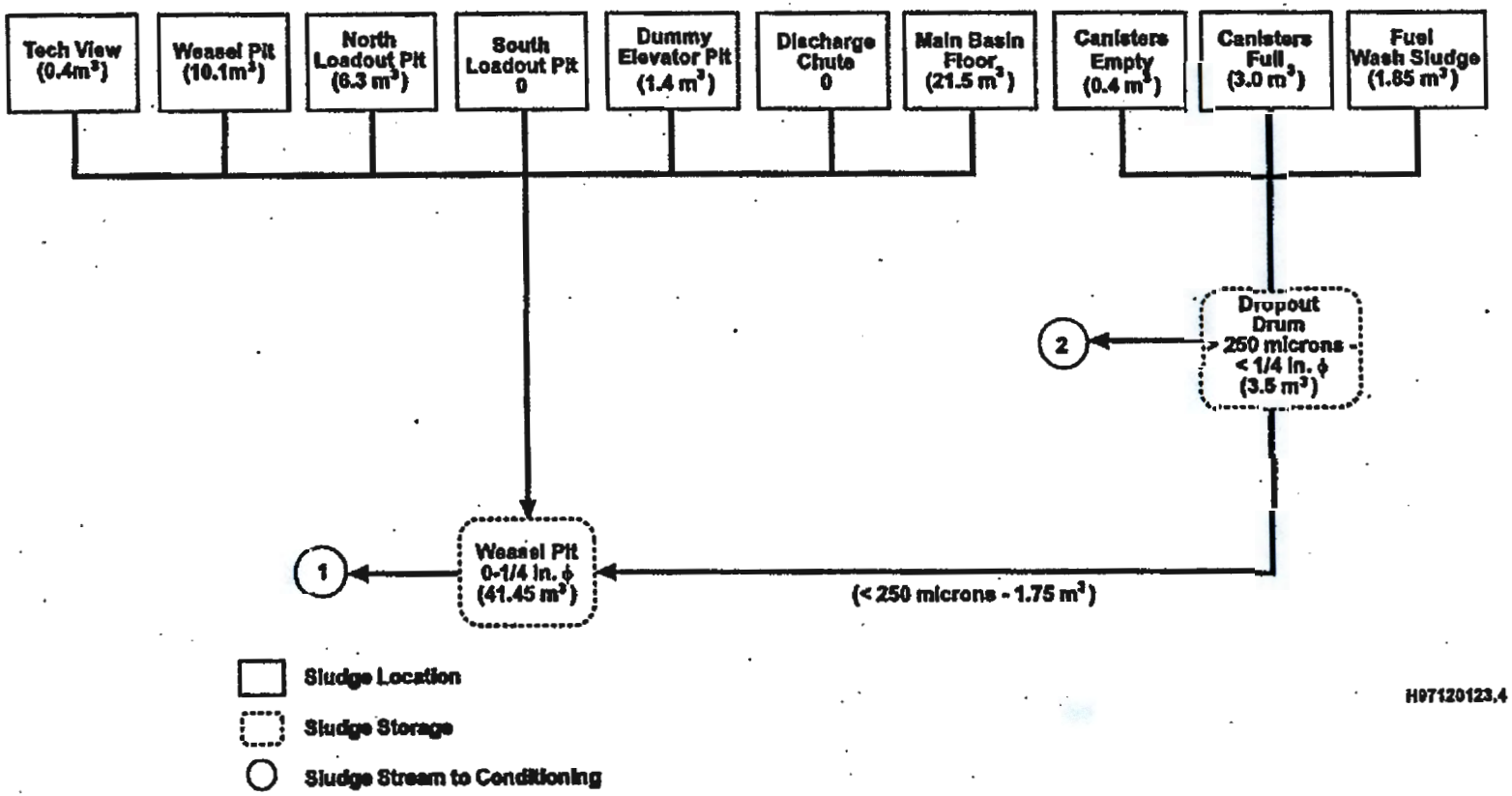
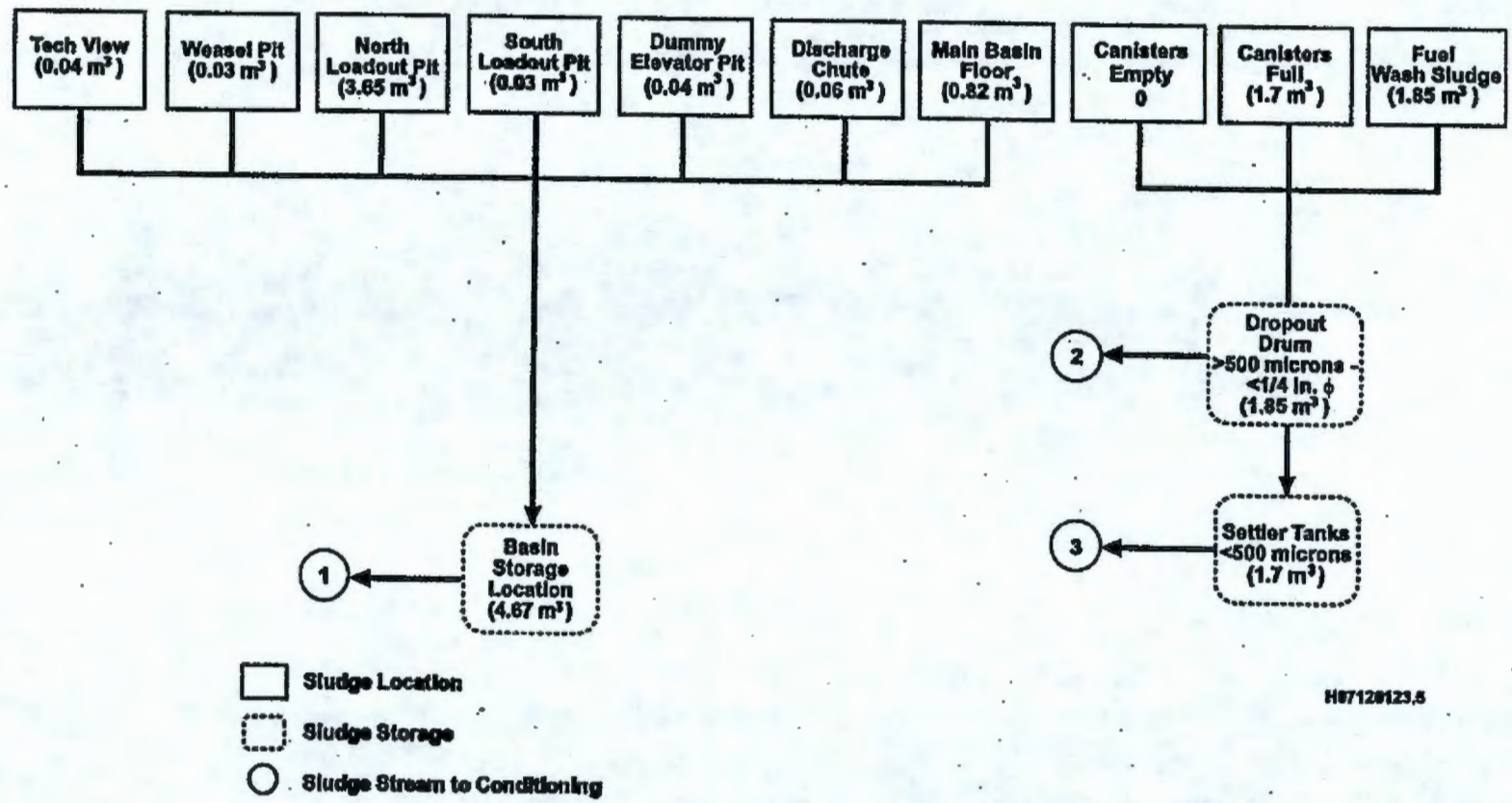


Figure 2. K West Basin Sludge Locations, Volumes, and Feed Streams.



The scope of this document will eventually include the various properties noted in Table 1 for each feed stream described on Figures 1 and 2. Table 1 also indicates those properties included in the current revision of the document and those to be provided in future revisions.

Table 1. Document Contents Provided and Planned for Future Revisions.

Subject	Subtopic	Provided Now or Future?
Physical properties		
	As-settled density	Now
	Viscosity	Future
	Stream mass (weight) inventory	Now
	Particle size	Future
	Settling time	Future
Chemical properties		
	Chemical compound-mass	Future
	Chemical element-mass	Now
	Hydrogen generation	Future
Radiological properties		
	Isotopic compound-Curies	Now
	Hydrogen generation rate	Future
	Fissile materials	Future
Thermodynamic properties		
	Heat generation	Future
	Radiological	Future
	Chemical	Future
Kinetics		
	Sludge volume-total and by stream	Now
	Solids/liquids fraction	Future
	Batch size	Future

Future revisions of this document may also address projections of the quantities of specific materials (e.g., ion exchange resin beads-KE Basin, Grafoil-KW Basin, etc.) found in the sludge samples (Makenas 1996; Makenas 1997; Silvers 1997) that may be of special interest to the process design for the sludge feed streams. As required future revisions of the document may address the polychlorinated biphenyls (PCBs) that were detected in the sludge materials (Makenas 1996; Schmidt 1997; Makenas 1997; Silvers 1997). As referenced in KE Basin, six floor and Weasel Pit samples ranged in concentration in PCBs from less than 8 to 140 ppm. In KE Basin canister sludge samples ranged from less than 0.011 to 1.1 ppm, and KW Basin canister sludge PCBs ranged from less than 0.03 to 6 ppm. Concentrations of PCBs in water samples from the KE and KW Basins were below 0.2 ppb.

2.0 RESULTS

2.1 CHEMICAL CONSTITUENTS AND RADIONUCLIDES

The nominal and upper bound results for total calculated chemical constituents and radionuclides in the KE and KW Basins, including each process feed stream, are listed in Tables 2 through 9. The "nominal" term, as used in this document, usually refers to any arithmetic average calculated from multiple values. See Sections 3.1 and 3.3 for nominal calculations per specific sludge storage area in the KE and KW Basins, respectively. Upper bound values are not determined from numerical statistics (although the KW values use a 95% confidence limit) but combine the use of a maximum sample concentration with a calculated upper bound as-settled sludge volume. See Sections 3.2 and 3.4 for upper bound calculations per specific sludge storage area.

The acid digest residue or "residue" referred to throughout this document and the supporting characterization data documents (both recent and historic) do not correspond directly with the "residue" expected from the acid digest method to be used as part of pretreatment of the K Basins sludge. The term residue in these documents relates to the solid material measured after the standard acid digest steps are used during preparations for laboratory chemical analyses (e.g., ICP). While the laboratory methods varied in the combination acids, temperatures, and times they were performed at, it is expected that they will be more aggressive toward dissolving the overall sludge materials than the pretreatment process acid digest step. This pretreatment step is aimed at dissolving primarily only fuel components (e.g., uranium, plutonium). For example the most recent work, the KE Basin and KW Basin canister sludge samples (Makenas 1997; Silvers 1997) were digested at the laboratory using a sequential addition of nitric acid, hydrogen peroxide, and hydrochloric acid. The acid solutions were subjected to boiling temperatures after each addition. By comparison the currently proposed K Basins sludge pretreatment digest method uses only nitric acid, at an as yet undetermined temperature but which could be significantly below boiling.

The following tables include weights for targeted components of the sludge on a dry basis, when summed they do not represent the total dry mass of sludge. If a mass balance were to be made it would have to also include assumptions on the valance state of the specific targeted elements in order to correctly compute the weight of oxygen, hydrogen, etc., which are combined with these targeted species.

Table 2 -- K East Nominal

Table 2 lists the calculated radionuclide and chemical constituent nominal values, in Curies (Ci) and kilograms (kg), respectively, per sludge storage location in the KE Basin. It is assumed the basin floor, basin pit areas, and North Loadout Pit sludge will be transferred to the Weasel Pit and stored along with the existing Weasel Pit sludge. These sludge storage area values are combined in the first column called "Total." The calculated values for the canister and fuel wash sludge are also included in separate columns

which are combined under the second column labeled "Total." The values for all the radionuclides and chemical constituents from the various storage locations (columns) are totaled under the "Sum Total" column. Calculated as-settled sludge volumes (in m^3) and densities (in g/mL) are listed above their respective sludge location column. See Section 3.1 for a detailed analysis.

Table 3 -- K East Basin Nominal Process Streams with 250 μm Filtration

Table 3 lists the calculated radionuclide and chemical constituent nominal values per sludge storage location in the KE Basin after the canister sludge is filtrated using 250 μm filters. The canister sludge less than or equal to 250 μm in diameter will be transferred to the Weasel Pit while the remaining canister sludge greater than 250 μm, but less than 1/4 in. in diameter, will be transferred to dropout drums (DD) as shown in Figure 1. Stream 1 consists of retrieved sludge from the basin floor, the various pit areas, North Loadout Pit, and the existing sludge from the Weasel Pit. Stream 2 consists of the DD sludge and any fuel pieces less than 1/4 in. and greater than 250 μm in diameter generated from the fuel wash process. No derivations are provided for particle size generation from the fuel wash. Both Streams 1 and 2 are sludge feed streams to the planned sludge conditioning process. See Section 3.1 for a detailed analysis.

Table 4 -- K East Basin Nominal Activity Conversions to Gram Moles

Table 4 lists the radionuclide values in gram moles (gmol) which are included to assist in process feed information for computer simulation programs. The radionuclide values, in Ci, from Table 3, are converted to gram moles and listed in Table 4 per associated process feed stream. See Section 4.1 for a detailed analysis.

Table 5 -- K East Basin Upper Bound

Table 5 is formatted identical to Table 2 but only upper bounded values are used. See Section 3.2 for a detailed analysis.

Table 6 -- K East Basin Upper Bound Process Streams with 250 μm Filtration

Table 6 is formatted identical to Table 3 but only upper bound values are used. See Section 3.2 for a detailed analysis.

