Appendix B
CsIX/TRU Grout Process

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CONTENTS

FIGURES

TABLES

ACRONYMS

AMP	ammonium molydophosphate
ASTM	American Society for Testing and Materials
BFS	blast furnace slag
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CH	contact handled
CST	crystalline silicotitanate
DBE	design basis element
DOE	Department of Energy
ETS	Evaporative Tank System
FGE	fissile gram equivalent
FY	fiscal year
HEPA	high-efficiency particulate air (filter)
HLLWE	High Level Liquid Waste Evaporator
HVAC	heating, ventilation and air conditioning (equipment or systems)
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LDR	land disposal restrictions (in RCRA)
LET&D	Liquid Effluent Treatment and Disposal Facility
NGLW	newly generated liquid waste
NWCF	New Waste Calcining Facility
PAN	polyacrylonitrile
PEWE	Process Equipment Waste Evaporator
PFC	process flow diagram
RCRA	Resource Conservation and Recovery Act
RH	remote-handled
SBW	sodium bearing waste
T&FR	Technical and Functional Requirements
TCLP	Toxicity Characteristic Leaching Procedure
TEC	total estimated cost
TFF	Tank Farm Facility
TPC	total project cost
TRU	transuranic (waste)
TSS	total suspended solids
VOC	volatile organic compounds
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant

Appendix B
Details of the CsIX TRU Grout Process

B-1. BACKGROUND

The concept of the CsIX/Transuranic (TRU) Grout process for treatment of sodium-bearing waste (SBW) developed out of engineering studies and research and development (R&D) testing of separations processes performed in the mid-1990s. These studies were aimed at developing treatment processes for both dissolved calcine and SBW which separated certain radionuclides from the initial Idaho Nuclear Technology and Engineering Center (INTEC) waste streams in order to produce both a relatively small volume of vitrified high activity waste and a larger volume of low-level waste grout.

Raytheon (Raytheon Engineers & Constructors, 1994) performed a feasibility study in 1994 that included separation of actinides and ^{90}Sr by solvent extraction, separation of cesium by ion exchange, vitrification of the separated radionuclides and grouting the low-level waste streams. During the period 1994-1997, researchers at the Idaho National Engineering and Environmental Laboratory (INEEL) tested many of the unit operations of this separation process, including cesium removal by ion exchange and grouting of low-level waste (Miller, 1995; Herbst, 1996; Herbst, 1997; Todd, 2001). A later study by Fluor Daniel (Fluor Daniel, 1997) updated the design of the process based on these development studies, process studies and the evolving project assumptions.

In late 1997, G. E. Stegen proposed a much simplified separations process based on the assumption that SBW would be classified as TRU waste rather than high level waste (Stegen, 1997). Stegen's proposed process included cesium removal by adsorption on a non-regenerable ion exchange resin followed by grouting the cesium free liquid and grouting the spent resin. Stegen calculated that removal of 99.9% of the cesium from SBW would result in a surface dose rate from product drums of less than 100 mR/hr.

Stegen amplified his treatment concept in two additional memorandums issued in March 1998 (Stegen, 1998a, 1998b). The objective of the proposed treatment process, according to the first of these memorandums, was to eliminate accumulation and storage of radioactive liquid waste by treating SBW, tank heels, and any "ongoing radioactive liquid waste" (now referred to as newly generated liquid waste [NGLW]) to produce solidified waste products and to accomplish this at a relatively low cost compared to other options being considered. An accompanying flow diagram showed (1) filtration of SBW to remove solids, (2) ion exchange columns to remove cesium from the filtrate, (3) grouting of the ion exchange effluent, and (4) grouting of the separated solids. Stegen discussed several options for disposal of the spent ion exchange media and also various options for use of existing facilities for all or part of the treatment process (Stegen, 1998a). In a separate memorandum, Stegen discussed the successful use of crystalline silicotitanate (CST) to remove cesium from a Melton Valley waste (Stegen, 1998b).

The first mass balances for the CsIX/TRU Grout process treating SBW and NGLW were prepared in early 1998 to supply information for the Idaho High Level Waste and Facilities Disposition Environmental Impact Statement (Barnes, 1998). A more detailed feasibility study was performed later that year (Losinski, 1998). The treatment process defined in this study included removal of undissolved solids by filtration, removal of cesium by ion exchange using CST, and cement-based grouting. Filtered undissolved solids and spend ion exchange media were dried and packaged for interim storage and disposal.

The Losinski CsIX/TRU Grout facility feasibility study included an investigation of alternative absorbents such as a low-density silica based absorbent, a clay based absorbent and a polymer based absorbent. However, based on a set of evaluation criteria, the cement-based grout was recommended. The treatment process feed included SBW and NGLW, but not tank heels. The study included preparing functional and operational requirements, developing a process flow diagram and mass balances, defining facility concepts and drawings, defining process and project uncertainties and estimating the project and life cycle costs and the project schedule. The mass balance showed that 7,500 m^3 of grout, 12 m^3 of spent ion exchange media and 10 m^3 of undissolved solids waste would be produced. The schedule showed performing the conceptual design over three years from 2000-2002, treating the waste in five years (2009-2013), and completing shipments to the Waste Isolation Pilot Plant (WIPP) by the end of 2022. The total estimate cost (TEC) for a new facility was estimated to be $102 million, and total project cost (TPC) $134 million, or $92 million if discounted.

Additional engineering studies of the CsIX/TRU Grout process were performed in 1999 (Valles, 1999). These studies sought to further simplify the process, reduce costs and final waste volume by evaluating each of the major unit operations. Recommended changes to the 1998 feasibility study design included (a) changing from vertical leaf pressure filters to a crossflow filter for UDS removal, (b) air drying the spent ion exchange media in place, and (c) using a higher waste loading grout formulation. The higher waste loading resulted a grout waste volume of about 4,400 m^3. Recommended changes were estimated to reduce the total estimated cost (TEC) of the 1998 study by about $7 million.

Raytheon performed a feasibility study of the CsIX/TRU Grout process in 2000 (Raytheon, 2000) for treatment of SBW. The Raytheon feasibility study report includes:

(a) Descriptions of process equipment and systems

(b) Descriptions of site, facility and utility systems

(c) A proposed approach to project execution

(d) Project cost and schedule estimates

(e) Technical evaluations and assessments of shielding, criticality, environmental and permitting considerations, waste analysis, sampling and waste characterization requirements, quality assurance, technology development needs

(f) A technical and functional requirements document

(g) Process flow diagrams and mass balances

(h) Drawings of equipment arrangement, HVAC diagrams, electrical single line diagrams, hot cell, remote operations and pump and valve corridor details

(i) Facility floor plans

(j) Details of interim storage areas

(k) A process design basis document

(l) A preliminary hazards analysis

(m) Evaluations and test results of equipment and systems selected to optimize the process.

The treatment process defined in the Raytheon study included the following unit operations:

- SBW/suspended undissolved solids receiving and storage
- Solids/liquid separation to remove UDS from the feed
- Collection and transfer of separated UDS to the Tank Farm Facility (TFF)
- Cesium removal by ion exchange using ammonium molybdophosphate (AMP) supported on a polyacrylonitrile (PAN) substrate
- Neutralization of the ion exchange effluent
- Sampling and waste characterization
- Grouting of the neutralized ion exchange effluent
- Packaging, examination and interim storage of grouted SBW
- Waste certification and shipping
- Treatment and disposal of secondary waste (spent sorbent).

The Raytheon mass balances were based on about 1.1 million gallons of SBW, but did not include tank heels. The mass balance showed that about 4,700 m^3 of grouted contact-handled (CH) waste would be produced. Spent ion exchange media was processed by dissolving the AMP with caustic, grouting the dissolved AMP, dewatering the separated PAN and loading the PAN into high integrity containers for disposal. About 43 m^3 of grouted AMP would be produced and 0.35 m^3 of PAN waste.

In the Raytheon study, the process included a cartridge type (Fundabac) filter to separate undissolved solids, and the separated solids were returned to the INTEC Tank Farm. Ion exchange effluent was neutralized with dry calcium oxide to a pH of about seven prior to grouting. Neutralized ion exchange effluent was fed into 55-gal drums, dry grouting ingredients added and mixing performed in the drum with a paddle that was left in place in the grouted waste. The grouting facility included three grouting lines.

Raytheon's TEC estimate was $285 million and TPC estimate $322 million. These estimates included the CsIX facility, the grouting facility, an interim storage facility and site development. The project schedule assumed approval of critical decision (CD) 0 in June 2001, start of operations in January 2010 and completion of treatment three years later at the end of December 2012.

Development of ion exchange as a method to remove cesium from acidic reprocessing aqueous wastes began at the INEEL in 1961 (Wilding, 1961). These early tests used ammonium phosphomolybdate as the ion exchange media. Testing of AMP for removal of cesium from dissolved calcine was performed in 1994 (Miller, 1994), and AMP-PAN was tested for cesium removal from SBW and dissolved calcine in 1995 (Miller, 1995). More recent development of AMP as a cesium ion exchange media for treatment of INTEC tank waste has focused on the development of an inorganic support material (Todd, 2003; Tranter, 2003a).

The Department of Energy (DOE) has funded the development and commercialization of CST as an ion exchange media applicable to the treatment of wastes at multiple DOE sites (Miller, 1997). After development studies that demonstrated the effectiveness of CST to remove cesium from various aqueous solutions, UOP was selected as a technology transfer partner to commercialize CST (Miller, 1997). Starting in 1994, UOP has supplied CST for both testing and use at various DOE sites, including Savannah River, Oak Ridge National Laboratory, Los Alamos National Laboratory, the Pacific Northwest Laboratory and the INEEL (Miller, 1997).

Testing of CST to remove cesium from SBW began in 1997 (Todd, 2001). Initial tests were performed in a 1-cm^3 column with actual waste from Tank WM-183 and from a simulant representing an average SBW composition. Additional tests with CST, also known as IONSIV IE-911, were performed in 1999 (Mann, 1999), 2000 (Mann, 2000), and 2003 (Tranter, 2003a).

Conclusions drawn from the 2000 test results included:

- Batch equilibrium experiments performed with IONSIV IE-911 and an SBW composite simulant showed that the sorbent displayed a high affinity for ^{137}Cs. Moreover, cesium loading was higher for batch experiments performed at 25°C compared to experiments performed at 50°C. IONSIV IE-911 failed to load ^{241}Am, ^{203}Hg, and ^{238}Pu under similar conditions.

- Batch equilibrium experiments performed with IONSIV IE-911 and solutions containing 15 μg/mL Cs, 10 μg/mL Sr and various combinations and concentrations of HNO_3, $NaNO_3$ and KNO_3 displayed a decrease in K_d when increasing HNO_3 from 1 M to 2 M. Further, it appeared that HNO_3 had a larger effect on cesium loading than $NaNO_3$. A further decrease in cesium loading was observed with the addition of KNO_3.

- Small-scale dynamic column experiments performed with IONSIV IE-911 and the composite tank waste simulant showed that the sorbent displayed a high affinity for ^{137}Cs. Am-241and ^{203}Hg in addition to various competing metals (Na, K, Cd, Ca, Cr, Eu, Fe, Pb, Mn, Mo, Ni, Zr, and Ba) were not sorbed by IONSIV IE-911.

Ion exchange tests performed in 2003 focused on (a) determining the stability of both AMP on an inorganic support and CST and in both SBW simulants and partially neutralized simulants, (b) determining the TRU content of spend ion exchange media to ensure proper disposal and (c) generating breakthrough curves using bench-scale columns (Tranter, 2003a; Tranter, 2003b). Results of these tests are discussed in later sections of this report.

Initial formulations for grouting SBW simulants were developed in 1997 (Herbst, 1997), and typically had waste loadings of 25-40%. With the advent of the concept of disposal of the grouted waste product at WIPP, the constraint of grout compressive strength was removed, and new formulations were developed with higher waste loadings (McCray, 1999; Herbst, 1999; Herbst, 2000; Raman, 2003). Conclusions from 1999 tests included:

- Approximately 80 wt% waste loading is the maximum achievable for either CsIX or NGLW waste.

- Land Disposal Restriction (LDR) Toxicity Characteristic Leaching Procedure (TCLP) limits can likely also be met at these high waste loadings.

- Considerably better grout products, both chemically and physically, can be attained by lowering the waste loading to 70-75 wt%.

- Heat generation from waste acid neutralization and cement powders hydration is significant. On a large-scale process, a mix system equipped with cooling coils or other means of cooling may be required, regardless of the grout formulation chosen.

Optimization of the formulation for CsIX grout continued in FY 2000 (Herbst, 2000). FY 2000 testing was performed to determine grout viscosities during mixing, power requirements for mixing, the change in viscosity after cooling, water loss during curing, and the potential for formation of liquid water in grout drums during thermal cycling. These tests resulted in improvements to the grout formulation to improve viscosity, verification of acceptability of grouts with a 70% waste loading, alleviation of concerns of free liquid formation due to thermal cycling, and a recommendation of a revised formulation to reduce mass loss via evaporation during grout mixing and cooling.

Separate tests were performed in 2000 of a continuous mixer (Readco) at the vendor's test facility using two grout formulations (Herbst, 2000). These demonstration tests showed that a continuous mixer was capable of blending the SBW stimulant and dry powder additives to produce a homogenous grout mix. An expanded matrix of grout formulations was tested with a different continuous mixer in FY 2003 (Scholes, 2003). The optimum waste loading determined in these recent tests for WM-180 simulant was 73%; for WM-189 simulant, a lower waste loading of 64% was required.

FY 2003 grout development focused on obtaining a better scientific, as opposed to simply empirical, understanding of the grouting process in order to be better prepared for scale up of the process (Raman, 2003).

The third major unit operation in the CsIX/TRU grout process, besides ion exchange and grouting, is solids filtration. Two types of filters have been tested for removal of solids from the CsIX feeds. Tests in 1997-1998 demonstrated the removal of undissolved calcine solids and undissolved solids in SBW using a cross-flow filter (Tripp, 1997; Mann, 1998). As part of the FY 2000 feasibility study of the CsIX process (Raytheon, 2000, Appendix F), initial tests were performed to demonstrate a Fundabac filter for removal of solids from SBW. The Fundabac filter demonstration used a 0.13 ft^2 filter and test feeds of TiO_2 and $TiO_2 – SiO_2 – ZrO_2$ mixtures.

Based on additional SBW solids characterization in late FY 2003, an improved SBW solids simulate has being developed (Barnes, 2003). Reviews of both crossflow and Fundabac filtration have been preformed in light of this characterization (Pao, 2003).

B-2. PROCESS DESCRIPTION

B-2.1 Waste Tanks (PFD-1)

Process flow diagram (PFD)-1 shows the existing seven storage tanks that will hold the feed to the CsIX TRU grout process. Tanks VES-WM-180 and VES-WM-189 presently contain SBW at near their administrative capacity limits. Tank VES-WM-188 is presently approximately 80% full of SBW, and will be filled to capacity as new wastes are generated and concentrated by the Evaporative Tank System (ETS, formerly the High Level Liquid Waste Evaporator [HLLWE]). Over the past few years solids that were in five tanks have been flushed to Tank VES-WM-187, which is being used as a collection tank for flush water and solids from operations to clean and close other TFF tanks. Upon flushing one more tank, VES-WM-181, the collection of solids in WM-187 will be complete.

After 2005, NGLW will be stored in the three tanks VES-WM-101, VES-WM-101, and VES-WM-102.

Existing steam jets in each of the tanks plus an existing airlift in VES-WM-189 will be used to transfer the SBW liquid/solids mixture from the TFF to the CsIX TRU Grout Facility SBW Receiving Tanks. Waste will be transferred to the treatment facility intermittently in batches at a rate of about 50 gpm. A transfer of approximately 4,000 gallons of liquid would provide a 2-day supply of feed to the treatment process. All equipment shown on PFD-1 presently exists.

B-2.2 Tank Solids Separations (PFD-2)

PFD-2 shows the Solids Settling/Decant Tanks, the Solids Filters and the Waste Water Tank. Waste from Tank VES-WM-187 would be transferred in batches of approximately 4000 gallons to one of two Solids Tanks. One tank would receive and decant waste while the other was feeding waste to treatment. Initial transfers from VES-WM-187 are expected to contain a high concentration of solids and require no decanting. The Solids Tanks are equipped with mixers and pump recycle to keep the solids in suspension while the waste is being fed to treatment.

A small amount of 50% caustic would be added to waste received in one of the Solids Tank. The caustic promotes flocculation of particles that in turn increases the particle-settling rate. After settling, supernate would overflow through side withdrawal ports into a surge tank and from there be transferred by steam jet to the Waste Water Tank. Upon reaching a solids concentration of 20 wt%, the tank contents would be mixed and sampled and are then ready to feed the Solids Filter.

The Solids Filter is a Fundabac filter and has six perforated tubes around a central tube. On the outside of these tubes is a filter cloth. The feed slurry would enter the filter vessel and liquid flow through the cloth into one of the six tubes. Liquid in these tubes would flow down and then enter the central tube and flow up to the discharge. Solids would be collected on the filter cloth. At the beginning of a filter cycle, a filter aid could be pumped through the filter to lay down an initial coating of solids to aid filtration of SBW solids. Alternatively, the filter discharge liquid could be recycled to the Settling Tank until adequate solids removal was achieved.

During filtration, solids would build up in a cake on the filter cloth. Upon reaching a set pressure drop across the filter, feed would be stopped and the filter drained. A steam jet would be used to transfer the filter liquid back to the Solids Tank. The cake would then be washed by flowing water through the filter to reduce the acidity of the solids waste. Discharge water would be collected in the Waste Water Tank. The cake would then be dried by passing low-pressure steam through the cake. Steam effluent from cake drying would be condensed and collected in the Waste Water Tank.

When the water content of the solids cake has been reduced to about 25 wt%, the steam flow would be stopped and pulses of compressed air used to cause the filter cloth to billow, in turn causing the filter cake to crack, drop off the cloth and fall by gravity into a waste canister.

The Waste Water Tank collects decant water from the Decant Tank, solids wash water effluent, filter cake drying steam condensate, vent gas condensate, and ion exchange media flush water. The Tank is sized to hold 4,000 gallons, equivalent to about a 3-day volume of waste water. Upon reaching capacity, the contents are steam jetted to the ETS for concentration.

B-2.3 SBW Filtration & Cesium Removal (PFD-3)

SBW from Tanks VES-WM-180, VES-WM-188 and VES-WM-189 would be received from the INTEC Tank Farm by the SBW Receiving Tanks, shown on PFD-3. One tank would receive, neutralize and hold waste while the other tank feeds liquid SBW treatment. The acidity of the SBW varies from about 1 M to 3 M. To minimize degradation of the ion exchange media, the acidity of the waste would be reduced to 0.5 M by the addition of 50 wt% caustic to the Receiving Tank. At this pH, ion exchange media stability is acceptable and precipitation from neutralization is avoided. During neutralization, mixing will be achieved by a recirculation line with a mixing jet on the discharge pump. Each Receiving Tank is sized for 2 days of waste.

Undissolved solids in the neutralized SBW are then removed by filtration using a crossflow filter. Crossflow filtration operates by recirculating the feed flow parallel to the filter membrane. A high fluid-circulation rate tangential to the membrane sweeps away particles on the membrane, thereby limiting the thickness of the filter cake. The recirculation rate is usually determined experimentally. For this design a nominal rate of 130 gpm was assumed, the mid-range value for a MOTT crossflow filter.

The permeate from the filter is collected in the Filtrate Receiver Tank and then pumped through three ion exchange columns in series to the Ion Exchange Effluent Tank. Three columns are used to achieve 99.9% removal of cesium from the SBW while also obtaining a reasonable cesium loading of the media. A fourth column is off-line. When breakthrough of cesium is detected in the effluent of the first column, it is taken offline for preparation for disposal. The fourth column is placed in service, with the second column becoming the first in the series and the newly on-line column the third in the series.

Each of the columns contains 60 gallons of CST sorbent. CST has been shown to be highly selective for removal of cesium from SBW and is commercially available.

Loading of an ion exchange column with fresh CST could take place outside of the hot cell. Sand would first be added to the column followed by fresh ion exchange media. The sand acts as a filter for loaded sorbent particles that would otherwise contaminate the effluent. After loading CST into the column, the bed would be backwashed with water to remove fine particles and to better distribute the bed. The water lines would then be disconnected and the bed transferred into position in the hot cell. Alternatively, the columns could be purchased pre-loaded from a vendor. In this case, backwashing would still be performed prior to moving a column into the hot cell.

The equipment required for disposal of spent ion exchange media has not been fully defined, but the processing steps are described here. After a column is taken off line from SBW flow, the bed would be rinsed with water and drained. The bed of CST and sand would then be dried using hot air until the moisture level falls below 25 wt%. Once dry, the bed column would be remotely disconnected from feed and product lines and transferred to a loading area. The entire column would be loaded into a remote-handled (RH)-TRU canister for interim storage and shipment to WIPP.

B-2.4 IX Effluent Grouting (PFD-4)

PFD-4 shows equipment to grout ion exchange effluent and treat process vent gas. Grout bulk materials, including Portland cement, calcium hydroxide and blast furnace slag, are received from suppliers into storage hoppers. Metering hoppers are used to control the rate at which these dry ingredients are fed to a mixer and then the Grout Mixer, to be mixed with ion exchange effluent. The Grout Mixer discharges into 55-gal drums. A drum would be filled every 0.5 hours, and 48 drums (average) would be produced per day. After filling with waste, a drum would be moved to a curing area and held for 24 hours. The drum surface would then be smeared to check for surface contamination. If found, the drum would be decontaminated. The head-space of the drum would then be sampled for organic compounds and the drum inspected for free liquid. Passing inspection, the drum would either be sent to interim storage or loaded into a Halfpact and shipped to WIPP.

Ion exchange effluent is used to flush the grout mixer, although alternatively water could be used. Effluent flush is collected in the Flush Water Receiver/Feed Tank and then can be reused or grouted.

Vent gas from process vessels is collected in a header and sent to a demister. Demister condensate flows by gravity to the Waste Water Tank. Vapor and gases from the demister are superheated and flow through a high efficiency particulate air (HEPA) filter prior to being sent to the INTEC stack via a blower.

B-2.5 ETS, LET&D Fractionator, & PEWE (PFD- 5, -6 & -7)

Wastewater collected in the Wastewater Tank (PFD-2) is treated in existing INTEC equipment. The wastewater is sent to VES-NCC-101, the Blend Tank used as the ETS feed tank. The waste is air lifted from the Blend Tank to the ETS Feed Head Tank and flows by gravity to the ETS evaporator, also called the "Flash Column". Evaporator bottoms is collected in VES-NCC-119 and transferred by steam jet to VES-WM-100, VES-WM-101 or VES-WM-102. This waste will be treated by the CsIX TRU Grout liquid processing equipment. The evaporator overhead is condensed and collected in VES-NCC-122. From this tank, the condensate is transferred to the Process Equipment Waste Evaporation (PEWE) for further treatment.

The condensate is processed through the PEWE to achieve additional decontamination. The ETS condensate is received into a feed collection tank, pumped to a feed head tank, and flows by gravity into one of two duplicate evaporators. Concentrate from the evaporator would be transferred by steam jet to WM-100, WM-101 or WM-102. Condensate from the PEWE evaporator is collected in storage tanks and periodically transferred to the Liquid Effluent Treatment and Disposal (LET&D) facility.

The LET&D Fractionator concentrates the condensate, thereby reducing the amount of waste that would require treatment and disposal. The condensate is fed by gravity from the LET&D Feed Tank to one of two identical fractionators, each containing 15 sieve trays. Each fractionator typically recovers at least 99% of the nitric acid from the feed into the bottoms product. The bottoms product is usually 12 molar nitric acid and contains a high fraction of the other impurities in the feed condensate (HCl, fluoride, $HgCl_2$). The fractionator overhead is steam with trace impurities. A partial condenser provides reflux to the column. The effluent from the condenser goes to a vapor/liquid separator, with the vapor from the separator superheated, filtered and discharged via a blower to the INTEC-708 stack. When the desired density of the fractionator bottoms is reached, a portion of the solution is drained out of the column and stored in the Bottoms Tank. This recovered acid is cooled by heat exchange with cooling water prior to entering the Bottoms Tank.

Except for the feed and bottoms tank, all acid fractionation equipment (fractionator with reboiler and condenser, separator, superheater, filter and blower) is duplicated. Recovered acid would be available for reuse in other INTEC activities. A 22,500-gal acid recycle tank, not shown of PFD-6, is available to collect and store LET&D bottoms for use in the New Waste Calcining Facility (NWCF). However, the projected volume needed for expected INTEC operations is much less than the amount that would be generated by the SBW treatment process, and hence the acid will be processed with SBW in the CsIX TRU Grout Treatment Facility.

