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(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
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		Design Agent				3		SNF Project Files			R3-11
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Diagram Mass Balance Calculations for K West Basin

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Integrated Water Treatment System Process Flow Diagram Mass Balance Calculations for K West Basin

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IWTS PFD Mass Balance Calculations for K West Basin

1.0 PURPOSE

The purpose of this calculation is to develop the rational for the material balances that are documented in the KW Basin water system Level 1 process flow diagrams

2.0 SUMMARY OF FINAL RESULTS

See Appendix A for numerical summary of results. See drawing H-1-81161 for process flow diagram.

3.0 ASSUMPTIONS

- Dilute slurries were assumed to have a density of 1.0 g/cc for simplicity.
- Continuous flow is 365 days per year for two years.
- Water loss from cask immersion pail during each loadout cycle = 50 gal/MCO.
- Final fresh water cask flush = 100 gal/MCO.
- Basin water for initial cask flush = 300 gal/MCO.
- Density of sludge in IC-017 is that of water.
- The fragments are assumed for this purpose as the uranium constituent within the sludge for WW-8.
- For IC-042 flow is continuous.
- For IC-204 water added to make 1% slurry mixture from WW-13.
- 100% sludge goes to WW-6 and 0% goes to WW-7.
- 60% of sludge remains in settler and all water passes through for WW-12.
- WW-15 has a flow rate of 300 gpm.
- WW-20 uses 400 gpm flow rate.

4.0 SOFTWARE APPLICATIONS

Calculations were done on Excel 97 spreadsheets.

5.0 COMPUTER MODEL

N/A

6.0 INPUT DATA

Input data is described throughout the calculation.

7.0 CALCULATIONS

Detailed logic and calculations are provided in this section for the flow streams.

IC-012 Cold Vacuum Drying Return

Input Stream(s): N/A

Logic:

The stream is based on calculations from cold vacuum drying, Ref EDT 625814, Item 1, page 17. The ambient temperature is used. The amount assumes all process water going through the CVDF including that from KE basins is returned to the KW IWTS system. The stream includes the treated process water, condensate and flush, and excess tempered water.

Table of Numbers:

Stream Number: IC-012

Flow Rate, L/s: Intermittent flow.

Volume, m³: 4.17E+2

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 4.17E+5

Total Mass, kg: 4.17E+5

IC-016 KW Basin Water into Fuel Process Enclosure

Input Stream(s): N/A

Logic:

This stream is taken from the fuel retrieval calculations. Basin properties are used. Ref. Drawing number H-1-81164, Rev. 3, sheet 3. This stream includes water sent to the primary cleaning machine and the secondary cleaning station and suction wand.

Table of Numbers:

Stream Number: IC-016

Flow Rate, L/s: Intermittent Flows

Volume, m³: 1.18E+6 Ref. H-1-81164, sheet 3, Rev. 3.

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.18E+9

Total Mass, kg: 1.18E+9

IC-017 KW Fuel Process Enclosure Contamination Control Water**Input Stream(s):** N/A**Logic:**

The water of this stream has a capability of withdrawing water and sludge at a rate of 150 gpm as per IC-017 documentation intermittently. The mass is the product of volumetric rate and time. Basin properties are used. Ref. Drawing number H-1-81164, Rev. 3, Sheet 3. This stream includes water and sludge from the primary cleaning machine and the secondary cleaning station and suction wand. Assume the density of the sludge is the same as water.

Table of Numbers:

Stream Number: IC-017

Flow Rate, L/s: pumping capability 9.5 L/s

Volume, m³: 5.97E+5

Density, g/cc: 1.0

Temperature, °C: 10

Sludge, kg: 6.51E+3 Ref. H-1-81164, sheet 3, Rev. 3.

Water in Sludge, kg: 1.27E+3

*Other, kg:U (total)	1531
UO ₂	1572
U ₃ O ₇	696
UO ₄ *4H ₂ O	9
UH ₃	156
Al(OH) ₃	406
FeO(OH)	338
SiO ₂	112
CaO	2
Other	248

**From HNF-SD-SNF-TI-009, Vol 2, Rev. 2, table 2-2. The sum of sludge from canisters full, fuel wash internal sludge, fuel wash coating, and fuel wash fuel pieces only.*

Water, kg: 5.97E+8

Total Mass, kg: 5.97E+8

IC-042 Water for KW Basin Debris Washing

Input Stream(s): N/A

Logic:

The debris washing water is 30 gpm as per the IC system documentation. The mass is the product of volumetric rate and time. Assume for ease of calculation that the flow is continuous although during processing it will be intermittent. Properties from WW-14 are used.

Table of Numbers:

Stream Number: IC-042

Flow Rate, L/s: 1.9

Volume, m³: 1.19E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.19E+8

Total Mass, kg: 1.19E+8

IC-046 KW Basin Cask Flush Water Supply

Input Stream(s): N/A

Logic:

The cask flush water rate is 15 gpm, per IC system documentation, when used on an intermittent basis. MCO loading taken from SD-SNF-CN-012, Rev. 0. There are a total of 684 Mk IA fuel baskets, 187 Mk IA scrap baskets, 225 Mk IV fuel baskets, and 57 Mk IV scrap baskets at the KW basin. An MCO holds 6 Mk IA baskets and 5 Mk IV baskets. Total MCOs from KW basin is:

$$[\text{Mk IA}(684 \text{ fuel} + 187 \text{ scrap})/6 \text{ baskets/MCO}] + [\text{Mk IV}(225 \text{ fuel} + 57 \text{ scrap})/5 \text{ baskets/MCO}] = 203 \text{ MCOs total.}$$

Assume 300 gallons of flush water per MCO. Total flush water used is:

$$300 \text{ gal/MCO} * 203 \text{ MCO} = 60900 \text{ gallons}$$

Table of Numbers:

Stream Number: IC-046

Flow Rate, L/s: approximately 0.95 intermittently

Volume, m³: 2.31E+2

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 2.31E+5

Total Mass, kg: 2.31E+5

IC-048 KW Basin Cask Flush Water

Input Stream(s): N/A

Logic:

This stream is taken from the cask transportation calculations. The ambient temperature is used. The KW basin flush water return stream is composed of the cask flush water supply from IC-046, the water loss from the cask immersion pail during each loadout cycle, and a fresh water final cask flush.

