ESP's Tank 42 Washwater Transfer to the 241-F/H Tank Farms

by

C. I. Aponte

Westinghouse Savannah River Company

Savannah River Site

Aiken, South Carolina 29808

E. D. Lee

Westinghouse Savannah River Col

SC US

MASTER

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APPROVALS

Ernest D. Lee / C. I. Aponte
E. D. Lee, WPTE / C. I. Aponte, CSTE, Co-authors

Date: 12/5/97

G. R. Beaumier
G. R. Beaumier, Technical Reviewer WPTE

Date: 12/5/97

M. E. Jamison
M. E. Jamison, Technical Reviewer CSTE

Date: 12/5/97

T. L. Ortner
T. L. Ortner, Manager WPTE Processing Eng.

Date: 12-5-97

M.C. Chandler for M.C. Chandler
M. C. Chandler, Manager CSTE Waste Characterization

Date: 12/5/97

B. L. Lewis
B. L. Lewis, Manager CSTE Support Group

Date: 12/5/97

M. S. Miller
M. S. Miller, Manager WPTE

Date: 12-5-97

T. M. Monahan
T. M. Monahan, Manager CSTE

Date: 12-5-97

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1. Summary

This report addresses requirements for transfers of ESP decants to CSTE's 242-16H evaporator system (i.e., Tank 43) and Tank 22 (i.e., Type IV waste tank). The requirements are provided in CSTE's Waste Acceptance Criteria (ref. 1) and Tank Farm Authorization Basis. The bounding radiological inhalation dose is expected to be less than $3E+06$ rem/gal for the ESP washwater. This waste transfer will comply with all of the Tank Farm WAC requirements. The bounding washwater volume that is planned to be transferred to the H-Tank Farm is 300 kgal. The receipt tank for the ESP wash water will have a maximum supernate temperature of 49°C until the next chemistry sample is taken and evaluated to determine the appropriate temperature limit.

Table 1. Summary of Radiological Source Term (RST) Limits for H-Tank Farm

Waste Stream	RST (rem _{inh} /gallon)	Factor Below RST Limits	Notes
Bounding Tank 42 ESP Washwater (Assuming a 1 wt.% insoluble entrained solids concentration)	below $3E6$	-	Source Term is expected to be 10 times lower
Influent Waste in Double Contained Transfer Lines	$2.3E9$	770	All transfer schemes are utilizing double contained lines.
242-16H Evaporator	$1E9$	330	Source term for the concentrated supernate
Type IV Supernate	$3E6$	>1	Source Term is expected to be 10 times lower

1.1 Summary of Requirements

- Temperature control for corrosion control purposes if transferred to Tank 43 and Tank 22.
- Vamp placement at Tank 42.
- Vamp placement within CST facilities if transferred to Tank 22.
- Transfer to Tank 22 will maintain >18 inches between the settling sludge interface and the transfer jet eductor.
- Divert storm water diversion gates in the affected zones.

2. Introduction

As a result of the separation of the High Level Liquid Waste Department into three separate organizations [formerly there were two] (Concentration, Storage, and Transfer [CST], Waste Pre-Treatment [WPT] and Waste Disposition [WD]) process interface controls are required. One of these controls is implementing the Waste Acceptance Criteria and Waste Compliance Plan system for transfers of waste between CST and WPT. At present, CST's Waste Acceptance Criteria is undergoing revision and WPT has not prepared the required Waste Compliance Plan [WCP].

The Waste Pre-Treatment organization is making preparations for transferring spent washwater in Tank 42 to Tank 43 and/or Tank 22. The washwater transfer is expected to complete the washing steps for preparing ESP batch 1B sludge.

This report is intended to perform the function of a Waste Compliance Plan for the proposed transfer. Previously, transfers between the Tank Farm and ITP/ESP were controlled by requirements outlined in the Tank Farm's Technical Standards and ITP/ESP's Process Requirements. Additionally, these controls are implemented primarily in operating procedure 241-FH-7TSQ and ITP Operations Manual SW16.1-SOP-WTS-1 which will be completed prior to performing the waste transfers.

3. Discussion

The requirements for the Waste Compliance Plan [WCP] are outlined in the WAC (ref. 1). The first requirement of the WCP is to provide a description of the waste generating process that includes flowsheet information, transfer volumes, transfer frequencies and the transfer route. A description of the Extended Sludge process can be found in the High-Level Waste System Process Interface Description (ref. 2) section 7. Therefore, a description of the waste generating process will not be part of this document. The proposed transfers from Tank 42 is expected to be the final ESP transfer to the evaporator system until sludge washing begins in Tank 40 for ESP Batch 2A in 1999.

Another requirement for the WCP is to provide a description and inventory of the chemicals and radionuclides used in the waste generating process. The waste generated in the ESP process is primarily contaminated water. The only chemicals used in the processing of waste in Tank 42 are sodium hydroxide and sodium nitrite and the trace impurities arriving with these chemicals which are also used by CST to prevent corrosion of their waste tanks. These chemicals can be added to the waste in the form of inhibited water or by direct addition from tanker trucks. The typical composition for these chemicals are provided in Appendix A. All other chemicals and radionuclides are received from CST's Tank Farm.

3.1 The Waste Stream Categories and Characterizations

The initial characterization of ESP decants to the H-Tank Farm is provided in Appendix B, stream number 560. The tables were taken from the Material Balance Tables for the DWPF Sludge Only Feed Flowsheet (ref. 3). Specific characterization of the sludge and

supernate in Tank 42 can also be found in CST's Waste Characterization System (WCS) maintained by CST Engineering Support Group (ref. 4).

Based on the categories of waste described in section 7 of the WAC, the ESP decant is classified as an Irregular Waste (IW) because the concentration of compounds and isotopes from decant to decant varies, but the same species are present in each transfer.

3.2 Compliance Strategy

Corrosion prevention requirements are provided in the Tank Farm WAC and the Tank Farm Authorization Basis (AB) (ref. 5). Based on the Tank 42 ESP washwater chemistry the Tank Farm Technical Standards and the Tank Farm WAC are met. However, a maximum supernate temperature of 49°C will have to be maintained until the bulk chemistry is changed from influent transfers and diffusion of the existing supernate. Tank chemistry will also be verified by the governing operating procedures (i.e., 241-FH-7TSQ and SW-16.1-SOP-WTS-1 Manual, "Waste Transfer Approval and Route Review").