B-3. PROCESS OPERATION

This section describes a possible operation scenario.

By 2005, flushing TFF heels to WM-187 tanks will be complete except for solids in the full SBW tanks that will not be transferred until the treatment facility is on-line. Tank WM-188 will be full. Subsequent to 2005, Tanks WM-100, WM-101, and WM-102 will be used to collect and store NGLW.

After startup, SBW liquid and tank solids would be processed simultaneously. Treatment is shown pictorially in Figure B-1.

Waste from WM-189 would be fed to the liquid processing section of the facility while solids in WM-187 would be carried in flush water to the solids treatment equipment. Tank WM-189, thought to contain the most heel solids of the three liquid SBW tanks, would be processed first, so that the heel solids could be flushed early to WM-187. As discussed in more detail in Section B-5.5.5, an estimated 414,000 gallons of water will be needed to flush WM-187 solids. At the completion of treatment of WM-189 liquid, about half of total volume of WM-187 flush water will have been sent to treatment.

When Tank WM-189 is empty (at heel level) of liquid, heel would immediately be flushed to WM-187. This flush, estimated to be about 87,000 gallons, will help flush solids remaining in WM-187, as will flushes from WM-180. While liquid from the last TFF tank (WM-188 according to Figure B-1) is being processed, the last flush from WM-187 will be performed, leaving WM-187 ready to close. The heel from WM-189 will then be flushed, either to WM-187 or preferably directly to treatment. The final solids are processed in a short period (~1.4 months as shown on Figure B-1) while NGLW is being processed in the liquid treatment portion of the facility.

4000-gal transfers of liquid SBW to the treatment facility will be made approximately every 1.3 hours. Waste is received and neutralized in one receiving tank, while being fed to treatment from a second tank. Liquid processing is continuous from the feed tank to the crossflow filter to the ion exchange columns to the grouting operation.

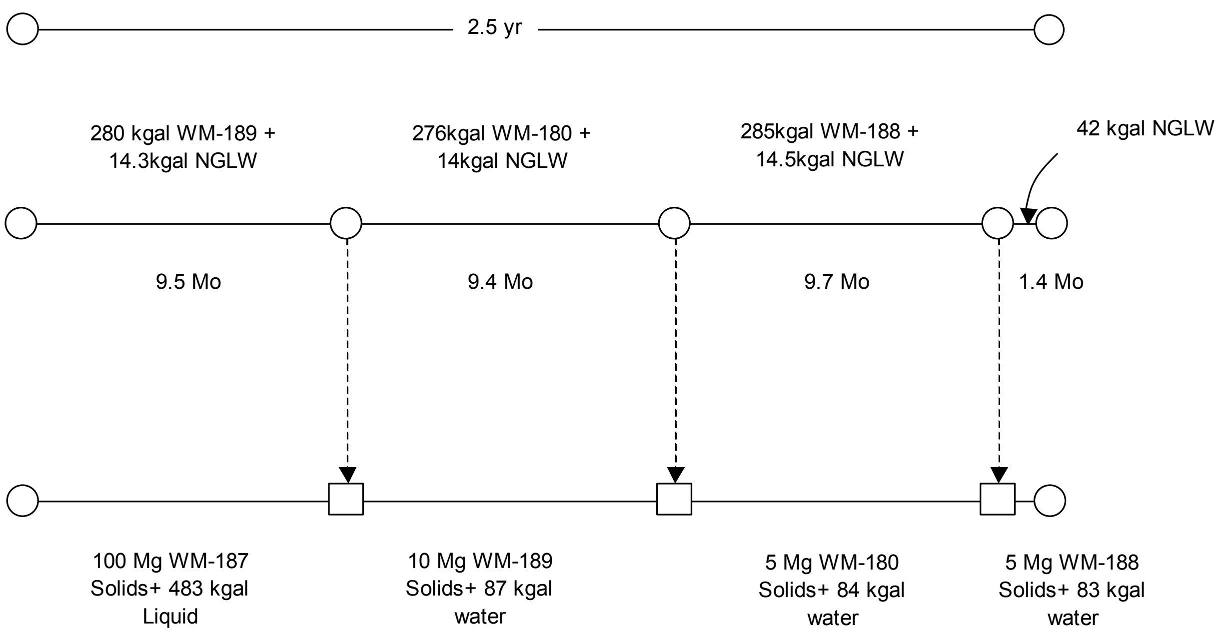


Figure B-1. A possible operating scenario.

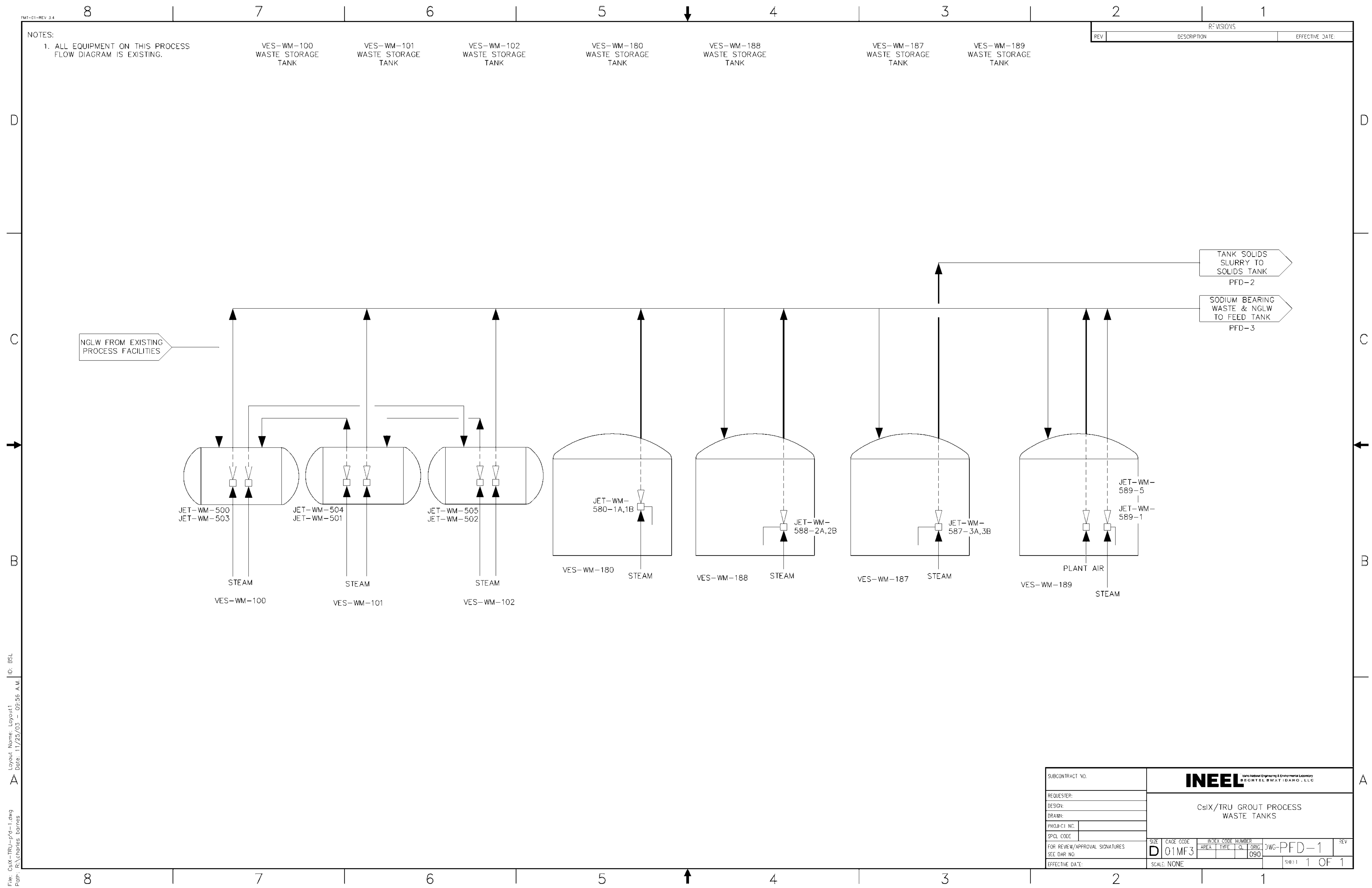
When breakthrough is achieved in the leading ion exchange column, the flow is valved to the next column in series, with a new column coming on line in the third position. The spent column is drained, the media flushed and dried while still in the column, and then the column is packaged in a canister for disposal.

The grout mixer has an effluent recycle line so that during the time when a full drum of grout is disconnected from the mixer effluent line and replaced with an empty one, grout exiting the mixer would be recycled to the mixer inlet. Ion exchange effluent would be used to flush the grout mixer if needed. This flush liquid would be bled into the grout feed line for grouting and disposal.

A purge of concentrated solids from the crossflow filter would be jet-pumped continuously from the Crossflow Filter Feed Tank to one of two Solids Tanks. The solids in TFF Tank WM-187 would be flushed to the Solids Tank periodically using existing jets at 50 gpm. 50% sodium hydroxide would then be mixed with the Solids Tank content to bring the pH to approximately 5. There would be several periods or time cycles for each batch. The first one is rapid mixing to form microfloc done by high-speed agitation using the mixer and recirculation. Two hours was allowed for this although it is expected to require less time. Flocculation can be accomplished via pH adjustment only if there is enough aluminum present to form the insoluble hydroxide. The small, slow settling particles will agglomerate to form larger, faster settling particles, thus reducing settling time. The resulting time cycle is based on an assumed settling of 95% of the solids in the top 5 ft of the tank at a cut diameter of 5 μm where this cut diameter is increased in size via flocculation from the received diameter of 2 μm. The settling takes 30 hours. The sampling time cycle can be accomplished prior to flocculation or prior to filter feed but it is assumed prior to filter feed when the batch at a 20 wt% maximum solids is pumped through the Fundabac® filter. Recirculation after settling is done to evenly suspend solids and has a time cycle associated with sampling of two hours. Filtration is done by pumping at a nominal flow of 10 gpm until 100 liters of cake is collected. This would take six minutes. A short cycle is defined as filtration (6 minutes), draining (12 minutes), and steam drying (20 minutes). There are 8 – 9 short cycles per batch. Since it takes 26 minutes to receive a batch using the 50 gpm jet, the total batch cycle time is 40 hours. There are two Solids Tanks so that one can receive waste while the other is doing the other operations. The above describes the system based on the design and the overall volume to be treated using WM-187 suspended solids. However, because of the uncertainties in flush volumes, the tank sizes were increased by a factor of three. This will also reduce the number of Tank Farm transfers and provide more flexibility in clarifier equipment operations.

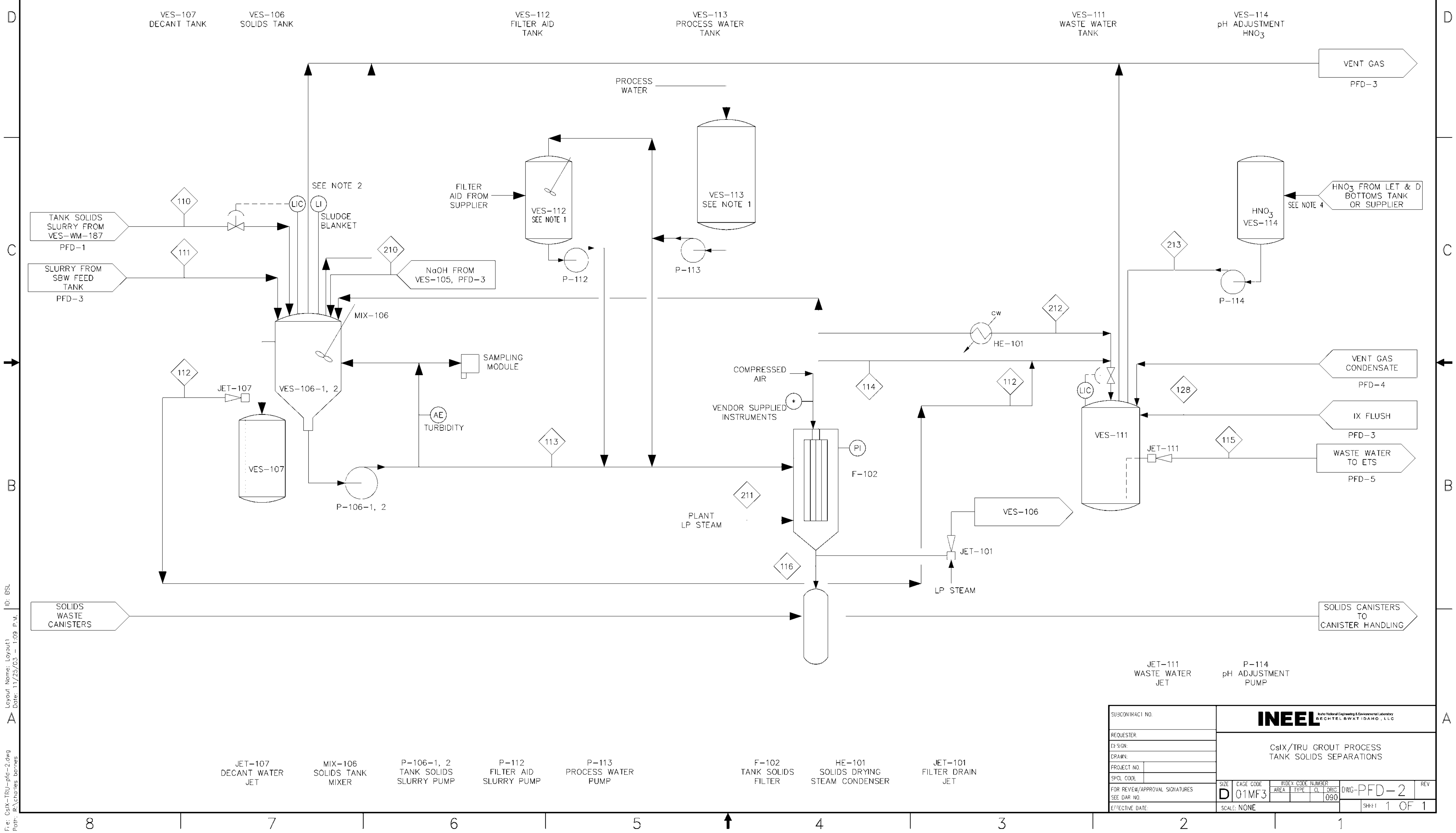
B-4. PROCESS FLOW DIAGRAMS

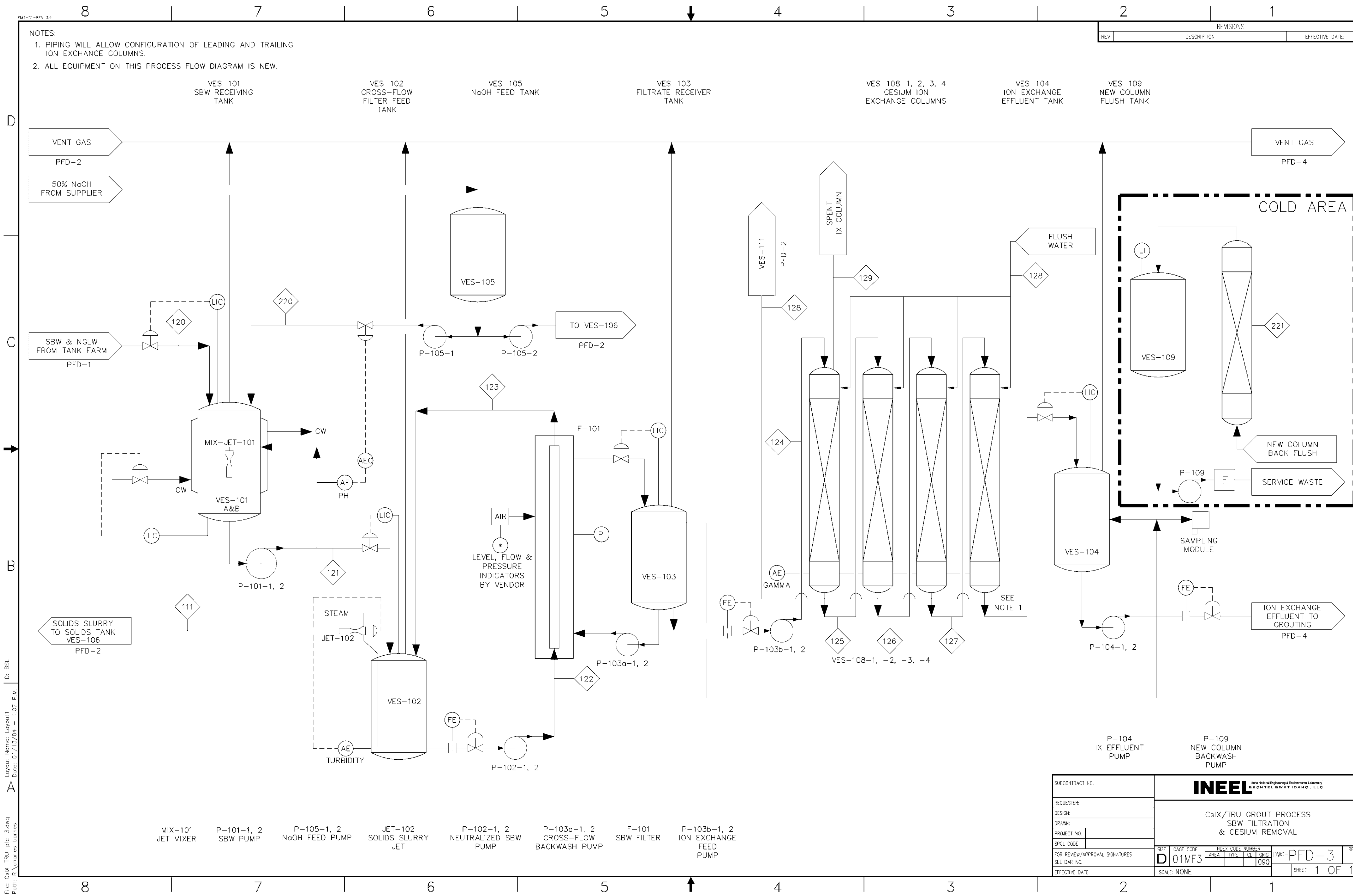
Process flow diagrams are shown on the following pages:

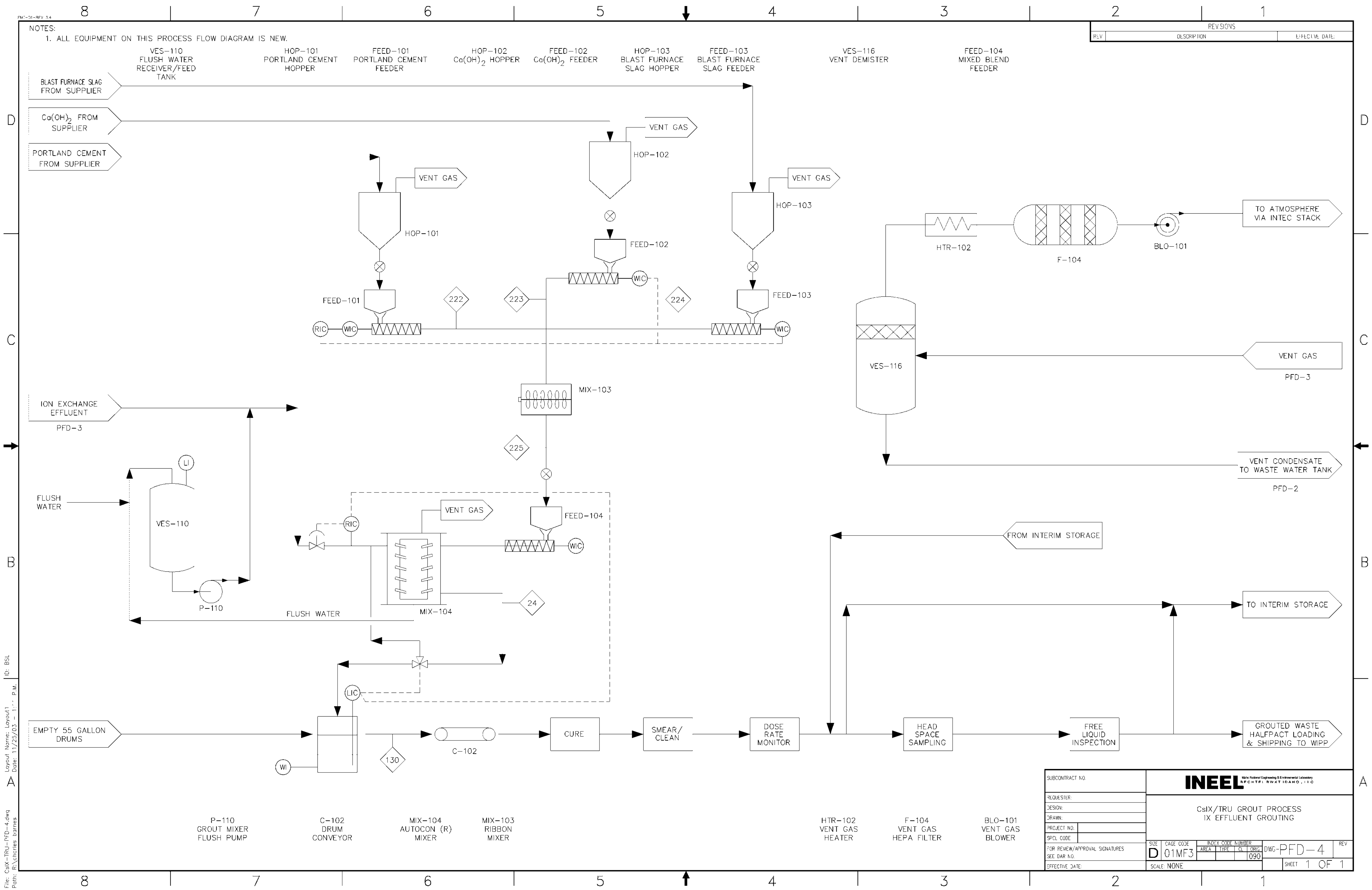

NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS EXISTING.
VES-WM-100 WASTE STORAGE TANK
VES-WM-101 WASTE STORAGE TANK
VES-WM-102 WASTE STORAGE TANK
VES-WM-180 WASTE STORAGE TANK
VES-WM-188 WASTE STORAGE TANK
VES-WM-187 WASTE STORAGE TANK
VES-WM-189 WASTE STORAGE TANK
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
TANK SOLIDS SLURRY TO SOLIDS TANK
PFD-2
SODIUM BEARING WASTE & NGLW TO FEED TANK
PFD-3
NGLW FROM EXISTING PROCESS FACILITIES
JET-WM-500
JET-WM-503
JET-WM-504
JET-WM-501
JET-WM-505
JET-WM-502
JET-WM-580-1A,1B
JET-WM-588-2A,2B
JET-WM-587-3A,3B
JET-WM-589-5
JET-WM-589-1
STEAM
STEAM
STEAM
STEAM
STEAM
STEAM
PLANT AIR
STEAM
VES-WM-100
VES-WM-101
VES-WM-102
VES-WM-180
VES-WM-188
VES-WM-187
VES-WM-189
SUBCONTRACT NO.
INEEL
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE
CsIX/TRU GROUT PROCESS
WASTE TANKS
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER
AREA
TYPE
QL
ORIG 090
DWG PFD-1
REV
SHEET 1 OF 1
SCALE: NONE

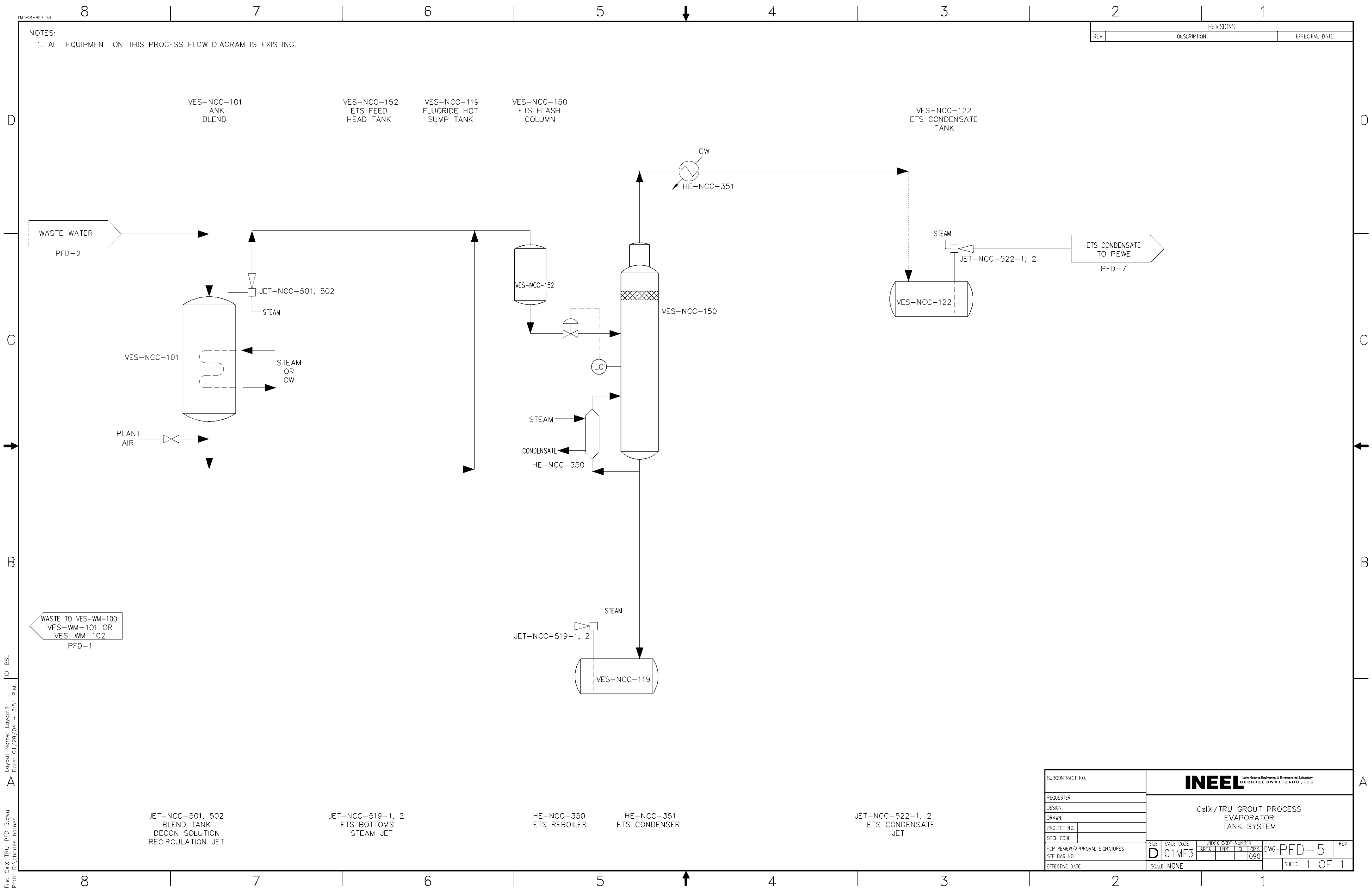
NOTES:

1. IT HAS NOT BEEN VERIFIED THAT THESE TANKS ARE REQUIRED. IT WILL BE DETERMINED BASED ON FILTER TESTING.
2. INSTRUMENTS SHOWN ARE ILLUSTRATIVE OF THE TYPE REQUIRED.
3. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS NEW.
4. NEED FOR VES-114 TO BE VERIFIED DURING CONCEPTUAL DESIGN.