Table 7 -- K East Basin Upper Bound Activity Conversions to Gram Moles

Table 7 is formatted identical to Table 4 but only upper bound values are used. See Section 4.1 for a detailed analysis.

Table 8 -- K West Basin Nominal Process Streams and Activity Conversions

Table 8 lists the calculated radionuclide and chemical constituent nominal values, in Ci and kg, respectively, per sludge storage location in the KW Basin. It is assumed the North Loadout Pit, fuel wash, and canister sludge will be stored in separate process feed streams. The KW Basin plans to use

500 μm filters to store canister and fuel wash sludge less than 1/4 in. (6.35 mm) but greater than 500 μm in diameter in dropout drums (Stream 2) per Figure 2. The lesser sludge fines (less than or equal to 500 μm) will be transferred to settler tanks (Stream 3). However, since there is no data on fuel wash particle size and the data that exists for canister sludge particles show almost all to be well under 600 μm, all the canister sludge is included in Stream 3 and all fuel wash sludge is in Stream 2.

The calculated values for the North Loadout, fuel wash, and canister sludge are combined under a single column called the "Total" column. The values for all the radionuclides are also converted from Curies to gram moles per process feed stream. Calculated as-settled sludge volumes (in m^3) are listed above their respective sludge location column. See Section 3.3 and Section 4.1 for a detailed analysis.

Table 9 -- K West Basin Upper Bound Process Streams and Activity Conversions

Table 9 is formatted identical to Table 8 but only upper bound values are used. See Section 3.4 and Section 4.1 for a detailed analysis.

Table 2. K East Basin Nominal.

KE Nominal													
Date: 01/21/98													
		Basin floor	Pit Areas	N.Loadout	Total			Canisters	Wash	Total		Sum Total	
As-settled	Vol (m3)	21.9*	11.9	6.3	40.1			3	1.85	4.85		44.95	
As-settled	Den (g/mL)	1.27	1.54	1.31				1.83	3				
Component		Ci	Ci	Ci	Ci			Ci	Ci	Ci		Ci	
Am241(AEA)		2.49E+02	7.97E+01	6.65E+00	3.36E+02			1.94E+02	7.05E+02	8.99E+02		1.23E+03	
Bi212		1.12E+01	6.48E+00		1.77E+01			3.52E+01		3.52E+01		5.29E+01	
Ce144/Pr		9.12E+01	3.83E+01		1.30E+02			6.91E+01	5.14E+00	7.42E+01		2.04E+02	
Cm243/244		5.60E+01	2.30E+01		7.90E+01			3.16E+01	2.98E+00	3.46E+01		1.14E+02	
Co57								1.54E+01		1.54E+01		1.54E+01	
Co60		1.57E+01	1.37E+01	1.36E+00	3.08E+01			3.16E+00	6.36E+00	9.52E+00		4.03E+01	
Cs134		7.29E+00	3.01E+00		1.03E+01			4.90E+00	2.38E+01	2.87E+01		3.90E+01	
Cs137		4.24E+03	2.33E+03	6.14E+01	6.63E+03			2.66E+03	2.24E+04	2.51E+04		3.17E+04	
Eu152		1.84E+00	1.17E+00		3.01E+00			1.11E+01	1.60E+00	1.27E+01		1.57E+01	
Eu154		3.90E+01	1.25E+01	1.36E+00	5.29E+01			3.44E+01	1.81E+02	2.15E+02		2.68E+02	
Eu155		1.99E+01	6.46E+00	7.46E-01	2.71E+01			2.58E+01	3.83E+01	6.41E+01		9.12E+01	
Nb94		5.46E+00	2.25E+00		7.71E+00			3.23E+00		3.23E+00		1.09E+01	
Np237		4.00E-02	1.77E-02		5.77E-02			4.17E-02	1.03E-01	1.45E-01		2.02E-01	
Pu238		4.97E+01	2.28E+01	1.32E+00	7.39E+01			1.07E+02	2.07E+02	3.14E+02		3.88E+02	
Pu239/240		2.13E+02	1.01E+02	8.05E+00	3.22E+02			3.94E+02	6.15E+02	1.01E+03		1.33E+03	
Ra226		1.67E+02	7.00E+01		2.37E+02			1.32E+02		1.32E+02		3.69E+02	
Ru106/Rh		1.22E+02	5.10E+01		1.73E+02			9.92E+01	9.51E+00	1.09E+02		2.81E+02	
Sb125		1.06E+01	5.13E+00		1.58E+01			3.12E+00	5.78E+01	6.09E+01		7.67E+01	
Sr90		3.99E+03	1.96E+03		5.95E+03			5.00E+03	1.70E+04	2.20E+04		2.80E+04	
Tc99								2.33E+01	4.96E+00	2.83E+01		2.83E+01	
Tl208		3.37E+01	1.63E+01		5.00E+01			8.39E+01		8.39E+01		1.34E+02	
U-233		1.30E-01	5.85E-02		1.89E-01			1.35E-01		1.35E-01		3.24E-01	
U-234		6.70E-01	2.75E-01		9.45E-01			1.30E+00	1.59E+00	2.89E+00		3.84E+00	
U-235		2.00E-02	9.38E-03		2.94E-02			4.32E-02	6.06E-02	1.04E-01		1.33E-01	
U-236		5.00E-02	3.00E-02		8.00E-02			9.36E-02	2.26E-01	3.20E-01		4.00E-01	
U-238		4.60E-01	2.06E-01		6.66E-01			9.45E-01	1.30E+00	2.25E+00		2.91E+00	
Y-90									1.70E+04	1.70E+04		1.70E+04	
Pu241				1.13E+02	1.13E+02				1.17E+04	1.17E+04		1.18E+04	
Ba-137m				5.81E+01	5.81E+01				2.12E+04	2.12E+04		2.13E+04	
Total		9.32E+03	4.74E+03	2.52E+02	1.43E+04			8.93E+03	9.12E+04	1.00E+05		1.14E+05	
Component		Basin floor	Pit Areas	N.Loadout	Total			Canisters	Wash	Total		Sum Total	
Dry Basis		Kg	Kg	Kg	Kg			Kg	Kg	Kg		Kg	
Ag		1.20E-01	1.87E-01		3.07E-01			4.24E-01		4.24E-01		7.31E-01	
Al		3.72E+02	3.24E+02	3.00E+01	7.26E+02			7.92E+01	2.93E+00	8.21E+01		8.08E+02	
B		1.48E+00	1.19E+00		2.67E+00			6.61E-01	1.04E-03	6.62E-01		3.33E+00	
Ba		1.69E+00	2.74E+00	4.01E-01	4.83E+00			4.21E-01		4.21E-01		5.25E+00	
Be		3.00E-01	1.49E-01	2.92E-02	4.78E-01			8.16E-02	2.81E-01	3.63E-01		8.41E-01	
Bi								1.63E+00		1.63E+00		1.63E+00	
Ca		3.90E+01	9.06E+01	2.27E+01	1.52E+02			2.14E+00		2.14E+00		1.54E+02	
Cd		8.10E-01	4.75E-01	2.06E-01	1.49E+00			6.97E-02	1.04E-03	7.07E-02		1.56E+00	
Cr		3.70E+00	9.33E+00	4.94E-01	1.35E+01			1.78E+00	4.67E-01	2.28E+00		1.58E+01	
Cu		4.08E+00	3.70E+00	1.04E+00	8.82E+00			3.39E-01	2.86E-01	6.25E-01		9.44E+00	
Fe		1.51E+03	2.74E+03	8.98E+01	4.34E+03			3.86E+01	1.62E+00	4.02E+01		4.38E+03	
K		9.19E+00	1.20E+01		2.12E+01			5.64E+00		5.64E+00		2.68E+01	
Mg		1.15E+01	1.65E+01	2.86E+00	3.08E+01			5.61E+00	9.63E-02	5.71E+00		3.65E+01	
Mn		3.35E+00	4.22E+00	1.24E+00	8.81E+00			2.17E-01	1.04E-01	3.21E-01		9.13E+00	
Na		4.35E+01	6.47E+00	1.63E+00	5.16E+01			1.54E+00	5.21E-03	1.55E+00		5.31E+01	
Pb		2.97E+00	4.70E+00	3.47E-01	8.02E+00			7.02E-01	2.62E-02	7.28E-01		8.75E+00	
Se		1.21E+00	1.87E+00		3.08E+00			6.53E-01	2.07E-02	6.74E-01		3.75E+00	
Sm		1.21E+00	1.87E+00		3.08E+00			6.53E-01	1.13E-02	6.64E-01		3.74E+00	
Tl		2.41E+00	3.74E+00		6.15E+00			1.31E+00		1.31E+00		7.46E+00	
Zn		5.98E+00	1.03E+01	8.88E-01	1.72E+01			2.82E-01		2.82E-01		1.75E+01	
Zr		2.88E+00	5.01E+00		7.89E+00			1.83E-01	2.55E+02	2.56E+02		2.64E+02	
U		1.39E+03	6.22E+02	3.90E+01	2.05E+03			2.32E+03	3.64E+03	5.96E+03		8.01E+03	
Residue		1.53E+03	1.95E+03	2.45E+03	5.93E+03							5.93E+03	
Total		4.93E+03	5.81E+03	2.64E+03	1.34E+04			2.46E+03	3.90E+03	6.36E+03		1.97E+04	
* The 21.9 m^3 of as-settled floor sludge is comprised of 21.5 m^3 of a calculated volume of floor sludge plus an additional volume of													
0.4 m^3 of unfueled canister sludge regarded as basin floor sludge. See Section 3.1.1 for a detailed description.													

Table 3. K East Basin Nominal Process Streams with 250 μm Filtration.

KE Nominal with 250 micron canister sludge filtration											
Date: 01/21/98					Total				Total		
		Basin floor	Pit Areas	N.Loadout	Stream 1		Canisters	Wash	Stream 2		Streams total
As-settled	Vol. (m3)	21.9	13.3	6.3	41.5		1.62	1.85	3.47		44.97
As-settled	Den(g/mL)	1.27		1.31				3			
Component		Ci	Ci	Ci	Ci		Ci	Ci	Ci		Ci
Am241(AEA)		2.49E+02	1.69E+02	6.65E+00	4.25E+02		1.05E+02	7.05E+02	8.10E+02		1.23E+03
Bi212		1.12E+01	2.27E+01		3.39E+01		1.90E+01		1.90E+01		5.29E+01
Ce144/Pr		9.12E+01	7.01E+01		1.61E+02		3.73E+01	5.14E+00	4.24E+01		2.04E+02
Cm243/244		5.60E+01	3.75E+01		9.35E+01		1.71E+01	2.98E+00	2.01E+01		1.14E+02
Co57			7.08E+00		7.08E+00		8.32E+00		8.32E+00		1.54E+01
Co60		1.57E+01	1.52E+01	1.36E+00	3.23E+01		1.71E+00	6.36E+00	8.07E+00		4.03E+01
Cs134		7.29E+00	5.26E+00		1.26E+01		2.65E+00	2.38E+01	2.65E+01		3.90E+01
Cs137		4.24E+03	3.55E+03	6.14E+01	7.85E+03		1.44E+03	2.24E+04	2.38E+04		3.17E+04
Eu152		1.84E+00	6.28E+00		8.12E+00		5.99E+00	1.60E+00	7.59E+00		1.57E+01
Eu154		3.90E+01	2.83E+01	1.36E+00	6.87E+01		1.86E+01	1.81E+02	2.00E+02		2.68E+02
Eu155		1.99E+01	1.83E+01	7.46E-01	3.89E+01		1.39E+01	3.83E+01	5.22E+01		9.11E+01
Nb94		5.46E+00	3.74E+00		9.20E+00		1.74E+00		1.74E+00		1.09E+01
Np237		4.00E-02	3.69E-02		7.69E-02		2.25E-02	1.03E-01	1.26E-01		2.02E-01
Pu238		4.97E+01	7.20E+01	1.32E+00	1.23E+02		5.78E+01	2.07E+02	2.65E+02		3.88E+02
Pu239/240		2.13E+02	2.82E+02	8.05E+00	5.03E+02		2.13E+02	6.15E+02	8.28E+02		1.33E+03
Ra226		1.67E+02	1.31E+02		2.98E+02		7.13E+01		7.13E+01		3.70E+02
Ru106/Rh		1.22E+02	9.66E+01		2.18E+02		5.36E+01	9.51E+00	6.31E+01		2.81E+02
Sb125		1.06E+01	6.57E+00		1.72E+01		1.68E+00	5.78E+01	5.95E+01		7.67E+01
Sr90		3.99E+03	4.26E+03		8.25E+03		2.70E+03	1.70E+04	1.97E+04		2.80E+04
Tc99			1.07E+01		1.07E+01		1.26E+01	4.96E+00	1.76E+01		2.83E+01
Tl208		3.37E+01	5.49E+01		8.86E+01		4.53E+01		4.53E+01		1.34E+02
U-233		1.30E-01	1.21E-01		2.51E-01		7.29E-02		7.29E-02		3.24E-01
U-234		6.70E-01	8.73E-01		1.54E+00		7.02E-01	1.59E+00	2.29E+00		3.84E+00
U-235		2.00E-02	2.93E-02		4.93E-02		2.33E-02	6.06E-02	8.39E-02		1.33E-01
U-236		5.00E-02	7.31E-02		1.23E-01		5.05E-02	2.26E-01	2.77E-01		4.00E-01
U-238		4.60E-01	6.41E-01		1.10E+00		5.10E-01	1.30E+00	1.81E+00		2.91E+00
Y-90								1.70E+04	1.70E+04		1.70E+04
Pu241				1.13E+02	1.13E+02			1.17E+04	1.17E+04		1.18E+04
Ba-137m				5.81E+01	5.81E+01			2.12E+04	2.12E+04		2.13E+04
Total		9.32E+03	8.85E+03	2.52E+02	1.84E+04		4.83E+03	9.12E+04	9.60E+04		1.14E+05
					Total				Total		
Component		Basin floor	Pit Areas	N.Loadout	Stream 1		Canisters	Wash	Stream 2		Streams total
Dry Basis		Kg	Kg	Kg	Kg		Kg	Kg	Kg		Kg
Ag		1.20E-01	3.82E-01		5.02E-01		2.29E-01		2.29E-01		7.31E-01
Al		3.72E+02	3.60E+02	3.00E+01	7.62E+02		4.28E+01	2.93E+00	4.57E+01		8.07E+02
B		1.48E+00	1.49E+00		2.97E+00		3.57E-01	1.04E-03	3.58E-01		3.33E+00
Ba		1.69E+00	2.93E+00	4.01E-01	5.02E+00		2.27E-01		2.27E-01		5.25E+00
Be		3.00E-01	1.87E-01	2.92E-02	5.16E-01		4.41E-02	2.81E-01	3.25E-01		8.41E-01
Bi			7.50E-01		7.50E-01		8.80E-01		8.80E-01		1.63E+00
Ca		3.90E+01	9.16E+01	2.27E+01	1.53E+02		1.16E+00		1.16E+00		1.54E+02
Cd		8.10E-01	5.07E-01	2.06E-01	1.52E+00		3.76E-02	1.04E-03	3.86E-02		1.56E+00
Cr		3.70E+00	1.01E+01	4.94E-01	1.43E+01		9.61E-01	4.97E-01	1.46E+00		1.58E+01
Cu		4.08E+00	3.86E+00	1.04E+00	8.98E+00		1.83E-01	2.86E-01	4.69E-01		9.45E+00
Fe		1.51E+03	2.76E+03	8.98E+01	4.36E+03		2.08E+01	1.62E+00	2.24E+01		4.38E+03
K		9.19E+00	1.46E+01		2.38E+01		3.05E+00		3.05E+00		2.68E+01
Mg		1.15E+01	1.91E+01	2.86E+00	3.34E+01		3.03E+00	9.63E-02	3.13E+00		3.65E+01
Mn		3.35E+00	4.32E+00	1.24E+00	8.91E+00		1.17E-01	1.04E-01	2.21E-01		9.13E+00
Na		4.35E+01	7.18E+00	1.63E+00	5.23E+01		8.32E-01	5.21E-03	8.37E-01		5.31E+01
Pb		2.97E+00	5.02E+00	3.47E-01	8.34E+00		3.79E-01	2.62E-02	4.05E-01		8.74E+00
Se		1.21E+00	2.17E+00		3.38E+00		3.53E-01	2.07E-02	3.74E-01		3.75E+00
Sm		1.21E+00	2.17E+00		3.38E+00		3.53E-01	1.13E-02	3.64E-01		3.74E+00
Ti		2.41E+00	4.34E+00		6.75E+00		7.07E-01		7.07E-01		7.46E+00
Zn		5.88E+00	1.04E+01	8.88E-01	1.73E+01		1.52E-01		1.52E-01		1.74E+01
Zr		2.88E+00	5.09E+00		7.97E+00		9.88E-02	2.55E+02	2.58E+02		2.64E+02
U		1.39E+03	1.69E+03	3.90E+01	3.12E+03		1.25E+03	3.64E+03	4.89E+03		8.00E+03
Residue		1.53E+03	1.95E+03	2.45E+03	5.93E+03						5.93E+03
Total		4.93E+03	6.95E+03	2.64E+03	1.45E+04		1.33E+03	3.90E+03	5.22E+03		1.97E+04