3.3 Specific Criteria for Tank 42 Washwater Decant

3.3.1 Evaluation for the Hydrogen Generation Rate and the 242-16H Evaporator Radiological Source Term

The Radiological Source Term (RST) for the evaporator is limited to 1E9 rem/gal by the current AB. The RST for the Tank 42 washwater is less than 3E6 rem/gal (see Section 3.3.4) based on the 1 wt.% entrained solids. This value is approximately 300 times lower than the RST value for the evaporator. Concentration of this waste stream is not expected to impact the RST since it would require concentrating the waste stream by a factor of 300 which is incredible (due to the insoluble solids and solids content) in the Tank Farm Evaporator system. This is demonstrated by the RST for Tank 42 assuming a 1 wt.% sludge solids content having to concentrate to an incredible 300 wt.% solids to exceed the allowable evaporator RST.

The evaporator feed must also be limited to control the hydrogen generation rate below $1.2\text{E-}05 \text{ ft}^3 \text{ H}_2/\text{gal liquid waste/hr}$ ($8.98\text{E-}05 \text{ gal H}_2/\text{gal liquid waste/hr}$) within the evaporator. To impact the assumed evaporator feed AB hydrogen generation value ($8.98\text{E-}05 \text{ gal H}_2/\text{gal liquid waste/hr}$) the Pu-238 concentration (Pu-238 is the most restrictive radionuclide due to its high contribution to the dose potential) must be higher than $9.6\text{E-}01 \text{ Ci/gal}$ (assuming 0M nitrate). This concentration is approximately 270 times greater than the Pu-238 concentration in the Tank 42 washwater. Additionally, if the Tank 42 washwater actual isotopic distribution is considered in estimating the hydrogen generation it would require a solids concentration of 128 wt.% (refer to Appendix D) to equal $8.98\text{E-}05 \text{ gal H}_2/\text{gal liquid waste/hr}$. It is incredible to achieve a concentration factor this high in the evaporator system due to the insoluble solids and solids content. Therefore, the bounding AB evaporator hydrogen generation rate criteria and the evaporator RST will not be exceeded.

The time to the lower flammability limit (TLFL) was calculated for Tank 22 and Tank 43. Assuming the tanks were filled to the AB limit, it was determined that Tank 22 will remain a slow generating tank and Tank 43 will stay a rapid generation tank. Therefore, there is no expected impact to the TLFL Authorization Basis control requirements.

3.3.2 Requirements for Corrosion Prevention

Compliance to the Corrosion Prevention requirements are based on the latest available Tank 42 analysis. The sample was taken after completing sludge suspension with all four slurry pumps fully inserted. No additional sludge or other additions have been made to the tank since the sample was taken. Sample results are provided in Table 2 (page 14).

3.3.2.1 Minimum pH of Waste (pH > 9.5)

The latest analytical results for Tank 42 washwater are shown in Table 2 (page 14). The pH of this sample was 12.5. Therefore, the minimum pH requirement is met.

3.3.2.2 Minimum Inhibitor Contents for all Waste Generators

For hydroxide (OH^-) concentration less than 1 M and nitrate (NO_3^-) concentrations between 0.02 M and 1.0 M, the WAC requires a minimum nitrite (NO_2^-) concentration of $1.66 \times [\text{NO}_3^-]$. From Table 2 (page 14) the nitrate concentration is 0.05 M and the nitrite concentration is 0.2 M. Thus the nitrite concentration is over four times the nitrate concentration and complies with the Tank Farm WAC.

Additionally, the ESP washwater nitrate and nitrite concentrations limit the maximum supernate temperature to 49°C for a Type III or a Type IV tank based on the Tank Farm Technical Standard (see calculation below). Complying with this requirement is not an issue since the supernate in Tanks 22, 42, and 43 is 21°C, 22°C, and 29°C, respectively. Transferring the washwater with a steam transfer jet will not result in a temperature increase above 49°C, assuming a conservative temperature increase of 15°C and no heat loss.

Technical Standard Calculation:

$$A = 0.038 * [\text{NO}_3^-] * 10^{(0.041 * T)}$$

where;

$$A = [\text{NO}_2^-]$$

T = temperature in °C

$$A = 0.038 * (0.05) * 10^{(0.041 * 49)}, A = 0.19 \text{ M NO}_2^-$$

At a temperature of 49°C and a nitrate concentration of 0.05M, the minimum required nitrite concentration is ~0.2M.

If the washwater is sent to Tank 22, subsequent DWPF recycle waste transfers and diffusion/mixing of the existing DWPF recycle in Tank 22 will increase the allowable temperature. In the event the ESP washwater is sent to Tank 43, recycle transfers and diffusion of the existing supernate in Tank 43 will permit higher supernate temperatures. The next tank chemistry sample result will be used to evaluate the temperature limit.

3.3.2.3 Maximum Concentration of Corrosive Species

Table 4 (page 15) lists the corrosive species in the WAC, their maximum limit and the concentration in Tank 42's washwater. The CST's WAC maximum concentrations for corrosive species are not exceeded by the washwater.

3.3.3 Requirements to Prevent Accumulation of Flammable/Explosive Species

3.3.3.1 Maximum NH₄⁺ Concentration and Transfer Rate

There are no sources for ammonium ion in the ESP wash water. Ammonium ion may have been originally introduced in the waste tank as ammonium nitrite and ammonium nitrate but the high pH maintained in the waste tank would have converted any ammonium ion to ammonia. Ammonia is volatile so it would have been already released (ref. 7) from the waste tank. Ammonium ion is not analyzed in ESP samples, but based on process knowledge, ammonium ion will be well below the limit given in section 13.2.2 of CST's WAC.

3.3.3.2 Maximum Concentration of Organic Compounds

Organic compounds are not added to Tank 42. Based on process knowledge, organic compounds in Tank 42 washwater will be well below the limit given in section 13.2.3 of CST's WAC.

3.3.3.3 Prevent Formation of Shock Sensitive Compounds

Silver is not added to Tank 42. Previous investigation have identified waste tanks that may contain shock sensitive compounds which did not include Tank 42 (ref. 7).

3.3.4 Requirement For Radionuclide Content

Source Term Criteria for Non Type IV Waste Tank

The specific source term criteria for Non-Type IV Waste Tanks is the composite inhalation dose potential concentration must be less than 2.3E9 rem/gallon (ref. 8). In addition, the solids inhalation dose potential concentration must be less than 4.5E9 rem/gallon (ref. 8).