Assume the water loss from the cask immersion pail during each loadout cycle is 50 gallons per MCO. The total water loss is:

$$50 \text{ gal/MCO} * 203 \text{ MCOs} = 10150 \text{ gallons}$$

Assume the final fresh water cask flush is 100 gallons per MCO. The total fresh water final flush is:

$$100 \text{ gal/MCO} * 203 \text{ MCOs} = 20300 \text{ gallons}$$

The total flush water return is:

$$60900 \text{ gal (initial cask flush)} + 10150 \text{ gal (water loss from loadout)} + 20300 \text{ gal (final cask flush)} \\ = 91350 \text{ gal}$$

Table of Numbers:

Stream Number: IC-048

Flow Rate, L/s: Intermittent flow

Volume, m³: 3.46E+2

Density, g/cc: 1.0

Temperature, °C: 20

Water, kg: 3.46E+5

Total Mass, kg: 3.46E+5

IC-051 KW Basin Debris Circulation Water

Input Stream(s): WW-1

Logic:

The debris loadout flow is 200 gpm as per IC-051 documentation. The mass is the product of volumetric rate and time. Properties from WW-1 are used. The stream is a continuous flow of water.

Table of Numbers:

Stream Number: IC-051

Flow Rate, L/s: 12.6

Volume, m³: 7.96E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 7.96E+8

Total Mass, kg: 7.96E+8

IC-053 KW Sludge Loading Transfer Line Flush Supply

Input Stream(s): N/A

Logic:

The sludge transfer flush is estimated at 50 gpm on an intermittent basis per the IC-053. Since this is only used after all fuel has been removed from the basin, it is not included in the total.

IC-065 Transfer Line Flush From Sludge Removal

Input Stream(s): N/A

Logic:

Since flush from sludge removal is only used after all fuel has been removed from the basin, it is not included in the total.

IC-091 KW Fuel Cleaning Water

Input Stream(s): N/A

Logic:

The fuel cleaning water is at 60 gpm on an intermittent use basis. The total is taken from the fuel retrieval drawing number H-1-81164, Rev. 3, sheet 3. Properties from WW-14 are used.

Table of Numbers:

Stream Number: IC-091

Flow Rate, L/s: Intermittent

Volume, m³: 1.96E+4

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.96E+7

Total Mass, kg: 1.96E+7

IC-093 KW Basin Filtered Water Supply

Input Stream(s): WW-16
IC-179

Logic:

This stream is the direct sum of streams IC-179 and WW-16. Average ambient temperature is used.

Table of Numbers:

Stream Number:	WW-16	IC-179	IC-093
Flow Rate, L/s:	N/A	N/A	N/A
Volume, m ³ :	9.65E+3	1.15E+2	9.77E+3
Density, g/cc:	1.0		
Temperature, °C:	20		
Water, kg:	9.65E+6	1.15E+5	9.77E+6
Total Mass, kg:	9.65E+6	1.15E+5	9.77E+6

IC-146 KW Basin Water TRT Low Level Solid Waste**Input Stream(s):** WW-23**Logic:**

This stream is the equivalent of WW-23.

Table of Numbers:

Stream Number:	WW-23	IC-146
Volume, m ³ :	2.12E+2	2.12E+2
Density, g/cc: 2.43		
Temperature, °C: Ambient		
Other Solids, kg:	5.15E+5	5.15E+5
Total Mass, kg:	5.15E+5	5.15E+5

IC-147 Sand Inventory to Solid Waste**Input Stream(s):** N/A**Properties, Constant & Conversions:** Density of sand is 2.3 g/cc**Logic:**

This stream is the existing inventory of sand that will eventually be disposed. The filter system has an inside diameter of 78 in. The support sand has a depth of 7.5 in and the filter sand is 32 in deep. Ref. K Basin SAR section 2.6.2.2.3. The mass is the product of volume and density. The density of sand is found in Perry's Chemical Engineering Handbook Sixth Edition.

Table of Numbers:

Stream Number: IC-147
Volume, m ³ : 3.09
Density, g/cc: 2.3
Temperature, °C: Ambient
Other Solids, kg: 7.11E+3
Total Mass, kg: 7.11E+3

IC-151 KW Basin Level Control Water**Input Stream(s):** N/A

Logic:

This stream provides for load out of accumulated water from the basin, if necessary. However, other losses require a net input of water so this stream is zero.

IC-177 KW Debris Loadout Enclosure Water Supply

Input Stream(s): N/A

Logic:

The debris load out enclosure supply is 15 gpm as per IC-177 agreement system documentation. The mass is the product of volumetric rate and time. Properties of WW-14 are used. The water flow is a continuous basis.

Table of Numbers:

Stream Number: IC-177

Flow Rate, L/s: 0.95

Volume, m³: 5.97E+4

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 5.97E+7

Total Mass, kg: 5.97E+7

IC-179 Fresh Water to KW Cask Loadout

Input Stream(s): N/A

Logic:

This stream is taken from the cask transportation calculation. The flow is intermittent at 12 gpm per IC-179 agreement.

Assume water loss from cask immersion pail during loadout cycle is 50 gallons per MCO and a total of 203 MCOs as in IC-048.

50 gallons water loss * 203 MCOs = 10150 gallons

Assume fresh water volume for final cask flush is 100 gallons per MCO as in IC-048.

100 gallons fresh water flush * 203 MCOs = 20300 gallons

Total fresh water to cask loadout is:

10150 gallons water loss + 20300 gallons water flush = 30450 gallons fresh water

Table of Numbers:

Stream Number: IC-179

Flow Rate, L/s: Intermittent flow, 0.76

Volume, m³: 1.15E+2

Density, g/cc: 1.0

Temperature, °C: 20

Water, kg: 1.15E+5

Total Mass, kg: 1.15E+5

IC-189 KW Loadout Pit Circulation Water

Input Stream(s): N/A

Logic:

This stream is the loadout circulation flow at 200 gpm as per IC-189. The mass is the product of volumetric rate and time. Properties from WW-14 are used. This a continuous flow stream.

Table of Numbers:

Stream Number: IC-189

Flow Rate, L/s: 12.6

Volume, m³: 7.96E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 7.96E+8

Total Mass, kg: 7.96E+8

IC-198 Fuel Retrieval Process Table

Input Stream(s): N/A

Logic:

The process table flow is 150 gpm as per the IC system documentation. The mass is the product of volumetric rate and time. Total mass is taken from drawing number H-1-81164, Rev. 3, sheet 3.

Table of Numbers:

Stream Number: IC-198

Flow Rate, L/s: 9.5

Volume, m³: 5.97E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 5.97E+8

Total Mass, kg: 5.97E+8

IC-204 Sludge Loadout

Input Stream(s): WW-11
 WW-13

Logic:

This stream is all the sludge that comes into the settler. Some of the sludge will go through the settler into the sand filter but will then be flushed back to the settler and sent out with the sludge loadout. Therefore 100% of the sludge going into the settler goes out with the sludge loadout. Assume sufficient water is added to make a 1% sludge slurry. The 1% concentration is taken from engineering judgement to ensure a pumpable stream. Properties are carried from WW-11.