Table 4. K East Basin Nominal Activity Conversions to Gram Moles.

KE Nominal with 250 micron canister sludge filtration — Date: 01/21/98

Component	activity gmol/Ci	Stream 1 gmol	Stream 2 gmol	Streams total gmol
Am241(AEA)	1.21E-03	5.14E-01	9.80E-01	1.49E+00
Bi212	3.21E-10	1.09E-08	6.10E-09	1.70E-08
Ce144/Pr	7.26E-07	1.17E-04	3.08E-05	1.48E-04
Cm243/244	5.06E-05	4.73E-03	1.02E-03	5.75E-03
Co57	2.08E-06	1.47E-05	1.73E-05	3.20E-05
Co60	1.47E-05	4.74E-04	1.19E-04	5.93E-04
Cs134	5.76E-06	7.23E-05	1.52E-04	2.25E-04
Cs137	8.42E-05	6.61E-01	2.01E+00	2.67E+00
Eu152	3.76E-05	3.05E-04	2.85E-04	5.91E-04
Eu154	2.40E-05	1.65E-03	4.79E-03	6.44E-03
Eu155	1.31E-05	5.10E-04	6.84E-04	1.19E-03
Nb94	5.58E-02	5.13E-01	9.71E-02	6.10E-01
Np237	5.97E+00	4.58E-01	7.49E-01	1.21E+00
Pu238	2.45E-04	3.01E-02	6.49E-02	9.50E-02
Pu239/240	4.90E-02	2.46E+01	4.06E+01	6.52E+01
Ra226	4.46E-03	1.33E+00	3.18E-01	1.65E+00
Ru106/Rh	1.42E-06	3.10E-04	8.96E-05	4.00E-04
Sb125	7.70E-06	1.33E-04	4.58E-04	5.91E-04
Sr90	8.12E-05	6.70E-01	1.60E+00	2.27E+00
Tc99	5.94E-01	6.36E+00	1.04E+01	1.68E+01
Th208	1.62E-11	1.43E-09	7.34E-10	2.17E-09
U-233	4.44E-01	1.11E-01	3.24E-02	1.44E-01
U-234	6.86E-01	1.06E+00	1.57E+00	2.63E+00
U-235	1.96E+03	9.66E+01	1.64E+02	2.61E+02
U-236	6.54E+01	8.05E+00	1.81E+01	2.61E+01
U-238	1.25E+04	1.38E+04	2.26E+04	3.64E+04
Y-90	2.04E-08	2.04E-08	3.47E-04	3.47E-04
Pu241	4.02E-05	4.54E-03	4.70E-01	4.75E-01
Ba-137m	1.36E-11	7.90E-10	2.88E-07	2.89E-07

Table 5. K East Basin Upper Bound.

KE Upper Bound												
Date: 01/21/98												
		Basin floor	Pit Areas	N.Loadout	Total			Canisters	Wash	Total		Sum Total
As-settled	Vol. (m3)	26.3	14.8	7.5	48.6			7.4	4.62	12.02		60.62
As-settled	Den(g/mL)											
Component		Ci	Ci	Ci				Ci	Ci	Ci		Ci
Am241(AEA)		1.47E+03	1.66E+02	7.91E+00	1.64E+03			1.27E+03	1.76E+03	3.04E+03		4.68E+03
Bi212		9.34E+01	1.58E+01		1.09E+02			1.86E+02		1.86E+02		2.95E+02
Ce144/Pr		3.02E+02	5.89E+01		3.61E+02			3.45E+02	1.29E+01	3.58E+02		7.19E+02
Cm243/244		3.37E+02	5.31E+01		3.90E+02			2.97E+02	7.45E+00	3.04E+02		6.95E+02
Co57								1.08E+02		1.08E+02		1.08E+02
Co60		5.29E+01	2.37E+01	1.62E+00	7.82E+01			1.77E+01	1.59E+01	3.36E+01		1.12E+02
Cs134		2.32E+01	4.60E+00		2.78E+01			2.46E+01	5.95E+01	8.41E+01		1.12E+02
Cs137		3.89E+04	6.97E+03	7.31E+01	4.59E+04			1.58E+04	5.60E+04	7.18E+04		1.18E+05
Eu152		1.27E+01	1.76E+00		1.45E+01			6.25E+01	4.00E+00	6.65E+01		8.09E+01
Eu154		2.34E+02	2.50E+01	1.62E+00	2.61E+02			2.55E+02	4.53E+02	7.08E+02		9.68E+02
Eu155		1.08E+02	1.42E+01	8.88E-01	1.23E+02			1.67E+02	9.58E+01	2.63E+02		3.86E+02
Nb94		1.18E+01	3.27E+00		1.51E+01			1.72E+01		1.72E+01		3.23E+01
Np237		2.25E-01	2.89E-02		2.54E-01			2.49E-01	2.58E-01	5.06E-01		7.60E-01
Pu238		2.87E+02	6.01E+01	1.57E+00	3.49E+02			9.62E+02	5.18E+02	1.48E+03		1.83E+03
Pu239/240		1.18E+03	2.20E+02	9.58E+00	1.41E+03			2.10E+03	1.54E+03	3.64E+03		5.05E+03
Ra226		5.78E+02	1.10E+02		6.89E+02			6.62E+02		6.62E+02		1.35E+03
Ru106/Rh		4.42E+02	8.24E+01		5.24E+02			5.00E+02	2.38E+01	5.24E+02		1.05E+03
Sb125		9.86E+01	1.26E+01		1.11E+02			1.52E+01	1.45E+02	1.60E+02		2.71E+02
Sr90		3.63E+04	5.22E+03		4.15E+04			3.01E+04	4.25E+04	7.26E+04		1.14E+05
Tc99								1.40E+02		1.40E+02		1.40E+02
Tl208		3.13E+02	3.94E+01		3.52E+02			4.21E+02		4.21E+02		7.73E+02
U-233		1.06E+00	1.05E-01		1.17E+00			5.71E-01		5.71E-01		1.74E+00
U-234		5.70E+00	4.83E-01		6.18E+00			6.06E+00	3.98E+00	1.00E+01		1.62E+01
U-235		1.76E-01	1.68E-02		1.93E-01			1.77E-01	1.52E-01	3.29E-01		5.21E-01
U-236		3.55E-01	5.32E-02		4.08E-01			4.68E-01	5.65E-01	1.03E+00		1.44E+00
U-238		3.71E+00	3.86E-01		4.10E+00			4.05E+00	3.25E+00	7.30E+00		1.14E+01
Y-90									4.25E+04	4.25E+04		4.25E+04
Pu241				1.34E+02	1.34E+02				2.93E+04	2.93E+04		2.94E+04
Ba-137m				6.91E+01	6.91E+01				5.30E+04	5.30E+04		5.31E+04
Total		8.08E+04	1.31E+04	2.99E+02	9.41E+04			5.34E+04	2.28E+05	2.81E+05		3.75E+05
Component		Basin floor	Pit Areas	N.Loadout	Total			Canisters	Wash	Total		Sum Total
Dry Basis		Kg	Kg	Kg	Kg			Kg	Kg	Kg		Kg
Ag		4.34E-01	3.49E-01		7.83E-01			2.13E+00		2.13E+00		2.91E+00
Al		1.12E+03	6.23E+02	3.57E+01	1.78E+03			3.15E+02	7.33E+00	3.18E+02		2.10E+03
B		3.10E+00	1.88E+00		4.98E+00			2.27E+00	2.60E-03	2.27E+00		7.25E+00
Ba		6.05E+00	8.24E+00	4.77E-01	1.48E+01			1.88E+00		1.88E+00		1.66E+01
Be		6.94E-01	2.10E-01	3.47E-02	9.39E-01			1.56E-01	7.03E-01	1.84E-01		1.12E+00
Bi								9.10E+00		9.10E+00		9.10E+00
Ca		1.47E+02	1.82E+02	2.70E+01	3.56E+02			1.07E+01		1.07E+01		3.67E+02
Cd		1.51E+00	7.49E-01	2.45E-01	2.50E+00			3.23E-01	2.60E-03	3.24E-01		2.83E+00
Cr		1.28E+01	1.51E+01	5.88E-01	2.85E+01			6.58E-01	1.24E+00	1.16E+00		2.96E+01
Cu		1.12E+01	6.98E+00	1.24E+00	1.94E+01			1.29E+00	7.15E-01	1.58E+00		2.10E+01
Fe		7.18E+03	4.40E+03	1.07E+02	1.17E+04			2.05E+02	4.05E+00	2.07E+02		1.19E+04
K		3.18E+01	2.49E+01		5.67E+01			3.80E+01		3.80E+01		9.47E+01
Mg		2.71E+01	3.02E+01	3.40E+00	6.07E+01			3.03E+01	2.41E-01	3.04E+01		9.11E+01
Mn		1.19E+01	5.71E+00	1.48E+00	1.91E+01			1.47E+00	2.60E-01	1.57E+00		2.07E+01
Na		3.92E+02	1.80E+01	1.94E+00	4.12E+02			5.88E+00	1.30E-02	5.89E+00		4.18E+02
Pb		9.55E+00	6.78E+00	4.13E-01	1.67E+01			3.12E+00	6.55E-02	3.15E+00		1.99E+01
Se		4.34E+00	3.49E+00		7.83E+00			3.12E+00	5.18E-02	3.12E+00		1.10E+01
Sm		4.34E+00	3.49E+00		7.83E+00			3.12E+00	2.83E-02	3.12E+00		1.10E+01
Tl		8.70E+00	6.98E+00		1.57E+01			6.24E+00		6.24E+00		2.19E+01
Zn		1.71E+01	1.67E+01	1.06E+00	3.49E+01			1.35E+00		1.35E+00		3.62E+01
Zr		6.97E+00	1.02E+01		1.72E+01			7.16E-01	6.38E+02	2.56E+02		2.73E+02
U		1.12E+04	1.11E+03	4.64E+01	1.24E+04			1.03E+04	9.10E+03	1.39E+04		2.63E+04
Residue		1.17E+04	6.10E+03	2.92E+03	2.07E+04							2.07E+04
Total		3.19E+04	1.26E+04	3.14E+03	4.76E+04			1.09E+04	9.75E+03	2.07E+04		6.83E+04

Table 6. K East Basin Upper Bound Process Streams with 250 μm Filtration.