The primary source of dose in ESP washwater (supernate) is soluble Pu-238. Other minor

contributors for inhalation dose in the supernate phase are Sr-90 and Cs-137 (ref. 9). For Tank 42 sludge, the primary inhalation dose contributors are Pu-238, Cm-244, Am-241 and Sr-90.

Normal analysis of washwater and supernate includes analysis of the significant inhalation dose contributors. Table 5 (page 16) lists the estimated concentration for these inhalation dose contributors in the washwater and the source for each estimate. Table 6 (page 16) lists the estimated concentration for the inhalation dose contributor and source of the estimate for Tank 42 sludge solids.

Determination of inhalation dose for wash water (supernate) is shown in Table 5 by multiplying each isotope concentration in Ci/gallon by the Ci to rem conversion factor and summing the rem for all the isotopes. A similar calculation is done for sludge in Table 6.

During full operation of the slurry pumps ~10 wt.% insoluble solids were suspended. A bounding source term for the washwater was determined by calculating the source term based on 1 wt.% insoluble solids in the washwater. This is $1/10^{\text{th}}$ the amount of insoluble solids in the slurry sample taken immediately after stopping all four slurry pumps on September 23, 1997 (after an extended sludge suspension run). The tank has remained as of December 5 undisturbed since October 3. Since Tank 42 has been allowed to settle for nine weeks, the suspended insoluble solids is expected to be ~0.1 wt.% in washwater. During ESP Process Verification testing in Tank 51, samples taken approximately 4 inches above the suspended solids/supernate interface contained less than 0.5 wt.% insoluble solids. This occurred 3 days after stopping the slurry pumps. By the earliest projected washwater transfer date of December 9, the tank will have remained in a quiescent period for at least 65 days. A clear supernate/sludge interface height measurement made after twenty-five days of settling has shown the insoluble solids level was 68 inches below the tank liquid level of ~175 inches. The latest turbidity reading shows that there are >18 inches between the supernate/sludge interface and the TTP eductor. The height of the transfer jet's eductor shall be set at least 6 inches above the clear liquid/ suspended solids interface for Tank 43 and >18 inches for Tank 22. The expectation is that the insoluble solids content in the washwater will be less than 0.1 wt.% solids (3E5 rem/gal). The bounding washwater source term was determined to be 3E6 rem/gal.

The rem/gal for the insoluble solids was calculated based on the 1992 Tank 42-25 Liter sludge sample which had a specific gravity of 1.17 and 22.1 wt.% insoluble solids concentration (ref. 10). The inhalation dose potential for the insoluble solids is 6E7 rem/gal.

The inhalation dose source term for both the washwater bounding case and insolubles are well below the limits in the "Draft" CST WAC Rev.2 (ref. 8) and ref. 13 for transfers to Tank 43.

Required Concentration of Insoluble Solids in the Tank 42 ESP Washwater to Reach the Type IV RST Limit

The calculation below (see Appendix C) determined the maximum allowable insoluble solids concentration allowed in the washwater is 1 wt.%. This calculation assumed the washwater RST (soluble phase) is negligible in comparison to the sludge RST since the sludge RST is 6E7 rem/gallon versus 3E5 rem/gallon for the soluble phase. Additionally, it conservatively assumes that any suspended solids that are transferred to Tank 22 do not settle. Settling is expected in Tank 22 as is demonstrated in Tank 42.

$$\frac{6E7 \frac{\text{rem}}{\text{gallon}} \text{ insoluble solids}}{22.1 \text{ wt.}\%} = \frac{3E6 \frac{\text{rem}}{\text{gallon}} \text{ insoluble solids}}{x \text{ wt.}\%}$$

$$x = 1 \text{ wt.}\% \text{ insoluble solids}$$

The Cs-137 concentration limit in the Technical Standard will not be exceeded since the Cs-137 concentration in Tank 42 is 0.01 Ci/gallon (Table 2, page 14). This is a factor of 60 times below the Technical Standard limit.

Source Term Criteria for Type IV Waste Tanks

The Tank Farm Authorization Basis states that the supernate of Type IV tanks is limited to 3E6 rem/gallon and <0.6 Ci of Cs-137 in the supernate (ref. 5,12). The Tank 42 ESP wash water (supernate) will be acceptable to the Type IV AB since it is less than the 3E6 rem/gallon (or <1 wt.% entrained insoluble solids) and 0.01 Ci/gallon Cs-137.

The washwater that will be transferred to the H-Tank Farm will have some entrained solids. During full operation of the slurry pumps ~10wt.% insoluble solids were suspended. Since Tank 42 has been allowed to settle for nine weeks, the suspended insoluble solids is expected to be ~0.1 wt.%. During ESP Process Verification testing in Tank 51, a sample taken approximately 4 inches above the suspended solids/supernate interface contained less than 0.5 wt.% insoluble solids. This occurred 3 days after stopping the slurry pumps (see discussion on page 8). The washwater transfer elevation is greater than 18 inches above the suspended solids/supernate interface (measured with a turbidity meter) for transfers to Tank 22. The RST calculation below demonstrates that the bulk Tank 42 washwater would have to contain 1 wt.% insoluble solids before it would reach the RST limit for a Type IV waste tank. As mentioned above, the wt.% insoluble solids is expected to be ~0.1 wt.% which would correlate to a RST of ~6E5 rem/gallon (3E5 rem/gallon from the washwater + 3E5 rem/gallon from entrained insoluble solids). Additionally no credit has been taken for blending with the existing Tank 22 supernate which has a very low RST. Waste transfers to Type IV waste tanks will maintain >18 inches between the solids/supernate interface and the transfer jet eductor.

Source Term Criteria for Double Contained Transfer Lines

Double contained transfer lines have been evaluated for a inhalation dose potential concentration of $2.3E9$ rem/gallon. The transfers lines between Tank 42 and 43 and between 42 and 22 all have double containment, therefore, they are limited to $2.3E9$ rem/gallon. The ESP washwater will have a dose potential concentration below $3E6$ rem/gallon which is 750 times below the allowable. Therefore, the washwater is well below the limit for a double contained transfer line. It is recognized that the $3E6$ rem/gallon requirement for the Type IV supernate dose potential must also be maintained.