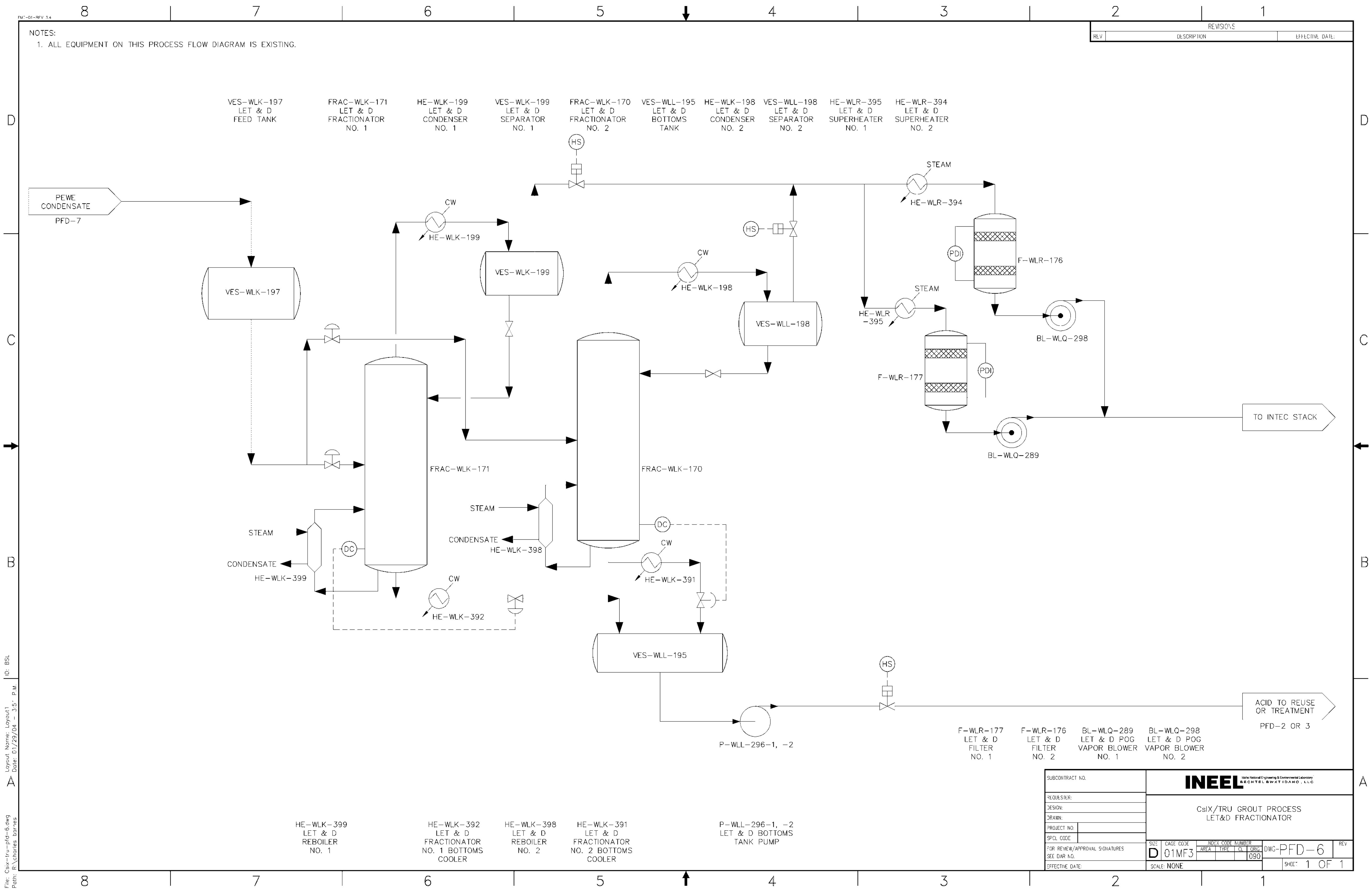


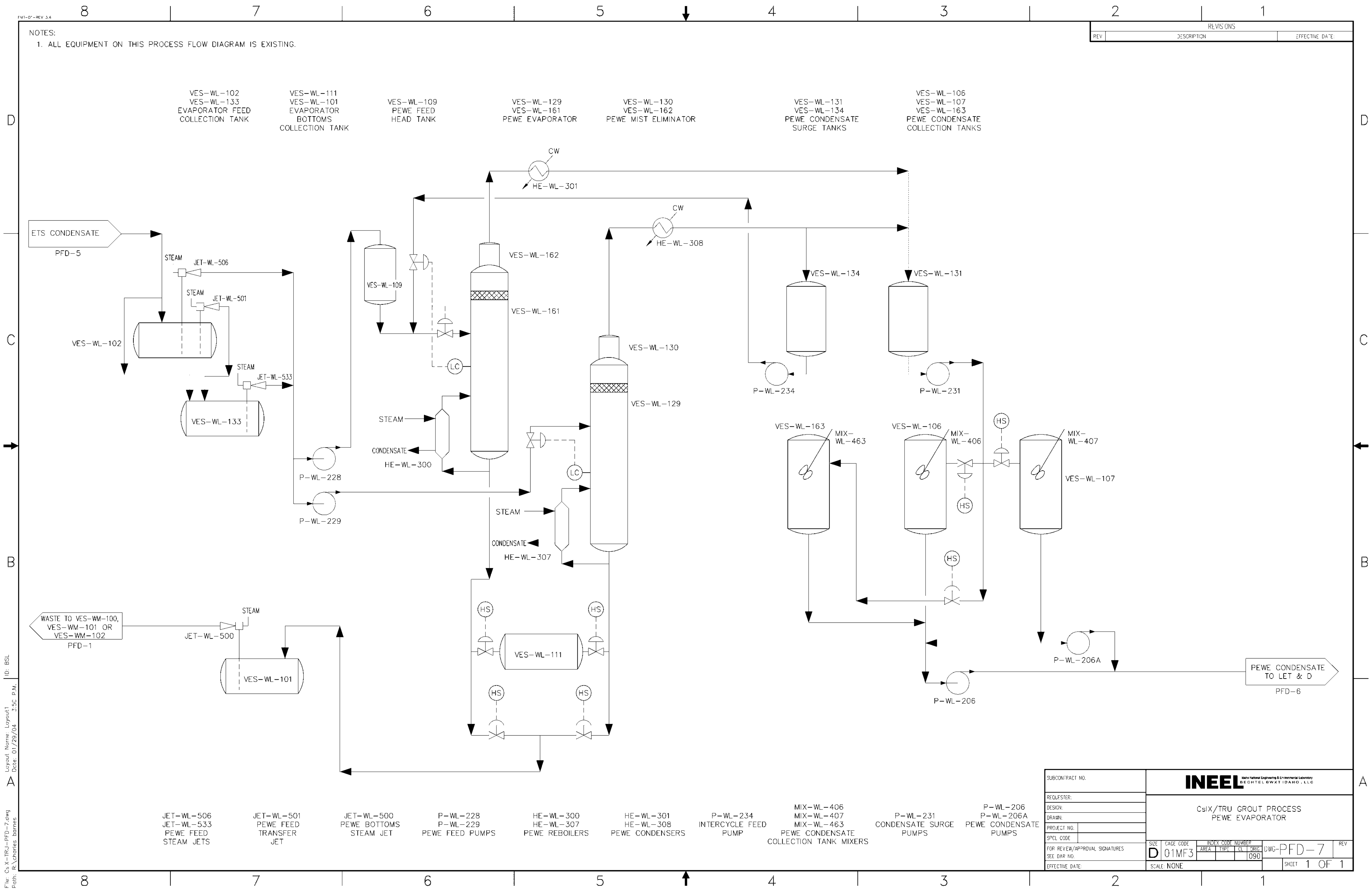

NOTES:
1. PIPING WILL ALLOW CONFIGURATION OF LEADING AND TRAILING ION EXCHANGE COLUMNS.
2. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS NEW.
VES-101 SBW RECEIVING TANK
VES-102 CROSS-FLOW FILTER FEED TANK
VES-105 NaOH FEED TANK
VES-103 FILTRATE RECEIVER TANK
VES-108-1, 2, 3, 4 CESIUM ION EXCHANGE COLUMNS
VES-104 ION EXCHANGE EFFLUENT TANK
VES-109 NEW COLUMN FLUSH TANK
VENT GAS
PFD-2
50% NaOH FROM SUPPLIER
VENT GAS
PFD-4
COLD AREA
SPENT IX COLUMN
VES-111
PFD-2
FLUSH WATER
SBW & NGLW FROM TANK FARM
PFD-1
TO VES-106
PFD-2
P-105-1
P-105-2
VES-105
MIX-JET-101
VES-101 A&B
CW
AEC
AE
PH
TIC
LIC
F-101
AIR
PI
LEVEL, FLOW & PRESSURE INDICATORS BY VENDOR
VES-103
VES-109
NEW COLUMN BACK FLUSH
P-109
SERVICE WASTE
SAMPLING MODULE
VES-104
AE GAMMA
SEE NOTE 1
P-101-1, 2
SOLIDS SLURRY TO SOLIDS TANK VES-106
PFD-2
STEAM
JET-102
VES-102
AE TURBIDITY
FE
P-102-1, 2
P-103a-1, 2
P-103b-1, 2
VES-108-1, -2, -3, -4
P-104-1, 2
ION EXCHANGE EFFLUENT TO GROUTING
PFD-4
120
220
123
121
111
122
124
125
126
127
128
129
221
MIX-101 JET MIXER
P-101-1, 2 SBW PUMP
P-105-1, 2 NaOH FEED PUMP
JET-102 SOLIDS SLURRY JET
P-102-1, 2 NEUTRALIZED SBW PUMP
P-103a-1, 2 CROSS-FLOW BACKWASH PUMP
F-101 SBW FILTER
P-103b-1, 2 ION EXCHANGE FEED PUMP
P-104 IX EFFLUENT PUMP
P-109 NEW COLUMN BACKWASH PUMP
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
SUBCONTRACT NO.
INEEL
REQUESTER
DESIGN
DRAWN
PROJECT NO.
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE
CsIX/TRU GROUT PROCESS SBW FILTRATION & CESIUM REMOVAL
SIZE D
CAGE CODE 01MF3
090
DWG PFD-3
SCALE NONE
SHEET 1 OF 1
8
7
6
5
4
3
2
1
D
C
B
A


NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS NEW.
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
VES-110 FLUSH WATER RECEIVER/FEED TANK
HOP-101 PORTLAND CEMENT HOPPER
FEED-101 PORTLAND CEMENT FEEDER
HOP-102 $Ca(OH)_2$ HOPPER
FEED-102 $Ca(OH)_2$ FEEDER
HOP-103 BLAST FURNACE SLAG HOPPER
FEED-103 BLAST FURNACE SLAG FEEDER
VES-116 VENT DEMISTER
FEED-104 MIXED BLEND FEEDER
BLAST FURNACE SLAG FROM SUPPLIER
$Ca(OH)_2$ FROM SUPPLIER
PORTLAND CEMENT FROM SUPPLIER
VENT GAS
HOP-101
HOP-102
HOP-103
FEED-101
FEED-102
FEED-103
FEED-104
RIC
WIC
222
223
224
225
24
130
HTR-102
F-104
BLO-101
TO ATMOSPHERE VIA INTEC STACK
VES-116
PFD-3
MIX-103
ION EXCHANGE EFFLUENT
LI
FLUSH WATER
VES-110
P-110
MIX-104
VENT CONDENSATE TO WASTE WATER TANK
PFD-2
FROM INTERIM STORAGE
TO INTERIM STORAGE
LIC
WI
EMPTY 55 GALLON DRUMS
C-102
CURE
SMEAR/CLEAN
DOSE RATE MONITOR
HEAD SPACE SAMPLING
FREE LIQUID INSPECTION
GROUTED WASTE HALFPACT LOADING & SHIPPING TO WIPP
P-110 GROUT MIXER FLUSH PUMP
C-102 DRUM CONVEYOR
MIX-104 AUTOCON (R) MIXER
MIX-103 RIBBON MIXER
HTR-102 VENT GAS HEATER
F-104 VENT GAS HEPA FILTER
BLO-101 VENT GAS BLOWER
INEEL
CsIX/TRU GROUT PROCESS
IX EFFLUENT GROUTING
SIZE D
CAGE CODE 01MF3
090
DWG-PFD-4
SHEET 1 OF 1
SCALE NONE
ID: BSL



NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS EXISTING.
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
VES-NCC-101 TANK BLEND
VES-NCC-152 ETS FEED HEAD TANK
VES-NCC-119 FLUORIDE HOT SUMP TANK
VES-NCC-150 ETS FLASH COLUMN
VES-NCC-122 ETS CONDENSATE TANK
CW
HE-NCC-351
WASTE WATER
PFD-2
JET-NCC-501, 502
STEAM
VES-NCC-152
VES-NCC-150
VES-NCC-101
STEAM OR CW
LC
PLANT AIR
STEAM
CONDENSATE
HE-NCC-350
STEAM
JET-NCC-522-1, 2
ETS CONDENSATE TO PEWE
PFD-7
VES-NCC-122
WASTE TO VES-WM-100, VES-WM-101 OR VES-WM-102
PFD-1
STEAM
JET-NCC-519-1, 2
VES-NCC-119
JET-NCC-501, 502 BLEND TANK DECON SOLUTION RECIRCULATION JET
JET-NCC-519-1, 2 ETS BOTTOMS STEAM JET
HE-NCC-350 ETS REBOILER
HE-NCC-351 ETS CONDENSER
JET-NCC-522-1, 2 ETS CONDENSATE JET
INEEL
CsIX/TRU GROUT PROCESS EVAPORATOR TANK SYSTEM
SIZE D
CAGE CODE 01MF3
090
DWG PFD-5
SCALE: NONE
SHEET 1 OF 1


NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS EXISTING.
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
VES-WLK-197 LET & D FEED TANK
FRAC-WLK-171 LET & D FRACTIONATOR NO. 1
HE-WLK-199 LET & D CONDENSER NO. 1
VES-WLK-199 LET & D SEPARATOR NO. 1
FRAC-WLK-170 LET & D FRACTIONATOR NO. 2
VES-WLL-195 LET & D BOTTOMS TANK
HE-WLK-198 LET & D CONDENSER NO. 2
VES-WLL-198 LET & D SEPARATOR NO. 2
HE-WLR-395 LET & D SUPERHEATER NO. 1
HE-WLR-394 LET & D SUPERHEATER NO. 2
PEWE CONDENSATE
PFD-7
CW
STEAM
CONDENSATE
HS
DC
PDI
TO INTEC STACK
ACID TO REUSE OR TREATMENT
PFD-2 OR 3
F-WLR-177 LET & D FILTER NO. 1
F-WLR-176 LET & D FILTER NO. 2
BL-WLQ-289 LET & D POG VAPOR BLOWER NO. 1
BL-WLQ-298 LET & D POG VAPOR BLOWER NO. 2
HE-WLK-399 LET & D REBOILER NO. 1
HE-WLK-392 LET & D FRACTIONATOR NO. 1 BOTTOMS COOLER
HE-WLK-398 LET & D REBOILER NO. 2
HE-WLK-391 LET & D FRACTIONATOR NO. 2 BOTTOMS COOLER
P-WLL-296-1, -2 LET & D BOTTOMS TANK PUMP
INEEL
CsIX/TRU GROUT PROCESS
LET&D FRACTIONATOR
SUBCONTRACT NO.
SIZE D
CAGE CODE 01MF3
DWG PFD-6
SCALE NONE
SHEET 1 OF 1


NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS EXISTING.
VES-WL-102
VES-WL-133
EVAPORATOR FEED
COLLECTION TANK
VES-WL-111
VES-WL-101
EVAPORATOR
BOTTOMS
COLLECTION TANK
VES-WL-109
PEWE FEED
HEAD TANK
VES-WL-129
VES-WL-161
PEWE EVAPORATOR
VES-WL-130
VES-WL-162
PEWE MIST ELIMINATOR
VES-WL-131
VES-WL-134
PEWE CONDENSATE
SURGE TANKS
VES-WL-106
VES-WL-107
VES-WL-163
PEWE CONDENSATE
COLLECTION TANKS
ETS CONDENSATE
PFD-5
CW
HE-WL-301
HE-WL-308
STEAM
JET-WL-506
JET-WL-501
JET-WL-533
VES-WL-102
VES-WL-133
VES-WL-109
VES-WL-162
VES-WL-161
VES-WL-130
VES-WL-129
VES-WL-134
VES-WL-131
LC
CONDENSATE
HE-WL-300
HE-WL-307
P-WL-228
P-WL-229
P-WL-234
P-WL-231
VES-WL-163
MIX-WL-463
VES-WL-106
MIX-WL-406
MIX-WL-407
VES-WL-107
HS
WASTE TO VES-WM-100,
VES-WM-101 OR
VES-WM-102
PFD-1
JET-WL-500
VES-WL-101
VES-WL-111
P-WL-206A
P-WL-206
PEWE CONDENSATE
TO LET & D
PFD-6
JET-WL-506
JET-WL-533
PEWE FEED
STEAM JETS
JET-WL-501
PEWE FEED
TRANSFER
JET
JET-WL-500
PEWE BOTTOMS
STEAM JET
P-WL-228
P-WL-229
PEWE FEED PUMPS
HE-WL-300
HE-WL-307
PEWE REBOILERS
HE-WL-301
HE-WL-308
PEWE CONDENSERS
P-WL-234
INTERCYCLE FEED
PUMP
MIX-WL-406
MIX-WL-407
MIX-WL-463
PEWE CONDENSATE
COLLECTION TANK MIXERS
P-WL-231
CONDENSATE SURGE
PUMPS
P-WL-206
P-WL-206A
PEWE CONDENSATE
PUMPS
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES
SEE DAR NO.
EFFECTIVE DATE:
INEEL
Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC
CsIX/TRU GROUT PROCESS
PEWE EVAPORATOR
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER
AREA TYPE CL ORIG
090
DWG-PFD-7
REV
SCALE: NONE
SHEET 1 OF 1

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B-5. PROCESS BASIS

This section includes a summary of technical and functional requirements, process assumptions, a discussion of variations of the CsIX/TRU Grout process, the basis for the process shown on the process flow diagrams, and the basis for the mass balances.

B-5.1 Requirements

A draft technical and functional requirements document (T&FR) was prepared for the CsIX/TRU Grout process (Barden, 2003). Most functional and performance requirements identified in the T&FR document are summarized below. For other requirements, including special requirements, design requirements, testing and maintenance requirements and codes, standards and regulations refer to the T&FR document. The T&FR document also provides the basis or reference for each requirement.

B-5.1.1 System Requirements

B-5.1.1.1 Retrieve Waste. The system shall have the capability to retrieve SBW from WM-180, WM-187, WM-188, and WM-189 and NGLW from WM-100, WM-101 and WM-102.

B-5.1.1.2 Treat Waste – Feed Volume. The system shall have the capability to treat 1.2 million gallons of waste. Current estimates of waste volumes are 926,000 gallons of liquid waste, and 88,000 gallons of waste in Tank WM-187 containing 100,000 kg of solids. The maximum volume of liquid volume is 20% greater than the expected and the maximum amount of solids is 60% greater that the present estimate.

B-5.1.1.3 Treat Waste – Throughput. The facility design throughput shall provide the capability of processing all SBW, both liquids and solids, and NGLW generated through 2011 within 3.0 years. This timeframe assumes six months of hot start-up, leaving 2.5 years for processing SBW and NGLW volumes.

B-5.1.1.4 Treat Waste – Location. The waste shall be treated and packaged at the INEEL, within the INTEC security enclosure.

B-5.1.1.5 Treat Waste – Remove Solids from Ion Exchange Column Feed. Solids shall be removed from liquid feeds to the extent that particulate does not contribute more than 10% to the grouted waste dose rate and solids not removed are not detrimental to ion exchange column performance.

B-5.1.1.6 Treat Waste – Remove Cesium from Liquid Waste. To assure the grouted SBW is a contact handled waste, the ion exchange effluent can contain no more than 0.02 μCi/mL of Cs-137.

B-5.1.1.7 Treat Waste – Solidify and Package. All waste streams shall be treated to comply with either RH or CH-TRU waste acceptance criteria (WAC) for WIPP. The effluent from the ion exchange process shall be solidified into a hydraulic cement grout matrix. The SBW solids shall be treated and packaged to meet the proposed WIPP RH-TRU WAC. This treatment will include removing liquid such that there is no free liquid and that the gas generation is below the limits established in the applicable TRUCON content code. The spent ion exchange media shall be characterized, treated, and packaged to meet the proposed WIPP RH-WAC. This treatment will include removing liquid such that there is no free liquid and that gas generation is below the limits established in the applicable TRUCON content code. Packaged solidified ion exchange media shall be stored for a minimum of 4 days for CH-TRU Waste and 15 days for RH-TRU waste to allow concentrations of flammable gases in the headspace to reach equilibrium.

Portland cement used in grouting must meet American Society for Testing and Materials (ASTM) C150-02, "Standard Specification for Portland Cement." Blast furnace slag must meet ASTM C989-99, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars." Blast furnace slag (BFS) Grade 120 must be further specified to designate the fineness of the slag powder.

CH TRU Waste Requirements

1. TRU waste payload containers shall contain more than 100 nCi/g of alpha-emitting TRU isotopes with half-lives greater than 20 years.

2. The activity and mass of each of the following radionuclides shall be established on a payload container basis: Am-241, Pu-238, Pu-239, Pu-240, Pu-242, U-233, U-234, U-238, Sr-90, and Cs-137.

3. If the radionuclides listed in (b) do not account for at least 95% of the total waste product radioactivity, the mass and activity of additional radionuclides shall be determined until 95% of the waste product activity is accounted for.

4. Any payload container intended to be shipped as CH-TRU shall have a dose rate at the external surface of the container less than 200 mrem/h.

5. The ^{239}Pu FGE plus two times the associated total measurement uncertainty expressed in terms of one standard deviation shall be as shown in Table B-1.