KE Upper Bound with 250 micron canister sludge filtration												
Date: 01/21/98					Total					Total		
		Basin floor	Pit Areas	N.Loadout	Stream 1			Canisters	Wash	Stream 2		Streams total
As-settled	Vol. (m3)	26.3	18.4	7.5	52.2			3.77	4.62	8.39		60.59
As-settled	Den(g/mL)											
Component		Ci	Ci	Ci				Ci	Ci	Ci		Ci
Am241(AEA)		1.47E+03	7.90E+02	7.91E+00	2.27E+03			6.49E+02	1.76E+03	2.41E+03		4.68E+03
Bi212		9.34E+01	1.07E+02		2.00E+02			9.49E+01		9.49E+01		2.95E+02
Ce144/Pr		3.02E+02	2.28E+02		5.30E+02			1.76E+02	1.29E+01	1.89E+02		7.19E+02
Cm243/244		3.37E+02	1.99E+02		5.36E+02			1.51E+02	7.45E+00	1.59E+02		6.95E+02
Co57			5.29E+01		5.29E+01			5.51E+01		5.51E+01		1.08E+02
Co60		5.29E+01	3.24E+01	1.62E+00	8.69E+01			9.03E+00	1.59E+01	2.49E+01		1.12E+02
Cs134		2.32E+01	1.67E+01		3.99E+01			1.25E+01	5.95E+01	7.20E+01		1.12E+02
Cs137		3.89E+04	1.47E+04	7.31E+01	5.37E+04			8.04E+03	5.60E+04	6.40E+04		1.18E+05
Eu152		1.27E+01	3.24E+01		4.51E+01			3.19E+01	4.00E+00	3.59E+01		8.10E+01
Eu154		2.34E+02	1.50E+02	1.62E+00	3.86E+02			1.30E+02	4.53E+02	5.83E+02		9.69E+02
Eu155		1.08E+02	9.60E+01	8.88E-01	2.05E+02			8.52E+01	9.58E+01	1.81E+02		3.86E+02
Nb94		1.18E+01	1.17E+01		2.35E+01			8.77E+00		8.77E+00		3.23E+01
Np237		2.25E-01	1.51E-01		3.76E-01			1.27E-01	2.58E-01	3.85E-01		7.61E-01
Pu238		2.87E+02	5.31E+02	1.57E+00	8.20E+02			4.91E+02	5.18E+02	1.01E+03		1.83E+03
Pu239/240		1.18E+03	1.25E+03	9.58E+00	2.44E+03			1.07E+03	1.54E+03	2.61E+03		5.05E+03
Ra226		5.79E+02	4.34E+02		1.01E+03			3.38E+02		3.38E+02		1.35E+03
Ru106/Rh		4.42E+02	3.27E+02		7.69E+02			2.55E+02	2.38E+01	2.79E+02		1.05E+03
Sb125		9.86E+01	2.00E+01		1.19E+02			7.75E+00	1.45E+02	1.53E+02		2.71E+02
Sr90		3.63E+04	2.00E+04		5.63E+04			1.54E+04	4.25E+04	5.79E+04		1.14E+05
Tc99			6.86E+01		6.86E+01			7.14E+01		7.14E+01		1.40E+02
Tl208		3.13E+02	2.46E+02		5.59E+02			2.15E+02		2.15E+02		7.74E+02
U-233		1.06E+00	3.86E-01		1.45E+00			2.91E-01		2.91E-01		1.74E+00
U-234		5.70E+00	3.45E+00		9.15E+00			3.09E+00	3.98E+00	7.07E+00		1.62E+01
U-235		1.76E-01	1.04E-01		2.80E-01			9.03E-02	1.52E-01	2.42E-01		5.22E-01
U-236		3.55E-01	2.83E-01		6.38E-01			2.39E-01	5.65E-01	8.04E-01		1.44E+00
U-238		3.71E+00	2.37E+00		6.08E+00			2.07E+00	3.25E+00	5.32E+00		1.14E+01
Y-90									4.25E+04	4.25E+04		4.25E+04
Pu241				1.34E+02	1.34E+02				2.93E+04	2.93E+04		2.94E+04
Ba-137m				6.91E+01	6.91E+01				5.30E+04	5.30E+04		5.31E+04
Total		8.08E+04	3.93E+04	2.99E+02	1.20E+05			2.73E+04	2.28E+05	2.55E+05		3.76E+05
					Total					Total		
Component		Basin floor	Pit Areas	N.Loadout	Stream 1			Canisters	Wash	Stream 2		Streams total
Dry Basis		Kg	Kg	Kg	Kg			Kg	Kg	Kg		Kg
Ag		4.34E-01	1.39E+00		1.82E+00			1.09E+00		1.09E+00		2.91E+00
Al		1.12E+03	7.77E+02	3.57E+01	1.93E+03			1.61E+02	7.33E+00	1.68E+02		2.10E+03
B		3.10E+00	2.99E+00		6.09E+00			1.16E+00	2.60E-03	1.16E+00		7.25E+00
Ba		6.05E+00	9.16E+00	4.77E-01	1.57E+01			9.59E-01		9.59E-01		1.66E+01
Be		6.94E-01	2.86E-01	3.47E-02	1.01E+00			7.96E-02	7.03E-01	7.83E-01		1.80E+00
Bi			4.46E+00		4.46E+00			4.64E+00		4.64E+00		9.10E+00
Ca		1.47E+02	1.87E+02	2.70E+01	3.61E+02			5.46E+00		5.46E+00		3.66E+02
Cd		1.51E+00	9.07E-01	2.45E-01	2.66E+00			1.65E-01	2.60E-03	1.67E-01		2.83E+00
Cr		1.28E+01	1.54E+01	5.88E-01	2.88E+01			3.36E-01	1.24E+00	1.58E+00		3.04E+01
Cu		1.12E+01	7.61E+00	1.24E+00	2.01E+01			6.58E-01	7.15E-01	1.37E+00		2.14E+01
Fe		7.18E+03	4.50E+03	1.07E+02	1.18E+04			1.05E+02	4.05E+00	1.09E+02		1.19E+04
K		3.18E+01	4.35E+01		7.53E+01			1.94E+01		1.94E+01		9.47E+01
Mg		2.71E+01	4.50E+01	3.40E+00	7.55E+01			1.55E+01	2.41E-01	1.57E+01		9.12E+01
Mn		1.19E+01	6.43E+00	1.48E+00	1.98E+01			7.50E-01	2.60E-01	1.01E+00		2.08E+01
Na		3.92E+02	2.09E+01	1.94E+00	4.15E+02			3.00E+00	1.30E-02	3.01E+00		4.18E+02
Pb		9.55E+00	8.31E+00	4.13E-01	1.83E+01			1.59E+00	6.55E-02	1.66E+00		1.99E+01
Se		4.34E+00	5.02E+00		9.36E+00			1.59E+00	5.18E-02	1.64E+00		1.10E+01
Sm		4.34E+00	5.02E+00		9.36E+00			1.59E+00	2.83E-02	1.62E+00		1.10E+01
Tl		8.70E+00	1.00E+01		1.87E+01			3.18E+00		3.18E+00		2.19E+01
Zn		1.71E+01	1.74E+01	1.06E+00	3.56E+01			6.88E-01		6.88E-01		3.62E+01
Zr		6.97E+00	1.06E+01		1.76E+01			3.65E-01	6.38E+02	6.38E+02		6.56E+02
U		1.12E+04	6.15E+03	4.64E+01	1.74E+04			5.25E+03	9.10E+03	1.43E+04		3.17E+04
Residue		1.17E+04	6.10E+03	2.92E+03	2.07E+04							2.07E+04
Total		3.19E+04	1.79E+04	3.14E+03	5.30E+04			5.57E+03	9.75E+03	1.53E+04		6.83E+04

Table 7. K East Basin Upper Bound Activity Conversions to Gram Moles.

KE Upper Bound with 250 micron canister sludge filtration						Date: 01/21/98
		activity	Stream 1	Stream 2		Total
		gmol/Ci	gmol	gmol		gmol
Am241(AEA)		1.21E-03	2.74E+00	2.91E+00		5.66E+00
Bi212		3.21E-10	6.43E-08	3.05E-08		9.48E-08
Ce144/Pr		7.26E-07	3.85E-04	1.37E-04		5.22E-04
Cm243/244		5.06E-05	2.71E-02	8.04E-03		3.52E-02
Co57		2.08E-06	1.10E-04	1.15E-04		2.25E-04
Co60		1.47E-05	1.28E-03	3.66E-04		1.64E-03
Cs134		5.76E-06	2.30E-04	4.15E-04		6.45E-04
Cs137		8.42E-05	4.52E+00	5.39E+00		9.91E+00
Eu152		3.76E-05	1.70E-03	1.35E-03		3.04E-03
Eu154		2.40E-05	9.25E-03	1.40E-02		2.32E-02
Eu155		1.31E-05	2.68E-03	2.37E-03		5.06E-03
Nb94		5.58E-02	1.31E+00	4.89E-01		1.80E+00
Np237		5.97E+00	2.24E+00	2.30E+00		4.54E+00
Pu238		2.45E-04	2.01E-01	2.47E-01		4.48E-01
Pu239/240		4.90E-02	1.20E+02	1.28E+02		2.48E+02
Ra226		4.46E-03	4.52E+00	1.51E+00		6.03E+00
Ru106/Rh		1.42E-06	1.09E-03	3.96E-04		1.49E-03
Sb125		7.70E-06	9.13E-04	1.18E-03		2.09E-03
Sr90		8.12E-05	4.57E+00	4.70E+00		9.27E+00
Tc99		5.94E-01	4.07E+01	4.24E+01		8.32E+01
Tl208		1.62E-11	9.06E-09	3.48E-09		1.25E-08
U-233		4.44E-01	6.42E-01	1.29E-01		7.71E-01
U-234		6.86E-01	6.28E+00	4.85E+00		1.11E+01
U-235		1.96E+03	5.49E+02	4.75E+02		1.02E+03
U-236		6.54E+01	4.17E+01	5.26E+01		9.43E+01
U-238		1.25E+04	7.60E+04	6.64E+04		1.42E+05
Y-90		2.04E-08	2.04E-08	8.67E-04		8.67E-04
Pu241		4.02E-05	5.39E-03	1.18E+00		1.18E+00
Ba-137m		1.36E-11	9.40E-10	7.21E-07		7.22E-07

Table 8. K West Basin Nominal Process Streams and Activity Conversions.

KW Nominal												
Date: 01/21/98												
		N.Loadout	Wash	Canisters		Total						
As-settled	Vol. (m3)	3.7	1.85	1.7		7.25						
As-settled	Den(g/mL)											Streams
		Stream 1	Stream 2	Stream 3		Streams total		activity	Stream 1	Stream 2	Stream 3	Total
Component		Ci	Ci	Ci		Ci		gmol/Ci	gmol	gmol	gmol	gmol
Am241(AEA)		8.44E-05	6.94E+02	5.46E+02		1.24E+03		1.21E-03	1.02E-07	8.40E-01	6.61E-01	1.50E+00
Bi212				2.94E+01		2.94E+01		3.21E-10			9.44E-09	9.44E-09
Ce144/Pr			1.29E+00	4.91E+01		5.04E+01		7.26E-07		9.37E-07	3.56E-05	3.66E-05
Cm242			2.78E-01	2.60E+00		2.88E+00		1.24E-06			3.22E-06	3.22E-06
Cm243/244			2.35E+00	2.02E+00		4.37E+00		5.06E-05		1.19E-04	1.02E-04	2.21E-04
Co60		1.72E-05	8.62E+00	2.28E+01		3.14E+01		1.47E-05	2.53E-10	1.27E-04	3.35E-04	4.62E-04
Cs134			3.68E+01	5.24E+00		4.20E+01		5.76E-06		2.12E-04	3.02E-05	2.42E-04
Cs137		7.79E-04	2.73E+04	7.28E+03		3.46E+04		8.42E-05	6.56E-08	2.30E+00	6.13E-01	2.91E+00
Eu152			1.96E+00	3.43E+00		5.39E+00		3.76E-05		7.37E-05	1.29E-04	2.03E-04
Eu154		1.72E-05	2.23E+02	1.01E+02		3.24E+02		2.40E-05	4.13E-10	5.35E-03	2.42E-03	7.78E-03
Eu155		9.46E-06	4.43E+01	4.66E+01		9.09E+01		1.31E-05	1.24E-10	5.80E-04	6.10E-04	1.19E-03
Nb95				1.47E+00		1.47E+00		2.67E-07			3.92E-07	3.92E-07
Np237			1.11E-01	6.04E-02		1.72E-01		5.97E+00		6.64E-01	3.61E-01	1.02E+00
Pu236				5.29E-01		5.29E-01		8.01E-06			4.24E-06	4.24E-06
Pu238		1.68E-05	2.09E+02	1.18E+02		3.27E+02		2.45E-04	4.12E-09	5.12E-02	2.89E-02	8.01E-02
Pu239/240		1.02E-04	6.42E+02	5.98E+02		1.24E+03		4.90E-02	5.00E-06	3.15E+01	2.93E+01	6.08E+01
Ra226				2.46E+01		2.46E+01		4.46E-03			1.10E-01	1.10E-01
Ru106/Rh			3.56E+00	9.83E+01		1.02E+02		1.42E-06		5.06E-06	1.40E-04	1.45E-04
Sb125			6.81E+01	2.01E+01		8.82E+01		7.70E-06		5.24E-04	1.55E-04	6.79E-04
Sr90			2.12E+04	1.18E+04		3.30E+04		8.12E-05		1.72E+00	9.58E-01	2.68E+00
Tc99			5.87E+00	4.25E+00		1.01E+01		5.94E-01			2.52E+00	2.52E+00
Tl208				1.97E+01		1.97E+01		1.62E-11			3.19E-10	3.19E-10
U-234			1.67E+00	1.18E+00		2.85E+00		6.86E-01		1.15E+00	8.09E-01	1.96E+00
U-235			6.57E-02	4.52E-02		1.11E-01		1.96E+03		1.29E+02	8.86E+01	2.17E+02
U-236			2.51E-01	1.63E-01		4.14E-01		6.64E+01		1.64E+01	1.07E+01	2.70E+01
U-238			1.30E+00	8.76E-01		2.17E+00		1.25E+04		1.62E+04	1.10E+04	2.72E+04
Y-90			2.12E+04			2.12E+04		2.04E-08		4.32E-04		4.32E-04
Pu241		1.43E-03	1.34E+04			1.34E+04		4.02E-05	5.75E-08	5.39E-01		5.39E-01
Ba-137m		7.37E-04	2.58E+04			2.58E+04		1.36E-11	1.00E-14	3.51E-07		3.51E-07
Total		3.19E-03	1.11E+05	2.08E+04		1.32E+05						
		N.Loadout	Wash	Canisters								
		Stream 1	Stream 2	Stream 3		Streams total						
Component												
Dry Basis		Kg	Kg	Kg		Kg						
Ag				1.28E+00		1.28E+00						
Al		3.81E-04	2.93E+00	5.07E+01		5.36E+01						
B			1.04E-03	1.42E+01		1.42E+01						
Ba		2.36E-01		6.88E-01		9.24E-01						
Be		3.70E-07	2.81E-01	1.96E-01		4.77E-01						
Bi				1.92E+00		1.92E+00						
Ca		1.33E+01		3.20E+01		4.53E+01						
Cd		2.61E-06	1.04E-03	6.39E-01		6.40E-01						
Cr		6.27E-06	4.97E-01	1.00E+00		1.50E+00						
Cu		1.32E-05	2.86E-01	6.39E+00		6.68E+00						
Fe		1.14E-03	1.62E+00	1.46E+02		1.48E+02						
K				8.84E+01		8.84E+01						
Mg		3.63E-05	9.63E-02	3.82E+01		3.83E+01						
Mn		1.57E-05	1.04E-01	6.39E-01		7.43E-01						
Na		2.07E-05	6.21E-03	1.62E+01		1.62E+01						
Ni				2.26E+00		2.26E+00						
P				6.39E+00		6.39E+00						
Pb		4.40E-06	2.62E-02	6.39E+00		6.42E+00						
Se			2.07E-02	3.20E+00		3.20E+00						
Sn			3.78E+00	1.28E+02		1.32E+02						
Ti				6.39E+00		6.39E+00						
Zn		5.22E-01		3.54E+00		4.06E+00						
Zr			2.55E+02	1.38E+00		1.38E+00						
U		4.95E-04	3.64E+03	2.62E+03		6.26E+03						
Residue		1.44E+03				1.44E+03						
Total		1.45E+03	3.90E+03	3.18E+03		8.53E+03						