Some small amount of drainback will occur to Pump Tank 3 after the Tank 42 to Tank 22 transfer. This drainback will be sent to Tank 38 through double contained transfer lines which is acceptable to the dose potential concentration limit of $2.3E9$ rem/gallon. Additionally, this small amount of drainback will not effect the time to LFL for Tank 38, temperature limits, or require any VAMP compensatory measures due to the small volume associated with the drainback.

Evaluation for the H Tank Farm Noncylindrical Valve Boxes

The transfer line between Tank 42 and Tank 22 will be transferred through the Tank 22 noncylindrical valve box. The Tank Farm Authorization Basis does not allow high hydrogen generation material (i.e., fresh waste slurry, sludge slurry) to be transferred through the noncylindrical valve box due to the flammability potential. The ESP washwater is not classified as a high hydrogen generating material due to its low radionuclide content. Hence, it is acceptable to transfer through the Tank 22 noncylindrical valve box.

3.3.5 Requirement for Regulatory Compliance

No RCRA hazardous "listed" waste not exempted in Section 13.4 of the WAC [1] will be present in the Tank 42 washwater stream.

3.3.6 Requirements for Criticality Safety

Tank 42 contents including the washwater have previously been shown to be critically safe for any concentration and mass (ref. 9). The ratio of iron to Pu-239, and Mn to Pu-239 far exceeds the minimum ratios provided in the "Draft" WAC Rev.2 (ref. 8) based on the same criteria represented in reference 9.

3.3.7 Requirement for Compatibility with the Tank Farm's Authorization Basis

Approval of this transfer by the CSTE is acknowledgment that the waste characterization provided is sufficient for CSTE to recognize and evaluate any impacts on downstream processes.

3.3.8 Requirement to Satisfy Downstream Facility Acceptance Criteria

Approval of this transfer by the CSTE is acknowledgment that the waste characterization provided is sufficient for CSTE to recognize and evaluate any impacts on downstream processes.

3.4 ITP Detection of Leak from Valve-box by VAMP

The amount of washwater and sludge that could leak before a VAMP would alarm was addressed in the Safety Evaluation (SE) for ESP (ref. 11). The calculation was based on a bounding source term and gamma dose for washwater and sludge. The calculation represents the bounding quantities of "Material at Risk" (radionuclides) for both off-site and on-site accidents. However, since the actual gamma dose constants for both sludge and washwater are less than the bounding term, the volume of liquid that could leak before a VAMP alarms exceeds the calculated volume.

The SE calculation was based on a VAMP located at a maximum distance of 50 feet from the source of a leak. For the proposed transfer, the only location for an above surface leak to occur is at the Tank 42 valve-box. A portable VAMP will be located at the valve-box during the transfer. Because the detection of radiation is inversely proportional to the square of the distance, a portable VAMP installed 1-meter from a potential leak site will detect a leak approximately $2.5E3$ times smaller than at 50 feet. The gamma dose for the wash water is approximately 30% of the dose used in the bounding calculation for washwater. The bounding calculation determined the maximum release of washwater to be 75 gallons. By placing a VAMP at the valve-box it is conservatively estimated that no more than a gallon of washwater would leak before detected by the portable VAMP.

3.5 H-Tank Farm Detection of Leak from Valve-box by VAMP

An evaluation (ref. 14,15) was performed to ensure adequate protection is afforded by the ARMs to facility during the transfer of Tank 42 washwater. The transfer route for Tank 42 to Tank 43 is only above ground at the Tank 42 valve box. The review above addresses the Vamp issue for this transfer since the valve box is within the WPT facility. If the transfer route is to tank 22, then the route will include HDB-2, HDB-5, HDB-7, and the Tank 22 valve box. These containments are potential sites for a surface release. Based on the gamma inventory of the washwater, 0.01 Ci/gal of Cs-137, a spill of at least 140 gallons is required to activate an ARM 50 feet away. Given the stream dose potential, $3E6$ rem/gal, the operator inhalation dose (from a 10 hour exposure at 10 feet from the spill) could exceed 4 rem. It is deemed prudent to provide ARM monitoring at the Tank 22 valve box. Vamps are already located at HDB-2, HDB-5, and HDB-7. Placement of Vamps closer to the leak site will allow detection at smaller volumes; for example, Vamps located within 10 feet of the spill will alarm with a spill < 10 gallons.

The storm water diversion gates will be diverted in the affected zones.

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10/27/97

Table 2. Tank 42 Slurry Sample Results, ESP-190

Species	Result	Units
SpG	1.02	g/mL, supernate
NO ₂	0.20	Molar (supernate)
NO ₃	0.05	Molar (supernate)
OH	0.03	Molar (supernate)
CO ₃	0.06	Molar (supernate)
SO ₄	0.01	Molar (supernate)
Cl	0.001	Molar (supernate)
PO ₄	0.0002	Molar (supernate)
Na	0.44	Molar (supernate)
pH	12.5	calc. from [OH-]
Cs-137	2.9	μCi/mL (or 0.01 Ci/gallon)
Total solids	13.1	wt.% of slurry
Dissolved solids	2.7	wt.% of supernate
Soluble solids	2.4	wt.% of slurry
Insoluble solids	10.7	wt.% of slurry
SpG slurry	1.09	g/mL
Fe	18.4	wt.% dried solids
Na	9.4	wt.% dried solids
Al	7.0	wt.% dried solids
Mn	3.2	wt.% dried solids
Ca	2.3	wt.% dried solids
P	0.7	wt.% dried solids
Mg	1.1	wt.% dried solids
U	2.1	wt.% dried solids

Table 3. Tank 42 Washwater Analytical Results, ESP-191

Species	Conc.	Unit
pH	-	N/A
density	1.02	g/mL
$C_2O_4^{=}$	0.004	M
$SO_4^{=}$	0.009	M
PO_4	0.0002	M
Cl^-	0.001	M
F^-	0.004	M
NO_3^-	0.05	M
NO_2^-	0.21	M
AlO_2^-	0.004	M
$CO_3^{=}$	-	M
OH (Free)	-	M
Total Gamma	3.15	$\mu Ci/mL$
Dissolved solids	2.68	Wt. % of Supernate
Fe (soluble)	0.54	mg/L
Mn (soluble)	<0.015	mg/L
U (soluble)	0.38	mg/L
Pu	-	mg/L