Table B-1. Fissile gram equivalent limits.

Container Type	^{239}Pu FGE Limit
55 gallon drum	≤200
Standard Waste Box (SWB)	≤325
HalfPACT	TBD
TRUPACT II containing fourteen 55 gallon drums or 1 TDOP	≤325

6. The concentration of alpha-emitting TRU isotopes with half-lives greater than 20 years in the waste, exclusive of the packaging, shall be greater than 100 nCi/g.

7. The ^{239}Pu equivalent curie limits in a payload container shall be less than the values shown in Table B-2.

Table B-2. Payload container PE-Ci limits.

Waste Container	Packing Configuration	^{239}Pu FGE Limit
55 gallon drum in good condition	direct load, all approved waste forms	≤80
55 gallon drum in good condition	direct load, solidified/vitrified waste only	≤1,800

8. The sum of the decay heat for each payload container plus its TMU shall be less than or equal to the limits for the assigned shipping category.

9. The final payload container shall contain no detectable liquid.

10. PCB concentrations in wastes destined for WIPP shall not exceed 50 ppm.

11. CH-TRU grout shall be sampled to determine the hazardous waste code assignment by acceptable knowledge.

12. Flammable volatile organic compound (VOC) concentrations shall be less than 500 ppm in the payload container headspace.

13. The physical waste form for newly generated CH-TRU mixed homogenous solids waste shall be characterized by documentation and verification.

14. CH-TRU waste shall be packaged in DOT type 7A steel drums.

15. The gross weight of 55-gallon drums shall be less than 1000 lbs.

16. Surface contamination on loaded payload containers, payload assemblies, and packages shall not exceed 20-dpm/100 cm2 alpha and 200-dpm/100 cm2 beta-gamma.

17. Unvented payload containers shall be aspirated for a length of time as described in the TRAMPACT to assure equilibration of any gases that may have accumulated in the closed payload container.

18. Each 55-gallon drum payload container shall have one filter vent. Each SWB shall have two filter vents.

RH TRU Waste Requirements

1. The activity and mass of each of the following radionuclides shall be established on a payload container Basis: Am-241, Pu-238, Pu-239, Pu-240, Pu-242, U-233, U-234, U-238, Sr-90, and Cs-137.

2. If the radionuclides listed in (a) do not account for at least 95% of the total waste product radioactivity, the mass and activity of additional radionuclides shall be determined until 95% of the waste product activity is accounted for.

3. Any RH-TRU waste product payload container shall have a dose rate at the surface of the container greater than 200 mrem/h and less than 1000 rem/h.

4. The ^{239}Pu FGE in each payload container, plus its associated uncertainty expressed in terms of one standard deviation, shall be less than 325 ^{239}Pu FGE.

5. The TRU radionuclide alpha activity concentration, exclusive of the packaging, shall be greater than 100 nCi/g.

6. The ^{239}Pu equivalent curie (PE-Ci) quantities in a payload container shall not exceed 80 PE-Ci for direct loaded RH-TRU waste canisters and shall not exceed 240 PE-Ci for RH-TRU canisters loaded with three 30-gallon or 55-gallon drums.

7. The sum of the decay heat for each RH-TRU payload container plus its TMU shall be less than or equal to 50 watts per RH-TRU 72-B cask.

8. The loaded payload container shall contain no detectable liquid.
9. The hydrogen gas generation rate within each payload container shall not exceed the limit specified in the applicable content code. In any case, the hydrogen gas concentration within each payload container shall not exceed 5% by volume.
10. PCB concentrations in wastes destined for WIPP shall not exceed 50 ppm.
11. Concentrations of flammable VOCs in the payload container headspace shall not exceed 500 ppm. If calculations cannot show that the VOC concentration in the headspace is less than 500 ppm if all potentially flammable VOCs vaporized into the headspace, sampling of the containers shall be required.
12. The RH-TRU waste shall be placed in a WIPP approved RH-TRU waste canister.
13. The gross weight of a direct loaded RH-TRU canister shall not exceed 5250 lb.
14. Surface contamination on loaded RH-TRU payload containers, payload assemblies, and packages shall not exceed 20 dpm/100 cm2 alpha and 200 dpm/100 cm2 beta-gamma.
15. Each payload container shall have one or more filter vents. Any sealed secondary or internal container overpacked in the RH-TRU canister shall have one or more filter vents. Use of filter vents with metal internal containers greater than 4 liters in size that contain only solid inorganic waste is optional.

B-5.1.1.8 Transfer waste to WIPP.

1. CH-TRU waste shall be shipped over-the-road in a TRUPACT-II or in a HalfPACT package.
2. The maximum number of the 55-gallon drums in a TRUPACT-II is 14. The maximum weight of a TRUPACT II payload assembly of 14 55-gallon drums, including pallet, guide tubes, slip sheets (optional), reinforcing plates, and banding material is 7,265 pounds.
3. The payload container assemblies to be shipped in the TRUPACT-II must meet the center of gravity requirements specified in the CH-TRAMPAC. The external dose rate at the surface of the TRUPACT II shall be ≤200 mrem/h at the surface and ≤10 mrem/h at 2 m.
4. The maximum number of the 55-gallons drums in a HalfPACT is 7. The maximum weight of the HalfPACT payload assembly weight is 7600 lbs. The external dose rate at the surface of the HalfPACT shall be ≤200 mrem/h at the surface and ≤10 mrem/h at 2 m.
5. RH-TRU waste shall be shipped in a RH-TRU 72-B cask.
6. The maximum number of payload containers in a RH-TRU 72-B cask is one. The maximum weight of a loaded 72-B cask is 45,000 pounds.
7. A minimum of 4 + TBD days of storage of packaged solidified CsIX CH-TRU waste shall be provided to accommodate CH-TRU lag storage. A minimum of 15 + TBD days of storage of packaged solidified CsIX RH-TRU waste shall be provided to accommodate RH-TRU lag storage.

8. A cask loading station compatible with loading WIPP supplied TRUPACT II and HalfPACT casks delivered on WIPP supplied transport vehicles shall be provided. The facility shall provide the capability to receive the cask transporters in an enclosed area, raise the casks for loading, load the waste payload assemblies and close the cask on the transporters.

9. A cask loading station compatible with loading WIPP supplied RH-TRU 72-B casks delivered on WIPP supplied transport vehicles shall be provided. The facility shall provide the capability to receive RH-TRU 72-B cask transporters in an enclosed area, raise the cask for loading, load the waste payload assemblies into RH-TRU 72-B cask, and close and lower the RH-TRU 72-B cask onto the transporters.

B-5.1.1.9 Close Facility.

1. The CsIX TRU Grout Facility shall be placed in standby after treating SBW and NGLW waste.

2. Prior to December 31, 2012, the CsIX TRU Grout Facility shall have all hazardous waste and hazardous waste residues removed and placed in safe shutdown for future decommissioning.

3. The hazardous waste and hazardous waste residues shall be solidified and prepared for acceptable disposal prior to December 31, 2012.

B-5.1.2 Systems, Subsystem, and Major Components

This system shall utilize major support systems and utilities that are available at the INEEL. These include:

1. Analytical services.

2. Fire protection. This includes a manned fire station, central alarm system, and fire water lines near the waste treatment facility; it does not include fire protection within the physical structures designed and built or used by this project.

3. Electrical power. Both normal and standby electrical power are available for use near the INTEC Tank Farm from the INTEC electrical distribution system (EDS).

4. Steam

5. Telephone

6. Optical cable

7. Security

8. Medical

9. Radiation records

10. Central Facilities maintenance

11. Document control

12. Configuration management

13. Office buildings. The project shall provide adequate office space only for any operations staff, engineers, technicians, supervisors, and managers whose presence is required in the facility full-time during operations, plus limited turn-around office space.

14. Roads

15. Bus transportation.

B-5.1.3 Boundaries and Interfaces

B-5.1.3.1 Liquid Waste Retrieval Feed System. The liquid waste retrieval system interfaces with Tank Farm Operations. All operations within the tank farm will be the responsibility of Tank Farm Operations. Prior to operation of the SBW treatment facility, all tank waste shall be delivered to Tanks WM-180, WM-187, WM-188, and WM-189. Any changes necessary to retrieve the SBW liquids and solids from these tanks will be the responsibility of this project.

B-5.1.3.2 Utility Interfaces.

1. Electric power will be obtained from existing sources at INTEC. The project shall provide the necessary equipment for distribution of power within the facility. The use of existing standby, emergency, or uninterruptible power supplies at INTEC shall be evaluated as the first choice during conceptual design.

2. The project shall tie in to the existing INTEC steam distribution piping at an appropriate location adjacent to the facility.

3. The project shall tie in to the existing INTEC water systems piping (de-mineralized, de-ionized, distilled, fire water, etc.) at an appropriate location adjacent to the facility.

B-5.1.3.3 Sample Handling. Radioactive sample handling shall be compatible with the existing pneumatic sample transport system.

B-5.1.3.4 Tank Farm Closure Project. The system shall interface with the Tank Farm Closure Project. The Tank Farm Closure Project will sequentially remove all liquids and waste solids from the eleven Tank Farm tanks WM-180 through 190. The TFC Project will also clean the tanks to performance parameters, grout the tanks, piping and vaults, and close the tanks by December 2012 in accordance with the INTEC TFF Management Plan. The SBW Treatment project retrieves the wastes from tanks with the support of the TFC Project and treats it in the Direct Evaporation Facility.

B-5.1.3.5 Tank Farm Soils Project. The system shall interface with the Tank Farm Soils Project, which is responsible to remediate, as required, and close the Tank Farm under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) program. The Tank Closure Project shall coordinate all work scope with the INTEC CERCLA Environmental Restoration Program (WAG 3) to ensure no conflicts.

B-5.1.3.6 ETS, PEWE and LET&D Facilities. The treatment process will interface with the ETS located in the NWCF. Per current operations, it is expected that condensate from the ETS evaporator will be sent to the PEWE and PEWE condensate to the LET&D facility, located in CPP-1618. Any modifications required to ETS, PEWE or LET&D treatment equipment, or associated piping and instrumentation, will be the responsibility of this project. Operation of the ETS and LET&D facility and transfers of waste to and from the NWCF and/or LET&D facilities will be coordinated with the SBW Treatment Project but the responsibility of INTEC Operations.

B-5.1.4 Operability

The operability requirements for the SBW facility shall support the completion of SBW treatment project by December 31, 2012.

B-5.1.4.1 Operational Lifetime. The facility shall have an operational lifetime adequate to process all SBW and tank heel solids without replacement of any process piping or major system components (tanks, hoppers, reaction vessels, etc).

B-5.1.4.2 Installed Spares. Installed spares shall be provided for all rotating or reciprocating machinery located in remotely operated areas of the facility.

B-5.1.4.3 Annual Operation. The facility shall be designed to operate continuously for at least 200 days per year for at least 3 sequential years. Note that three-year window is based on a 6-month hot startup of the facility and a two and a half year processing period for the entire SBW and NGLW.

B-5.2 Assumptions

Process designs considered for the CsIX TRU Grout process have been based on the following major assumptions. Additional assumptions used in the mass balance are identified in Section B-5.5.

1. The SBW, both liquids and solids, and NGLW to be treated are not high-level waste.

2. The solidified SBW waste can be qualified for disposal at WIPP.

3. The existing ETS, PEWE and LET&D facility will be available for use if needed to process waste water.

4. Toxic Substance Control Act regulations do not apply.

5. The facility will not require NRC licensing.

B-5.3 Process Variations

Variations of the CsIX TRU grout process have been described in past studies (Raytheon, 2000; Valles, 1999; Losinski, 1998), and are briefly reviewed in Section 2.1. Variations in the CsIX TRU grout process could be categorized as differences in:

1. How tank solids are treated
2. How solids are filtered from liquid SBW
3. What sorbent is used to remove cesium
4. How the spent sorbent is treated
5. How the ion exchange effluent liquid is solidified
6. How the tank solids and spent sorbent wastes are disposed
7. What if any existing INTEC facilities are used.

In all processes proposed to date in which tank solids were processed, they were first filtered and then either dried or grouted, followed by packaging for disposal. Various types of filters and other equipment have been proposed for filtering both the tank solids, and the undissolved solids in the liquid SBW. One study (Raytheon, 2000) reviews various types of cartridge filters, centrifuges, hydroclones, Spintek filters and crossflow filters for separation of undissolved solids from SBW liquid.

Several studies have evaluated cesium sorbents for use in the CsIX TRU grout process (Todd, 2003; Tranter, 2003a, Tranter, 2003c; Kimmitt, 2003a). While the most recent of these recommend CST, development has shown that other sorbents are feasible. The method of treatment of spent ion exchange media depends, in part, on the particular sorbent used and also on its planned disposal site. The current process is based on disposal of the spent sorbent at WIPP as a remote handled TRU waste.

Alternatives to a Portland cement-based solidified waste form for the ion exchange effluent are possible. Waste loadings have been determined for adsorption of the ion exchange effluent on silica gel (Raman, 2003; Herbst, 2003). Ashworth compared the use of silica gel as an adsorbent to Portland-based grout based on 10 criteria (Ashworth, 2003). Although six of the ten criteria favor silica, the remaining four have higher weighting factors, and result in the recommendation of the grout waste form. An alternatively use of silica gel in the CsIX process involves an evaporation step of the waste-loaded silica gel. A process design for this scheme is contained in Barnes (2002a) and has been demonstrated by Kirkham (Herbst, 2002). Other solidification agents that have been reviewed for use in the CsIX process include clay-based binders and chemically bonded phosphate ceramics (Raytheon, 2000). During the Raytheon feasibility study, bench-scale solidification tests were performed using Metalplex, a clay-based waste solidification agent (Raytheon, 2000, Appendix F).

Early studies of the CsIX process considered the use of existing INTEC facilities for housing part of the process. However, Losinski (1999) found that meeting the 2012 treatment deadline was not feasible for the scenario of locating the high-radiation equipment in the NWCF. The same study identified eight other issues with using the NWCF for the CsIX process. Use of the FPR facility for the CsIX process has also been suggested, but no evaluation has been performed.

B-5.4 Basis for the Flow Diagrams

B-5.4.1 Waste Tanks (PFD-1)

PFD-1 shows the SBW feed tanks VES-WM-180, VES-WM-187, VES-WM-188 and VES-WM-189, and the NGLW tanks VES-WM-100, VES-WM-101 and VES-WM-102. These tanks currently exist and are in use. Tank WM-187 is being used to collect solids from flushing other Tank Farm tanks. According to current plans, solids from all but the SBW tanks will have been flushed to WM-187 by 2005. Thus, solids will settle in WM-187 over several years prior to the beginning of treatment. It is anticipated that flushing of WM-187 to treatment will be similar to flushing the heel of other tanks. Existing jets would be used to transfer waste out of the tank. A “wash ball” would be added to the tank to break up solids and entrain them into the flush water, which would be added as needed.

B-5.4.2 Tank Solids Separation (PFD-2)

In an evaluation of methods to remove undissolved solids from SBW liquid, Raytheon recommended the Fundabac filter (Raytheon, 2000, Appendix E). Their evaluation was based on six criteria that included the state of process development of the separation method, the process and mechanical complexity, the operability and dose rate, the life cycle cost and impacts to the schedule. In later development of the CsIX process (Barnes 2002a; Ashworth, 2003), the Fundabac filter was retained for removal of SBW solids because of the advantages identified by Raytheon, as well as the ability to dry the solids in place on the filter rather than needing a separate drying step.

Initial demonstration tests of a laboratory (0.13 ft^2) Fundabac filter were performed in 2000 (Raytheon, 2000, Appendix F). These tests used 0.1 wt%, 0.3 wt% or 5 wt% of ZrO_2, SiO_2, TiO_2 and a mixture of these solids in 30 wt% $NaNO_3$ adjusted to pH 2 with nitric acid as the SBW simulant. In eight runs of various concentrations and combinations of solids, a clear filtrate was obtained in 0.5 to 4 minutes.

Additional filtration tests pertaining to Fundabac filtration were performed in 2003 by Jenn-Hai Pao and Russel Lewis (Pao, 2003). The SBW simulant for these tests utilized a liquid composition based on Tank WM-180 analysis and solids prepared by a metathesis procedure. The filtration apparatus consisted of 600 ml filtration cylinder, a filtrate collection vessel, a pressurized air supply, an air heater, a pressure regulator and a mass flow meter. Two types of filter cloths, polyvinylidene fluoride and polypropylene sulfide were used in the tests. Conclusions from the tests included:

- The removal of solid particles from the SBW slurry is feasible and will result in low moisture content dry cakes that separate from the filter cloth.

- Without filter-aid, the filter cake from SBW-solids simulant was found to have low-moderate compressibility and high resistance; higher filtration pressures lead to higher filtration rates.

- Without cake washing, the low moisture content relatively hard cakes from filtering the SBW-solids simulant were easily separated from the filter medium.

B-5.4.3 SBW Filtration and Cesium Removal (PFD-3)

PFD-3 includes equipment to remove solids and cesium from waste from Tanks WM-180, WM-188 and WM-189. Solids are removed by a crossflow filter, cesium is removed by CST sorbent contained in a series of ion exchange columns.

Several types of filters could be used to remove the small amount of solids in the feed waste. Crossflow filtration was first recommended for the CsIX TRU grout process in 1999 (Valles, 1999) in a study that compared four filtration methods. Testing of a crossflow filter using actual Tank Farm waste was performed in 1997 (Tripp, 1997) and concluded that crossflow filtration was feasible.

As mentioned in Section B-5.3, several studies have evaluated cesium sorbents for use in the CsIX TRU grout process (Todd, 2003; Tranter, 2003a, Tranter, 2003c; Kimmitt, 2003a). While other sorbents are feasible, CST is the most common recommendation of these studies because of its demonstrated performance using SBW simulants and its commercial availability.

The basis for the number of ion exchange columns and the method of loading fresh media and processing spent media is given in Kimmitt (2003b). The number of columns is based on achieving the required cesium removal efficiency and producing an acceptable spent sorbent waste while minimizing the frequency of column changeout. Likewise, operational factors are of primary concern in determining the methods of column loading and spent column. Loading and preparing each column is done in a cold area rather than the alternative of sluicing and backwashing sorbent into an installed column in the hot cell. Likewise, packaging the entire column as waste involves fewer steps than sluicing spent sorbent into a different vessel for drying, following by then either disposing of that container or transferring the dried waste sorbent into a canister.

B-5.4.4 IX Effluent Grouting (PFD-4)

The equipment to grout the ion exchange effluent is shown on PFD-4. Storage and transfer vessels are shown for grouting ingredients based on the optimum grout formulation developed at the INEEL for this waste (Herbst, 1999; Herbst, 2000; Herbst, 2002; Raman, 2003). This formulation includes Portland cement, calcium hydroxide and blast furnace slag. Equipment is shown to mix these ingredients prior to mixing them with the SBW ion exchange effluent.

The method of mixing the dry ingredients with the liquid ion exchange effluent has been the subject of several studies (Raytheon, 2000; Williams, 2003; Ashworth, 2003). Both an in-drum, lost paddle approach and out-of-drum mixers have been evaluated. Based on the most recent study (Ashworth, 2003), the PFD shows out-of-drum mixing. This and previous evaluations show that either method of mixing is feasible and neither have major advantages over the other. Out-of-drum mixing was selected for the flowsheet because of small advantages in waste volume/cost, process operability and plant layout. Demonstration tests of an out-of-drum (Readco) mixer were first performed in 2000 (Raytheon, 2000, Appendix F). Further tests using a 6-inch diameter Autocon mixer were performed in 2003 (Scholes, 2003).

B-5.4.5 ETS, PEWE and LET&D Fractionator (PFD-5, PFD-6, and PFD-7)

The ETS, PEWE and LET&D are existing INTEC processes that have operated successfully for many years. The ETS, rather than the PEWE, is used to concentrate waste water because the PEWE has feed acceptance criteria that would require high dilution ratios. This in turn would multiply the operating time and the energy requirements. However, the PEWE is then used to concentrate the ETS concentrate to provide the decontamination needed prior to fractionating the condensate in the LET&D.

B-5.5 Basis for the Mass Balances

Mass balances were developed for the CsIX TRU grout process to provide a basis for sizing equipment, determining feed chemical requirements, determining utility requirements, estimating emissions and determining waste volumes, compositions and properties. The sections below document the basis for the mass balance. The basis is capsulated in succinct statements, called "design basis elements" (DBEs), shown in italics in the following paragraphs. The DBEs are amplified with background information, references, explanation, and, in some cases, a discussion of uncertainties.

B-5.5.1 Feeds

Feeds to the CsIX TRU grout process include NGLW and SBW from the INTEC TFF. According to present Tank Farm management plans (Barnes, 2002b), waste presently in the TFF tanks will be consolidated into four tanks, WM-180, WM-187, WM-188 and WM-189, by the end of 2005. Tanks WM-180, WM-188 and WM-189 will contain liquid SBW with relatively small quantities of undissolved solids, while WM-187 will be used as a collection tank for solids and dilute liquid wastes. Waste generated after 2005 will be collected in WM-100, WM-101 and WM-102.

Mass balances are shown in Section B-6 for four liquid feed cases and one solids feed case. The liquid feed cases correspond to present estimates of waste quantities and compositions in Tanks WM-180, WM-188, WM-189 and a combined NGLW feed. The mass balance shows these wastes processed through the liquid treatment equipment. Waste from Tank WM-187 is processed through the solids treatment equipment.

DBE #1: Four waste compositions, corresponding to waste in Tanks WM-180, WM-188, WM-189 and a combined NGLW, are assumed to adequately envelope the liquid waste fed to the SBW Treatment Facility for conceptual design purposes. Waste in Tank WM-187 is assumed representative of the solids waste.

Table B-3 shows the variability of feed composition between the tanks for major species. Variation in feed composition in addition to what is shown in Table B-3 could be due to (a) uncertainties in sample analyses and (b) uncertainties in NGLW quantity and composition. However, the magnitude of these uncertainties is small compared to the range in concentration of a species from tank to tank. Feed composition uncertainties and expected composition ranges are discussed in more detail by Barnes (2003).

The estimated quantity of solids in Tank WM-187 is 100,000 kg (Barnes, 2003). The estimated quantity of solids present in all the liquid tanks, including NGLW, is about 22,000 kg (Barnes, 2003). Solids removed by the crossflow filter and solids in the heels of the liquid tanks will periodically be added to the Solids Decant Tank and fed to the solids treatment equipment. However, because the quantity added will be small relative to the amount of solids coming from WM-187, and analyses of solids from different tanks (see Barnes, 2003) shows the composition of solids from tank to tank is somewhat similar, the composition of solids in WM-187 should be adequate for the design of treatment equipment. It should be noted that the solids composition could vary from what is shown in the material balance not only because of the addition of solids from other tanks but also because of uncertainties in solids analysis and unrepresentative solids samples. However, the solids treatment equipment is very insensitive to solids composition, dependent more on physical properties.

Table B-3. Feed concentration variations.

	Minimum mol/liter	**Maximum mol/liter**	**Max/Min Ratio**
H+	1.12	4.10	3.65
Al+3	0.14	0.71	4.96
Ca+2	0.014	0.07	5.13
Cs+	1.0E-05	2.9E-05	2.91
Cl-	0.011	0.030	2.81
F-	0.014	0.042	3.09
Fe+3	0.006	0.027	4.33
Mg+2	0.011	0.022	1.95
Mn+4	0.013	0.022	1.67
NO_3-	5.16	7.52	1.46
PO_4-3	0.0004	0.013	32.45
K+	0.18	0.73	3.95
Na+	1.43	2.04	1.43
SO_4-2	0.015	0.11	7.25
U+4	0.0004	0.011	30.54

B-5.5.2 Stream Factor, Operating Schedule and Feed Rate

The Technical and Functional Requirements (Barden, 2003) specifies a 3-year processing time that includes six months of hot start up. A stream factor of 200 days per year is assumed. The mass balance is based on a feed rate of 5% in excess of that required for continuous processing to allow for down time at the end of processing liquid while tank heels would still be processed or for processing additional waste. The average feed rate is thus:

972,300 gal x 1.05 / (2.5 yrs * 200 d/yr * 24 hr/day) = 85 gal/hr or 1.4 gal/min

The feed rate of slurry to the solids processing equipment is based on a total flush water volume of 654,000 gallons (414,000 for WM-187 and 80,000 each for three other tanks) (see Section B-5.5.5 for the basis for the flush water volume). The corresponding total volume of slurry to treatment is:

753,100 gal x 1.05 / (2.5 yrs * 200 d/yr * 24 hr/day) = 65.9 gal/hr or 1.1 gal/min

DBE #2: The total liquid and solids waste inventory will be processed over 2.5 years, during 200 24-hr operating days per year. The average liquid feed rate of 1.4 gpm. The average feed rate to solids treatment is 1.1 gpm.