Table 9. K West Basin Upper Bound Process Streams and Activity Conversions.

KW Upper Bound												
Date: 01/21/98												
		N.Loadout	Wash	Canisters		Total						
As-settled	Vol (m3)	4.5	4.62	3		12.12						
As-settled	Den(g/mL)											
		Stream 1	Stream 2	Stream 3				activity	Stream 1	Stream 2	Stream 3		Total
Component		Ci	Ci	Ci		Ci		gmol/Ci	gmol	gmol	gmol		gmol
Am241(AEA)		1.03E-04	1.74E+03	3.36E+03		5.10E+03		1.21E-03	1.25E-07	2.10E+00	4.07E+00		6.16E+00
Bi212				5.19E+01		5.19E+01		3.21E-10			1.67E-08		1.67E-08
Ce144/Pr			3.23E+00	8.66E+01		8.98E+01		7.26E-07		2.34E-06	6.29E-05		6.52E-05
Cm242				4.59E+00		4.59E+00		1.24E-06			5.69E-06		5.69E-06
Cm243/244			5.88E+00	1.70E+01		2.29E+01		5.06E-05		2.97E-04	8.60E-04		1.16E-03
Co60		2.09E-05	2.16E+01	1.93E+02		2.15E+02		1.47E-05	3.07E-10	3.17E-04	2.84E-03		3.15E-03
Cs134			9.20E+01	2.97E+01		1.22E+02		5.76E-06		5.30E-04	1.71E-04		7.01E-04
Cs137		9.47E-04	6.83E+04	5.28E+04		1.21E+05		8.42E-05	7.97E-08	5.75E+00	4.45E+00		1.02E+01
Eu152			4.90E+00	6.06E+00		1.10E+01		3.76E-05		1.84E-04	2.28E-04		4.12E-04
Eu154		2.09E-05	5.58E+02	5.40E+02		1.10E+03		2.40E-05	5.02E-10	1.34E-02	1.30E-02		2.63E-02
Eu155		1.15E-05	1.11E+02	2.20E+02		3.31E+02		1.31E-05	1.51E-10	1.45E-03	2.88E-03		4.33E-03
Nb95				2.60E+00		2.60E+00		2.67E-07			6.94E-07		6.94E-07
Np237			2.78E-01	3.30E-01		6.08E-01		5.97E+00		1.66E+00	1.97E+00		3.63E+00
Pu236				3.72E+00		3.72E+00		8.01E-06			2.98E-05		2.98E-05
Pu238		2.04E-05	5.23E+02	7.62E+02		1.28E+03		2.45E-04	5.00E-09	1.28E-01	1.87E-01		3.15E-01
Pu239/240		1.24E-04	1.61E+03	3.00E+03		4.61E+03		4.90E-02	6.08E-06	7.86E+01	1.47E+02		2.26E+02
Ra226				4.35E+01		4.35E+01		4.46E-03			1.94E-01		1.94E-01
Ru106/Rh			8.90E+00	1.73E+02		1.82E+02		1.42E-06		1.26E-05	2.46E-04		2.58E-04
Sb125			1.70E+02	1.12E+02		2.82E+02		7.70E-06		1.31E-03	8.62E-04		2.17E-03
Sr90			5.30E+04	5.49E+04		1.08E+05		8.12E-05		4.30E+00	4.46E+00		8.76E+00
Tc-99				1.81E+01		1.81E+01		5.94E-01			1.08E+01		1.08E+01
Tl208				3.48E+01		3.48E+01		1.62E-11			5.64E-10		5.64E-10
U-234			4.18E+00	5.76E+00		9.94E+00		6.86E-01		2.86E+00	3.95E+00		6.82E+00
U-235			1.64E-01	2.17E-01		3.81E-01		1.96E+03		3.22E+02	4.25E+02		7.47E+02
U-236			6.28E-01	7.95E-01		1.42E+00		6.54E+01		4.10E+01	5.20E+01		9.30E+01
U-238			3.25E+00	4.20E+00		7.45E+00		1.25E+04		4.06E+04	5.26E+04		9.31E+04
Y-90			5.30E+04			5.30E+04		2.04E-08		1.08E-03			1.08E-03
Pu241		1.74E-03	3.35E+04			3.35E+04		4.02E-05	6.99E-08	1.35E+00			1.35E+00
Ba-137m		8.96E-04	6.45E+04			6.45E+04		1.36E-11	1.22E-14	8.77E-07			8.77E-07
Total		3.88E-03	2.77E+05	1.16E+05		3.93E+05							
		N.Loadout	Wash	Canisters									
		Stream 1	Stream 2	Stream 3		Streams total							
Component													
Dry Basis		Kg	Kg	Kg		Kg							
Ag				2.26E+00		2.26E+00							
Al		4.63E-04	7.33E+00	3.33E+02		3.40E+02							
B			2.60E-03	2.51E+01		2.51E+01							
Ba		2.87E-01		3.03E+00		3.32E+00							
Be		4.50E-07	7.03E-01	3.45E-01		1.05E+00							
Bi				3.39E+00		3.39E+00							
Ca		1.62E+01		5.64E+01		7.26E+01							
Cd		3.17E-06	2.60E-03	1.13E+00		1.13E+00							
Cr		7.63E-06	1.24E+00	3.33E+00		4.57E+00							
Cu		1.60E-05	7.15E-01	1.13E+01		1.20E+01							
Fe		1.39E-03	4.05E+00	1.12E+03		1.12E+03							
K				1.56E+02		1.56E+02							
Mg		4.42E-05	2.41E-01	6.75E+01		6.77E+01							
Mn		1.91E-05	2.60E-01	1.13E+00		1.39E+00							
Na		2.52E-05	1.30E-02	2.86E+01		2.86E+01							
Ni				3.99E+00		3.99E+00							
P				1.13E+01		1.13E+01							
Pb		5.35E-06	6.55E-02	1.13E+01		1.14E+01							
Se			5.05E-03	5.64E+00		5.65E+00							
Sn				2.26E+02		2.26E+02							
Tl				1.13E+01		1.13E+01							
Zn		6.35E-01		6.24E+00		6.88E+00							
Zr			6.38E+02	5.46E+00		6.43E+02							
U		6.02E-04	9.10E+03	1.27E+04		2.18E+04							
Residue		1.75E+03				1.75E+03							
Total		1.77E+03	9.75E+03	1.48E+04		2.63E+04							

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3.0 ASSUMPTIONS AND ANALYSIS

3.1 K EAST BASIN NOMINAL SLUDGE VALUES

3.1.1 Basin Floor Sludge

The mass and activity values are taken directly from WHC-SD-SNF-TI-038 (Hecht 1996) and are associated with the nominal as-settled sludge volume (21.9 m^3) as calculated below. It is assumed that the measured concentrations of samples (Makenas 1996) incorporated into the inverse-distance method, along with depth-weighted averaged concentrations summed over the basin floor (Hecht 1996) constitute nominal values for the chemical constituents and radionuclides. The basis of WHC-SD-SNF-038 (Hecht 1996) are numerous sludge depth measurements (Baker 1995) and a related set of results of 12 "normal" (as opposed to "research" samples analyzed for composition as part of KE Basin characterization) (Makenas 1996).

From 1 to 34 wt% of the sludge samples could not be acid digested (see Section 2.1 for acids used) for chemical analyses (Makenas 1996); therefore, a residue component, assumed to consist of silica (SiO_2), is included with the chemical constituents. The sludge in the unfueled canisters* (0.4 m^3) (Baker 1997) is included with the basin floor sludge since it is assumed the basin floor sludge has settled into the canisters once the canisters were emptied of fuel elements (i.e., column in Tables 2 through 9 labeled "Basin Floor" includes both floor and empty canister sludge).

The density (ρ) of the basin floor sludge is:

$$\rho = 1.27 \frac{\text{g as-settled sludge}}{\text{mL as-settled sludge}} \text{ or } 1270 \frac{\text{kg}}{\text{m}^3}$$

based on the arithmetic average** from 12 basin floor density samples from Page C-11 in WHC-SP-1182 (Makenas 1996).

*The term "unfueled canisters" refer to canisters which once contained fuel but have been emptied of fuel and have since allowed a deposition of assorted basin sludge particles within the canisters. The mean uranium concentration results from the different fueled canister sludge samples show a range from 31 to 75 w/w% (Makenas 1997); however, the unfueled sample shows a maximum of 13 w/w% uranium. Therefore, the volume of sludge in unfueled canisters will be treated (in this document) as basin floor sludge.

**From hereon, in this document, any concentration averages or mean values are depicted as arithmetic averages, in other words, not volume weighted.

Therefore, the total as-settled sludge in the basin floor is calculated as:

$$21.9\ m^3 \times 1270\ \frac{kg}{m^3} = 27{,}800\ kg\ \text{as-settled sludge}$$

The 4930 kg of basin floor sludge components in Table 2 represent the principle elements, on a dry basis, on the KE Basin floor.

3.1.2 Weasel Pit/Tech View/Dummy Elevator Pit Sludge

Sludge constituent data for KE Basin pit area nominal values have been obtained from average concentration values of four samples taken from the Weasel Pit (Makenas 1996). These concentration values are multiplied by the KE Basin pit area nominal total volume (11.9 m^3) calculated (Baker 1997) which include the Weasel Pit and Channel,* Tech View Pit and North/South Channel, and the Dummy Elevator Pit. No previous concentration data have been obtained for the Tech View Pit and Dummy Elevator Pit so constituent concentration values associated with the Weasel Pit are used. The final mass calculations for chemical constituents are as follows.

Average total kg of component i in the Weasel Pit/Tech View/Dummy Elevator Pit sludge equals:

$$X_i\ \frac{\mu g\ \text{component i}}{mL\ \text{as-settled sludge}} \times \frac{10^6\ mL}{m^3} \times \frac{g}{10^6\ \mu g} \times \frac{kg}{10^3\ g} \times 11.9\ m^3$$

where:

X_i is the average chemical concentration of constituent i sample in the Weasel Pit as listed in locations 16 through 19 on page C-18 through C-21 in WHC-SP-1182 (Makenas 1996).

Total Ci of isotope j in KE Basin Weasel Pit/Tech View/Dummy Elevator Pit sludge equals:

$$Y_j\ \frac{\mu Ci\ \text{isotope j}}{mL\ \text{as-settled sludge}} \times \frac{10^6\ mL}{m^3} \times \frac{Ci}{10^6\ \mu Ci} \times 11.9\ m^3$$

---

*The concentrations from the sludge in the Weasel Pit were also used for the Weasel Pit Channel because the only sample taken from this area (Willis, Praga 1998) is not fully documented. This early sample may not have collected a sample of sludge material representative of the full depth of the layer of sludge (i.e., including heavy sludge perhaps residing next to floor). The recent Weasel Pit samples (Makenas 1996) are documented fully and the sampling made major efforts to be representative of the material present; therefore, using these recent Weasel Pit concentrations is judged the most realistic approach for the channel.

where:

Y_j is the mean activity concentration value of radionuclide j in the KE Basin Weasel Pit/Tech View/Dummy Elevator Pit sludge (Makenas 1996).