Table 4. CST's WAC Listed Corrosive Species Comparison

Species	WAC Max. Limit	Tank 42 Washwater	Below Limit
Cl^-	0.11	0.001	Yes
F^-	0.086	0.004	Yes
NO_3^-	8.5	0.05	Yes
$SO_4^{=}$	0.18	0.009	Yes

Table 5. Tank 42 Inhalation Dose Species in Washwater

Species	Ci/Gal	Dose Factor (rem/Ci)	Dose rem/gal.	Source of Reported Concentrations
Cs-137	1.1E-02	3.2E+04	3.5E+02	ESP-191 Sample ¹
Pu-238	5.6E-07	4.6E+08	2.6E+02	ESP-183 Sample + WSRC-RP-94-730 ²
Pu-239	4.0E-08	5.1E+08	2.0E+01	ESP-183 Sample + WSRC-RP-94-730 ²
Pu-240	1.2E-08	5.1E+08	6.1E+00	ESP-183 Sample + WSRC-RP-94-730 ²
Pu-241	1.3E-06	1.0E+07	1.3E+01	ESP-183 Sample + WSRC-RP-94-730 ²
Pu-242	3.4E-11	4.8E+08	1.7E-02	ESP-183 Sample + WSRC-RP-94-730 ²
Total	1.1E-02		6.5E+02	

- Notes: 1. Sample results reported in $\mu\text{Ci/mL}$ and converted to Ci/gal by author.
 2. Sample ESP-183 results reported as dpm/mL Total Pu converted to Ci/gal for each isotope based on Tank 42 Pu isotope distribution reported in WSRC-RP-94-730.

Table 6. Tank 42 Inhalation Dose Species in Sludge Insoluble Solids

Species	Ci/gram insol. solid	Dose Factor (rem/Ci)	Dose (rem/g insol. solids)	Source of Reported Concentrations
Cs-137	1.8E-04	3.2E+04	5.8E+00	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Sr-90	6.2E-03	1.3E+06	8.1E+03	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Pu-238	8.1E-05	4.6E+08	3.7E+04	"Centrifuge Tube 4," Table 10 & "Composition after 4 Wash Cycles," Table 9, WSRC-RP-94-730
Pu-239	5.9E-06	5.1E+08	3.0E+03	"Centrifuge Tube 4," Table 10 & "Composition after 4 Wash Cycles," Table 9, WSRC-RP-94-730
Pu-240	1.8E-06	5.1E+08	8.9E+02	"Centrifuge Tube 4," Table 10 & "Composition after 4 Wash Cycles," Table 9, WSRC-RP-94-730
Pu-241	1.9E-04	1.0E+07	1.9E+03	"Centrifuge Tube 4," Table 10 & "Composition after 4 Wash Cycles," Table 9, WSRC-RP-94-730
Pu-242	5.1E-09	4.8E+08	2.4E+00	"Centrifuge Tube 4," Table 10 & "Composition after 4 Wash Cycles," Table 9, WSRC-RP-94-730
Am-241	7.6E-06	5.2E+08	4.0E+03	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Cm-244	1.5E-05	2.7E+08	4.0E+03	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Co-60	1.5E-06	1.5E+05	2.2E-01	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Eu-154	1.8E-05	2.6E+05	4.6E+00	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Eu-155	3.1E-06	3.9E+04	1.2E-01	"Composition. after 4 Cycles," Table 9, WSRC-RP-94-730
Total	6.7E-03		5.9E+04	

5. Appendix A

Composition of Chemicals added to Tank 42

Du Pont Chemicals

3740CR

Revised 08-Jul-91

Printed 11-Feb-92

SODIUM NITRITE SOLUTION

MATERIAL IDENTIFICATION

Corporate Number	DU002807	
Manufacturer/Distributor	Du Pont 1007 Market Street Wilmington, DE 19898	
Phone Numbers	Product Information	1-800-441-9442
	Transport Emergency	CHEMTREC: 1-800-424-9300
	Medical Emergency	1-800-441-3637
Grade	TECH; OXIDIZING SALT SOL.	
Chemical Family	INORGANIC SALT SOLUTION	
CAS Name	NITROUS ACID, SODIUM SALT	
Du Pont Registry Number	DP170-67-6	
Formula	NaNO ₂ (in water)	
TSCA Inventory Status	Reported/Included	

COMPONENTS

Material	CAS Number	Percent
TECHNICAL GRADE:		
SODIUM NITRITE	7632-00-0	41
WATER	7732-18-5	59
OXIDIZING SALT SOLUTION:		
SODIUM NITRITE	7632-00-0	40
SODIUM CARBONATE	497-19-8	2
SODIUM NITRATE	7631-99-4	10
WATER	7732-18-5	48

(continued)

ATTN: Gary Cook 704-399-5007

Quality Certificate/Shipping Info

Date Printed 05/11/97 Page
Ship Date 05/12/97 1Customer Purchase Order
24755

Third Party Purchase Order

Ship-to Customer No.: 90000682
CONTINENTAL INDUSTRIAL CHEMICALS; C
5010 HOVIS RD
CHARLOTTE-MECKLENBURG, NC 28208
United StatesOlin Delivery Note No.
20042667Olin Sales Order
10041551Material No. Description: Olin / Your reference
105016 Caustic 50% Rayon Grade /

Gross weight:	78,200.000 LB	Route/Carrier:	50112/CTL Distribution
Net weight:	46,500.000 LB	Mode:	Truck
Seal No.:		Vehicle No.:	21829 222

Olin Chlor Alkali Plants are ISO 9002 Certified under QSR100, 110, 125 or 170

Inspection lot 29365 from 05/09/97 Inspection plan S_RAY162

Characteristic	Unit	Value	Lower Limit	Upper Limit
NaOH	wt%	50.83	50.00	52.00
Na2O	wt%	39.38	38.70	40.30
Fe, typical	wt%	< 0.00020		0.00020
NaCl, typical	wt%	< 0.0030		0.0030
Na2CO3, typical	wt%	< 0.06		0.06

*** End ***

The above analysis is certified to comply with Olin/Customer specifications (exceptions are noted above).

HARRY WADE
Olin Corporation

If your specifications have changed or if you received this document in error please call 1-800-299-6546.