B-5.5.3 Feed Transfers from Tank Farm

Transfers from the Tank Farm will be made using existing steam jets. Based on past operation, dilution of the feed with steam is equivalent to about 5%.

DBE #3: A dilution of 5 vol % is assumed for waste transferred from the Tank Farm due to steam condensate from jet transfer.

B-5.5.4 Processing Temperature

All processing in the CsIX TRU Grout Facility except waste drying steps are expected to be done at or near ambient temperature. Heat generated during liquid feed neutralization will be removed by cooling water plus heat losses and heat generated during grout mixing and curing will be dissipated by heat loss over time. The maximum temperature reached during grout mixing is estimated to be approximately 48^{o}C (Ashworth, 2003).

DBE #4: Processing in the CsIX TRU Grout Facility will occur at or near ambient temperature.

B-5.5.5 SBW Solids Treatment

A brief evaluation was performed to determine the volume of slurry to the solids treatment equipment. The following are constraints on the design and operation of lines and equipment to transfer and treating the tank solids:

- *Waste Transfers:* The solids loading must be below about 100 g/L (as total suspended solids [TSS] and UDS) to prevent line/nozzle plugging (Wood, 2002).

- *Tank Cleaning:* Enough flush water must be used to remove solids. Data obtained from mock up cleaning tests (Poloski, 2001) was used to estimate the amount of flush water to remove solids from WM-187 based on this criteria. Recent flushing experience for Tanks

WM-182, WM-183 and WM-185 indicates that 80,000 gal per tank is adequate and this amount was assumed for the three SBW tanks.

- *Pumping Slurry to Filter:* Based on previous testing at the INEEL of separation methods for use for INTEC wastes (Tripp, 1997), the maximum amount of solids in the feed to the Fundabac® filter is 20 wt%, as this is about the maximum solids loading that can be pumped.

- *PEWE WAC:* The solids/flush water from the Tank Farm will be received by a Solids (decant) Tank in the CsIX TRU Grout Facility. If the decanted liquid ("supernate") and filtrate from the Fundabac® filter is then fed to the PEWE:

  - The waste water must meet the PEWE waste acceptance criteria (WAC) (PRD-166). Table B-4 provides non-RCRA limits for feed concentrations. The gross β was determined by summing all components that have numerical β energies.

  - The feed rate to the PEWE must not exceed about 30,000 gal/week.

- *ETS WAC:* If the supernate and filtrate were to be processed in the ETS, the following constraints would need to be met:

  - The maximum bottoms free HF at boiling temperature is 50 mg/L for corrosion control (bottoms Al/F ratio is greater than about 3) (PLN-17).

  - The maximum ETS bottoms temperature is 117oC to prevent red oil formation (TSR 3.103.1-B)

  - The maximum ETS bottoms density is 1.35 Sp. G. (based on the TFF design specification)

  - The ETS feed rate is typically one 4,400 gal batch per day. The operating permit limits the feed input to 10,000 gal per day (TPR-7112).

A comparison of tank farm liquid compositions to the PEWE Waste Acceptance Criteria and are shown in Table B-4. Calculations of required dilution assume that the initial solids concentration in the heel is 16 vol% (Barnes, 2003). The maximum ratio to the PEWE limits for each tank shown in bold italics. Table B-4 shows that SO_4^{-2} has the highest ratio to the limit for all of the tanks. These calculations indicate that dilution factors of 4.5 (for WM-187 heel) to 103 (for WM-189 heel) would be required for the supernate solutions to meet the PEWE WAC limits.

Table B-5 provides the volumes required to meet the worst case for processing supernate in the PEWE. All cases are based on diluting the sulfate to meet the PEW WAC except for tank WM-187, which has a maximum flush volume of 414,000 gal based on the mock up test results (Poloski, 2001). The total volume over the assumed 2.5-year treatment period does not exceed the planning rate of 30,000 gal/wk., i.e., the processing rate is 55,000 gal/month.

Table B-4. PEW WAC limits compared to Tank Farm liquid compositions before dilution with flush water.

Component	Limit	WM-180		WM-187		WM-188		WM-189	
	mg/L	mg/L	Ratio	mg/L	Ratio	mg/L	Ratio	mg/L	Ratio
Al	2600	1.63E+04	6.28	9.66E+02	0.37	1.51E+04	5.80	19200.00	7.38
B	75	1.16E+02	1.55	2.23E+01	0.30	1.89E+02	2.52	229.00	3.05
Ce	200	6.25E+00	0.03	2.50E-01	0.00	3.88E+00	0.02	4.92	0.02
Cs	200	1.33E+00	0.01	2.58E-01	0.00	3.85E+00	0.02	3.56	0.02
Cl	50	1.07E+03	21.30	5.62E+01	1.12	9.42E+02	18.85	729.00	14.58
Cu	150	4.18E+01	0.28	7.03E-01	0.00	4.13E+01	0.28	60.60	0.40
F	200	8.06E+02	4.03	2.11E+02	1.06	3.33E+02	1.67	261.00	1.31
Mg	250	2.76E+02	1.10	5.39E+01	0.22	5.01E+02	2.00	537.00	2.15
Mn	150	7.31E+02	4.87	8.52E+01	0.57	8.51E+02	5.68	1070.00	7.13
Hg	80	2.70E+02	3.38	2.45E+01	0.31	1.21E+03	15.14	1300.00	16.25
Mo	150	1.74E+01	0.12	7.75E-01	0.01	2.14E+01	0.14	26.90	0.18
Ni	130	8.48E+01	0.65	9.80E+00	0.08	1.08E+02	0.83	136.00	1.05
PO_4	950	2.74E+02	0.29						
Pu	5	4.84E-01	0.10	1.36E-01	0.03	1.05E+00	0.21	0.93	0.19
K	39000	7.20E+03	0.18	6.19E+02	0.02	1.36E+04	0.35	8800.00	0.23
Si	20	8.48E-03	0.00	4.55E+00	0.23	1.67E+01	0.84	8.64	0.43
Na	23000	4.54E+04	1.98	2.60E+03	0.11	3.28E+04	1.43	46900.00	2.04
SO_4	100	4.96E+03	***49.7***	4.49E+02	***4.49***	2.68E+03	***26.8***	10300.00	***103.***
Zn	100	6.48E+01	0.65	7.17E-01	0.01	5.27E+01	0.53	69.90	0.70
U-235	20	1.83E+01	0.91	8.25E-01	0.04	4.39E+01	2.20	27.80	1.39
	mCi/L	**mCi/L**	**Ratio**	**mCi/L**	**Ratio**	**mCi/L**	**Ratio**	**mCi/L**	**Ratio**
Gross beta	4.50	4.71E+01	10.45	1.03E+01	2.28	5.58E+01	12.39	90.31	20.05

Alternatively, the supernate could be processed in the ETS. In this scenario, the ETS condensate would be processed in the PEWE, and the PEWE condensate processed through LET&D Facility. Bottoms products from the two evaporators and the LET&D fractionator would be collected in the NGLW tanks.

Most previous ETS operation used relatively concentrated feeds with boil-down ratios of at most 4 to 1; however, the ETS has recently been successfully evaporating dilute decanted tank flush solution from WM-187 at high boil-down ratios. Therefore, evaporation of dilute solutions such as the supernate in the ETS has been successfully demonstrated.

Table B-5. Limiting case volumes for processing supernate in PEWE.

	WM-180	WM-187	WM-188	WM-189
Liquid Density, kg/L	1.26	1.01	1.3	1.33
Floor Volume, gal	4128	82563	4128	8256
Liquid Volume, gal	3468	69353	3468	6935
Height on floor, in	3.37	67.45	3.37	6.74
Expected mass (solids), kg	5000	100000	5000	10000
Flush Volume @ 80kgal/tank, gal	80000	80000	80000	80000
Flush Volume by EDF-15722-048, gal	35000	414029	30201	50403
Flush Volume to meet PEW WAC, gal[a]	168700	242108	89537	707398
Flush Volume to prevent plugging, gal	11598	231962	11598	23196
Limiting/Worst Case Volumes for PEWE Processing				
Total liquid volume/tank, gal	172167	483381	93004	714333
Total volume/tank, gal	172828	496592	93665	715654
PEWE Operating time, month	3	9	2	13
TSS in feed to clarifier, g/L by limiting case	8	55	14	4
Wt% by limiting case	0.77%	5.47%	1.42%	0.37%

a. PEW WAC for $SO_4^{=}$ of 100 mg/L

The tank flush solutions after solids removal for the three different flush volume cases and for all four tanks were evaluated in the same ASPEN ETS model (Nenni, 2003) used for evaluating ETS feeds for the HLLWE Operational Run Plan (PLN-17). This model also calculates flows and concentrations for processing the resulting ETS condensate through the PEWE and LET&D. The resulting net waste volumes after processing the supernates through the ETS, PEWE, and LET&D are summarized in Table B-6. Note that the ETS was evaluated for three cases – the flush water volume based on (a) 80,000 gallons per tank, (b) tank mock test results (Poloski, 2001), and (c) the criteria to prevent line plugging.

For all tanks but WM-187, none of the cases challenged the limits for bottoms from ETS or condensate to PEWE. The flush water volume impacted the final liquid waste volume for each tank by less than 13%. In general, the final waste volumes were very close to the original tank farm heel liquid volumes, with WM-189 being the worst case, requiring a 25% increase in liquid waste volume. For WM-187, the original heel liquid is already quite dilute even without flush water addition since it has received heel flushes from WM-182, 183, 185 and 186, but the boil-down in the ETS was limited by the 100 g/L solids limit to prevent plugging in bottoms collection tank NCC-119 or in transfer lines. Net waste volumes for WM-187 might decrease if more than 95% of the heel solids are removed from the tank flush solution in the settler/clarifier.

Although past ETS condensates usually required dilution with other wastes to meet the PEW limit of 50 mg chloride per liter, the ETS condensates from processing the supernates can all be sent directly to PEWE without dilution with other wastes.

Based on this review, the mass balances are based on 414,000 gallons of flush water to transfer solids from tank WM-187 and 80,000 gal for each of the other tanks. If actual volumes used prove less than these, the feed rate the Solids Tank will be less than shown in the mass balance and less waste water will be processed in the ETS, PEWE and LET&D.

Table B-6. Calculated liquid waste volumes after ETS/PEWE/LET&D processing of tank flush supernate.

Original Supernate Volumes:	**WM-180**	**WM-187**	**WM-188**	**WM-189**
Flush + Tank Liquid Volume @ 80kgal per tank, gal	83,468	149,353	83,468	86,935
Flush + Tank Liquid Volume from EDF-15722-048, gal	35,003	483,380	30,204	50,410
Flush + Tank Liquid Volume to prevent plugging, gal	16,598	331,962	16,598	33,196
Final Volume of ETS Bottoms, PEWE Bottoms, and LET&D Bottoms:				
Volume from Flush Volume @ 80kgal per tank, gal	3,574	15,507	3,768	8,541
Bottoms Volume from Flush Volume by EDF-15722-048, gal	3,278	18,143	3,533	8,663
Bottoms Volume from Flush Volume to Prevent Plugging, gal	3,161	16,672	3,485	8,480

Note: The remainder of the liquid volume is water that is vaporized and discharged from LET&D to the main INTEC stack.

B-5.5.5.1 Solids Content of Slurry Feed. The solids content of waste transferred from WM-187 to the Solids Tank will vary. The estimated total amount of solids in the waste tanks is 120,000 kg. Thus the average solids concentration of solids in the slurry feed is:

$$120{,}000 \text{ kg} \times 1000 \text{ g/kg} / (753{,}100 \text{ gal} \times 3.785 \text{ liters/gal}) = 42 \text{ g/liter}$$

DBE #5: Waste from Tank WM-187 will have an average undissolved solids content of 42 g/liter.

B-5.5.5.2 Decant Tank. The decant tank is sized to allow settling of 95% of the solids fed to the tank. After settling and decanting the average solids concentration of the tank contents will be 20 wt%. According to recent data for WM-187 solids, it takes approximately 16 days to settle ⅓-½ of the solids. The settling velocity of a 2 µm particle is 2×10^{-6} ft/s based on the wet density and the Stokes Law region verifying a lengthy settling time. Based on this data flocculation is required to achieve reasonable settling times. A pH adjustment will result in flocculation due to aluminum hydroxide precipitation. Adding sufficient sodium hydroxide to bring the pH to about 5 is expected to increase a 2-µm particle to 5 µm and reduce the settling time (for 95% of the particles) to 30 hours.

DBE #6: The mass balance assumes settling of 95% of the solids fed to it with the settled solids having an average concentration of 20 wt%. Settling will require 30 hours.

B-5.5.5.3 Solids Filtration. Filtration efficiency for the Fundabac filter will depend on several variables. A PVDF fabric can be specified as 1 µm nominal. Since the particle distribution for WM-183 has 98.88% greater than this size, a reasonable assumption for the filtration efficiency is 98%.

Based on FY 2003 filtration studies (Pao, 2003), the mass balance assumes no filter aid is added to the filter feed. The process maintains the capability to add filter aid until more complete testing can be performed.

DBE #7: The Fundabac filter is assumed to remove 98% of the solids fed to it, and will require no filter aid.

B-5.5.5.4 Solids Drying.

DBE #8: Solids are dried to a moisture content of 25 wt%. It is assumed this water content will meet the WIPP WAC for no liquids.

B-5.5.5.5 Wet Filter Cake Volume and Dry Density. The solids filter is designed to collect 100 liters of solids. The dried filter cake is assumed to occupy the same volume and have a density of 0.68 g/cm^3. This density is based on a measured density of a sample of solids, washed and dried, taken from WM-187 in FY 2004. It is not known whether the dried filter cake density will differ from this value.

DBE #9: The filter cycle is based on collecting 100 liters of solids. Removing water to 25 wt% is expected to reduce the density to 0.68 g/cm^3.

B-5.5.5.6 Solids Packaging. The solids will be packaged in WIPP RH TRU canisters, which have a capacity of 0.89 m^3. On average, the solids waste will fill 90% of the canister volume, or 0.8 m^3. Approximately 2 inches of silica gel, equivalent to 0.015 m^3 per canister will be added on top of the waste.

DBE #10: The solids waste volume is assumed to average 0.8 m^3 per canister.

B-5.5.6 SBW Liquid Treatment

B-5.5.6.1 Neutralization. Neutralization of the liquid feed is required to minimize degradation of CST by the acidic waste. Neutralization of the feed with caustic to a pH of 0.5 has been shown to result in acceptable CST performance (Tranter, 2003a; Tranter, 2003d).

DBE #11: SBW liquid will be neutralized in the receiving tank to a pH of 0.5 using 50 wt% NaOH.

B-5.5.6.2 Filtration. The nominal filter pore diameter is 0.5 μm and 99.94% of the particles are greater than this size based on the particle size distribution for WM-183. While the filtration solids removal efficiency is a function of several variables, a removal efficiency of 99% is reasonable based on present data.

DBE #12: The crossflow filter will remove 99% of the undissolved solids in the SBW and NGLW feeds.

The recirculation rate provides the high axial velocity required for the system. The vendor's range is 5-15 ft/s. The midpoint of 10 ft/s corresponds to 130 gpm and was assumed for the mass balance. Other crossflow design parameters were based on scale-up from test data (Mann, 1998), and scale-up based on shear stress would indicate a velocity of 6.25 ft/s.

Permeate is based on testing of filtration of dissolved calcine (Mann, 1998). These tests, using a feed with 2.44 wt% solids, showed a filtrate flux of 0.04 gpm/ft^2 at a pressure of about 33 psig. Based on this flux, 2 MOTT filter systems are required to obtain the required permeate flow of 315 L/hr.

These parameters of circulation rate, pressure, permeate flux and solids concentration will need to be optimized during start-up. Permeate flux increases with increasing pressure and decreasing solids concentration. In addition, it is not known if SBW solids will behave like undissolved calcine particles.

DBE #13: The crossflow filter circulation rate is based on a velocity of 10 ft/s. The permeate rate is based on a flux of 0.04 gpm/ft^2.

B-5.5.6.3 Ion Exchange. The mass balance assumes a 90% cesium removal efficiency for each ion exchange column, thus the total cesium removal efficiency is 99.9%. This removal efficiency is based on the requirement to produce a CH waste and on test results at both bench- and intermediate-scale. The most recent bench-scale dynamic tests used a 2-cm^3 column (Tranter, 2003a). Tranter (2003a) shows breakthrough curves - plots of effluent to feed cesium concentration ratios, C/Co, versus bed volumes - for flow rates of 5 and 10 bed volumes per hour and using a simulant for Tank WM-189 waste. Similar breakthrough curves were obtained earlier for a different SBW stimulant (Mann, 2000).

A bench-scale test using a larger column (500 cm^3) was recently completed and provided an additional breakthrough curve for Tank WM-189 simulant (Tranter 2003d). This test was conducted to support design efforts, specifically to compare the models developed from the 2 cm^3 column with those based on the 500 cm^3 column.

Two models have been developed to design the ion exchange column based on test data (Kimmitt, 2003c). One model solves material balance and mass transfer differential equations using a finite difference method. An iterative approach is applied to obtain agreement between the model output and experimental breakthrough curves. The second model uses the experimental breakthrough data to estimate an effective distribution coefficient, K_d. The ion exchange column is modeled as equilibrium stages in series using K_d, which is constant over the range of interest.

The modeling procedures have been applied to the 2 and 500 cm^3 test results (breakthrough curves). The key parameters in both models are nearly the same for the two sets of tests (Kimmitt 2003d). The effective distribution coefficient, K_d, for the equilibrium model was 0.513 and 0.497 for the 2 and 500 cm^3 tests, respectively. Figure B-2 shows the 500 cm^3 column data plotted with the equilibrium model results for the different K_d values. Very little difference is seen in predicted column performance for the differing K_d values, particularly at low cesium effluent concentrations. For the mass transfer model, the adjusted mass transfer coefficient, k_pa, was 0.0035 for both column sizes, therefore predicted curves for the mass transfer model would be exactly the same for either sized column. The significance of having the key parameters being very nearly the same for different column sizes is that this suggests the models can predict breakthrough curves independent of column size – in other words, one set of breakthrough curves can be used to infer column behavior when plotted as shown in Figure B-3 below. The inference is that the models can provide reasonable scale-up for larger systems, with the restriction that liquid flow rates be approximately 10 BV/hr. The specific design information of interest would include column sizing, liquid throughput, and change-out schedule for operating to a pre-determined cesium breakthrough value (Kimmitt 2003b).

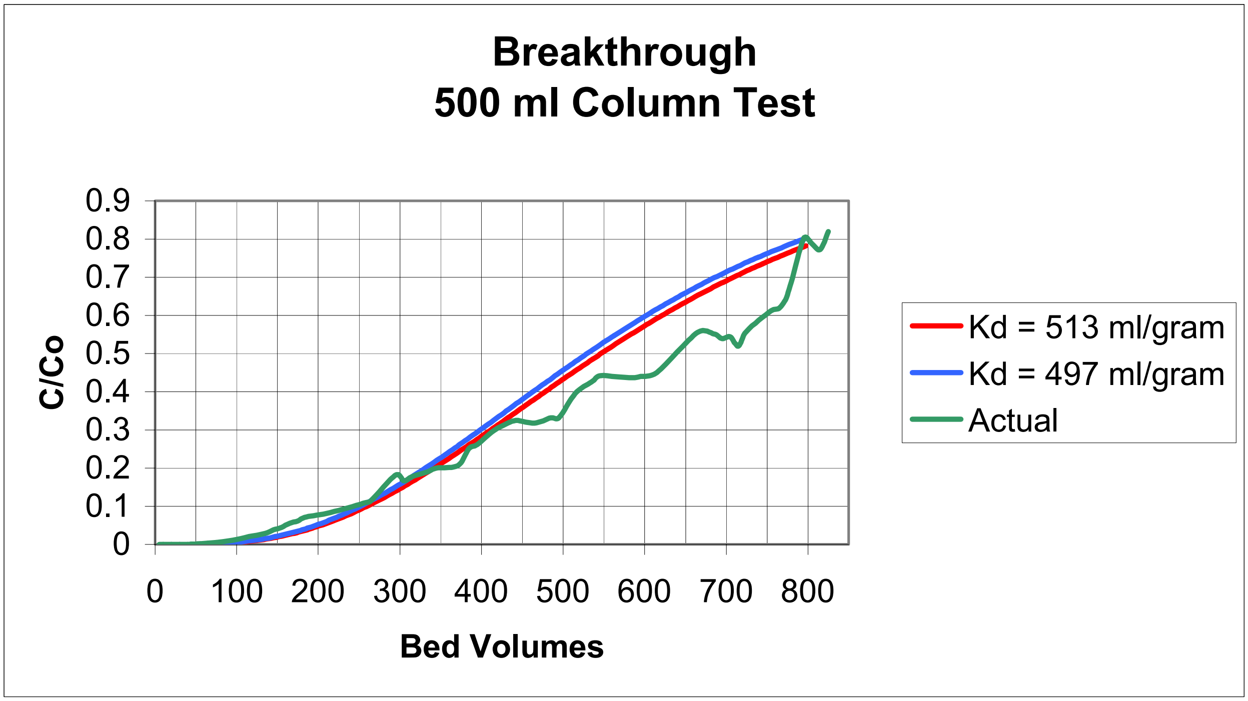

Figure B-2. Comparison of actual 500 cm^3 column data with the K_d values for the 2 and 500 cm^3 column equilibrium models (Kimmitt 2003e).

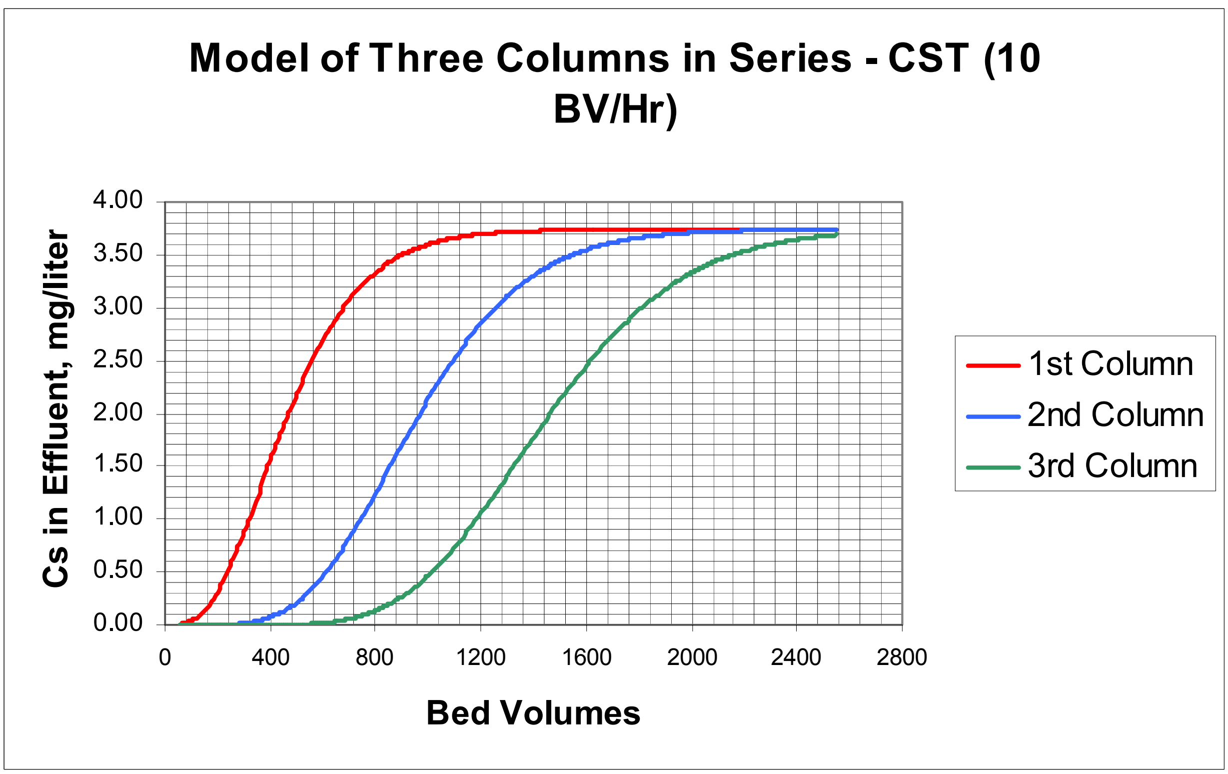

Figure B-3. Typical breakthrough curves for a series of three columns of CST removing Cs (Kimmit 2003b).