The density of the pit area sludge is:

$$\rho = 1.54 \frac{\text{g as-settled sludge}}{\text{mL as-settled sludge}} \text{ or } 1540 \frac{\text{kg}}{\text{m}^3}$$

based on the arithmetic average from four Weasel Pit density samples from page C-11 in WHC-SP-1182 (Makenas 1996).

Therefore, the total as-settled sludge in the pit areas is calculated as:

$$13.3 \text{ m}^3 \times 1540 \frac{\text{kg}}{\text{m}^3} = 20{,}500 \text{ kg as-settled sludge}$$

The 5810 kg of pit area sludge components in Table 2 represent the principle elements, on a dry basis, in the KE Basin pit areas.

3.1.3 North Loadout Pit Sludge

The total as-settled KE Basin nominal sludge volume (6.3 m^3) is obtained from (Baker 1997) for the North Loadout Pit and Channel (aka Sandfilter Backwash Pit and Channel). This nominal volume is associated with the total mass values for chemical constituents and total activity for radionuclides as presented on Pages 46 and 47 in WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998) for the Sandfilter Backwash Pit. Also included on Page 55 is the residue mass amount which is labeled as "other."

The density of the North Loadout Pit sludge is:

$$\rho = 1.31 \frac{\text{g as-settled sludge}}{\text{mL as-settled sludge}} \text{ or } 1310 \frac{\text{kg}}{\text{m}^3}$$

based on Table 5.1, page 45 of WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998). Therefore, the total as-settled sludge in the North Loadout Pit is calculated as:

$$6.3 \text{ m}^3 \times 1310 \frac{\text{kg}}{\text{m}^3} = 8250 \text{ kg as-settled sludge}$$

The 2640 kg of North Loadout Pit sludge components in Table 2 represent the principle elements on a dry basis, in the KE North Loadout Pit.

3.1.4 Canister Sludge

The total nominal KE Basin fueled canister sludge volume (3.0 m^3) is calculated in (Baker 1997). Mean concentration values for the various chemical constituents and radionuclides from five to six canister samples* (Makenas 1997) are multiplied by the nominal sludge volume (3.0 m^3) as follows.

Total kg of component i in KE Basin canister sludge equals:

$$X_i \frac{\mu g \text{ component } i}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{g}{10^6 \mu g} \times \frac{kg}{10^3 g} \times 3.0 \text{ m}^3$$

where:

X_i is the mean chemical concentration value for constituent i sample in the KE Basin canister sludge (Makenas 1997).

Total Ci of isotope j in KE Basin canister sludge equals:

$$Y_j \frac{\mu Ci \text{ isotope } j}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{Ci}{10^6 \mu Ci} \times 3.0 \text{ m}^3$$

where:

Y_j is the mean activity concentration value of radionuclide j in the KE Basin canister sludge (Makenas 1997).

The assumed nominal amount of as-settled canister sludge with particles less than 250 μm in diameter scheduled to be stored in the Weasel Pit is calculated at approximately 46 v/v%, which correlates to 1.4 m^3 (Makenas 1997).

The density of the canister sludge is:

$$\rho = 1.83 \frac{g \text{ as-settled sludge}}{mL \text{ as-settled sludge}} \text{ or } 1830 \frac{kg}{m^3}$$

based on the arithmetic average from six samples in Table D3, Page D-18 of HNF-SP-1201 (Makenas 1997).

*Only the six non-research (i.e., "normal") samples (Makenas), were averaged for mean concentrations. One of these six samples, Sample 96-01, displayed an outlier in values for ^{241}Am, ^{238}Pu, $^{239/240}Pu$, Cr, Fe, Na, and U. These outlier values are omitted from the mean concentrations for these analytes.

Therefore, the total as-settled sludge in the canisters is calculated as:

$$3.0\ m^3 \times 1830\ \frac{kg}{m^3} = 5490\ kg\ \text{as-settled sludge}$$

The 2460 kg of canister sludge components in Table 2 represent the principle elements, on a dry basis, from the KE fueled canisters.

3.1.5 Newly Generated Sludge from Fuel Wash

Mass calculations for newly generated sludge (all broken fuel pieces are less than or equal to 1/4 in. in diameter and are assumed greater than 250 μm as data is not yet available) from the fuel wash process amount to 200 liters of 19 g/mL fuel plus 38 liters of 3 g/mL "defected" (assumed oxidized uranium) fuel (Pitner 1997). Therefore, the newly generated sludge mass from the fuel wash amounts to:

$$200\ L \times 19\ \frac{kg}{L}\ \text{N-fuel} = 3800\ kg\ \text{N-fuel}$$

plus

$$38\ L \times 3\ \frac{kg}{L}\ UO_2 \times 0.88\ \frac{kg\ \text{N-fuel}}{kg\ UO_2} = 100\ kg\ \text{N-fuel}$$

therefore,

$$3800\ kg\ \text{N-fuel} + 100\ kg\ \text{N-fuel} = 3900\ kg\ \text{N-fuel}$$

The total mass of the chemical constituents and activity of the radionuclides of KE Basin fuel wash sludge is determined as follows below.

Total kg of component i in KE Basin fuel wash sludge equals:

$$X_i\ \frac{kg\ \text{component i}}{2.26 \times 10^6\ kg\ \text{N-fuel}} \times 3900\ kg\ \text{N-fuel}$$

where:

X_i is the total mass amount of chemical constituent i in both the KE and KW Basins as listed in Table 2.1 on Page 5 of WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998). Also listed is the total N-fuel, 2.26×10^6 kg, which accounts for the summed total of N-fuel in KE and KW Basins.

Total Ci of isotope j in KE Basin fuel wash sludge equals:

$$Y_j\ \frac{\text{Ci isotope j}}{1.14 \times 10^6\ kg\ \text{N-fuel}} \times 3900\ kg\ \text{N-fuel}$$

where:

Y_j is the total amount of isotope j in KE Basin as listed in Table 3.6 of WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998). Also listed is the total KE Basin N-fuel of 1.14×10^6 kg.

The density of the fuel wash sludge is:

$$\rho = 3.0 \frac{\text{g as-settled sludge}}{\text{mL as-settled sludge}} \text{ or } 3000 \frac{\text{kg}}{\text{m}^3}$$

based on (Pitner 1997).

The fuel wash as-settled sludge density is calculated to be 3.0 g/mL (or 3000 kg/m^3) with a dry mass basis of 3900 kg (Pitner 1997) and dry volume basis calculated to be 0.205 m^3 (3900 kg/19000 kg/m^3). Therefore, the as-settled sludge volume is calculated as:

$$\frac{(3900 + X)\ \text{kg}}{(0.205 + Y)\ \text{m}^3} = 3000 \frac{\text{kg}}{\text{m}^3}$$

where:

X = kg water in as-settled sludge at 60 °F

Y = m^3 water in as-settled sludge at 60 °F

and

density of water at 60 °F is:

$$\rho = \frac{X}{Y} = 1000 \frac{\text{kg}}{\text{m}^3} \text{ or } X = 1000\ Y$$

Therefore,

$$(3900 + 1000\ Y) = 3000\ (0.205 + Y)$$

and solving for Y,

$$Y = 1.642\ \text{m}^3 \text{ water}$$

and the total as-settled volume of fuel wash sludge is equal to (0.205 + 1.642)m^3 or 1.85 m^3 as-settled fuel wash sludge. This as-settled fuel wash sludge volume is compared to a previous estimate of 1.276 m^3 (Pitner 1997). Since no particle size and volume data exists for the nominal KE fuel wash sludge generated by the mechanical process, it is assumed all

particles are greater than 250 μm and will be captured and fall into Stream 2 as shown in Figure 1. However, it must be considered that some fuel particles from the wash process could be less than 250 μm and would be transferred to the Weasel Pit.

The 3900 kg of fuel wash sludge components in Table 2 represent the principle elements, on a dry basis, from the fuel wash.

3.2 K EAST BASIN UPPER BOUND SLUDGE VALUES

3.2.1 Basin Floor Sludge

A total of 15 samples were taken across the KE Basin main basin in the recent sludge characterization campaign (Makenas 1996). Twelve samples were designated for general chemical analyses ("normal samples") for averaged (i.e., stirred solids) values, two samples were selected for special analyses of individual settled layers and physical analyses ("research samples"), and two were designated as archive samples for future analyses. In general only the results of the 12 "normal" samples were considered in current report.

The upper or working bound KE Basin floor sludge values are taken from the maximum as-settled sludge concentrations of chemical constituents and radionuclides in WHC-SP-1182 (Makenas 1996). These values are multiplied by the upper limit as-settled sludge volume (25.8 m^3) from the basin floor and empty canister sludge (0.5 m^3) as calculated (Baker 1997) for a total of 26.3 m^3. As previously noted, it is assumed the unfueled canisters have collected the same settled sludge as the basin floor; therefore, the unfueled canister sludge volume is included with the basin sludge. The final calculations for chemical constituents and radionuclides are as follows.

Upper bound total kg of component i in KE Basin floor sludge equals:

$$X_i \frac{\mu g \text{ component } i}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{g}{10^6 \mu g} \times \frac{kg}{10^3 g} \times 26.3 \text{ m}^3$$

where:

X_i is the maximum chemical constituent i sample in the KE Basin floor sludge as listed in Appendix C of WHC-SP-1182 (Makenas 1996). The maximum residue concentration value is listed on Page 41 of WHC-SP-1182.

Total Ci of isotope j in KE Basin floor sludge equals:

$$Y_j \frac{\mu Ci \text{ isotope } j}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{Ci}{10^6 \mu Ci} \times 26.3 \text{ m}^3$$

where:

Y_j is the maximum isotope j sample in the KE Basin floor sludge as listed in Appendix C of WHC-SP-1182 (Makenas 1996).

3.2.2 Weasel Pit/Tech View/Dummy Elevator Pit Sludge

Sludge constituent and radionuclide data for upper bound values have been obtained from the maximum concentration values of four samples taken from the Weasel Pit (Makenas 1996). These maximum concentration values are multiplied by the upper bound total as-settled volume (14.8 m^3) calculated (Baker 1997) which include the Weasel Pit and Channel, Tech View Pit and North/South Channel, and the Dummy Elevator Pit. No previous concentration data have been obtained for the Tech View Pit and Dummy Elevator Pit so constituent concentration values associated with the Weasel Pit are used. The final calculations for mass of chemical constituents and for activity of radionuclides are as follows below.

Upper bound total kg of component i in the Weasel Pit/Tech View/Dummy Elevator Pit sludge equals:

$$X_i \frac{\mu g \text{ component } i}{mL \text{ as-settled sludge}} \times \frac{10^6\ mL}{m^3} \times \frac{g}{10^6\ \mu g} \times \frac{kg}{10^3\ g} \times 14.8\ m^3$$

where:

X_i is the maximum chemical constituent i sample in the Weasel Pit as listed in locations 16 through 19 on Pages C-18 through C-21 in WHC-SP-1182 (Makenas 1996).

Upper bound total Ci of isotope j in the Weasel Pit/Tech View/Dummy Elevator Pit sludge equals:

$$Y_j \frac{\mu Ci \text{ isotope } j}{mL \text{ as-settled sludge}} \times \frac{10^6\ mL}{m^3} \times \frac{Ci}{10^6\ \mu Ci} \times 14.8\ m^3$$

where:

Y_j is the maximum isotope j sample in the Weasel Pit as listed in locations 16 through 19 on Pages C-15 through C-17 in WHC-SP-1182 (Makenas 1996).

3.2.3 North Loadout Pit Sludge

The upper bound total as-settled sludge volume (7.5 m^3) is obtained from (Baker 1997) for the North Loadout Pit and Channel. No range of analytical samples, such as minimum, mean, and maximum analyte concentration samples, are available for the North Loadout Pit and Channel sludge. Therefore, it is assumed the multiplicative increase in going from "nominal" to "upper bound" analyte values for North Loadout Pit and Channel is approximately equal to the increase of that analyte for the Basin Floor sludge. In other words, the ratio of upper bound and nominal amounts of radionuclides and chemical constituents in the North Loadout Pit is assumed equal to the ratio of the

upper bound and nominal amounts of identical radionuclides and chemical constituents in the Basin Floor sludge. Calculations for these values are shown as follows:

$$R_{BF} = \frac{X_{BF}{}^{U}}{X_{BF}{}^{N}} \qquad R_{NL} = \frac{X_{NL}{}^{U}}{X_{NL}{}^{N}}$$

where:

R = Ratio (upper bound/nominal)

X^U = Upper bound total (in kg or Ci)

X^N = Nominal total (in kg or Ci)

BF = Basin Floor sludge

NL = North Loadout Pit sludge

Therefore, assuming $R_{BF} = R_{NL}$:

$$R_{BF} = \frac{X_{NL}{}^{U}}{X_{NL}{}^{N}} \text{ and } X_{NL}{}^{U} = R_{BF} \times X_{NL}{}^{N}$$

The Basin Floor sludge ratio was used because it was representative of the sludge fines which eventually become backwashed into the North Loadout Pit. Also, the basin floor was sampled extensively.

3.2.4 Canister Sludge

The upper bound total as-settled KE Basin canister sludge volume (7.4 m^3) calculated (Baker 1997), is multiplied by the maximum KE Basin canister concentration values (Makenas 1997) for both the chemical constituents and radionuclides as shown in the KE Basin nominal case for canister sludge.

The filtrated canister sludge particles (less than or equal to 250 μm in diameter) to be transferred to the Weasel Pit is calculated at 49 v/v% (Makenas 1997). This fraction correlates to approximately 3.6 m^3 of as-settled sludge.