6. Appendix B

Composition of Sludge Washing Decants (Extracted from Ref. 3)

SECTION 0. MAJOR STREAMS IN THE SLUDGE-ONLY FEED FLOWSHEET MODEL

Table 1. DWPF Sludge-Only Feed Flowsheet Material Balance Tables
Section 0, Table A-7. Major Streams in the Model

STREAM NUMBERS → STREAM NAME	401 Salt Soln Feed to Prec	513 Sludge Slurry Fd to A/D	516 NaOH to Dis Al(OH) ₃	521 Inhib H ₂ O to A/D Wash	543 Sludge Slurry to Wash Only	546 Inhib H ₂ O to W/O Wash	560 Sludge Proc Totl Dcants
COMPONENT FLOWS, LB/HR							
122 (C6H5) ₂	0.1413E-10	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
123 (C6H5) ₂ C6H4	0.6119E-05	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
118 (C6H5) ₂ NH	0.1826E-15	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
133 (C6H5B(OH) ₂ salt)	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
132 (C6H5B(OH) ₂)	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
131 (C6H5OH salt)	0.2618E+01	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
130 (C6H5OH)	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
121 (G6H6)	0.1986E-09	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
155 (CH ₃) ₂ CHOH	0.8493E-09	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
154 (CH ₃ OH)	0.5308E-10	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
45 Ag	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
116 Ag ₂ O	ZERO	0.1939E-02	ZERO	ZERO	0.1091E-01	ZERO	ZERO
134 AgNO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
77 Al ₂ O ₃	ZERO	0.1545E+02	ZERO	ZERO	0.4744E+01	ZERO	ZERO
106 B ₂ O ₃	ZERO	ZERO	ZERO	ZERO	0.1667E+00	ZERO	ZERO
9 Ba(OH) ₂	0.1741E+00	0.8241E-02	ZERO	ZERO	0.1199E-01	ZERO	0.2014E-01
15 BaO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
24 BaSO ₄	ZERO	0.1151E+00	ZERO	ZERO	0.2091E+00	ZERO	ZERO
66 CO	0.1435E-15	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
37 CO ₂	0.2215E-09	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
142 CO ₂ (C14)	0.1112E-18	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
63 Ca(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
120 Ca(OH) ₂	0.1430E-01	0.6765E-03	ZERO	ZERO	0.9846E-03	ZERO	0.1653E-02
113 Ca ₃ (PO ₄) ₂	ZERO	0.5429E-01	ZERO	ZERO	0.1046E+00	ZERO	ZERO
20 CaC ₂ O ₄	ZERO	0.6977E+00	ZERO	ZERO	0.3115E-01	ZERO	ZERO
18 CaCO ₃	ZERO	0.5830E+00	ZERO	ZERO	0.2292E+01	ZERO	ZERO
64 CaCO ₃ (C14)	ZERO	0.1369E-06	ZERO	ZERO	0.9818E-07	ZERO	ZERO
78 CaF ₂	ZERO	0.1072E-01	ZERO	ZERO	0.1148E+00	ZERO	ZERO
41 CaO	ZERO	ZERO	ZERO	ZERO	0.2074E-01	ZERO	ZERO
19 CaSO ₄	ZERO	0.1631E-01	ZERO	ZERO	0.2195E+00	ZERO	ZERO
29 Carbon	ZERO	0.7243E-02	ZERO	ZERO	0.9668E-01	ZERO	ZERO
99 Cement	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
26 Co(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
59 CoO	ZERO	0.4302E-03	ZERO	ZERO	0.5804E-02	ZERO	ZERO
98 Cr ₂ O ₃	ZERO	0.1007E+00	ZERO	ZERO	0.1739E+00	ZERO	ZERO
42 Cs ₂ O	ZERO	0.6389E-02	ZERO	ZERO	0.1126E-02	ZERO	ZERO
53 CaCOOH	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
96 CaCl	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
8 CsOH	0.2515E+00	0.1066E-01	ZERO	ZERO	0.1552E-01	ZERO	0.2606E-01
151 CsTPB	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
54 Cu(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
55 CuO	ZERO	0.2762E-01	ZERO	ZERO	0.8148E-01	ZERO	ZERO
80 Fe ₂ O ₃	ZERO	0.7687E+01	ZERO	ZERO	0.1771E+02	ZERO	ZERO
101 FeO	ZERO	ZERO	ZERO	ZERO	0.3848E-01	ZERO	ZERO
102 Group A	0.1483E+00	0.1400E+00	ZERO	ZERO	0.4255E-01	ZERO	0.1714E-01
103 Group B	0.3582E-03	0.7447E+00	ZERO	ZERO	0.1247E+00	ZERO	0.4142E-04
25 H ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
158 H ₂ C ₂ O ₄	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO

Table 1. DWPF Sludge-Only Feed Flowsheet Material Balance Tables
Section 0, Table A-7. Major Streams in the Model