Figure B-3 was generated from the equilibrium model and shows the behavior of a set of three columns of CST resin operated in series. Details are given in the referenced report, but generally the curves show that when fed with a solution containing cesium with about 3.5 mg/L at a rate of 10 BV/hr, the effluent from the third column will be nearly free of cesium until about 500 bed volumes of liquid are treated (Kimmitt 2003b). When the cesium level in the effluent from the third column reaches a pre-determined "breakpoint" value, the lead column is removed from service and a fresh column placed at the end of the series. Cascading columns in this manner allows the lead column to become nearly saturated with cesium, while maintaining low cesium levels in the process effluent.

Nick Mann obtained breakthrough curves not only for cesium, but also for ^{241}Am, Hg, Ba, Ca, Cd, Cr, Eu, Fe, K, Mn, Mo, Na, Ni, Pb, and Zr (Mann, 2000). These data show that sorption of all species except cesium is negligible and can be assumed to be zero.

DBE #14: The ion exchange columns will remove greater than 99.9% of the cesium in the feed SBW. The mass balance is based on this minimum removal efficiency. Removal of all other species by the columns is assumed to be zero.

Isotherms for CST have been determined by Tranter (2003d) and Mann (2000). These data, as shown in Table B-7, have been used to determine cesium capacities for CST.

Table B-7. Isotherms for CST.

Waste	Cs in waste (mg/liter)	CST capacity (mg/g CST)
WM-180	1.34	1.22
WM-188	3.87	2.52
WM-189	3.59	2.40
NGLW	2.94	2.09

DBE #15: The mass balance assumes sorbent cesium capacities of 1.22 to 2.52 mg Cs/g CST depending on the waste feed.

The volume of sand at the bottom of the columns is 0.9 ft^3. The corresponding sand height of 6-inches is assumed sufficient to capture fines from eroded media. The small amount of particles passing through the cross-flow filtration elements will be captured, likely due to Brownian motion mechanisms onto the media so that the effluent from the columns will be virtually particle free.

DBE #16: A sand volume of 0.9 ft^3 in the ion exchange column is assumed sufficient to capture all residual SBW solids and eroded media particles.

CST has an "as-shipped" bulk density of 60 lbs/ft^3 (UOP). The particle density is 2.44 g/cm^3 (UOP).

DBE #17: The bulk density of CST is 60 lb/ft; the particle density is 2.44 g/$cm^{3.}$

Washing with ten bed volumes (600 gallons) is assumed sufficient to reduce the acidity of the spent ion exchange media to levels meeting WIPP WAC.

DBE #18: The spent ion exchange media will be washed with 10 bed volumes of water.

The spent ion exchange media requires drying to meet the WIPP criteria for "no free liquids" and to minimize radiolytic hydrogen generation in the waste package. While the moisture level to satisfy the second requirement cannot be determined until a waste code has been assigned to the waste, based on a review of other wastes disposed at WIPP, a moisture level of 25 wt% is expected to meet the requirement.

DBE #19: The spent ion exchange column beds will be dried to a moisture content of 25 wt% or less.

After drying the ion exchange column bed, the entire column will be loaded into a RH-TRU waste canister for interim storage and disposal.

DBE #20: Spent ion exchange columns will be disposed in RH-TRU waste canisters, one column per canister.

B-5.5.6.4 Grouting. Based on the most recent SBW grout testing (Raman, 2003), different waste loadings are recommended for the different tank wastes. For Tank WM-180 waste, a waste loading of 72 wt% was recommended, while for Tank WM-189 waste, a waste loading of 68 wt% was recommended (Raman, 2003). However, when based on the waste after partial neutralization, the waste loading is the same for these two wastes. The recommended formulation for both WM-180 and WM-189 wastes includes 7 wt% $Ca(OH)_2$, 6 wt% BFS and 12 wt% Portland cement. The product density using this formulation was 1.47 and 1.53 g/cm^3 respectively. The mass balance uses a grout density of 1.5 g/cm^3 for all tank wastes, the average of these two experimentally determined densities.

DBE #21: The grout formulation is 75 wt% waste partially neutralized with 50% NaOH, 7 wt% calcium hydroxide, 6 wt% blast furnace slag and 12 wt% Portland cement. (Note: the NaOH is added upstream of filtration and ion exchange.) This density of waste grouted with this formulation is 1.5 kg/m^3.

The mass balance assumes bulk densities of calcium hydroxide, blast furnace slag and Portland cement of 480 kg/m^3, 1200 kg/m^3 and 1200 kg/m^3 respectively. The density of calcium hydroxide is the average of densities for $Ca(OH)_2$ from three suppliers. The density for blast furnace slag was also based on supplier literature and is a typical density for packed, air-cooled blast furnace slag. The density for Portland cement is consistent with manufacturers' literature for aerated ordinary Portland cement.

DBE #22: The mass balance assumes bulk densities of 480 kg/m^3, 1200 kg/m^3 and 1200 kg/m^3 for calcium hydroxide, blast furnace slag and Portland cement respectively.

Grout will be packaged in 55-gal drums. The mass balance assumes a fill volume of 0.2 m^3, equivalent to approximately 94% of the capacity of standard 55-gal drums.

DBE #23: The mass balance assumes a grouted waste volume of 0.2 m^3 per drum.

B-5.5.7 Waste Water Treatment

B-5.5.7.1 ETS and PEWE Feedrate. Based on past operation, the ETS will process about 10,000 gallons of waste water per day, and the PEWE about 4,500 gallons per day.

B-5.5.7.2 ETS and PEWE Endpoint. Waste fed to the ETS or PEWE is concentrated to a bottoms specific gravity of 1.3.

B-5.5.7.3 LET&D Feedrate. The minimum L&T&D feed flow rate is 275 gal/hr; the maximum is 550 gal/hr; the nominal feed flow rate of 500 gal/hr. The mass balance assumes that the LET&D process the ETS condensate at the same rate as it is generated, about 400 gal/hr.

B-5.5.7.4 LET&D Removal Efficiency and Bottoms Composition. The LET&D concentrates acidic feed streams to a bottoms concentration of 12 molar nitric acid. The LET&D recovers 99% of the nitric acid in the feed. The mass balance assumes a decontamination factor (moles or curies in feed divided by moles or curies in vapor from the partial condenser) of 1000 for all nonvolatile species as well as volatile metals such as mercury.[a]

B-5.5.8 Utilities

B-5.5.8.1 Cooling Water. Cooling water is used to remove heat of solution and reaction generated in the SBW Receiving Tank during neutralization of SBW feed. For purposes of the material balances, the supply temperature of the cooling water was assumed to be 20°C (68°F), and the return temperature 35°C (95°F).

B-5.5.8.2 Steam. Steam is used to dry the separated tank solids prior to packaging for disposal and for jet transfer of liquids. Steam is available at INTEC at 35 psig and 150 psig.

B-5.5.8.3 Air. Air is available from the INTEC plant air supply at 100 psig and 50 psig. This air will be filtered and regulated to 20 psig for instrument air. In addition, atmospheric air is assumed available for use in drying spent CST beds.

B-6. MASS BALANCES

A summary of waste products is shown in Table B-8. Tank solids and spent ion exchange media are packaged in nominally 2-ft diameter by 10-ft high RH canisters. One ion exchange column is packaged in a canister. Twenty-one spent columns are produced during treatment, and three additional columns will be packaged for disposal during decommissioning. The ion exchange effluent is grouted and packaged in 55-gal drums.

Table B-8. Summary of waste products.

Waste Products	WM-180	WM-188	WM-189	NGLW	Decommissioning	Total	Total m^3
Tank Solids							223
RH canisters	87	90	89	13		279	
Spent CST							10[a]
RH canisters	5	8	7	1	3	24	
CH Grout							4,800
CH drums	6,820	8,030	7,950	1,200		24,000	

[a] Volume of spent CST based on volume of IX columns and includes sand filter

a This decontamination factor of 1000 is given in the LET&D Safety Analysis, PSD 8.6A, for "nonvolatile radionuclides" and Hg, Cd and Pu.

A mass balance for treating waste from WM-180 is shown in Table B-9. Similar mass balances for WM-188, WM-189 and NGLW are shown in Tables B-10, B-11, and B-12 respectively. Tables B-13 through B-15 show properties of the product wastes and Table B-16 shows consumption of feed chemicals and materials.

Table B-9. Tank WM-180 mass balance.

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2		PFD-3
Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
Rate, gal/hr	65.9	1.1	55.0	14.7	8.3	67.0	6.3		85.2
Rate, lb/hr	571	12	467	137	70	569	36		886
Rate, peak, gpm	50	0.019	50	10	0.14	190	4.32		50
Operation	Batch	Cont	Batch	Batch	Batch	Batch	Batch		Batch
Temperature, °F	70	83	70	70	70	70	70		70
Pressure, psia	12.8	12.8	12.8	50.0	12.8	12.8	12.8		12.8
Specific Gravity	1.04	1.25	1.02	1.12	1.02	1.02	0.68		1.25
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
H+	3.13E-02	4.76E-01	3.90E-02	3.90E-02	3.90E-02	3.59E-02	9.63E-04		1.21E+00
Al+3	3.04E-02	5.24E-01	1.51E-02	1.24E-01	1.72E-02	2.71E-02	1.00E+00		5.56E-01
Am+4	8.51E-10	2.84E-08	1.33E-09	1.33E-09	1.33E-09	1.24E-09	7.84E-09		3.09E-08
Sb+5	1.51E-05	8.83E-06	8.64E-07	6.52E-05	2.10E-06	8.31E-06	2.66E-03		6.85E-07
As+5	1.28E-04	4.64E-04	1.40E-05	5.57E-04	2.44E-05	7.68E-05	1.38E-02		4.30E-04
Ba+2	2.76E-05	5.89E-05	2.89E-06	1.18E-04	5.09E-06	1.61E-05	5.35E-03		4.82E-05
Be+2	6.21E-06	9.62E-06	4.65E-07	2.68E-05	9.71E-07	3.52E-06	8.07E-05		6.81E-06
B+3	7.79E-04	9.41E-03	4.63E-04	2.58E-03	5.04E-04	6.80E-04	7.88E-03		9.95E-03
Br-	4.45E-09	1.48E-07	6.94E-09	6.94E-09	6.94E-09	6.49E-09	1.36E-08		1.61E-07
Cd+2	1.50E-04	6.97E-04	8.40E-05	4.28E-04	9.06E-05	1.17E-04	1.34E-02		7.10E-04
Ca+2	2.14E-03	3.34E-02	1.42E-03	7.13E-03	1.53E-03	2.00E-03	7.89E-02		3.56E-02
Ce+4	1.39E-05	4.62E-05	1.67E-06	5.97E-05	2.79E-06	8.37E-06	2.76E-03		4.22E-05
Cs+	5.55E-05	3.96E-05	3.52E-06	2.39E-04	8.03E-06	3.07E-05	1.06E-02		1.04E-05
Cl-	3.23E-03	2.71E-02	8.22E-04	1.36E-02	1.07E-03	2.28E-03	1.55E-01		2.77E-02
Cr+3	5.85E-04	3.37E-03	1.42E-04	2.38E-03	1.85E-04	3.95E-04	3.96E-02		3.36E-03
Co+2	4.86E-06	1.97E-04	3.74E-06	2.39E-05	4.13E-06	6.05E-06	4.09E-04		2.11E-04
Cu+2	1.55E-04	6.36E-04	1.97E-05	6.75E-04	3.22E-05	9.53E-05	1.41E-02		6.01E-04
Eu+3	7.38E-09	2.46E-07	1.15E-08	1.15E-08	1.15E-08	1.08E-08	4.29E-08		2.68E-07
F-	2.82E-02	5.14E-02	3.63E-03	1.17E-01	5.80E-03	1.66E-02	7.32E-01		4.03E-02
Gd+3	2.82E-05	1.61E-04	4.96E-06	1.21E-04	7.18E-06	1.83E-05	6.20E-03		1.59E-04
Ge+4	1.28E-10	4.28E-09	2.00E-10	2.00E-10	2.00E-10	1.87E-10	3.56E-10		4.66E-09
In+3	2.02E-08	6.77E-07	3.16E-08	3.16E-08	3.16E-08	2.95E-08	8.88E-08		7.36E-07
I-	3.70E-08	1.23E-06	5.76E-08	5.76E-08	5.76E-08	5.39E-08	1.79E-07		1.34E-06
Fe+3	1.07E-02	2.16E-02	1.11E-03	4.56E-02	1.97E-03	6.24E-03	8.44E-01		1.73E-02
La+3	1.34E-07	4.47E-06	2.09E-07	2.09E-07	2.09E-07	1.96E-07	7.12E-07		4.87E-06
Pb+2	6.39E-05	1.15E-03	3.86E-05	2.39E-04	4.24E-05	6.01E-05	1.43E-02		1.23E-03
Li+	3.18E-04	4.96E-04	2.37E-05	1.38E-03	4.97E-05	1.80E-04	3.19E-03		3.52E-04
Mg+2	1.23E-03	1.07E-02	5.27E-04	4.49E-03	6.03E-04	9.55E-04	3.30E-02		1.11E-02
Mn+4	4.45E-04	1.22E-02	4.29E-04	1.42E-03	4.48E-04	5.22E-04	1.91E-02		1.31E-02
Hg+2	3.11E-05	1.22E-03	3.81E-05	9.92E-05	3.93E-05	4.35E-05	4.34E-03		1.32E-03
Mo+6	8.91E-04	6.49E-04	5.38E-05	3.84E-03	1.26E-04	4.92E-04	1.23E-01		1.82E-04
Nd+3	4.32E-07	1.44E-05	6.74E-07	6.74E-07	6.74E-07	6.31E-07	2.38E-06		1.57E-05
Np+4	2.47E-07	7.78E-06	3.77E-07	3.77E-07	3.77E-07	3.53E-07	2.19E-06		8.47E-06
Ni+2	2.03E-04	1.34E-03	5.40E-05	8.22E-04	6.87E-05	1.41E-04	1.54E-02		1.35E-03
Nb+5	1.47E-03	8.10E-04	8.28E-05	6.36E-03	2.03E-04	8.09E-04	1.98E-01		1.08E-05
NO3-	6.65E-02	4.62E+00	1.45E-01	1.47E-01	1.45E-01	1.38E-01	2.61E-01		5.03E+00
O-2	2.23E-01	1.23E-01	1.25E-02	9.64E-01	3.08E-02	1.23E-01	5.16E+00		1.57E-03
Pd+4	2.45E-03	1.35E-03	1.38E-04	1.06E-02	3.38E-04	1.35E-03	3.77E-01		2.39E-05
PO4-3	1.39E-01	8.68E-02	8.04E-03	5.97E-01	1.93E-02	7.63E-02	1.90E+01		1.28E-02
Pu+4	7.79E-08	5.05E-06	1.64E-07	1.64E-07	1.64E-07	1.56E-07	9.56E-07		5.49E-06
K+	1.86E-02	1.93E-01	6.23E-03	7.62E-02	7.57E-03	1.41E-02	9.34E-01		2.01E-01
Pr+4	1.22E-07	4.07E-06	1.90E-07	1.90E-07	1.90E-07	1.78E-07	6.57E-07		4.42E-06
Rh+4	5.26E-08	1.75E-06	8.20E-08	8.20E-08	8.20E-08	7.67E-08	2.07E-07		1.91E-06

Table B-9 Tank WM-180 mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from TFF
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
Rb+	8.10E-08	2.70E-06	1.26E-07	1.26E-07	1.26E-07	1.18E-07	2.64E-07		2.94E-06
Ru+3	1.03E-03	6.68E-04	5.98E-05	4.43E-03	1.44E-04	5.66E-04	1.50E-01		1.20E-04
Sm+3	8.02E-08	2.67E-06	1.25E-07	1.25E-07	1.25E-07	1.17E-07	4.61E-07		2.91E-06
Se+4	3.82E-04	2.19E-04	2.16E-05	1.65E-03	5.28E-05	2.10E-04	4.36E-02		1.26E-05
Si+4	1.26E-01	6.90E-02	7.07E-03	5.42E-01	1.73E-02	6.90E-02	5.10E+00		8.95E-04
Ag+	5.89E-04	3.27E-04	3.37E-05	2.54E-03	8.17E-05	3.23E-04	9.16E-02		8.31E-06
Na+	4.19E-02	2.38E+00	5.76E-02	1.70E-01	5.98E-02	6.89E-02	9.09E-01		1.89E+00
Sr+2	8.53E-06	1.03E-04	2.37E-06	3.78E-05	3.05E-06	6.45E-06	1.06E-03		1.07E-04
SO4-2	6.39E-04	4.37E-02	1.38E-03	1.38E-03	1.38E-03	1.32E-03	3.26E-03		4.75E-02
Tc+7	9.40E-08	5.01E-06	1.79E-07	1.79E-07	1.79E-07	1.69E-07	4.25E-07		5.45E-06
Te+4	4.21E-08	1.47E-06	6.68E-08	6.68E-08	6.68E-08	6.26E-08	2.09E-07		1.60E-06
Tb+4	3.09E-11	1.03E-09	4.81E-11	4.81E-11	4.81E-11	4.50E-11	1.87E-10		1.12E-09
Th+4	2.87E-12	8.88E-07	1.54E-08	1.54E-08	1.54E-08	1.53E-08	8.73E-08		9.66E-07
Sn+4	2.63E-03	1.44E-03	1.48E-04	1.13E-02	3.62E-04	1.44E-03	4.51E-01		1.97E-05
Ti+4	1.29E-03	7.55E-04	7.42E-05	5.56E-03	1.79E-04	7.09E-04	8.91E-02		6.12E-05
U+4	3.83E-05	7.84E-04	2.09E-05	1.59E-04	2.35E-05	3.62E-05	1.12E-02		8.34E-04
V+5	1.12E-05	7.76E-04	1.73E-05	4.97E-05	1.79E-05	2.06E-05	5.81E-04		8.40E-04
Y+3	1.00E-07	3.33E-06	1.56E-07	1.56E-07	1.56E-07	1.46E-07	3.40E-07		3.63E-06
Zn+2	8.90E-05	8.92E-04	2.10E-05	3.93E-04	2.81E-05	6.39E-05	8.29E-03		9.18E-04
Zr+4	5.35E-02	2.94E-02	3.10E-03	2.30E-01	7.46E-03	2.94E-02	7.04E+00		4.91E-04
H2O	5.55E+01	4.76E+01	5.55E+01	5.42E+01	5.54E+01	5.47E+01	5.70E+01		4.72E+01
Canisters/day							0.59		
Canisters total							87		
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Ra-226	1.15E-13	3.87E-12	1.80E-13	1.80E-13	1.80E-13	1.69E-13	4.42E-14		4.21E-12
Ac-227	5.43E-13	1.82E-11	8.49E-13	8.49E-13	8.49E-13	7.94E-13	2.08E-13		1.98E-11
Th-228	4.51E-11	1.51E-09	7.04E-11	7.04E-11	7.04E-11	6.59E-11	1.73E-11		1.64E-09
Th-230	3.37E-10	5.67E-10	3.64E-11	1.42E-09	6.29E-11	1.96E-10	4.71E-09		4.25E-10
Th-232	9.98E-18	3.34E-16	1.56E-17	1.56E-17	1.56E-17	1.46E-17	3.82E-18		3.64E-16
Pa-231	1.26E-12	4.22E-11	1.97E-12	1.97E-12	1.97E-12	1.84E-12	4.82E-13		4.59E-11
Pa-233	4.13E-08	1.38E-06	6.45E-08	6.45E-08	6.45E-08	6.04E-08	1.58E-08		1.51E-06
U-232	6.99E-10	1.31E-09	8.14E-11	2.94E-09	1.36E-10	4.09E-10	9.70E-09		1.03E-09
U-233	1.27E-11	4.41E-11	2.41E-12	5.16E-11	3.35E-12	8.00E-12	1.68E-10		4.11E-11
U-234	2.08E-07	1.05E-06	3.85E-08	8.77E-07	5.46E-08	1.34E-07	2.85E-06		1.03E-06
U-235	1.09E-08	4.15E-08	1.45E-09	4.68E-08	2.32E-09	6.67E-09	1.54E-07		3.88E-08
U-236	1.43E-08	5.88E-08	2.12E-09	6.11E-08	3.25E-09	8.90E-09	2.01E-07		5.58E-08
U-237	9.07E-11	3.04E-09	1.42E-10	1.42E-10	1.42E-10	1.33E-10	3.47E-11		3.30E-09
U-238	1.23E-09	2.11E-08	8.25E-10	4.22E-09	8.90E-10	1.17E-09	1.17E-08		2.24E-08
Np-236	6.44E-14	1.78E-12	9.40E-14	9.40E-14	9.40E-14	8.76E-14	2.30E-14		1.93E-12
Np-237	1.02E-07	1.33E-06	6.65E-08	3.27E-07	7.15E-08	9.25E-08	8.98E-07		1.42E-06
Pu-236	1.22E-09	1.93E-09	1.54E-10	5.07E-09	2.49E-10	7.17E-10	1.67E-08		1.42E-09
Pu-238	6.41E-04	8.39E-04	6.25E-05	2.71E-03	1.13E-04	3.67E-04	8.99E-03		5.46E-04
Pu-239	6.72E-05	1.08E-04	5.95E-06	2.88E-04	1.13E-05	3.84E-05	9.56E-04		7.85E-05
Pu-240	4.68E-06	7.26E-06	5.49E-07	1.95E-05	9.13E-07	2.72E-06	6.45E-05		5.27E-06
Pu-241	5.07E-04	3.96E-04	4.54E-05	2.13E-03	8.54E-05	2.86E-04	7.09E-03		1.41E-04
Pu-242	3.69E-09	5.60E-09	5.76E-10	1.49E-08	8.50E-10	2.20E-09	4.87E-08		4.11E-09
Pu-244	2.89E-16	4.69E-16	2.21E-17	1.25E-15	4.56E-17	1.64E-16	4.16E-15		3.40E-16
Am-241	1.71E-05	7.06E-05	2.80E-06	7.18E-05	4.12E-06	1.07E-05	2.35E-04		6.73E-05
Am-242m	2.14E-10	7.19E-09	3.35E-10	3.35E-10	3.35E-10	3.13E-10	8.21E-11		7.82E-09
Am-243	6.07E-09	1.33E-08	7.96E-10	2.53E-08	1.27E-09	3.61E-09	8.34E-08		1.11E-08
Cm-242	2.00E-10	6.57E-09	2.88E-10	3.87E-10	2.90E-10	2.82E-10	4.05E-10		7.14E-09

Table B-9. Tank WM-180 mass balance (continued).