Table of Numbers:

Stream Number:	WW-11	IC-204
Flow Rate, L/s:	19	N/A
Volume, m ³ :	1.19E+6	4.98E+2
Density, g/cc: 1.0		
Temperature, °C: 10		
Sludge, kg:	4.98E+3	4.98E+3
Water in Sludge:	1.27E+3	1.27E+3
*Other, kg:UO ₂	1572	1572
U ₃ O ₇	696	696
UO ₄ *4H ₂ O	9	9
UH ₃	156	156
Al(OH) ₃	406	406
FeO(OH)	338	338
SiO ₂	112	112
CaO	2	2
Other	248	248

**From HNF-SD-SNF-TI-009, Vol 2, Rev. 2, table 2-2. The sum of sludge from canisters full, fuel wash internal sludge, fuel wash coating, and fuel wash fuel pieces only.*

Water, kg:	1.19E+9	4.93E+5
Total Mass, kg:	1.19E+9	4.98E+5

The total water needed is the slurry minus the sludge mass.

WW-1 Chiller Loop Re-circulation Suction

Input Stream(s): N/A

Logic:

The existing chiller recirculation pump is rated at 500 gpm K Basin SAR section 2.6.1.1 and is operated continuously at that flow. The mass is the product of volumetric rate and time. The basin operating temperature is used.

Table of Numbers:

Stream Number: WW-1

Flow Rate, L/s: 31.5

Volume, m³: 1.99E+6

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.99E+9

Total Mass, kg: 1.99E+9

WW-2 Chiller Loop Water

Input Stream(s): WW-1
IC-051

Properties, Constant & Conversions: N/A

Logic:

This stream is the difference between WW-1 and IC-051. Properties are carried from WW-1.

Table of Numbers:

Stream Number:	WW-1	IC-051	WW-2
Flow Rate, L/s:	31.5	12.6	18.9
Volume, m ³ :	1.99E+6	7.96E+5	1.19E+6
Density, g/cc: 1.0			
Temperature, °C: 10			
Water, kg:	1.99E+9	7.96E+8	1.19E+9
Total Mass, kg:	1.99E+9	7.96E+8	1.19E+9

WW-3 Chiller Bypass Water

Input Stream(s): WW-2
WW-4

Logic:

This stream is the difference between WW-2 and WW-4. It is expected to be used only sparingly so a low flow rate is shown. Properties are carried from stream WW-2.

Table of Numbers:

Stream Number:	WW-2	WW-4	WW-3
Flow Rate, L/s:	18.9	15.8	3.2
Volume, m ³ :	1.19E+6	9.95E+5	1.99E+5
Density, g/cc: 1.0			
Temperature, °C: 10			
Water, kg:	1.19E+9	9.95E+8	1.99E+8
Total Mass, kg:	1.19E+9	9.95E+8	1.99E+8

WW-4 Water to Chiller

Input Stream(s): WW-2

Logic:

The water to chiller is operated at 250 gpm Ref. K Basin SAR section 2.6.1.1. The mass is the product of volumetric rate and time. Properties are carried from stream WW-2. This stream is operated continuously.

Table of Numbers:

Stream Number: WW-4

Flow Rate, L/s: 15.8

Volume, m³: 9.95E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 9.95E+8

Total Mass, kg: 9.95E+8

WW-6 Primary Cleaning Water**Input Stream(s):** IC-017**Logic:**

The primary cleaning machine operates at 80 gpm. The mass is the product of volumetric rate and time. Properties from IC-017 are used. The components are taken from drawing number H-1-81164, Rev. 3, sheet 2. Assume flow is continuous and 100% of the sludge comes from the primary cleaning water.

Table of Numbers:

Stream Number: IC-017 WW-6

Flow Rate, L/s: 5.0

Volume, m³: 3.18E+5

Density, g/cc: 1.0

Temperature, °C: 10

Sludge, kg: 6.51E+3

Water in Sludge, kg: 1.27E+3

*Other, kg:U (total)	1531
UO ₂	1572
U ₃ O ₇	696
UO ₄ *4H ₂ O	9
UH ₃	156
Al(OH) ₃	406
FeO(OH)	338
SiO ₂	112
CaO	2
Other	248

Water, kg: 3.18E+8

Total Mass, kg: 3.18E+8

WW-7 De-Capping Station Water

Input Stream(s): N/A

Logic:

The delidding station operates at 70 gpm. The mass is the product of volumetric rate and time. Properties from IC-017 are used. The components are taken from drawing number H-1-81164, Rev. 3, sheet 2. Assume flow is continuous and 0% of the sludge comes from the de-capping station..

Table of Numbers:

Stream Number: WW-7

Flow Rate, L/s: 4.4

Volume, m³: 2.79E+5

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 2.79E+8

Total Mass, kg: 2.79E+8

WW-8 Metal Knockout

Input Stream(s): IC-017

Logic:

This stream is the accumulation of sludge fragments during the campaign in the knockout pot. The sludge fragments will eventually be processed with the sludge, and are thus added to IC-204. The steps for doing this have not yet been defined however, since the knock-out pot is not directly flushable. The fragments are assumed for this purpose as the uranium constituent within the sludge. The density of the sludge is estimated to be 8.549 g/cc on an as-settled basis per HNF-SD-SNF-TI-009, vol. 2, rev. 2, table 3-2.

Table of Numbers:

Stream Number: IC-017 WW-8

Flow Rate, L/s: N/A

Volume, m³: 1.79E-1 1.79E-1

Density, g/cc: 8.549 8.549

Temperature, °C: 10

Sludge, kg: U(total) 1531 1531

Total Mass, kg: 1531 1531

WW-9 Chilled Basin Station Water Return

Input Stream(s): WW-3
WW-4

Logic:

This stream is the direct sum of streams WW-3 and WW-4. Properties are carried from stream WW-4.

Table of Numbers:

Stream Number:	WW-3	WW-4	WW-9
Flow Rate, L/s:	3.2	15.8	18.9
Volume, m ³ :	1.99E+5	9.95E+5	1.19E+6
Density, g/cc: 1.0			
Temperature, °C: 10			
Water, kg:	1.99E+8	9.95E+8	1.19E+9
Total Mass, kg:	1.99E+8	9.95E+8	1.19E+9

WW-10 Discharge Chute Recirculation Water

Input Stream(s): WW-14
IC-042
IC-046
IC-091
IC-151
IC-177
IC-189

Properties, Constant & Conversions: N/A

Logic:

This stream is the difference of WW-14 and the sum of IC-042, IC-046, IC-091, IC-151, IC-177, and IC-189. Properties from WW-14 are used.