STREAM NUMBERS (CONT'D) -- STREAM NAME	401 Salt Soln Feed to Prec	513 Sludge Slrry Fd to A/D	516 NaOH to Dis Al(OH) ₃	521 Inhib H ₂ O to A/D Wash	543 Sludge Slrry to Wash Only	546 Inhib H ₂ O to W/O Wash	560 Sludge Proc Totl Dcants
93 H ₂ SO ₄	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
90 H ₃ BO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
34 HCOOH	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
43 HCl	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
85 HF	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
49 HNO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
36 Hg	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
129 Hg(C ₆ H ₅) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
135 Hg(NO ₃) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
144 Hg ₂ Cl ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
117 Hg ₂ I ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
146 HgCl ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
21 HgO	ZERO	0.1120E+01	ZERO	ZERO	0.3280E+01	ZERO	ZERO
97 I ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
39 K ₂ O	ZERO	0.5583E-01	ZERO	ZERO	0.1542E+00	ZERO	ZERO
51 KCOOH	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
157 KMnO ₄	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
161 KNO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
10 KOH	0.9424E+01	0.1900E+00	ZERO	ZERO	0.2174E+00	ZERO	0.4055E+00
150 KTPB	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
105 La ₂ O ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
108 Li ₂ O	ZERO	ZERO	ZERO	ZERO	0.1173E+00	ZERO	ZERO
65 Mg(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
33 MgO	ZERO	0.1153E+00	ZERO	ZERO	0.1339E+00	ZERO	ZERO
60 Mn(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
56 MnO	ZERO	ZERO	ZERO	ZERO	0.4874E-01	ZERO	ZERO
14 MnO ₂	ZERO	0.2420E+01	ZERO	ZERO	0.3492E+01	ZERO	ZERO
145 MoO ₂	ZERO	ZERO	ZERO	ZERO	0.3166E-05	ZERO	ZERO
81 N ₂	0.1931E-08	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
74 N ₂ O	0.5045E-24	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
114 NH ₃ OHNO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
52 NH ₄ COOH	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
68 NH ₄ OH	0.3573E+00	0.1691E-01	ZERO	ZERO	0.2461E-01	ZERO	0.4132E-01
148 NH ₄ TPB	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
35 NO	0.6899E-14	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
84 NO ₂	0.5289E-20	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
70 Na(HgO(OH))	0.8308E+00	0.1605E-01	ZERO	ZERO	0.2335E-01	ZERO	0.5519E+00
94 Na ₂ B ₄ O ₇	0.1314E+00	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
109 Na ₂ C ₂ O ₄	0.1884E+02	0.5171E+00	ZERO	ZERO	0.7526E+00	ZERO	0.1264E+01
5 Na ₂ CO ₃	0.1868E+03	0.8364E+01	ZERO	ZERO	0.1217E+02	ZERO	0.2044E+02
143 Na ₂ CO ₃ (Cl ₄)	0.1774E-06	0.8394E-08	ZERO	ZERO	0.1222E-07	ZERO	0.2051E-07
89 Na ₂ CrO ₄	0.5431E+01	0.2570E+00	ZERO	ZERO	0.3740E+00	ZERO	0.6279E+00
115 Na ₂ MoO ₄	0.8952E+00	0.4236E-01	ZERO	ZERO	0.6165E-01	ZERO	0.1035E+00
32 Na ₂ O	ZERO	ZERO	ZERO	ZERO	0.3044E+00	ZERO	ZERO
71 Na ₂ PuO ₂ (OH) ₄	0.1618E-03	0.7658E-05	ZERO	ZERO	0.1115E-04	ZERO	0.1871E-04
73 Na ₂ RhO ₄	0.2261E-01	0.1070E-02	ZERO	ZERO	0.1557E-02	ZERO	0.2614E-02
72 Na ₂ RuO ₄	0.9707E-01	0.4593E-02	ZERO	ZERO	0.6685E-02	ZERO	0.1122E-01
6 Na ₂ SO ₄	0.2017E+03	0.9639E+01	ZERO	ZERO	0.1388E+02	ZERO	0.2330E+02
88 Na ₂ SiO ₃	0.4739E+01	0.2243E+00	ZERO	ZERO	0.3264E+00	ZERO	0.5480E+00

Table 1. DWPF Sludge-Only Feed Flowsheet Material Balance Tables
Section 0, Table A-7. Major Streams in the Model

STREAM NUMBERS (CONT'D) -> STREAM NAME	401 Salt Soln Feed to Prec	513 Sludge Slurry Fd to A/D	516 NaOH to Dis Al(OH) ₃	521 Inhib H ₂ O to A/D Wash	543 Sludge Slurry to Wash Only	546 Inhib H ₂ O to W/O Wash	560 Sludge Proc Totl Dcants
87 Na ₃ PO ₄	0.1428E+02	0.6855E+00	ZERO	ZERO	0.9842E+00	ZERO	0.1652E+01
91 NaAg(OH) ₂	0.7801E-02	0.3692E-03	ZERO	ZERO	0.5373E-03	ZERO	0.9021E-03
75 NaAl(OH) ₄	0.3666E+03	0.1620E+02	ZERO	ZERO	0.2357E+02	ZERO	0.6625E+02
50 NaCOOH	0.9488E+00	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
7 NaCl	0.1302E+02	0.7463E+00	ZERO	ZERO	0.1628E+01	ZERO	0.1454E+01
69 NaF	0.6358E+01	0.3742E+00	ZERO	ZERO	0.4364E+00	ZERO	0.7269E+00
11 NaHCO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
12 NaI	0.1571E-01	0.1091E-02	ZERO	ZERO	0.1272E-01	ZERO	0.3678E-03
3 NaNO ₂	0.5045E+03	0.1962E+02	ZERO	0.1461E+02	0.2855E+02	0.2374E+02	0.7917E+02
2 NaNO ₃	0.1685E+04	0.8067E+02	ZERO	ZERO	0.1165E+03	ZERO	0.1940E+03
4 NaOH	0.5100E+03	0.2046E+02	0.3637E+02	0.4705E-01	0.3045E+02	0.7643E-01	0.8232E+02
149 NaTPB	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
160 NaTcO ₄	0.9269E-01	0.4386E-02	ZERO	ZERO	0.6384E-02	ZERO	0.1072E-01
152 NaTi ₂ O ₅ H	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
61 Ni(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
40 NiO	ZERO	0.6555E+00	ZERO	ZERO	0.1511E+01	ZERO	ZERO
82 O ₂	0.2002E-08	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
86 PbCO ₃	ZERO	0.3452E-01	ZERO	ZERO	0.6020E-01	ZERO	ZERO
67 PbO	ZERO	ZERO	ZERO	ZERO	0.7992E-03	ZERO	ZERO
147 PbS	ZERO	ZERO	ZERO	ZERO	0.1703E-02	ZERO	ZERO
28 PbSO ₄	ZERO	0.5405E-01	ZERO	ZERO	0.1597E+00	ZERO	ZERO
124 Pd	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
112 Pd(NO ₃) ₂	0.5173E-05	0.2448E-06	ZERO	ZERO	0.3563E-06	ZERO	0.5981E-06
110 PdO	ZERO	0.3280E-01	ZERO	ZERO	0.1216E-01	ZERO	ZERO
76 PuO ₂	ZERO	0.4555E-01	ZERO	ZERO	0.2848E-02	ZERO	ZERO
156 PuO ₂ (NaTi ₂ O ₅) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
58 Rh	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
22 RhO ₂	ZERO	0.1701E-01	ZERO	ZERO	0.4690E-02	ZERO	ZERO
95 Ru	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
79 RuO ₂	ZERO	0.9352E-01	ZERO	ZERO	0.1861E-01	ZERO	ZERO
83 RuO ₄	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
38 SO ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
141 SO ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
137 Semi Vol Cs ₂ O	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
136 Semi Vol CsCl	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
126 Semi Vol Group A	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
140 Semi Vol Na ₂ B ₄ O ₇	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
138 Semi Vol NaCl	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
139 Semi Vol NaF	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
125 Semi Vol NaI	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
23 Semi Vol RuO ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
111 SiO ₂	ZERO	0.1628E+01	ZERO	ZERO	0.2102E+01	ZERO	ZERO
48 Sr(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
153 Sr(NaTi ₂ O ₅) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
127 Sr(OH) ₂	0.2121E-04	0.1004E-05	ZERO	ZERO	0.1461E-05	ZERO	0.2452E-05
30 SrCO ₃	ZERO	0.1286E+00	ZERO	ZERO	0.1822E-01	ZERO	ZERO
46 SrO	ZERO	ZERO	ZERO	ZERO	0.1041E-02	ZERO	ZERO
159 TcO ₂	ZERO	0.2509E-01	ZERO	ZERO	0.5894E-02	ZERO	ZERO
92 ThO ₂	ZERO	0.4360E+00	ZERO	ZERO	0.3990E-01	ZERO	ZERO