Stream #	110	111	112	113	114	115	116
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg
Cm-243	1.23E-08	1.99E-08	1.29E-09	5.18E-08	2.26E-09	7.10E-09	1.72E-07
Cm-244	7.68E-07	1.21E-06	8.00E-08	3.24E-06	1.41E-07	4.44E-07	1.08E-05
Cm-245	1.30E-10	2.10E-10	1.36E-11	5.49E-10	2.39E-11	7.52E-11	1.82E-09
Cm-246	8.44E-12	1.38E-11	8.91E-13	3.56E-11	1.56E-12	4.88E-12	1.18E-10
H-3	3.92E-07	1.57E-05	6.57E-07	6.57E-07	6.57E-07	6.17E-07	1.61E-07
Be-10	4.23E-14	1.42E-12	6.60E-14	6.60E-14	6.60E-14	6.18E-14	1.62E-14
C-14	5.49E-11	8.58E-11	5.62E-12	2.32E-10	9.96E-12	3.16E-11	7.68E-10
Se-79	1.98E-07	3.11E-07	2.04E-08	8.35E-07	3.60E-08	1.14E-07	2.77E-06
Rb-87	4.13E-13	1.38E-11	6.45E-13	6.45E-13	6.45E-13	6.03E-13	1.58E-13
Sr-90	1.06E-03	1.86E-02	9.97E-04	2.66E-03	1.03E-03	1.12E-03	5.88E-03
Y-90	1.06E-03	1.86E-02	9.97E-04	2.66E-03	1.03E-03	1.12E-03	5.88E-03
Zr-93	3.12E-08	1.05E-06	4.88E-08	4.88E-08	4.88E-08	4.56E-08	1.19E-08
Nb-93m	2.41E-08	8.06E-07	3.76E-08	3.76E-08	3.76E-08	3.51E-08	9.21E-09
Nb-94	5.10E-07	8.09E-07	5.28E-08	2.15E-06	9.31E-08	2.94E-07	7.14E-06
Tc-98	3.63E-14	1.22E-12	5.68E-14	5.68E-14	5.68E-14	5.31E-14	1.39E-14
Tc-99	4.43E-06	1.07E-05	5.40E-07	1.87E-05	8.89E-07	2.63E-06	6.18E-05
Ru-106	4.27E-07	6.66E-07	4.37E-08	1.80E-06	7.75E-08	2.46E-07	5.98E-06
Rh-102	4.14E-07	2.28E-07	2.32E-08	1.78E-06	5.70E-08	2.27E-07	5.98E-06
Pd-107	2.33E-10	7.80E-09	3.64E-10	3.64E-10	3.64E-10	3.40E-10	8.91E-11
Cd-113m	4.68E-08	1.57E-06	7.31E-08	7.31E-08	7.31E-08	6.84E-08	1.79E-08
In-115	1.42E-18	4.75E-17	2.22E-18	2.22E-18	2.22E-18	2.07E-18	5.43E-19
Sn-121m	9.42E-10	3.16E-08	1.47E-09	1.47E-09	1.47E-09	1.38E-09	3.61E-10
Sn-126	1.87E-07	2.93E-07	1.92E-08	7.89E-07	3.39E-08	1.08E-07	2.61E-06
Sb-125	5.93E-04	3.31E-04	3.38E-05	2.56E-03	8.22E-05	3.26E-04	8.56E-03
Sb-126	8.10E-10	2.71E-08	1.27E-09	1.27E-09	1.27E-09	1.18E-09	3.10E-10
Te-123	5.40E-21	1.81E-19	8.43E-21	8.43E-21	8.43E-21	7.89E-21	2.07E-21
Te-125m	4.44E-08	1.49E-06	6.93E-08	6.93E-08	6.93E-08	6.48E-08	1.70E-08
I-129	2.42E-08	3.48E-08	2.44E-09	1.02E-07	4.35E-09	1.39E-08	3.38E-07
Cs-134	4.92E-05	3.17E-05	3.64E-06	2.09E-04	7.58E-06	2.74E-05	6.99E-04
Cs-135	3.49E-07	5.91E-07	3.78E-08	1.47E-06	6.54E-08	2.02E-07	4.88E-06
Cs-137	1.98E-02	3.35E-02	2.17E-03	8.36E-02	3.73E-03	1.15E-02	2.77E-01
Ba-137m	1.88E-02	3.17E-02	2.05E-03	7.91E-02	3.53E-03	1.09E-02	2.62E-01
La-138	2.69E-18	9.01E-17	4.20E-18	4.20E-18	4.20E-18	3.93E-18	1.03E-18
Ce-142	4.21E-13	1.41E-11	6.58E-13	6.58E-13	6.58E-13	6.16E-13	1.61E-13
Ce-144	2.90E-07	4.50E-07	2.96E-08	1.22E-06	5.25E-08	1.67E-07	4.06E-06
Nd-144	2.27E-17	7.59E-16	3.54E-17	3.54E-17	3.54E-17	3.31E-17	8.67E-18
Pm-146	7.17E-10	2.40E-08	1.12E-09	1.12E-09	1.12E-09	1.05E-09	2.74E-10
Pm-147	7.68E-05	1.21E-04	7.92E-06	3.24E-04	1.40E-05	4.43E-05	1.08E-03
Sm-146	3.89E-15	1.30E-13	6.07E-15	6.07E-15	6.07E-15	5.68E-15	1.49E-15
Sm-147	1.04E-13	3.48E-12	1.62E-13	1.62E-13	1.62E-13	1.52E-13	3.97E-14
Sm-148	5.33E-19	1.79E-17	8.33E-19	8.33E-19	8.33E-19	7.79E-19	2.04E-19
Sm-149	4.73E-20	1.59E-18	7.39E-20	7.39E-20	7.39E-20	6.92E-20	1.81E-20
Sm-151	1.53E-04	2.40E-04	1.57E-05	6.47E-04	2.78E-05	8.84E-05	2.15E-03
Eu-152	5.55E-07	1.47E-06	8.45E-08	2.29E-06	1.27E-07	3.37E-07	7.51E-06
Eu-154	2.44E-05	5.36E-05	5.49E-06	9.38E-05	7.19E-06	1.54E-05	3.01E-04
Eu-155	3.50E-05	9.32E-05	4.19E-06	1.49E-04	6.96E-06	2.08E-05	4.91E-04
Gd-152	2.00E-20	6.71E-19	3.13E-20	3.13E-20	3.13E-20	2.93E-20	7.67E-21
Ho-166m	6.49E-13	2.17E-11	1.01E-12	1.01E-12	1.01E-12	9.48E-13	2.48E-13
Co-60	2.81E-06	5.09E-06	1.11E-06	8.98E-06	1.26E-06	1.93E-06	2.70E-05
Ni-63	1.48E-05	2.95E-05	2.09E-06	6.10E-05	3.22E-06	8.81E-06	2.00E-04

Table B-9. Tank WM-180 mass balance (continued).

PFD Sheet #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Rate, gal/hr	88.2	7800	7712	88.2	88.2	88.2	88.2	0.5
Rate, lb/hr	925	81796	80871	925	925	925	925	5
Rate, peak, gpm	1.47	130	129	1.47	1.47	1.47	1.47	2.99
Operation	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Batch
Temperature, °F	70	70	70	70	70	70	70	70
Pressure, psia	12.8	35.0	35.0	24.8	20.8	16.8	12.8	12.8
Specific Gravity	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.05
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
H+	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	1.01E-01
Al+3	5.36E-01	5.51E-01	5.51E-01	5.36E-01	5.36E-01	5.36E-01	5.36E-01	1.08E-01
Am+4	2.98E-08	2.98E-08	2.98E-08	2.98E-08	2.98E-08	2.98E-08	2.98E-08	6.02E-09
Sb+5	6.61E-07	9.34E-06	9.44E-06	5.59E-07	5.59E-07	5.59E-07	5.59E-07	1.13E-07
As+5	4.15E-04	4.88E-04	4.89E-04	4.14E-04	4.14E-04	4.14E-04	4.14E-04	8.36E-05
Ba+2	4.65E-05	6.20E-05	6.21E-05	4.63E-05	4.63E-05	4.63E-05	4.63E-05	9.36E-06
Be+2	6.57E-06	1.01E-05	1.02E-05	6.53E-06	6.53E-06	6.53E-06	6.53E-06	1.32E-06
B+3	9.60E-03	9.88E-03	9.89E-03	9.60E-03	9.60E-03	9.60E-03	9.60E-03	1.94E-03
Br-	1.56E-07	1.56E-07	1.56E-07	1.56E-07	1.56E-07	1.56E-07	1.56E-07	3.15E-08
Cd+2	6.86E-04	7.32E-04	7.33E-04	6.85E-04	6.85E-04	6.85E-04	6.85E-04	1.38E-04
Ca+2	3.43E-02	3.51E-02	3.51E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	6.93E-03
Ce+4	4.07E-05	4.85E-05	4.86E-05	4.06E-05	4.06E-05	4.06E-05	4.06E-05	8.21E-06
Cs+	1.01E-05	4.18E-05	4.22E-05	9.70E-06	9.70E-07	9.70E-08	9.70E-09	1.96E-09
Cl-	2.68E-02	2.85E-02	2.85E-02	2.67E-02	2.67E-02	2.67E-02	2.67E-02	5.41E-03
Cr+3	3.24E-03	3.55E-03	3.55E-03	3.24E-03	3.24E-03	3.24E-03	3.24E-03	6.55E-04
Co+2	2.04E-04	2.07E-04	2.07E-04	2.04E-04	2.04E-04	2.04E-04	2.04E-04	4.12E-05
Cu+2	5.80E-04	6.69E-04	6.70E-04	5.79E-04	5.79E-04	5.79E-04	5.79E-04	1.17E-04
Eu+3	2.58E-07	2.58E-07	2.58E-07	2.58E-07	2.58E-07	2.58E-07	2.58E-07	5.22E-08
F-	3.88E-02	5.41E-02	5.43E-02	3.87E-02	3.87E-02	3.87E-02	3.87E-02	7.81E-03
Gd+3	1.53E-04	1.69E-04	1.69E-04	1.53E-04	1.53E-04	1.53E-04	1.53E-04	3.09E-05
Ge+4	4.49E-09	4.49E-09	4.49E-09	4.49E-09	4.49E-09	4.49E-09	4.49E-09	9.08E-10
In+3	7.10E-07	7.10E-07	7.10E-07	7.10E-07	7.10E-07	7.10E-07	7.10E-07	1.44E-07
I-	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	2.62E-07
Fe+3	1.67E-02	2.27E-02	2.28E-02	1.67E-02	1.67E-02	1.67E-02	1.67E-02	3.37E-03
La+3	4.69E-06	4.69E-06	4.69E-06	4.69E-06	4.69E-06	4.69E-06	4.69E-06	9.49E-07
Pb+2	1.18E-03	1.21E-03	1.21E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	2.39E-04
Li+	3.40E-04	5.22E-04	5.24E-04	3.37E-04	3.37E-04	3.37E-04	3.37E-04	6.82E-05
Mg+2	1.07E-02	1.13E-02	1.13E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	2.17E-03
Mn+4	1.26E-02	1.28E-02	1.28E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02	2.55E-03
Hg+2	1.27E-03	1.28E-03	1.28E-03	1.27E-03	1.27E-03	1.27E-03	1.27E-03	2.56E-04
Mo+6	1.75E-04	6.86E-04	6.92E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	3.42E-05
Nd+3	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	3.06E-06
Np+4	8.17E-06	8.17E-06	8.17E-06	8.17E-06	8.17E-06	8.17E-06	8.17E-06	1.65E-06
Ni+2	1.30E-03	1.41E-03	1.41E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	2.63E-04
Nb+5	1.04E-05	8.57E-04	8.66E-04	4.03E-07	4.03E-07	4.03E-07	4.03E-07	8.14E-08
NO3-	4.85E+00	4.85E+00	4.85E+00	4.85E+00	4.85E+00	4.85E+00	4.85E+00	9.80E-01
O-2	1.51E-03	1.30E-01	1.31E-01					
Pd+4	2.31E-05	1.43E-03	1.45E-03	6.50E-06	6.50E-06	6.50E-06	6.50E-06	1.31E-06
PO4-3	1.23E-02	9.18E-02	9.27E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	2.30E-03
Pu+4	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	1.07E-06
K+	1.94E-01	2.03E-01	2.03E-01	1.93E-01	1.93E-01	1.93E-01	1.93E-01	3.91E-02
Pr+4	4.27E-06	4.27E-06	4.27E-06	4.27E-06	4.27E-06	4.27E-06	4.27E-06	8.63E-07
Rh+4	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	3.72E-07

Table B-9. Tank WM-180 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
Rb+	2.83E-06	2.83E-06	2.83E-06	2.83E-06	2.83E-06	2.83E-06	2.83E-06	5.73E-07
Ru+3	1.16E-04	7.06E-04	7.13E-04	1.09E-04	1.09E-04	1.09E-04	1.09E-04	2.21E-05
Sm+3	2.81E-06	2.81E-06	2.81E-06	2.81E-06	2.81E-06	2.81E-06	2.81E-06	5.67E-07
Se+4	1.21E-05	2.31E-04	2.34E-04	9.56E-06	9.56E-06	9.56E-06	9.56E-06	1.93E-06
Si+4	8.63E-04	7.30E-02	7.38E-02	1.38E-05	1.38E-05	1.38E-05	1.38E-05	2.79E-06
Ag+	8.02E-06	3.46E-04	3.50E-04	4.04E-06	4.04E-06	4.04E-06	4.04E-06	8.16E-07
Na+	2.49E+00	2.50E+00	2.50E+00	2.49E+00	2.49E+00	2.49E+00	2.49E+00	5.02E-01
Sr+2	1.03E-04	1.08E-04	1.08E-04	1.03E-04	1.03E-04	1.03E-04	1.03E-04	2.09E-05
SO4-2	4.59E-02	4.59E-02	4.59E-02	4.59E-02	4.59E-02	4.59E-02	4.59E-02	9.27E-03
Tc+7	5.26E-06	5.26E-06	5.26E-06	5.26E-06	5.26E-06	5.26E-06	5.26E-06	1.06E-06
Te+4	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	3.12E-07
Tb+4	1.08E-09	1.08E-09	1.08E-09	1.08E-09	1.08E-09	1.08E-09	1.08E-09	2.18E-10
Th+4	9.33E-07	9.33E-07	9.33E-07	9.33E-07	9.33E-07	9.33E-07	9.33E-07	1.88E-07
Sn+4	1.90E-05	1.53E-03	1.55E-03	1.26E-06	1.26E-06	1.26E-06	1.26E-06	2.55E-07
Ti+4	5.91E-05	7.99E-04	8.07E-04	5.04E-05	5.04E-05	5.04E-05	5.04E-05	1.02E-05
U+4	8.05E-04	8.23E-04	8.24E-04	8.05E-04	8.05E-04	8.05E-04	8.05E-04	1.63E-04
V+5	8.10E-04	8.14E-04	8.14E-04	8.10E-04	8.10E-04	8.10E-04	8.10E-04	1.64E-04
Y+3	3.50E-06	3.50E-06	3.50E-06	3.50E-06	3.50E-06	3.50E-06	3.50E-06	7.07E-07
Zn+2	8.86E-04	9.36E-04	9.37E-04	8.86E-04	8.86E-04	8.86E-04	8.86E-04	1.79E-04
Zr+4	4.74E-04	3.11E-02	3.15E-02	1.13E-04	1.13E-04	1.13E-04	1.13E-04	2.28E-05
H2O	4.77E+01	4.68E+01	4.68E+01	4.77E+01	4.77E+01	4.77E+01	4.77E+01	5.36E+01
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Ra-226	4.06E-12	4.06E-12	4.06E-12	4.06E-12	4.06E-12	4.06E-12	4.06E-12	8.20E-13
Ac-227	1.91E-11	1.91E-11	1.91E-11	1.91E-11	1.91E-11	1.91E-11	1.91E-11	3.86E-12
Th-228	1.59E-09	1.59E-09	1.59E-09	1.59E-09	1.59E-09	1.59E-09	1.59E-09	3.21E-10
Th-230	4.10E-10	5.96E-10	5.99E-10	4.07E-10	4.07E-10	4.07E-10	4.07E-10	8.24E-11
Th-232	3.51E-16	6.30E-11	3.51E-16	3.51E-16	3.51E-16	3.51E-16	3.51E-16	7.09E-17
Pa-231	4.43E-11	4.43E-11	4.43E-11	4.43E-11	4.43E-11	4.43E-11	4.43E-11	8.95E-12
Pa-233	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	2.94E-07
U-232	9.89E-10	1.37E-09	1.38E-09	9.85E-10	9.85E-10	9.85E-10	9.85E-10	1.99E-10
U-233	3.97E-11	4.63E-11	4.64E-11	3.96E-11	3.96E-11	3.96E-11	3.96E-11	8.01E-12
U-234	9.95E-07	1.11E-06	1.11E-06	9.94E-07	9.94E-07	9.94E-07	9.94E-07	2.01E-07
U-235	3.75E-08	4.36E-08	4.37E-08	3.74E-08	3.74E-08	3.74E-08	3.74E-08	7.56E-09
U-236	5.38E-08	6.17E-08	6.18E-08	5.37E-08	5.37E-08	5.37E-08	5.37E-08	1.09E-08
U-237	3.19E-09	3.19E-09	3.19E-09	3.19E-09	3.19E-09	3.19E-09	3.19E-09	6.45E-10
U-238	2.17E-08	2.21E-08	2.21E-08	2.16E-08	2.16E-08	2.16E-08	2.16E-08	4.37E-09
Np-236	1.87E-12	1.87E-12	1.87E-12	1.87E-12	1.87E-12	1.87E-12	1.87E-12	3.77E-13
Np-237	1.37E-06	1.40E-06	1.40E-06	1.37E-06	1.37E-06	1.37E-06	1.37E-06	2.76E-07
Pu-236	1.37E-09	2.04E-09	2.04E-09	1.36E-09	1.36E-09	1.36E-09	1.36E-09	2.76E-10
Pu-238	5.27E-04	8.83E-04	8.88E-04	5.22E-04	5.22E-04	5.22E-04	5.22E-04	1.06E-04
Pu-239	7.57E-05	1.14E-04	1.14E-04	7.53E-05	7.53E-05	7.53E-05	7.53E-05	1.52E-05
Pu-240	5.08E-06	7.64E-06	7.67E-06	5.05E-06	5.05E-06	5.05E-06	5.05E-06	1.02E-06
Pu-241	1.37E-04	4.18E-04	4.21E-04	1.33E-04	1.33E-04	1.33E-04	1.33E-04	2.69E-05
Pu-242	3.96E-09	5.89E-09	5.92E-09	3.94E-09	3.94E-09	3.94E-09	3.94E-09	7.97E-10
Pu-244	3.28E-16	4.93E-16	4.95E-16	3.26E-16	3.26E-16	3.26E-16	3.26E-16	6.59E-17
Am-241	6.49E-05	7.42E-05	7.43E-05	6.48E-05	6.48E-05	6.48E-05	6.48E-05	1.31E-05
Am-242m	7.55E-09	7.55E-09	7.55E-09	7.55E-09	7.55E-09	7.55E-09	7.55E-09	1.52E-09
Am-243	1.07E-08	1.40E-08	1.40E-08	1.06E-08	1.06E-08	1.06E-08	1.06E-08	2.15E-09
Cm-242	6.89E-09	6.90E-09	6.90E-09	6.89E-09	6.89E-09	6.89E-09	6.89E-09	1.39E-09

Table B-9. Tank WM-180 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Cm-243	1.42E-08	2.10E-08	2.11E-08	1.41E-08	1.41E-08	1.41E-08	1.41E-08	2.85E-09
Cm-244	8.48E-07	1.28E-06	1.28E-06	8.43E-07	8.43E-07	8.43E-07	8.43E-07	1.70E-07
Cm-245	1.49E-10	2.21E-10	2.22E-10	1.48E-10	1.48E-10	1.48E-10	1.48E-10	2.99E-11
Cm-246	9.80E-12	1.45E-11	1.45E-11	9.74E-12	9.74E-12	9.74E-12	9.74E-12	1.97E-12
H-3	1.65E-05	1.65E-05	1.65E-05	1.65E-05	1.65E-05	1.65E-05	1.65E-05	3.34E-06
Be-10	1.49E-12	1.49E-12	1.49E-12	1.49E-12	1.49E-12	1.49E-12	1.49E-12	3.01E-13
C-14	5.98E-11	9.03E-11	9.07E-11	5.95E-11	5.95E-11	5.95E-11	5.95E-11	1.20E-11
Se-79	2.18E-07	3.28E-07	3.29E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	4.37E-08
Rb-87	1.45E-11	1.45E-11	1.45E-11	1.45E-11	1.45E-11	1.45E-11	1.45E-11	2.93E-12
Sr-90	1.93E-02	1.96E-02	1.96E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	3.91E-03
Y-90	1.93E-02	1.96E-02	1.96E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	3.91E-03
Zr-93	1.10E-06	1.10E-06	1.10E-06	1.10E-06	1.10E-06	1.10E-06	1.10E-06	2.22E-07
Nb-93m	8.46E-07	8.46E-07	8.46E-07	8.46E-07	8.46E-07	8.46E-07	8.46E-07	1.71E-07
Nb-94	5.68E-07	8.51E-07	8.54E-07	5.65E-07	5.65E-07	5.65E-07	5.65E-07	1.14E-07
Tc-98	1.28E-12	1.28E-12	1.28E-12	1.28E-12	1.28E-12	1.28E-12	1.28E-12	2.58E-13
Tc-99	8.85E-06	1.13E-05	1.13E-05	8.82E-06	8.82E-06	8.82E-06	8.82E-06	1.78E-06
Ru-106	4.64E-07	7.01E-07	7.04E-07	4.61E-07	4.61E-07	4.61E-07	4.61E-07	9.31E-08
Rh-102	3.23E-09	2.41E-07	2.43E-07	4.27E-10	4.27E-10	4.27E-10	4.27E-10	8.63E-11
Pd-107	8.19E-09	8.19E-09	8.19E-09	8.19E-09	8.19E-09	8.19E-09	8.19E-09	1.65E-09
Cd-113m	1.65E-06	1.65E-06	1.65E-06	1.65E-06	1.65E-06	1.65E-06	1.65E-06	3.33E-07
In-115	4.99E-17	4.99E-17	4.99E-17	4.99E-17	4.99E-17	4.99E-17	4.99E-17	1.01E-17
Sn-121m	3.31E-08	3.31E-08	3.31E-08	3.31E-08	3.31E-08	3.31E-08	3.31E-08	6.70E-09
Sn-126	2.05E-07	3.09E-07	3.10E-07	2.04E-07	2.04E-07	2.04E-07	2.04E-07	4.11E-08
Sb-125	1.04E-05	3.50E-04	3.54E-04	6.40E-06	6.40E-06	6.40E-06	6.40E-06	1.29E-06
Sb-126	2.85E-08	2.85E-08	2.85E-08	2.85E-08	2.85E-08	2.85E-08	2.85E-08	5.76E-09
Te-123	1.90E-19	1.90E-19	1.90E-19	1.90E-19	1.90E-19	1.90E-19	1.90E-19	3.84E-20
Te-125m	1.56E-06	1.56E-06	1.56E-06	1.56E-06	1.56E-06	1.56E-06	1.56E-06	3.15E-07
I-129	2.33E-08	3.67E-08	3.68E-08	2.31E-08	2.31E-08	2.31E-08	2.31E-08	4.67E-09
Cs-134	5.75E-06	3.35E-05	3.38E-05	5.42E-06	5.42E-07	5.42E-08	5.42E-09	1.10E-09
Cs-135	4.28E-07	6.22E-07	6.24E-07	4.26E-07	4.26E-08	4.26E-09	4.26E-10	8.61E-11
Cs-137	2.42E-02	3.52E-02	3.53E-02	2.41E-02	2.41E-03	2.41E-04	2.41E-05	4.87E-06
Ba-137m	2.29E-02	3.33E-02	3.34E-02	2.28E-02	2.28E-02	2.28E-02	2.28E-02	4.61E-03
La-138	9.46E-17	9.46E-17	9.46E-17	9.46E-17	9.46E-17	9.46E-17	9.46E-17	1.91E-17
Ce-142	1.48E-11	1.48E-11	1.48E-11	1.48E-11	1.48E-11	1.48E-11	1.48E-11	2.99E-12
Ce-144	3.12E-07	4.74E-07	4.75E-07	3.11E-07	3.11E-07	3.11E-07	3.11E-07	6.28E-08
Nd-144	7.97E-16	7.97E-16	7.97E-16	7.97E-16	7.97E-16	7.97E-16	7.97E-16	1.61E-16
Pm-146	2.52E-08	2.52E-08	2.52E-08	2.52E-08	2.52E-08	2.52E-08	2.52E-08	5.10E-09
Pm-147	8.49E-05	1.28E-04	1.28E-04	8.44E-05	8.44E-05	8.44E-05	8.44E-05	1.71E-05
Sm-146	1.37E-13	1.37E-13	1.37E-13	1.37E-13	1.37E-13	1.37E-13	1.37E-13	2.76E-14
Sm-147	3.65E-12	3.65E-12	3.65E-12	3.65E-12	3.65E-12	3.65E-12	3.65E-12	7.38E-13
Sm-148	1.88E-17	1.88E-17	1.88E-17	1.88E-17	1.88E-17	1.88E-17	1.88E-17	3.79E-18
Sm-149	1.66E-18	1.66E-18	1.66E-18	1.66E-18	1.66E-18	1.66E-18	1.66E-18	3.36E-19
Sm-151	1.67E-04	2.52E-04	2.53E-04	1.66E-04	1.66E-04	1.66E-04	1.66E-04	3.36E-05
Eu-152	1.25E-06	1.55E-06	1.55E-06	1.25E-06	1.25E-06	1.25E-06	1.25E-06	2.52E-07
Eu-154	4.45E-05	5.64E-05	5.65E-05	4.43E-05	4.43E-05	4.43E-05	4.43E-05	8.96E-06
Eu-155	7.85E-05	9.80E-05	9.82E-05	7.83E-05	7.83E-05	7.83E-05	7.83E-05	1.58E-05
Gd-152	7.04E-19	7.04E-19	7.04E-19	7.04E-19	7.04E-19	7.04E-19	7.04E-19	1.42E-19
Ho-166m	2.28E-11	2.28E-11	2.28E-11	2.28E-11	2.28E-11	2.28E-11	2.28E-11	4.61E-12
Co-60	4.29E-06	5.35E-06	5.37E-06	4.28E-06	4.28E-06	4.28E-06	4.28E-06	8.65E-07
Ni-63	2.31E-05	3.10E-05	3.11E-05	2.30E-05	2.30E-05	2.30E-05	2.30E-05	4.64E-06

Table B-9. Tank WM-180 mass balance (continued).