Table of Numbers:

Stream Number:	WW-14	IC-042	IC-046	IC-091	IC-151	IC-177	IC-189	WW-10
Flow Rate, L/s:	19	1.9	N/A	N/A	N/A	0.95	12.6	3.55
Volume, m ³ :	1.19E+6	1.19E+5	2.31E+2	1.96E+4	0	5.97E+4	7.96E+5	1.99E+5
Density, g/cc: 1.0								
Temperature : 10°C								
Water, kg:	1.19E+9	1.19E+8	2.31E+5	1.96E+7	0	5.97E+7	7.96E+8	1.99E+8
Total Mass, kg:	1.19E+9	1.19E+8	2.31E+5	1.96E+7	0	5.97E+7	7.96E+8	1.99E+8

WW-11 Process Water to Settler**Input Stream(s):** IC-017, IC-198, WW-8**Logic:**

This stream is the direct sum of the water and sludge components of streams IC-017 and IC-198 minus WW-8. The fuel fragments in IC-017 are omitted because they remain in the knock-out pot (see WW-8). Properties are carried from IC-017.

Table of Numbers:

Stream Number:	IC-017	IC-198	WW-8	WW-11
Flow Rate, L/s:	9.5	9.5	N/A	19
Volume, m ³ :	5.97E+5	5.97E+5	1.79E-1	1.19E+6
Density, g/cc: 1.0				
Temperature, °C: 10				
Sludge, kg:	6.51E+3		1.53E+3	4.98E+3
Water in Sludge:	1.27E+3			1.27E+3
*Other, kg:UO ₂	1572			1572
U ₃ O ₇	696			696
UO ₄ *4H ₂ O	9			9
UH ₃	156			156
Al(OH) ₃	406			406
FeO(OH)	338			338
SiO ₂	112			112
CaO	2			2
Other	248			248

**From HNF-SD-SNF-TI-009, Vol 2, Rev. 2, table 2-2. The sum of sludge from canisters full, fuel wash internal sludge, fuel wash coating, and fuel wash fuel pieces only.*

Water, kg:	5.97E+8	5.97E+8		1.19E+9
Total Mass, kg:	5.97E+8	5.97E+8	1.53E+3	1.19E+9

WW-12 Process Water to Sand Filters

Input Stream(s): WW-11

Logic:

This stream is the water from WW-11. Since the settler is assumed to capture 60% of the evenly mixed, incoming sludge in WW-11, the remaining 40% continues with the settler overflow, but 100% of the sludge will eventually be sent back to the settler and out with the sludge loadout. Properties are carried from WW-11. See IC-204 for sludge disposition. Assume 60% of all sludge remains in the settler and all water passes through.

Table of Numbers:

Stream Number:	WW-11	WW-12
Flow Rate, L/s:	19	19
Volume, m ³ :	1.19E+6	1.19E+6
Density, g/cc: 1.0		
Temperature, °C: 10		
Sludge, kg:	4.98E+3	1.99E+3
Water in Sludge:	1.27E+3	5.08E+2
*Other, kg:UO ₂	1572	629
U ₃ O ₇	696	278
UO ₄ *4H ₂ O	9	3.6
UH ₃	156	62
Al(OH) ₃	406	162
FeO(OH)	338	135
SiO ₂	112	45
CaO	2	0.8
Other	248	99

**From HNF-SD-SNF-TI-009, Vol 2, Rev. 2, table 2-2. The sum of sludge from canisters full, fuel wash internal sludge, fuel wash coating, and fuel wash fuel pieces only.*

Water, kg:	1.19E+9	1.19E+9
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Total Mass, kg: 1.19E+9 1.19E+9

WW-13 Sand Filter Back Flush Return

Input Stream(s): WW-12

Logic:

This stream is the sludge component from WW-12 backwashed to the settler. Sufficient water is added to make a 1% slurry. The backwash will be done intermittently. The 1% concentration is taken from engineering judgement to ensure a pumpable stream. Properties are carried from WW-12.

Table of Numbers:

Stream Number:	WW-12	WW-13
Flow Rate, L/s:	19	N/A
Volume, m ³ :	1.19E+6	1.99E+2
Density, g/cc: 1.0		
Temperature, °C: 10		
Sludge, kg:	1.99E+3	1.99E+3
Water in Sludge:	5.08E+2	5.08E+2
*Other, kg:UO ₂	629	629
U ₃ O ₇	278	278
UO ₄ *4H ₂ O	3.6	3.6
UH ₃	62	62
Al(OH) ₃	162	162
FeO(OH)	135	135
SiO ₂	45	45
CaO	0.8	0.8
Other	99	99

**From HNF-SD-SNF-TI-009, Vol 2, Rev. 2, table 2-2. The sum of sludge from canisters full, fuel wash internal sludge, fuel wash coating, and fuel wash fuel pieces only.*

Water, kg: 1.19E+9 1.97E+5

Total Mass, kg: 1.19E+9 1.99E+5

WW-14 Filtered Basin Water

Input Stream(s): WW-12
IC-012

Logic:

This stream is the sum of the water components of streams WW-12 and IC-012. The sludge from WW-12 is trapped by the sand filters and flushed back to the settler. The water supply for the backwash is from WW-19. Properties are carried from WW-12. Assume a flow rate of 300 gpm.

Table of Numbers:

Stream Number:	WW-12	IC-012	WW-14
Flow Rate, L/s:	19	N/A	19
Volume, m ³ :	1.19E+6	4.17E+2	1.19E+6
Density, g/cc: 1.0			
Temperature, °C: 10			
Water, kg:	1.19E+9	4.17E+5	1.19E+9
Total Mass, kg:	1.19E+9	4.17E+5	1.19E+9

WW-16 Fresh Basin Water Makeup

Input Stream(s):	IC-016
	WW-1 IC-177
	WW-20 WW-9
	WW-27 WW-10
	WW-31 WW-17
	IC-042 WW-21
	IC-051 WW-22

Logic:

The stream is the difference between all the inputs and outputs of the basin. WW-16 is the sum of IC-016, WW-1, WW-20, WW-27, WW-31, SW-27A, and SW-27B. From this is subtracted the sum of IC-042, IC-051, IC-177, WW-9, WW-10, WW-17, WW-21, and WW-22. Properties are carried from IC-093.