Table 1. DWPF Sludge-Only Feed Flowsheet Material Balance Tables
Section 0, Table A-7. Major Streams in the Model

STREAM NUMBERS (CONT'D) ->	401	513	516	521	543	546	560
STREAM NAME	Salt Soln Feed to Prec	Sludge Slurry Fd to A/D	NaOH to Dis Al(OH) ₃	Inhib H ₂ O to A/D Wash	Sludge Slurry to Wash Only	Inhib H ₂ O to W/O Wash	Sludge Proc Totl Decants
107 TiO ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
119 Tritium	0.5967E-06	0.2824E-07	ZERO	ZERO	0.4110E-07	ZERO	0.6900E-07
17 U ₃ O ₈	ZERO	0.1443E+01	ZERO	ZERO	0.3782E+01	ZERO	ZERO
62 UO ₂ (COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
16 UO ₂ (OH) ₂	0.1237E-02	0.5856E-04	ZERO	ZERO	0.8522E-04	ZERO	0.1431E-03
27 Y(COOH) ₃	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
128 Y(OH) ₃	0.2138E-04	0.1012E-05	ZERO	ZERO	0.1473E-05	ZERO	0.2472E-05
31 Y ₂ (CO ₃) ₃	ZERO	0.5007E-01	ZERO	ZERO	0.7020E-02	ZERO	ZERO
47 Y ₂ O ₃	ZERO	ZERO	ZERO	ZERO	0.3640E-03	ZERO	ZERO
100 Zeolite	ZERO	0.1646E+00	ZERO	ZERO	0.1779E+00	ZERO	ZERO
44 Zn(COOH) ₂	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
57 ZnO	ZERO	0.3432E-01	ZERO	ZERO	0.1513E+00	ZERO	ZERO
104 ZrO ₂	ZERO	ZERO	ZERO	ZERO	0.1676E-01	ZERO	ZERO
13 hydrate H ₂ O	ZERO	0.1116E+02	ZERO	ZERO	0.9189E+01	ZERO	ZERO
1 water	0.6017E+04	0.5546E+03	0.3637E+02	0.1176E+04	0.8474E+03	0.1910E+04	0.3951E+04
TOTAL FLOW, LB/HR	0.9550E+04	0.7580E+03	0.7274E+02	0.1190E+04	0.1128E+04	0.1933E+04	0.4424E+04
TEMPERATURE, DEG C	0.2768E+02	0.4289E+02	0.2500E+02	0.2500E+02	0.4095E+02	0.2500E+02	0.3500E+02
PRESSURE, ATM	0.1000E+01	0.1000E+01	0.1000E+01	0.1000E+01	0.1000E+01	0.1000E+01	0.1000E+01
PRESSURE, PSIG	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO	ZERO
PRESSURE, MM HG							
ENTHALPY, PCU/HR	ZERO	0.2576E+05	0.1208E+04	0.2958E+05	0.3737E+05	0.4805E+05	0.1427E+06
VAPOR FLOW, CFM							
LIQUID FLOW, GPM	0.1466E+02	0.1265E+01	0.9513E-01	0.2357E+01	0.1902E+01	0.3829E+01	0.8246E+01
DENSITY, LBS/FT ³	0.8123E+02	0.7473E+02	0.9533E+02	0.6295E+02	0.7399E+02	0.6295E+02	0.6689E+02
PHASE	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID

7. Appendix C

Determination of Wash Water and Sludge Inhalation Source Terms

Inhalation Dose Source Term for Washwater Containing 1 Wt.% Insoluble Solid Sludge

Grams insoluble solids/gal washwater = wt.% insolubles * SpG of slurry * 3785 g/gal /100

$$= 1 * 1.02 * 3785/100$$

$$= 39 \text{ grams/Gal. of washwater}$$

Inhalation Dose = rem/gal liquid * gal liq/gal washwater + rem/gram insolubles * gram/gal washwater

$$= 6.5\text{E}+02 * 1 + 5.9\text{E}+04 * 39$$

$$= 3\text{E}+06 \text{ rem/gal}$$

Inhalation Dose Source Term for insoluble solids in Settled sludge

Input SpG 1.17

Wt.% insoluble solids 22.1

Dose (rem/gal) = 1.17 g/mL x 3785 mL/gal x 0.221 g insolubles/gram x 5.9E+04 rem/gram insol. solids

$$= 6\text{E}+07 \text{ rem/gal}$$

8. Appendix D

Tank 42 Washwater Hydrogen Generation

Hydrogen Generation

	Ci/g insoluble solids	Ci/gal	gal H ₂ /gal/hr
Cs-137	1.80E-04	7.0E-03	7.1E-09
Sr-90	6.20E-03	2.4E-01	2.8E-07
Pu-238	8.10E-05	3.2E-03	3.0E-07
Pu-239	5.90E-06	2.3E-04	2.0E-08
Pu-240	1.80E-06	7.0E-05	6.2E-09
Pu-241	1.90E-04	7.4E-03	2.3E-10
Pu-242	5.10E-09	2.0E-07	1.7E-11
Am-241	7.60E-06	3.0E-04	2.8E-08
Cm-244	1.50E-05	5.9E-04	5.8E-08
Co-60	1.50E-06	5.9E-05	9.0E-10
Eu-154	1.80E-05	7.0E-04	6.3E-09
Eu-155	3.10E-06	1.2E-04	9.1E-11
		Total	7.0E-07