3.2.5 Newly Generated Sludge from Fuel Wash

The upper bound fuel wash as-settled sludge amount is calculated as follows:

Defected fuel volume: 95 L UO_2 x 3.0 kg UO_2/L UO_2 x 0.88 kg N-fuel/kg UO_2 = 251 kg N-fuel (Pitner 1997)

Bad fuel volume: 500 L N-fuel x 19 kg N-fuel/L N-fuel = 9500 kg N-fuel

Therefore, total mass of dry fuel wash sludge is equal to 0751 kg N-fuel and the associated dry volume is calculated to be 0.513 m^3 (9751 kg/19000 kg/m^3).

Assuming the fuel-related chemical constituents and radionuclides are equally proportioned in the fuel wash sludge as in the fuel, the upper bound values for these analytes are calculated by multiplying the nominal analyte values by the ratio of the upper bound and nominal uranium amount for the fuel in the fuel expected in the fuel wash sludge. For example, chemical constituent and radionuclide amounts are calculated by multiplying the nominal values by 2.5 (or 9751 kg N-fuel/3900 kg N-fuel).

Since the fuel wash as-settled sludge density is calculated to be 3.0 g/mL (or 3000 kg/m^3) the total as-settled fuel wash volume is calculated as follows:

$$\frac{(9751 + X\ \text{kg})}{(0.513 + Y\ \text{m}^3)} = 3000\ \frac{\text{kg}}{\text{m}^3}$$

where:

X = kg water in as-settled sludge at 60 °F

Y = m^3 water in as-settled sludge at 60 °F

and

density of water at 60 °F is:

$$\rho = \frac{X}{Y} = 1000\frac{\text{kg}}{\text{m}^3} \text{ or } X = 1000Y$$

Therefore,

$$(9751 + 1000Y) = 3000\ (0.513 + Y)$$

and solving for Y,

$$Y = 4.106\ \text{m}^3 \text{ water}$$

and the total as-settled volume of fuel wash sludge is equal to (0.513 + 4.106)m^3 or 4.62 m^3 as-settled fuel wash sludge. This as-settled fuel was sludge volume is compared to a previous estimate of 3.19 m^3 (Pitner 1997). As in the nominal case, no particle size and volume data exists for the upper bound KE fuel wash sludge generated by the mechanical process. Therefore, it is assumed all particles are greater than 250 μm and will be captured and fall into Stream 2. However, it must be considered that some fuel particles from the wash process could be less than 250 μm and would be transferred to the Weasel Pit.

3.3 K WEST NOMINAL SLUDGE VALUES

3.3.1 K West Basin Floor Sludge

There is a calculation volume of 0.82 m^3 of KW Basin floor sludge (Maassen 1997). There are no recorded chemical constituent and radionuclide data for KW Basin floor sludge. Since the KW Basin fueled canisters are sealed, no correlation will be made between the canister sludge and the floor sludge constituents or the KE Basin floor sludge and the KW Basin floor sludge constituents. Therefore, no values are reported for the KW Basin floor nominal case. Table 8 does not reflect this as-settled volume and associated chemical constituents and radionuclides.

3.3.2 K West Weasel Pit/Tech View/Dummy Elevator Pit Sludge

There is a calculated as-settled sludge volume of 0.1 m^3 (Maassen 1997) in these areas in the KW Basin. There are no recorded chemical constituent and radionuclide data for sludge in these areas in the KW Basin. Therefore, no values are reported for these KW Basin pit areas. Table 8 does not reflect this as-settled volume and associated chemical constituents and radionuclides.

3.3.3 K West North/South Loadout Pit Sludge

The total as-settled KW Basin nominal sludge volume (3.7 m^3) is obtained (Baker 1997) for the North and South Loadout Pits and associated Channels. There are no data corresponding to this volume in the KW Basin with the exception of occasional sandfilter backwash water sample results from operations analysis and waste handling (Nuzum 1997). The plutonium accounted for from the backwash results is considerably less (not TRU) than the plutonium concentration in the KE Basin North Loadout Pit; however, fuel-related constituents and radionuclides from the KW Basin are still calculated from the ratio of constituents and radionuclides to the $^{239/240}Pu$ amount in the KE Basin North Loadout Pit. These ratios from the KW and KE Basins are assumed equal. These resulting low values show the fuel-related components to be insignificant in the KW North Loadout Pit. For the non-fuel related components, the different sludge constituent amounts are calculated from the as-settled sludge volume ratio of the two North Loadout Pits.

3.3.4 K West Canister Sludge

The nominal total as-settled KW Basin sludge volume (1.7 m^3) is calculated (Baker 1997). Mean concentration values for the various chemical constituents and radionuclides from eight canister samples (Alderman 1997) are multiplied by the nominal KW Basin sludge volume (1.7 m^3) as follows below.

Total kg of component i in KW Basin canister sludge equals:

$$X_i \frac{\mu g \text{ component } i}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{g}{10^6 \mu g} \times \frac{kg}{10^3 g} \times 1.7 \text{ m}^3$$

where:

X_i is the mean chemical concentration value for constituent i sample in the KW Basin canister sludge (Alderman 1997).

Total Ci of isotope j in KE Basin canister sludge equals:

$$Y_j \frac{\mu Ci \text{ isotope } j}{mL \text{ as-settled sludge}} \times \frac{10^6 \text{ mL}}{m^3} \times \frac{Ci}{10^6 \mu Ci} \times 1.7 \text{ m}^3$$

where:

Y_j is the mean activity concentration value of radionuclide j in the KW Basin canister sludge (Alderman 1997).

The filtrated canister sludge particles (less than or equal to 500 μm in diameter) to be transferred to the settler tanks is calculated at approximately 100 v/v% since preliminary data shows almost all KW Basin canister sludge to be under 600 μm in diameter.

3.3.5 Newly Generated Sludge from Fuel Wash

The total mass (in kg) and volume of chemical constituents of KW Basin fuel wash sludge is assumed to be that identical to the KE Basin fuel wash sludge (Baker 1997). The total mass of the chemical constituents and activities of the radionuclides of KW Basin fuel wash sludge is determined as follows below.

Total kg of component i in KW Basin fuel wash sludge equals:

$$X_i \frac{\text{kg component } i}{2.26 \times 10^6 \text{ kg N-fuel}} \times 3900 \text{ kg N-fuel}$$

where:

X_i is the total mass amount of chemical constituent i in both the KE and KW Basins as listed in Table 2.1 on Page 5 of WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998). Also listed is the total N-fuel, 2.26×10^6 kg, which accounts for the summed total of N-fuel in KE and KW Basins.

Nominal total Ci of isotope j in KW Basin fuel wash sludge equals:

$$Y_j \frac{\text{Ci isotope } j}{9.50 \times 10^5 \text{ kg N-fuel}} \times 3900 \text{ kg N-fuel}$$

where:

Y_j is the total amount of chemical constituent j in the KW Basin as listed in Table 3.7 of WHC-SD-SNF-TI-009, Rev. 1 (Willis, Praga 1998). Also listed is the total KW Basin N-fuel of 9.50×10^5 kg.

Identical to the nominal KE fuel wash sludge volume generated, the nominal KW as-settled fuel wash volume amounts to 1.85 m^3. This is compared to a previous estimate of 1.3 m^3 (Baker 1996). Since no particle size and volume data exists for the nominal KW fuel wash sludge generated by the mechanical process, it is assumed all particles are greater than 500 μm and will fall into Stream 2 as shown in Figure 2. However, it must be considered that some fuel particles from the wash process could be less than 500 μm and would be transferred to Stream 3.

3.4 K WEST UPPER BOUND SLUDGE VALUES

3.4.1 Basin Floor Sludge

There is a calculation upper bound volume of 1.88 m^3 of KW Basin floor sludge (Maassen 1997). As in the nominal case, no values are recorded. Table 9 does not reflect this as-settled volume and associated chemical constituents and radionuclides.

3.4.2 Weasel Pit/Tech View/Dummy Elevator Pit Sludge

There is a calculation upper bound as-settled sludge volume of 0.4 m^3 in these areas in the KW Basin (Maassen 1997). The maximum values are identical to the nominal values. As in the nominal case, no values are recorded. Table 9 does not reflect this as-settled volume and associated chemical constituents and radionuclides.

3.4.3 North/South Loadout Pit Sludge

The upper bound total as-settled KW Basin sludge volume (4.5 m^3) is obtained for the North and South Loadout Pits and associated Channels (Baker 1995). For the upper bound chemical constituent and radionuclide amounts, the KW Basin nominal value is used multiplied by the ratio 4.5/3.7.

3.4.4 Canister Sludge

The upper bound total as-settled KW Basin sludge volume (3.0 m^3) is calculated (Baker 1997). The maximum values for the chemical constituents and radionuclides are obtained by multiplying the upper bound values* KW Basin canister sludge values by the upper bound sludge volume of 3.0 m^3. Where no upper bound value is available, the "maximum observed" value is used.

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*One-side UL tolerance interval (Alderman 1997).

The filtrated canister sludge particles (less than or equal to 500 μm in diameter) to be transferred to the settler tanks is calculated at approximately 100 v/v% since preliminary data shows almost all KW Basin canister sludge to be under 600 μm in diameter.

3.4.5 Newly Generated Sludge from Fuel Wash

For the calculated maximum case of 25 v/v% broken fuel (Pitner 1997), a ratio with the nominal case (0.25/0.10 = 2.5) is multiplied by the values calculated for both chemical constituents and radionuclides of the KW Basin nominal fuel wash amount. See Section 3.2.5 for details and calculations.

Identical to the upper bound KE fuel wash sludge volume generated, the upper bound KW as-settled fuel wash volume amounts to 4.62 m^3. This is compared to a previous estimate of 3.2 m^3 (Baker 1997). As in the nominal case, no particle size and volume data exists for the upper bound KW fuel wash sludge generated by the mechanical process. Therefore, it is assumed all particles are greater than 500 μm and will be captured and fall into Stream 2. However, it must be considered that some fuel particles from the wash process could be less than 500 μm and would be transferred to Stream 3.

4.0 CALCULATIONS

4.1 ACTIVITY CONVERSIONS

This section details conversion calculations for converting radionuclide values in Curies to gram moles. Basic conversions for single radionuclide values are presented as:

$$\frac{\text{gmol}}{\text{Ci}} = \frac{t_{1/2}\ (\text{in seconds})_j}{1.13 \times 10^{13}\ \text{s/gmol/Ci}} \quad \text{(Glasstone 1955)}$$

where:

$t_{1/2}$ is the half-life in seconds of radionuclide j

For "split" radionuclides, such as $^{239/240}Pu$, the specific activity (in gmol/Ci) is calculated as follows:

From the March 29, 1995 RADNUC 2.0 run for KE Basin fuel (Willis, Praga 1995)

^{239}Pu = 1910 kg

^{240}Pu = 303 kg

^{239}Pu: $t_{1/2} = 2.41 \times 10^4$ year $\times\ 3.1536 \times 10^7$ s/year $= 7.6 \times 10^{11}$ s

$$\frac{\text{gmol}}{\text{Ci}} = \frac{7.6 \times 10^{11}\ \text{s}}{1.13 \times 10^{13}\ \text{s/gmol/Ci}} = 0.0672\ \frac{\text{gmol}}{\text{Ci}}$$

and

^{240}Pu: $t_{1/2} = 6760$ year $\times\ 3.1536 \times 10^7$ s/year $= 2.069 \times 10^{11}$ s

$$\frac{\text{gmol}}{\text{Ci}} = \frac{2.069 \times 10^{11}\ \text{s}}{1.13 \times 10^{13}\ \text{s/gmol/Ci}} = 0.0183\ \frac{\text{gmol}}{\text{Ci}}$$

therefore, converting isotopes to kgmol,

$$1910\ \text{kg}\ ^{239}\text{Pu} \times 1\ \frac{\text{kg mol}}{239\ \text{kg}} = 7.99\ \text{kgmol}\ ^{239}\text{Pu}$$

$$303\ \text{kg}\ ^{240}\text{Pu} \times \frac{1\ \text{kgmol}}{240\ \text{kg}} = 1.26\ \text{kgmol}\ ^{240}\text{Pu}$$

Total = 9.25 kgmol $^{239/240}Pu$

and

$$0.0672 \frac{\text{gmol } ^{239}\text{Pu}}{\text{Ci } ^{239}\text{Pu}} \times \frac{9.25 \text{ kgmol } ^{239/240}\text{Pu}}{7.99 \text{ kgmol } ^{239}\text{Pu}} +$$

$$0.0183 \frac{\text{gmol } ^{240}\text{Pu}}{\text{Ci } ^{240}\text{Pu}} \times \frac{9.25 \text{ kgmol } ^{239/240}\text{Pu}}{1.26 \text{ kgmol } ^{240}\text{Pu}} =$$

$$0.0778 \frac{\text{gmol } ^{239/240}\text{Pu}}{\text{Ci } ^{239}\text{Pu}} + \frac{0.134 \text{ gmol } ^{239/240}\text{Pu}}{\text{Ci } ^{240}\text{Pu}}$$

Taking the inverse of the final two terms,

$$12.8 \frac{\text{Ci } ^{239}\text{Pu}}{\text{gmol } ^{239/240}\text{Pu}} + 7.44 \frac{\text{Ci } ^{240}\text{Pu}}{\text{gmol } ^{239/240}\text{Pu}} = 20.3 \text{ Ci} \frac{^{239/240}\text{Pu}}{\text{gmol } ^{239/240}\text{Pu}}$$

or

$$0.049 \frac{\text{gmol}}{\text{Ci}} ^{239/240}\text{Pu}$$

4.2 CANISTER SLUDGE COMPARISON CALCULATIONS

4.2.1 Previous Canister Sludge Calculations

Comparisons were made from values calculated from recent canister sludge sampling with past calculations (Pearce 1997) derived from N-fuel ORIGEN runs. For example, taking KE Basin canister sludge, it is assumed all KE canister sludge consists of corroded N Reactor fuel elements. In other words, 1 kg N-fuel is equal to 1 kg dry canister sludge. The concentration contribution for each chemical constituent is taken from (Willis, Praga 1995). Total constituent values are given per total mass fuel. Since the canister sludge volumes are given on an as-settled sludge basis, an as-settled basis for fuel wash sludge needs to be determined. Average density values are given for as-settled (wet) and as-centrifuged (assumed dry) KE Basin sludge in WHC-SP-1182. The two average density values (where ρ_{dry} = 1.52 g/cc and ρ_{wet} = 1.39 g/cc) correspond to a weight fraction of 0.82 kg dry sludge per kg of as-settled sludge as shown below:

$$x = \frac{(1/\rho_{wet} - 1)}{(1/\rho_{dry} - 1)} = \frac{(1/1.39 - 1)}{(1/1.52 - 1)} = 0.82$$

The arithmetic average density for canister sludge is taken to be 2.0 g/cc (Baker memo 9654989 dated November 1, 1996). Therefore, the total mass (in kg and Ci) of KE Basin canister sludge is determined as follows:

Total kg of component i in canister sludge =

$$X_i \frac{\text{kg component i}}{2.26 \times 10^6 \text{ kg N-fuel}} \times \frac{\text{kg N-fuel}}{\text{kg dry canister sludge}} \times$$

$$\frac{0.82 \text{ kg dry canister sludge}}{\text{kg wet canister sludge}} \times$$

$$\frac{2000 \text{ kg as-settled canister sludge}}{\text{m}^3 \text{ wet canister sludge}} \times$$

$$3.0 \text{ m}^3 \text{ wet canister sludge}$$

where:

X_i is the total amount of chemical constituent i in both the East and West Basins as listed in Table 2.1 on Page 7 of WHC-SD-SNF-TI-009, Rev. 0. Also listed is the total N-fuel, 2.26×10^6 kg, which accounts for the total N-fuel in both East and West Basin.