Table of Numbers:

Stream Number	IC-016	WW-1	WW-20	WW-27	WW-31	IC-042	IC-051
Flow Rate, L/s	NA	32	25	5.26E-3	NA	2	13
Volume, m ³	1.18E+6	1.99E+6	1.59E+6	3.32E+2	1.73E+1	1.19E+5	7.96E+5
Density, g/cc	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Temperature, °C	10	10	10	10	10	10	10
Water, kg	1.18E+9	1.99E+9	1.59E+9	3.32E+5	1.73E+4	1.19E+8	7.96E+8
Total Mass, kg	1.18E+9	1.99E+9	1.59E+9	3.32E+5	1.73E+4	1.19E+8	7.96E+8

Stream Number	IC-177	WW-9	WW-10	WW-17	WW-21	WW-22	WW-16
Flow Rate, L/s	1	19	3	13	10	15	NA
Volume, m ³	5.97E+4	1.19E+6	1.99E+5	7.96E+5	6.37E+5	9.54E+5	9.65E+3
Density, g/cc	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Temperature, °C	10	10	10	10	10	10	10
Water, kg	5.97E+7	1.19E+9	1.99E+8	7.96E+8	6.37E+8	9.54E+8	9.65E+6
Total Mass, kg	5.97E+7	1.19E+9	1.99E+8	7.96E+8	6.37E+8	9.54E+8	9.65E+6

WW-17 Loadout Pit Return Water to Basin

Input Stream(s): WW-30
IC-048
IC-189

Logic:

This stream is the sum of streams IC-048 and IC-189 minus WW-30. Basin properties are used.

Table of Numbers:

Stream Number:	IC-048	IC-189	WW-30	WW-17
Flow Rate, L/s:	N/A	12.6	N/A	12.6
Volume, m ³ :	3.46E+2	7.96E+5	6.93E+1	7.96E+5
Density, g/cc: 1.0				
Temperature, °C: 10				
Water, kg:	3.46E+5	7.96E+8	6.93E+4	7.96E+8
Total Mass, kg:	3.46E+5	7.96E+8	6.93E+4	7.96E+8

WW-19 Backflush Feed

Input Stream(s): WW-13

Logic:

This stream supplies the necessary water for the periodic flushing of the sand filters. All water needed for WW-13 comes from WW-19.

Table of Numbers:

Stream Number:	WW-13	WW-19
----------------	-------	-------

Flow Rate, L/s:	N/A	N/A
Volume, m ³ :	1.99E+2	1.97E+2
Density, g/cc: 1.0		
Temperature, °C: 10		
Water, kg:	1.97E+5	1.97E+5
Total Mass, kg:	1.99E+5	1.97E+5

WW-20 Skimmer Filter Supply**Input Stream(s):** N/A**Logic:**

The existing skimmer flow is rated be between 360 gpm and 420 gpm Ref. K Basin SAR section 2.6.2.1. Assume 400 gpm and it is operated continuously at that flow. The basin properties are used. The mass is the product of volumetric rate and time.

Table of Numbers:

Stream Number: WW-20

Flow Rate, L/s: 25.2

Volume, m³: 1.59E+6

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.59E+9

Total Mass, kg: 1.59E+9

WW-21 Skimmer IXM Return**Input Stream(s):** N/A**Logic:**

The existing ion exchange flow is rated at 160 gpm and is operated continuously at that flow Ref. K Basin SAR section 2.6.2.2.4. Properties are carried from WW-20. The mass is the product of volumetric rate and time.

Table of Numbers:

Stream Number: WW-21

Flow Rate, L/s: 10.1

Volume, m³: 6.37E+5
 Density, g/cc: 1.0
 Temperature, °C: 10

Water, kg: 6.37E+8

Total Mass, kg: 6.37E+8

WW-22 Skimmer IXM Bypass

Input Stream(s): WW-19
 WW-20
 WW-21

Logic:

This stream is the difference of WW-20 and the sum of WW-18, WW-19, and WW-21. Properties from WW-20 are used.

Table of Numbers:

Stream Number:	WW-20	WW-19	WW-21	WW-22
Flow Rate, L/s:	25.2	N/A	10.1	15.1
Volume, m ³ :	1.59E+6	1.97E+3	6.37E+5	9.54E+5
Density, g/cc: 1.0				
Temperature, °C: 10				
Water, kg:	1.59E+9	1.97E+5	6.37E+8	9.54E+8
Total Mass, kg:	1.59E+9	1.97E+5	6.37E+8	9.54E+8

WW-23 Replacement Ion Exchange Modules

Input Stream(s): N/A

Logic:

The ion exchange module use is based on 300 Ci/unit Ref. K Basin SAR section 2.6.2.2.4. There is an estimated 2.1 Ci/canister going into the IXM's per HNF-SD-SNF-TI-048, Rev. 0. The processing loop IXM consists of three modules working together and one modules for the skimmer loop IXM. There is a total of 3841 canisters in the K west basin.

2.1 Ci/canister x 3841 canisters = 8066.1 total Ci going into the basin IXM's.

8066.1 Ci ÷ 300 Ci = 26.89 ≈ 27 replacement modules needed.

This requires 27 replacement modules. Each module is 86 x 70 x 79.5 in weighing 42,000 lb Ref. K Basin SAR section 2.6.2.2.4. Total solids and mass are based on ion exchange masses, the entire unit will be replaced. ^{137}Cs is the component of primary concern because of the long half life. The density is the average for the entire unit.

Table of Numbers:

Stream Number: WW-23A

Volume, m^3 : $2.12\text{E}+2$

Density, g/cc: 2.43

Temperature, $^{\circ}\text{C}$: Ambient

Other Solids, kg: $5.15\text{E}+5$

Total Mass, kg: $5.15\text{E}+5$

WW-27 Normal Basin Water Loss

Input Stream(s): N/A

Logic:

The stream is the normal water loss from evaporation assume 120 gal/day. The mass is the product of volumetric rate and time. Basin properties are used.

Table of Numbers:

Stream Number: WW-27

Flow Rate, L/s: $5.26\text{E}-3$

Volume, m^3 : $3.32\text{E}+2$

Density, g/cc: 1.0

Temperature, $^{\circ}\text{C}$: 10

Water, kg: $3.32\text{E}+5$

Total Mass, kg: $3.32\text{E}+5$

WW-30 Volume Decrease as Fuel Removed

Input Stream(s): N/A

Logic:

This stream accounts for volume loss by removal of fuel and is taken from the fuel retrieval calculations. The basin operating temperature is used.

The displacement volume of fuel is 67 L/MTU per HNF-SD-SNF-TI-009, Vol. 1, Rev. 3, Table 3.1.

The total weight of fuel is 1035000 kg per drawing H-1-81164, Rev. 3.

Total displaced volume from fuel is:

$$67 \text{ l/MTU} \div 1000 \text{ kg/MTU} \times 1035000 \text{ kg} = 69345 \text{ l}$$

Table of Numbers:

Stream Number: WW-30

Volume, m³: 6.93E+1

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 6.93E+4

Total Mass, kg: 6.93E+4

WW-31 Volume Decrease as Debris Removed

Input Stream(s): N/A

Logic:

This stream accounts for volume loss by removal of debris. Debris is considered canisters as well as canister lids. The basin operating temperature is used.

Breakdown of canister types with lids per HNF-3272, Rev. 0.

Mark I (Al) 780 canisters

Mark I (SS) 958 canisters

Mark II (SS) 2104 canisters

Canister weights with lids in kg per canister:

	Al	SS	Drawing Ref.
Mark I	8.64		Dimensions taken from H-1-36935
Mark I	6.4	24.9	Dimensions taken from H-1-42793, H-1-42807 for lids
Mark II		35.0	H-1-46215

Densities per Perry's Chemical Engineering Handbook, Sixth Edition.

Stainless Steel 489 lb/ft³ = 7.83 g/cc

Aluminium 165 lb/ft³ = 2.64 g/cc

Total volume per canister:

Mark I $8.64 \text{ kg} \div 2.64 \text{ g/cc} \times 1000 \text{ g/kg} = 3273 \text{ cc}$

Mark I $[6.4 \text{ kg Al} \div 2.64 \text{ g/cc} + 24.9 \text{ kg SS} \div 7.83 \text{ g/cc}] \times 1000 \text{ g/kg} = 5604 \text{ cc}$

Mark II $35.0 \text{ kg SS} \div 7.83 \text{ g/cc} \times 1000 \text{ g/kg} = 4470 \text{ cc}$

Total volume is: $3273 \text{ cc} \times 780 \text{ can} + 5604 \text{ cc} \times 958 \text{ can} + 4470 \text{ cc} \times 2104 \text{ can} = 1.733\text{E}+7 \text{ cc}$

Total mass is the displaced water which is calculated using the density of water.

Table of Numbers:

Stream Number: WW-31

Flow Rate, L/s: N/A

Volume, m³: 17.33

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 1.733E+4

Total Mass, kg: 1.733E+4

SW-27A Basin Water Included in Sludge Transfer

Input Stream(s): N/A

Logic:

The process of sludge removal will take place after the fuel processing and is not yet defined. This stream is for future use and is not included in the total.

Table of Numbers:

Stream Number: SW-27A

Flow Rate, L/s:

Volume, m³:

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 0.0

Total Mass, kg: 0.0

SW-27B Basin Water Included in Sludge Transfer

Input Stream(s): N/A

Logic:

The process of sludge removal will take place after the fuel processing and is not yet defined. This stream is for future use and is not included in the total.

Table of Numbers:

Stream Number: SW-27B

Flow Rate, L/s:

Volume, m³:

Density, g/cc: 1.0

Temperature, °C: 10

Water, kg: 0.0

Total Mass, kg: 0.0

8.0 RESULTS

See Excel Spreadsheet for results.

9.0 CONCLUSIONS

See Excel Spreadsheet for results

10.0 REFERENCES

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Drawings

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H-1-36930, Rev. 6, *Irradiated Fuel Storage Canister*