Total Ci of isotope j in canister sludge =

$$Y_j \frac{\text{Ci isotope j}}{1.14 \times 10^6 \text{ (KE) or } 9.50 \times 10^5 \text{ (KW) kg N-fuel}} \times$$

$$\frac{\text{kg N-fuel}}{\text{kg dry canister sludge}} \times \frac{0.82 \text{ kg dry canister sludge}}{\text{kg wet canister sludge}} \times$$

$$\frac{2000 \text{ kg as-settled canister sludge}}{\text{m}^3 \text{ wet canister sludge}} \times$$

$$3.0 \text{ m}^3 \text{ wet canister sludge}$$

where:

Y_j is the total amount of chemical constituent j in the East and West Basins as listed in Tables 3.6 or 3.7 of WHC-SD-SNF-TI-009, Rev. 0.

Table 10 presents these KE sludge constituent values and the values recently derived from the KE canister sludge samples.

Table 10. Comparison of K East and K West Nominal Canister Sludge Constituents from Chemical Analyses Versus those Calculated for N Reactor Fuel Elements from ORIGEN.

KE Nominal						KW Nominal				Date: 12/30/97	
		Recent Data		N-fuel Basis				Recent Data		N-fuel Basis	
		Canisters		Canisters				Canisters		Canisters	
As-settled	Vol (m3)	3.00		3.00				1.7		1.7	
As-settled	Den (g/mL)	1.83		2.00							
Component		Ci		Ci				Ci		Ci	
Am241(AEA)		1.94E+02		1.05E+03				5.46E+02		8.64E+02	
Bi212		3.52E+01						2.94E+01			
Ce144/Pr		6.91E+01		1.12E+01				4.91E+01		2.34E+00	
Cm243/244		3.16E+01		4.57E+00				2.60E+00		3.00E+00	
Co57		1.54E+01						2.02E+00			
Co60		3.16E+00		1.01E+01				2.28E+01		1.15E+01	
Cs134		4.90E+00		4.13E+01				5.24E+00		5.33E+01	
Cs137		2.66E+03		3.42E+04				7.28E+03		3.47E+04	
Eu152		1.11E+01		2.47E+00				3.43E+00		2.52E+00	
Eu154		3.44E+01		2.84E+02				1.01E+02		2.91E+02	
Eu155		2.58E+01		6.16E+01				4.66E+01		5.95E+01	
Nb95		3.23E+00						1.47E+00			
Np237		4.17E-02		1.56E-01				6.04E-02		1.40E-01	
Pu238		1.07E+02		3.14E+02				1.18E+02		2.65E+02	
Pu239/240		3.94E+02		9.25E+02				5.98E+02		7.99E+02	
Ra226		1.32E+02						2.46E+01			
Ru106/Rh		9.92E+01		1.90E+01				9.83E+01		5.96E+00	
Sb125		3.12E+00		9.73E+01				2.01E+01		9.57E+01	
Sr90		5.00E+03		2.59E+04				1.18E+04		2.70E+04	
Tc99		2.33E+01		7.50E+00				4.25E+00		7.40E+00	
Tl208		8.39E+01						1.97E+01			
U-233		1.35E-01									
U-234		1.30E+00		2.41E+00				1.17E+00		2.11E+00	
U-235		4.32E-02		9.16E-02				4.52E-02		8.28E-02	
U-236		9.36E-02		3.42E-01				1.63E-01		3.16E-01	
U-238		9.45E-01		1.96E+00				4.71E-01		1.63E+00	
Y-90				2.59E+04						2.70E+04	
Pu241				1.34E+04						1.56E+04	
Ba-137m				3.23E+04						3.28E+04	
Total		8.93E+03		1.35E+05				2.08E+04		1.40E+05	
Component		Canisters		Canisters				Canisters		Canisters	
Dry Basis		Kg		Kg				Kg		Kg	
Ag		4.24E-01						1.28E+00			
Al		7.92E+01		3.70E+00				5.07E+01		2.10E+00	
B		6.61E-01		1.32E-03				1.42E+01		7.46E-04	
Ba		4.21E-01						6.88E-01			
Be		8.16E-02		3.55E-01				1.96E-01		2.01E-01	
Bi		1.63E+00						1.92E+00			
Ca		2.14E+00						3.20E+01			
Cd		6.97E-02		1.32E-03				6.39E-01		7.46E-04	
Cr		1.78E+00		6.27E-01				1.00E+00		3.55E-01	
Cu		3.39E-01		3.61E-01				6.39E+00		2.05E-01	
Fe		3.86E+01		2.05E+00				1.46E+02		1.16E+00	
K		5.64E+00						8.84E+01			
Mg		5.61E+00		1.21E-01				3.82E+01		6.88E-02	
Mn		2.17E-01		1.31E-01				6.39E-01		7.44E-02	
Na		1.54E+00		6.57E-03				1.62E+01		3.73E-03	
Ni								2.26E+00			
P								6.39E+00			
Pb		7.02E-01		3.30E-02				6.39E+00		1.88E-02	
Se		6.53E-01						3.20E+00		1.44E-03	
Sm		6.53E-01						1.28E+02			
Ti		1.31E+00						6.39E+00			
Zn		2.82E-01						3.54E+00			
Zr		1.83E-01		3.22E+02				1.38E+00		1.83E+02	
U		2.32E+03		4.57E+03				2.62E+03		2.69E+03	
Residue											
Total		2.46E+03		4.90E+03				3.18E+03		2.78E+03	

5.0 PEER REVIEW

Peer review has been performed in accordance with the Peer Review Plan, Appendix A. Peer reviews were made on two draft versions of this document and two sets of comments were made, the review comment record (RCR) forms with resolutions are documented in EDT-620797.

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A P P E N D I X A

PEER REVIEW PLAN

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Peer Review Plan.

PROJECT: SPENT NUCLEAR FUEL PROJECT

SUBJECT OF REVIEW: K Basin Sludge Composition

DOCUMENTS TO BE REVIEWED

DOCUMENT TITLE	DOCUMENT NUMBER	REVISION NO. AND DATE
K BASIN SLUDGE INVENTORY COMPOSITION	HNF-SD-SNF-TI-053	draft

SCOPE OF PEER REVIEW:

Best estimate and bounding inventories for the K Basin sludge constituents are provided in the document to be reviewed (HNF-SD-SNF-TI-053). The inventory values will be incorporated in the Spent Nuclear Fuel Project Technical Databook (HNF-SD-SNF-TI-015) providing design bases feed compositions for all sludge locations in the K Basins. The values will be used for analysis and modeling in support of the sludge disposal project design and safety bases.

The peer review is intended to ensure that appropriate values for the K Basin sludge compositions are provided to the SNFP Technical Databook for subsequent application to SNFP sub-project design efforts. The scope of the review should evaluate if the best available information has been used and that the methodology used to calculate nominal and bounding values is technically sound. Assumptions used must be clearly documented and soundly based. Results should be traceable to and consistent with recorded data, and the data used should be traceable to their origin. Where inferences are drawn and conclusion made, they should be soundly based and documented. Accuracy of calculations should be spot checked.

PEER REVIEW REQUIREMENTS:

Comments shall be documented on a review comment record [RCR].

PEER REVIEWERS:

D. J. Trimble: Metallurgical engineer with experience in materials and SNF characterization including evaluations of SNF storage canister contents. His review should ensure that assumptions about KW sludge are consistent with previously documented and accepted work.

S. L. Hecht: Mechanical engineer with extensive nuclear experience in data evaluation.

R. B. Baker: Mechanical engineer with extensive nuclear fuel experience including SNF sludge characterization.

LEVEL OF EFFORT:

Level of effort should be 16 to 32 hours per reviewer using charge code LB032

CHECKLIST FOR PEER REVIEW

DOCUMENT REVIEWED: HNF-SD-SNF-TI-053, Rev. 0

Yes	No	NA		Scope of Review
			*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
X				Problem completely defined.
		X		Accident scenarios developed in a clear and logical manner.
X				Necessary assumptions explicitly stated and supported.
		X		Computer codes and data files documented.
X				Data used in calculations explicitly stated in document.
X				Data checked for consistency with original source information as applicable.
X				Mathematical derivations checked including dimensional consistency of results.
X				Models appropriate and used within range of validity or use outside range of established validity justified.
X				Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
		X		Software input correct and consistent with document reviewed.
		X		Software output consistent with input and with results reported in document reviewed.
X				Limits/criteria/guidelines applied to analysis result are appropriate and referenced. Limits/criteria/guidelines checked against references.
		X		Safety margins consistent with good engineering practices.
X				Conclusions consistent with analytical results and applicable limits.
X				Results and conclusions address all points required in the problem statement.
		X		Format consistent with appropriate NRC regulatory guide or other standards.
Dft /	X			Review calculations, comments, and/or notes are attached.
X				Document approved.

D. Trimble — 1-19-98

Reviewer (printed name and signature) — Date

*The May 1997 draft to this document was reviewed. Review comments and resolutions were documented on RCRs and submitted to the SNF Project files under EDT 620797.

CHECKLIST FOR PEER REVIEW

DOCUMENT REVIEWED: HNF-SD-SNF-TI-053, Rev. 0

Yes	No	NA		Scope of Review
X			*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
X				Problem completely defined.
		X		Accident scenarios developed in a clear and logical manner.
X				Necessary assumptions explicitly stated and supported.
		X		Computer codes and data files documented.
X				Data used in calculations explicitly stated in document.
X				Data checked for consistency with original source information as applicable.
X				Mathematical derivations checked including dimensional consistency of results.
X				Models appropriate and used within range of validity or use outside range of established validity justified.
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		X		Software input correct and consistent with document reviewed.
		X		Software output consistent with input and with results reported in document reviewed.
		X		Limits/criteria/guidelines applied to analysis result are appropriate and referenced. Limits/criteria/guidelines checked against references.
		X		Safety margins consistent with good engineering practices.
X				Conclusions consistent with analytical results and applicable limits.
X				Results and conclusions address all points required in the problem statement.
		X		Format consistent with appropriate NRC regulatory guide or other standards.
	X+			Review calculations, comments, and/or notes are attached.
X				Document approved.

S.L. HECHT [signature] 1-21-98

Reviewer (printed name and signature) Date

*The May 1997 draft to this document was reviewed. Review comments and resolutions were documented on RCRs and submitted to the SNF Project files under EDT 620797.

+ FOR COMMENT ON PREVIOUS DRAFTS - SEE EDT - 620797

CHECKLIST FOR PEER REVIEW

DOCUMENT REVIEWED: HNF-SD-SNF-TI-053, Rev. 0

Yes	No	NA		Scope of Review
X			*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
X				Problem completely defined.
		X		Accident scenarios developed in a clear and logical manner.
X				Necessary assumptions explicitly stated and supported.
		X		Computer codes and data files documented.
X				Data used in calculations explicitly stated in document.
X				Data checked for consistency with original source information as applicable.
X				Mathematical derivations checked including dimensional consistency of results.
X				Models appropriate and used within range of validity or use outside range of established validity justified.
X				Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
		X		Software input correct and consistent with document reviewed.
		X		Software output consistent with input and with results reported in document reviewed.
X				Limits/criteria/guidelines applied to analysis result are appropriate and referenced. Limits/criteria/guidelines checked against references.
		X		Safety margins consistent with good engineering practices.
X				Conclusions consistent with analytical results and applicable limits.
X				Results and conclusions address all points required in the problem statement.
		X		Format consistent with appropriate NRC regulatory guide or other standards.
	X**			Review calculations, comments, and/or notes are attached.
X				Document approved.

R B Baker RBBaker — 1/22/98

Reviewer (printed name and signature) — Date

*The May 1997 draft to this document was reviewed. Review comments and resolutions were documented on RCRs and submitted to the SNF Project files under EDT 620797.

** See EDT 620797

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