H-1-42793, Rev. 3, *Fuel Encapsulation Program Storage Canister*

H-1-42807, Rev. 1, *Fuel Encapsulation Canister Seal Arrgt.*

H-1-46215, Rev. 6, *Fuel Encapsulation Mark II Canister Assembly*

H-1-81161, Rev. 2, *SNF Project KW Basin Water System Level 1 PFD*

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Appendix A

Appendix A

LEVEL 1 KW BASIN WATER SYSTEM PROCESS FLOW

PHASES PROJECT TOTAL OVER 2 YEARS OF OPERATION

REPLATED
FROM WW2
14-Dec-89

STREAM NUMBER	SC02	ECM	EC07	EC02	EC03	EC04	EC05	EC06	EC08	EC09	EC10	EC11	EC12	EC13	EC14	EC15	EC16	EC17	EC18	EC19	EC20	EC21	EC22	EC23	EC24	EC25	EC26	EC27	EC28	EC29	EC30	EC31	EC32	EC33	EC34	EC35	EC36	EC37	EC38	EC39	EC40	EC41	EC42	EC43	EC44	EC45	EC46	EC47	EC48	EC49	EC50	EC51	EC52	EC53	EC54	EC55	EC56	EC57	EC58	EC59	EC60	EC61	EC62	EC63	EC64	EC65	EC66	EC67	EC68	EC69	EC70	EC71	EC72	EC73	EC74	EC75	EC76	EC77	EC78	EC79	EC80	EC81	EC82	EC83	EC84	EC85	EC86	EC87	EC88	EC89	EC90	EC91	EC92	EC93	EC94	EC95	EC96	EC97	EC98	EC99	EC100	EC101	EC102	EC103	EC104	EC105	EC106	EC107	EC108	EC109	EC110	EC111	EC112	EC113	EC114	EC115	EC116	EC117	EC118	EC119	EC120	EC121	EC122	EC123	EC124	EC125	EC126	EC127	EC128	EC129	EC130	EC131	EC132	EC133	EC134	EC135	EC136	EC137	EC138	EC139	EC140	EC141	EC142	EC143	EC144	EC145	EC146	EC147	EC148	EC149	EC150	EC151	EC152	EC153	EC154	EC155	EC156	EC157	EC158	EC159	EC160	EC161	EC162	EC163	EC164	EC165	EC166	EC167	EC168	EC169	EC170	EC171	EC172	EC173	EC174	EC175	EC176	EC177	EC178	EC179	EC180	EC181	EC182	EC183	EC184	EC185	EC186	EC187	EC188	EC189	EC190	EC191	EC192	EC193	EC194	EC195	EC196	EC197	EC198	EC199	EC200	EC201	EC202	EC203	EC204	EC205	EC206	EC207	EC208	EC209	EC210	EC211	EC212	EC213	EC214	EC215	EC216	EC217	EC218	EC219	EC220	EC221	EC222	EC223	EC224	EC225	EC226	EC227	EC228	EC229	EC230	EC231	EC232	EC233	EC234	EC235	EC236	EC237	EC238	EC239	EC240	EC241	EC242	EC243	EC244	EC245	EC246	EC247	EC248	EC249	EC250	EC251	EC252	EC253	EC254	EC255	EC256	EC257	EC258	EC259	EC260	EC261	EC262	EC263	EC264	EC265	EC266	EC267	EC268	EC269	EC270	EC271	EC272	EC273	EC274	EC275	EC276	EC277	EC278	EC279	EC280	EC281	EC282	EC283	EC284	EC285	EC286	EC287	EC288	EC289	EC290	EC291	EC292	EC293	EC294	EC295	EC296	EC297	EC298	EC299	EC300	EC301	EC302	EC303	EC304	EC305	EC306	EC307	EC308	EC309	EC310	EC311	EC312	EC313	EC314	EC315	EC316	EC317	EC318	EC319	EC320	EC321	EC322	EC323	EC324	EC325	EC326	EC327	EC328	EC329	EC330	EC331	EC332	EC333	EC334	EC335	EC336	EC337	EC338	EC339	EC340	EC341	EC342	EC343	EC344	EC345	EC346	EC347	EC348	EC349	EC350	EC351	EC352	EC353	EC354	EC355	EC356	EC357	EC358	EC359	EC360	EC361	EC362	EC363	EC364	EC365	EC366	EC367	EC368	EC369	EC370	EC371	EC372	EC373	EC374	EC375	EC376	EC377	EC378	EC379	EC380	EC381	EC382	EC383	EC384	EC385	EC386	EC387	EC388	EC389	EC390	EC391	EC392	EC393	EC394	EC395	EC396	EC397	EC398	EC399	EC400	EC401	EC402	EC403	EC404	EC405	EC406	EC407	EC408	EC409	EC410	EC411	EC412	EC413	EC414	EC415	EC416	EC417	EC418	EC419	EC420	EC421	EC422	EC423	EC424	EC425	EC426	EC427	EC428	EC429	EC430	EC431	EC432	EC433	EC434	EC435	EC436	EC437	EC438	EC439	EC440	EC441	EC442	EC443	EC444	EC445	EC446	EC447	EC448	EC449	EC450	EC451	EC452	EC453	EC454	EC455	EC456	EC457	EC458	EC459	EC460	EC461	EC462	EC463	EC464	EC465	EC466	EC467	EC468	EC469	EC470	EC471	EC472	EC473	EC474	EC475	EC476	EC477	EC478	EC479	EC480	EC481	EC482	EC483	EC484	EC485	EC486	EC487	EC488	EC489	EC490	EC491	EC492	EC493	EC494	EC495	EC496	EC497	EC498	EC499	EC500	EC501	EC502	EC503	EC504	EC505	EC506	EC507	EC508	EC509	EC510	EC511	EC512	EC513	EC514	EC515	EC516	EC517	EC518	EC519	EC520	EC521	EC522	EC523	EC524	EC525	EC526	EC527	EC528	EC529	EC530	EC531	EC532	EC533	EC534	EC535	EC536	EC537	EC538	EC539	EC540	EC541	EC542	EC543	EC544	EC545	EC546	EC547	EC548	EC549	EC550	EC551	EC552	EC553	EC554	EC555	EC556	EC557	EC558	EC559	EC560	EC561	EC562	EC563	EC564	EC565	EC566	EC567	EC568	EC569	EC570	EC571	EC572	EC573	EC574	EC575	EC576	EC577	EC578	EC579	EC580	EC581	EC582	EC583	EC584	EC585	EC586	EC587	EC588	EC589	EC590	EC591	EC592	EC593	EC594	EC595	EC596	EC597	EC598	EC599	EC600	EC601	EC602	EC603	EC604	EC605	EC606	EC607	EC608	EC609	EC610	EC611	EC612	EC613	EC614	EC615	EC616	EC617	EC618	EC619	EC620	EC621	EC622	EC623	EC624	EC625	EC626	EC627	EC628	EC629	EC630	EC631	EC632	EC633	EC634	EC635	EC636	EC637	EC638	EC639	EC640	EC641	EC642	EC643	EC644	EC645	EC646	EC647	EC648	EC649	EC650	EC651	EC652	EC653	EC654	EC655	EC656	EC657	EC658	EC659	EC660	EC661	EC662	EC663	EC664	EC665	EC666	EC667	EC668	EC669	EC670	EC671	EC672	EC673	EC674	EC675	EC676	EC677	EC678	EC679	EC680	EC681	EC682	EC683	EC684	EC685	EC686	EC687	EC688	EC689	EC690	EC691	EC692	EC693	EC694	EC695	EC696	EC697	EC698	EC699	EC700	EC701	EC702	EC703	EC704	EC705	EC706	EC707	EC708	EC709	EC710	EC711	EC712	EC713	EC714	EC715	EC716	EC717	EC718	EC719	EC720	EC721	EC722	EC723	EC724	EC725	EC726	EC727	EC728	EC729	EC730	EC731	EC732	EC733	EC734	EC735	EC736	EC737	EC738	EC739	EC740	EC741	EC742	EC743	EC744	EC745	EC746	EC747	EC748	EC749	EC750	EC751	EC752	EC753	EC754	EC755	EC756	EC757	EC758	EC759	EC760	EC761	EC762	EC763	EC764	EC765	EC766	EC767	EC768	EC769	EC770	EC771	EC772	EC773	EC774	EC775	EC776	EC777	EC778	EC779	EC780	EC781	EC782	EC783	EC784	EC785	EC786	EC787	EC788	EC789	EC790	EC791	EC792	EC793	EC794	EC795	EC796	EC797	EC798	EC799	EC800	EC801	EC802	EC803	EC804	EC805	EC806	EC807	EC808	EC809	EC810	EC811	EC812	EC813	EC814	EC815	EC816	EC817	EC818	EC819	EC820	EC821	EC822	EC823	EC824	EC825	EC826	EC827	EC828	EC829	EC830	EC831	EC832	EC833	EC834	EC835	EC836	EC837	EC838	EC839	EC840	EC841	EC842	EC843	EC844	EC845	EC846	EC847	EC848	EC849	EC850	EC851	EC852	EC853	EC854	EC855	EC856	EC857	EC858	EC859	EC860	EC861	EC862	EC863	EC864	EC865	EC866	EC867	EC868	EC869	EC870	EC871	EC872	EC873	EC874	EC875	EC876	EC877	EC878	EC879	EC880	EC881	EC882	EC883	EC884	EC885	EC886	EC887	EC888	EC889	EC890	EC891	EC892	EC893	EC894	EC895	EC896	EC897	EC898	EC899	EC900	EC901	EC902	EC903	EC904	EC905	EC906	EC907	EC908	EC909	EC910	EC911	EC912	EC913	EC914	EC915	EC916	EC917	EC918	EC919	EC920	EC921	EC922	EC923	EC924	EC925	EC926	EC927	EC928	EC929	EC930	EC931	EC932	EC933	EC934	EC935	EC936	EC937	EC938	EC939	EC940	EC941	EC942	EC943	EC944	EC945	EC946	EC947	EC948	EC949	EC950	EC951	EC952	EC953	EC954	EC955	EC956	EC957	EC958	EC959	EC960	EC961	EC962	EC963	EC964	EC965	EC966	EC967	EC968	EC969	EC970	EC971	EC972	EC973	EC974	EC975	EC976	EC977	EC978	EC979	EC980	EC981	EC982	EC983	EC984	EC985	EC986	EC987	EC988	EC989	EC990	EC991	EC992	EC993	EC994	EC995	EC996	EC997	EC998	EC999	EC1000
DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

STREAM NUMBER	S-147	S-151	S-177	S-179	S-189	S-198	S-204	WW-1	WW-2	WW-3
DESCRIPTION	SAND INVENTORY TO SOLID WASTE BATCH	LOW BASIN LEVEL CONTROL WATER BATCH	NEW TRENDS LOADOUT ENCLOSURE WATER SUPPLY CONTINUOUS	FRESH WATER TO NEW CASK LOADOUT BATCH	RAW LOADOUT BY CIRCULATION WATER CONTINUOUS	FUEL RETRIEVAL PROCESS TABLE CONTINUOUS	SLUDGE LOADOUT BATCH	DECHILLER LOOP RECIRCULATION SECTION CONTINUOUS	FILTERED CHILLER LOOP WATER CONTINUOUS	CHILLER BYPASS WATER CONTINUOUS
TRANSFER TYPE	S	L	L	L	L	L	L/S	L	L	L
PHASE NOTE 1)										
NUMBER OF TRENDS	-	-	-	-	-	-	-	-	-	-
ITEM COUNT BAGS	-	-	-	-	13	-	-	-	-	-
FLOW UNIT	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG
VOLUME CUBIC METERS	3.10	0.06-40	5.97E-04	1.95E-02	7.88E-05	5.97E-05	4.88E-02	1.88E-05	1.88E-05	1.88E-05
DENSITY, G/CM ³	2.80	1.00	1.00	1	1	1.00	1.00	1.00	1.00	1.00
PRESSURE, PSIG	-	-	-	-	-	-	-	-	-	-
TEMPERATURE, DEG C	15	10	10	20	10	10	90	10	10	10
COMPONENTS IN NOTE 2)										
FUEL							4.88E-02			
SLUDGE							1.27E-02			
WATER IN SLUDGE							0.02E-03			
UO ₂							1.97E-02			
UO ₂							8.88E-02			
UO ₂ H ₂ O							9.08E-03			
U ₂							1.88E-03			
AN ₂							4.08E-02			
Fe ₂ O ₃							3.38E-02			
SiO ₂							1.12E-02			
Na ₂							2.02E-03			
OTHER							2.88E-02			
OTHER SOLIDS	7.11E-03									
WATER		0.02E-40	5.97E-07	1.18E-05	7.88E-05	5.97E-05	4.88E-05	1.88E-02	1.88E-05	1.88E-05
WAS										
OTHER GASES										
TOTAL MASS, MG	7.11E-03		5.97E-07	1.18E-05	7.88E-05	5.97E-05	4.88E-05	1.88E-02	1.88E-05	1.88E-05

[illegible]

STREAM NUMBER	WWS-17	WWS-18	WWS-20	WWS-21	WWS-22	WWS-25	WWS-8	WWS-27	WWS-30	WWS-31
DESCRIPTION	DISCHARGE RETURN WATER TO BASIN	BACKLIGHT FEED	SPRINKLER OUTPUT	DEMULSIFIER RETURN	SPRINKLER FILTER BYPASS	REPLACEMENT ON EXCHANGE MODULES	METAL ANALYSIS/217	NORMAL BASIN WATER LOSS	VOLUME DECREASE AS FUEL REMOVED	VOLUME DECREASE AS OILS REMOVED
TRANSFER TYPE	CONTINUOUS	BATCH	CONTINUOUS	CONTINUOUS	CONTINUOUS	BATCH	BATCH	VARIABLE	BATCH	BATCH
PHASE (NOTE 1)	L	L	L	L	L	S	S	L	L	L
NUMBER OF ITEMS	—	—	—	—	—	27	—	—	—	—
ITEM COUNT BASIS	—	—	—	—	—	—	—	—	—	—
FLOW RATE (L/S)	13	—	25	10	15	—	—	—	—	—
VOLUME CUBIC METERS	7.98E-05	1.97E-02	1.66E-05	8.37E-05	9.44E-05	2.72E-02	1.79E-01	2.00E-02	6.93E-01	1.78E-01
DENSITY (g/cc)	1	1.00	1	1	1	2.40	8.99	1	1	1
PRESSURE (bar)	—	—	—	—	—	—	—	—	—	—
TEMPERATURE (C)	10	10	10	10	10	10	10	10	10	10
COMMENTS (NOTE 2)							1.53E-03			
FUEL							1.53E-03			
SOLIDS							1.53E-03			
WATER IN SLUDGE							1.53E-03			
WATER							1.53E-03			
OTHER							1.53E-03			
OTHER SOLIDS							1.53E-03			
WATER							1.53E-03			
WATER							1.53E-03			
OTHER GASES							1.53E-03			
OTHER GASES							1.53E-03			
TOTAL WASTE (kg)	7.98E-05	0.00E+00	1.98E-05	8.37E-05	9.44E-05	5.14E-05	1.53E-03	3.00E-05	6.93E-01	1.78E-01

NOTES

1. S = SOLID, L = LIQUID, G = GAS, AND MIXTURES INDICATED AS SL = SOLID-OR-LIQUID MIXTURE

2. FUEL COMPOSITIONS OF TOTAL MASS OF FUEL COMPOSITIONS INCLUDING FUEL AND CLOSING SLUDGE MASS IS REPORTED ON A WET BASIS. OTHER SOLIDS CONSIST OF A VARIETY OF MATERIALS. REMAINING MATERIALS INCLUDE CONTAINER MATERIALS LIKE THE WOOD, CARBON, AND SOLID WASTE INCLUDING DRUMS

1. Data streams were assumed to have a density of 1.0 g/cc for simplicity
2. Continuous flow is 365 days per year for two years.
3. Winter flow from each immersion pit during each wet/dry cycle = 50 gal/MCO
4. First flush water tank flush = 100 gal/MCO
5. Basin water for initial tank flush = 500 gal/MCO
6. Density of sludge in IC-17 is that of water
7. The fragments are assumed for this purpose as the uranium contained within the sludge for WW-8
8. For IC-14 flow is continuous
9. For IC-20 water added to make 1% slurry measure from WW-13
10. 100% sludge goes to WW-6 and 0% goes to WW-7
11. 50% of sludge remains in sifter and all water passes through for WW-12
12. WW-15 has a flow rate of 300 gpm
13. WW-20 uses 400 gpm flow rate