PFD Sheet #		PFD-4	PFD Sheet #		PFD-4			PFD-4
Stream #	129	130	Stream #	129	130		129	130
Stream Name	Spent IX Media	Grouted Waste	Stream Name	Spent IX Media	Grouted Waste		Spent IX Media	Grouted Waste
Rate, gal/hr	0.08	99		Wt %	Wt %		Ci/kg	Ci/kg
Rate, lb/hr	0.93	1233	Rb+	1.22E-06	1.44E-05	Cm-243	2.85E-09	8.39E-09
Rate, total columns	5	N/A	Ru+3	5.58E-05	6.58E-04	Cm-244	1.70E-07	5.03E-07
Operation	Batch	Cont	Sm+3	2.13E-06	2.51E-05	Cm-245	2.99E-11	8.81E-11
Temperature, °F	70	70	Se+4	3.81E-06	4.50E-05	Cm-246		
Pressure, psia	12.8	12.8	Si+4	1.96E-06	2.31E-05		1.97E-12	5.81E-12
Specific Gravity	1.33	1.50	Ag+	2.20E-06	2.60E-05	H-3	3.34E-06	9.85E-06
Chemical Composition	Wt %	Wt %	Na+	2.89E-01	3.41E+00	Be-10	3.01E-13	8.86E-13
CST	7.30E+01	N/A	Sr+2	4.57E-05	5.40E-04	C-14	1.20E-11	3.54E-11
H+	2.55E-03	N/A	SO4-2	2.22E-02	2.63E-01	Se-79	4.37E-08	1.29E-07
Al+3	7.30E-02	8.62E-01	Tc+7	2.58E-06	3.04E-05	Rb-87	2.93E-12	8.65E-12
Am+4	3.63E-08	4.28E-07	Te+4	9.96E-07	1.17E-05	Sr-90	3.91E-03	1.15E-02
Sb+5	3.44E-07	4.05E-06	Tb+4	8.67E-10	1.02E-08	Y-90	3.91E-03	1.15E-02
As+5	1.57E-04	1.85E-03	Th+4	1.09E-06	1.29E-05	Zr-93	2.22E-07	6.54E-07
Ba+2	3.21E-05	3.79E-04	Sn+4	7.58E-07	8.94E-06	Nb-93m	1.71E-07	5.04E-07
Be+2	2.97E-07	3.51E-06	Ti+4	1.22E-05	1.44E-04	Nb-94	1.14E-07	3.36E-07
B+3	5.24E-04	6.18E-03	U+4	9.67E-04	1.14E-02	Tc-98	2.58E-13	7.62E-13
Br-	6.29E-08	7.42E-07	V+5	2.08E-04	2.46E-03	Tc-99	1.78E-06	5.26E-06
Cd+2	3.89E-04	4.59E-03	Y+3	1.57E-06	1.85E-05	Ru-106	9.31E-08	2.75E-07
Ca+2	6.95E-03	8.20E-02	Zn+2	2.93E-04	3.45E-03	Rh-102	8.63E-11	2.55E-10
Ce+4	2.87E-05	3.39E-04	Zr+4	5.20E-05	6.14E-04	Pd-107	1.65E-09	4.88E-09
Cs+	6.51E-09	7.68E-08	H2O	2.50E+01		Cd-113m	3.33E-07	9.81E-07
Cl-	4.79E-03	5.65E-02	Canisters total	5		In-115	1.01E-17	2.97E-17
Cr+3	8.51E-04	1.00E-02	Drums/day		46	Sn-121m	6.70E-09	1.97E-08
Co+2	6.07E-05	7.16E-04	Radiological Comp.	Ci/kg	Ci/kg	Sn-126	4.11E-08	1.21E-07
Cu+2	1.86E-04	2.19E-03	Ra-226	8.20E-13	2.42E-12	Sb-125	1.29E-06	3.81E-06
Eu+3	1.98E-07	2.34E-06	Ac-227	3.86E-12	1.14E-11	Sb-126	5.76E-09	1.70E-08
F-	3.71E-03	4.38E-02	Th-228	3.21E-10	9.45E-10	Te-123	3.84E-20	1.13E-19
Gd+3	1.22E-04	1.43E-03	Th-230	8.24E-11	2.43E-10	Te-125m	3.15E-07	9.30E-07
Ge+4	1.65E-09	1.94E-08	Th-232	7.09E-17	2.09E-16	I-129	4.67E-09	1.38E-08
In+3	4.12E-07	4.86E-06	Pa-231	8.95E-12	2.64E-11	Cs-134	1.10E-09	3.23E-09
I-	8.29E-07	9.79E-06	Pa-233	2.94E-07	8.66E-07	Cs-135	8.61E-11	2.54E-10
Fe+3	4.70E-03	5.54E-02	U-232	1.99E-10	5.87E-10	Cs-137	4.87E-06	1.44E-05
La+3	3.29E-06	3.89E-05	U-233	8.01E-12	2.36E-11	Ba-137m	4.61E-06	1.36E-05
Pb+2	1.24E-03	1.46E-02	U-234	2.01E-07	5.92E-07	La-138	1.91E-17	5.64E-17
Li+	1.18E-05	1.40E-04	U-235	7.56E-09	2.23E-08	Ce-142	2.99E-12	8.83E-12
Mg+2	1.32E-03	1.55E-02	U-236	1.09E-08	3.20E-08	Ce-144	6.28E-08	1.85E-07
Mn+4	3.50E-03	4.13E-02	U-237	6.45E-10	1.90E-09	Nd-144	1.61E-16	4.75E-16
Hg+2	1.29E-03	1.52E-02	U-238	4.37E-09	1.29E-08	Pm-146	5.10E-09	1.50E-08
Mo+6	8.20E-05	9.67E-04	Np-236	3.77E-13	1.11E-12	Pm-147	1.71E-05	5.03E-05
Nd+3	1.10E-05	1.30E-04	Np-237	2.76E-07	8.14E-07	Sm-146	2.76E-14	8.15E-14
Np+4	9.78E-06	1.15E-04	Pu-236	2.76E-10	8.13E-10	Sm-147	7.38E-13	2.18E-12
Ni+2	3.86E-04	4.55E-03	Pu-238	1.06E-04	3.11E-04	Sm-148	3.79E-18	1.12E-17
Nb+5	1.89E-07	2.23E-06	Pu-239	1.52E-05	4.49E-05	Sm-149	3.36E-19	9.92E-19
NO3-	1.52E+00	1.79E+01	Pu-240	1.02E-06	3.01E-06	Sm-151	3.36E-05	9.91E-05
Pd+4	3.49E-06	4.12E-05	Pu-241	2.69E-05	7.94E-05	Eu-152	2.52E-07	7.43E-07
PO4-3	5.46E-03	6.44E-02	Pu-242	7.97E-10	2.35E-09	Eu-154	8.96E-06	2.64E-05
Pu+4	6.40E-06	7.52E-05	Pu-244	6.59E-17	1.94E-16	Eu-155	1.58E-05	4.67E-05
K+	3.82E-02	4.51E-01	Am-241	1.31E-05	3.86E-05	Gd-152	1.42E-19	4.20E-19
Pr+4	3.04E-06	3.58E-05	Am-242m	1.52E-09	4.50E-09	Ho-166m	4.61E-12	1.36E-11
Rh+4	9.57E-07	1.13E-05	Am-243	2.15E-09	6.34E-09	Co-60	8.65E-07	2.55E-06
			Cm-242	1.39E-09	4.11E-09	Ni-63	4.64E-06	1.37E-05

Table B-9. Tank WM-180 mass balance (continued).

	PFD-2	PFD-2	PFD-2	PFD-3	PFD-3
	210	211	212	213	220
Stream Name	Solids Flocculent	Steam to Fundabac Filter	Filter Condensate	Nitric Acid	50% Caustic
Rate, gal/hr	0.1	0.8	4.6	TBD	3.1
Rate, lb/hr	1.7	6.4	38		39
Rate, peak, gpm	Batch	0.20	1.2		10
Operation	Batch	Batch	Batch		Batch
Temperature, °F	75	328	114	0	70
Pressure, psia	12.8	112.8	12.8	0.0	12.8
Specific Gravity	1.51	1.00	1.00	0.00	1.51
Stream Composition	Wt %	Wt %	Wt %	Wt %	Wt %
50% NaOH	100%				100%
HNO3				100%	
Steam		100%			
Water			100%		
CST					
Portland cement					
Ca(OH)2					
Blast furnace slag					

PFD Sheet #	PFD-3	PFD-4	PFD-4	PFD-4	PFD-4
Stream #	221	222	223	224	225
Stream Name	Fresh IX Media	Portland Cement	Calcium Hydroxide	Blast Furnace Slag	Solid Blend
Rate, gal/hr	0.08	14.81	21.59	7.40	36.40
Rate, lb/hr	0.67	148	86	74	308
Rate, peak, gpm	NA	TBD	TBD	TBD	0.61
Operation	Batch	Cont	Cont	Cont	Cont
Temperature, °F	70	70	70	70	70
Pressure, psia	12.8	12.8	12.8	12.8	12.8
Specific Gravity	0.96	1.20	0.48	1.20	1.02
	Wt %	Wt %	Wt %	Wt %	Wt %
Chemical Composition					
NaOH					
H2O					
CST	100%				
Portland cement		100%			
Ca(OH)2			100%		
Blast furnace slag				100%	
No. Replacement col's	5				

Table B-10. Tank WM-188 mass balance.

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2		PFD-3
Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
Rate, gal/hr	65.9	1.8	55.9	14.7	8.3	67.9	6.3		85.2
Rate, lb/hr	571	19	475	138	71	577	36		930
Rate, peak, gpm	50	0.030	50	10	0.14	190	4.32		50.00
Operation	Batch	Cont	Batch	Batch	Batch	Batch	Batch		Batch
Temperature, °F	70	83	70	70	70	70	70		70
Pressure, psia	12.8	12.8	12.8	50.0	12.8	12.8	12.8		12.8
Specific Gravity	1.04	1.32	1.02	1.12	1.02	1.02	0.68		1.31
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
H+	3.13E-02	4.76E-01	4.31E-02	4.31E-02	4.31E-02	3.96E-02	1.06E-03		2.76E+00
Al+3	3.04E-02	4.52E-01	1.78E-02	1.27E-01	1.99E-02	2.95E-02	1.01E+00		5.13E-01
Am+4	8.51E-10	5.48E-08	2.28E-09	2.28E-09	2.28E-09	2.14E-09	1.35E-08		6.42E-08
Sb+5	1.51E-05	1.25E-05	9.57E-07	6.53E-05	2.20E-06	8.41E-06	2.67E-03		5.06E-06
As+5	1.28E-04	7.58E-05	7.25E-06	5.50E-04	1.77E-05	7.01E-05	1.39E-02		8.17E-06
Ba+2	2.76E-05	6.62E-05	3.47E-06	1.18E-04	5.68E-06	1.67E-05	5.37E-03		6.05E-05
Be+2	6.21E-06	1.51E-05	6.65E-07	2.70E-05	1.17E-06	3.71E-06	8.11E-05		1.38E-05
B+3	7.79E-04	1.40E-02	6.66E-04	2.78E-03	7.06E-04	8.70E-04	7.96E-03		1.61E-02
Br-	4.45E-09	2.86E-07	1.19E-08	1.19E-08	1.19E-08	1.12E-08	2.34E-08		3.35E-07
Cd+2	1.50E-04	2.04E-03	1.25E-04	4.69E-04	1.31E-04	1.56E-04	1.35E-02		2.33E-03
Ca+2	2.14E-03	4.28E-02	1.97E-03	7.67E-03	2.08E-03	2.51E-03	7.98E-02		4.93E-02
Ce+4	1.39E-05	3.03E-05	1.60E-06	5.96E-05	2.72E-06	8.28E-06	2.77E-03		2.69E-05
Cs+	5.55E-05	5.36E-05	3.95E-06	2.39E-04	8.49E-06	3.11E-05	1.07E-02		2.79E-05
Cl-	3.23E-03	2.26E-02	9.34E-04	1.38E-02	1.18E-03	2.38E-03	1.56E-01		2.46E-02
Cr+3	5.85E-04	4.12E-03	1.89E-04	2.42E-03	2.33E-04	4.39E-04	3.98E-02		4.50E-03
Co+2	4.86E-06	2.25E-04	6.28E-06	2.65E-05	6.67E-06	8.38E-06	4.14E-04		2.61E-04
Cu+2	1.55E-04	5.91E-04	2.34E-05	6.79E-04	3.61E-05	9.87E-05	1.42E-02		5.95E-04
Eu+3	7.38E-09	4.75E-07	1.98E-08	1.98E-08	1.98E-08	1.86E-08	7.36E-08		5.56E-07
F-	2.82E-02	2.96E-02	3.36E-03	1.17E-01	5.55E-03	1.63E-02	7.35E-01		1.78E-02
Gd+3	2.82E-05	1.40E-04	5.73E-06	1.22E-04	7.97E-06	1.89E-05	6.23E-03		1.47E-04
Ge+4	1.28E-10	8.26E-09	3.44E-10	3.44E-10	3.44E-10	3.23E-10	6.12E-10		9.67E-09
In+3	2.02E-08	1.47E-06	5.86E-08	5.86E-08	5.86E-08	5.52E-08	1.65E-07		1.72E-06
I-	3.70E-08	2.38E-06	9.90E-08	9.90E-08	9.90E-08	9.30E-08	3.08E-07		2.79E-06
Fe+3	1.07E-02	2.23E-02	1.27E-03	4.58E-02	2.13E-03	6.39E-03	8.48E-01		1.95E-02
La+3	1.34E-07	8.63E-06	3.59E-07	3.59E-07	3.59E-07	3.37E-07	1.22E-06		1.01E-05
Pb+2	6.39E-05	8.10E-04	3.97E-05	2.41E-04	4.36E-05	6.05E-05	1.44E-02		9.19E-04
Li+	3.18E-04	4.14E-04	2.43E-05	1.38E-03	5.05E-05	1.81E-04	3.20E-03		2.84E-04
Mg+2	1.23E-03	1.72E-02	7.88E-04	4.75E-03	8.64E-04	1.20E-03	3.33E-02		1.95E-02
Mn+4	4.45E-04	1.30E-02	5.60E-04	1.55E-03	5.80E-04	6.42E-04	1.93E-02		1.51E-02
Hg+2	3.11E-05	4.76E-03	1.43E-04	2.04E-04	1.44E-04	1.44E-04	4.87E-03		5.57E-03
Mo+6	8.91E-04	6.70E-04	5.53E-05	3.84E-03	1.28E-04	4.94E-04	1.24E-01		2.22E-04
Nd+3	4.32E-07	2.78E-05	1.16E-06	1.16E-06	1.16E-06	1.09E-06	4.10E-06		3.26E-05
Np+4	2.47E-07	2.23E-06	3.00E-07	3.00E-07	3.00E-07	2.74E-07	1.74E-06		2.61E-06
Ni+2	2.03E-04	1.56E-03	7.09E-05	8.39E-04	8.57E-05	1.56E-04	1.55E-02		1.71E-03
Nb+5	1.47E-03	8.29E-04	8.25E-05	6.36E-03	2.04E-04	8.10E-04	1.99E-01		3.87E-05
NO3-	6.65E-02	5.38E+00	2.07E-01	2.09E-01	2.07E-01	1.95E-01	3.55E-01		6.30E+00
O-2	2.23E-01	1.23E-01	1.24E-02	9.64E-01	3.08E-02	1.23E-01	5.19E+00		2.42E-03
Pd+4	2.45E-03	1.60E-03	1.43E-04	1.06E-02	3.45E-04	1.35E-03	3.79E-01		3.17E-04
PO4-3	1.39E-01	7.64E-02	7.78E-03	5.97E-01	1.92E-02	7.61E-02	1.91E+01		1.94E-03
Pu+4	7.79E-08	3.79E-06	1.76E-07	1.76E-07	1.76E-07	1.65E-07	1.03E-06		4.44E-06
K+	1.86E-02	3.07E-01	1.09E-02	8.09E-02	1.23E-02	1.85E-02	9.42E-01		3.50E-01
Pr+4	1.22E-07	7.84E-06	3.27E-07	3.27E-07	3.27E-07	3.07E-07	1.13E-06		9.19E-06
Rh+4	5.26E-08	3.38E-06	1.41E-07	1.41E-07	1.41E-07	1.32E-07	3.55E-07		3.96E-06

Table B-10. Tank WM-188 mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from TFF
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
Rb+	8.10E-08	5.21E-06	2.17E-07	2.17E-07	2.17E-07	2.04E-07	4.54E-07		6.10E-06
Ru+3	1.03E-03	6.79E-04	6.04E-05	4.43E-03	1.45E-04	5.67E-04	1.51E-01		1.46E-04
Sm+3	8.02E-08	5.16E-06	2.15E-07	2.15E-07	2.15E-07	2.02E-07	7.91E-07		6.04E-06
Se+4	3.82E-04	2.13E-04	2.13E-05	1.65E-03	5.27E-05	2.10E-04	4.37E-02		8.47E-06
Si+4	1.26E-01	6.94E-02	7.01E-03	5.42E-01	1.73E-02	6.90E-02	5.12E+00		1.92E-03
Ag+	5.89E-04	3.26E-04	3.33E-05	2.54E-03	8.17E-05	3.23E-04	9.20E-02		9.67E-06
Na+	4.19E-02	3.08E+00	9.78E-02	2.10E-01	9.99E-02	1.06E-01	9.35E-01		1.39E+00
Sr+2	8.53E-06	7.12E-05	2.43E-06	3.79E-05	3.12E-06	6.45E-06	1.06E-03		7.81E-05
SO4-2	6.39E-04	2.22E-02	1.21E-03	1.21E-03	1.21E-03	1.13E-03	2.85E-03		2.60E-02
Tc+7	9.40E-08	1.06E-05	3.74E-07	3.74E-07	3.74E-07	3.54E-07	8.88E-07		1.25E-05
Te+4	4.21E-08	3.10E-06	1.23E-07	1.23E-07	1.23E-07	1.16E-07	3.86E-07		3.64E-06
Tb+4	3.09E-11	1.99E-09	8.27E-11	8.27E-11	8.27E-11	7.77E-11	3.22E-10		2.33E-09
Th+4	2.87E-12	2.20E-05	5.83E-07	5.83E-07	5.83E-07	5.60E-07	3.31E-06		2.58E-05
Sn+4	2.63E-03	1.47E-03	1.47E-04	1.13E-02	3.63E-04	1.44E-03	4.53E-01		6.53E-05
Ti+4	1.29E-03	7.50E-04	7.38E-05	5.56E-03	1.80E-04	7.09E-04	8.95E-02		6.42E-05
U+4	3.83E-05	7.10E-04	2.59E-05	1.64E-04	2.86E-05	4.06E-05	1.13E-02		8.12E-04
V+5	1.12E-05	2.35E-05	4.43E-06	3.68E-05	5.05E-06	7.82E-06	5.67E-04		2.27E-05
Y+3	1.00E-07	6.43E-06	2.68E-07	2.68E-07	2.68E-07	2.52E-07	5.84E-07		7.53E-06
Zn+2	8.90E-05	6.89E-04	2.33E-05	3.96E-04	3.05E-05	6.57E-05	8.33E-03		7.52E-04
Zr+4	5.35E-02	3.13E-02	3.12E-03	2.31E-01	7.51E-03	2.95E-02	7.07E+00		2.94E-03
H2O	5.55E+01	4.79E+01	5.52E+01	5.39E+01	5.51E+01	5.45E+01	5.67E+01		4.66E+01
Canisters/day							0.59		
Canisters total							90		
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Ra-226	1.15E-13	8.39E-12	3.35E-13	3.35E-13	3.35E-13	3.15E-13	8.21E-14		9.83E-12
Ac-227	5.43E-13	3.95E-11	1.58E-12	1.58E-12	1.58E-12	1.48E-12	3.86E-13		4.63E-11
Th-228	4.51E-11	3.28E-09	1.31E-10	1.31E-10	1.31E-10	1.23E-10	3.21E-11		3.84E-09
Th-230	3.37E-10	1.02E-09	5.17E-11	1.44E-09	7.84E-11	2.10E-10	4.73E-09		9.91E-10
Th-232	9.98E-18	7.26E-16	2.90E-17	2.90E-17	2.90E-17	2.72E-17	7.10E-18		8.50E-16
Pa-231	1.26E-12	9.15E-11	3.65E-12	3.65E-12	3.65E-12	3.44E-12	8.95E-13		1.07E-10
Pa-233	4.13E-08	3.00E-06	1.20E-07	1.20E-07	1.20E-07	1.13E-07	2.94E-08		3.52E-06
U-232	6.99E-10	2.40E-09	1.19E-10	2.97E-09	1.74E-10	4.45E-10	9.75E-09		2.39E-09
U-233	1.27E-11	8.83E-11	3.91E-12	5.31E-11	4.86E-12	9.43E-12	1.69E-10		9.61E-11
U-234	2.08E-07	1.02E-06	4.60E-08	8.85E-07	6.22E-08	1.41E-07	2.87E-06		1.07E-06
U-235	1.09E-08	8.18E-08	2.84E-09	4.82E-08	3.72E-09	8.00E-09	1.55E-07		8.92E-08
U-236	1.43E-08	4.29E-08	2.16E-09	6.11E-08	3.30E-09	8.92E-09	2.01E-07		4.15E-08
U-237	9.07E-11	6.59E-09	2.63E-10	2.63E-10	2.63E-10	2.48E-10	6.45E-11		7.73E-09
U-238	1.23E-09	1.14E-08	7.53E-10	4.15E-09	8.19E-10	1.09E-09	1.17E-08		1.28E-08
Np-236	6.44E-14	3.15E-12	1.46E-13	1.46E-13	1.46E-13	1.37E-13	3.58E-14		3.69E-12
Np-237	1.02E-07	4.06E-07	5.35E-08	3.14E-07	5.85E-08	7.93E-08	8.99E-07		4.37E-07
Pu-236	1.22E-09	3.45E-09	2.05E-10	5.13E-09	3.00E-10	7.66E-10	1.68E-08		3.31E-09
Pu-238	6.41E-04	7.76E-04	6.49E-05	2.71E-03	1.16E-04	3.69E-04	9.02E-03		5.16E-04
Pu-239	6.72E-05	8.80E-05	6.03E-06	2.88E-04	1.15E-05	3.85E-05	9.60E-04		6.12E-05
Pu-240	4.68E-06	1.29E-05	7.37E-07	1.97E-05	1.10E-06	2.91E-06	6.48E-05		1.22E-05
Pu-241	5.07E-04	5.41E-04	5.00E-05	2.14E-03	9.03E-05	2.90E-04	7.12E-03		3.24E-04
Pu-242	3.69E-09	9.97E-09	7.21E-10	1.50E-08	9.98E-10	2.34E-09	4.89E-08		9.56E-09
Pu-244	2.89E-16	8.44E-16	3.47E-17	1.26E-15	5.84E-17	1.76E-16	4.18E-15		8.06E-16
Am-241	1.71E-05	5.47E-05	2.93E-06	7.19E-05	4.26E-06	1.08E-05	2.36E-04		5.38E-05
Am-242m	2.14E-10	1.60E-08	6.33E-10	6.33E-10	6.33E-10	5.96E-10	1.55E-10		1.88E-08
Am-243	6.07E-09	2.57E-08	1.21E-09	2.58E-08	1.69E-09	4.01E-09	8.39E-08		2.65E-08
Cm-242	2.00E-10	3.51E-08	1.10E-09	1.20E-09	1.10E-09	1.06E-09	6.06E-10		4.11E-08

Table B-10. Tank WM-188 mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Cm-243	1.23E-08	3.56E-08	1.82E-09	5.23E-08	2.80E-09	7.61E-09	1.72E-07		3.42E-08
Cm-244	7.68E-07	1.20E-06	8.64E-08	3.25E-06	1.48E-07	4.50E-07	1.08E-05		9.34E-07
Cm-245	1.30E-10	3.75E-10	1.92E-11	5.55E-10	2.95E-11	8.05E-11	1.83E-09		3.60E-10
Cm-246	8.44E-12	2.46E-11	1.26E-12	3.60E-11	1.93E-12	5.24E-12	1.19E-10		2.37E-11
H-3	3.92E-07	1.18E-05	6.95E-07	6.95E-07	6.95E-07	6.45E-07	1.70E-07		1.39E-05
Be-10	4.23E-14	3.07E-12	1.23E-13	1.23E-13	1.23E-13	1.15E-13	3.01E-14		3.60E-12
C-14	5.49E-11	1.52E-10	7.86E-12	2.34E-10	1.22E-11	3.38E-11	7.72E-10		1.45E-10
Se-79	1.98E-07	5.53E-07	2.85E-08	8.43E-07	4.42E-08	1.22E-07	2.78E-06		5.26E-07
Rb-87	4.13E-13	3.00E-11	1.20E-12	1.20E-12	1.20E-12	1.13E-12	2.94E-13		3.52E-11
Sr-90	1.06E-03	3.90E-02	1.70E-03	3.36E-03	1.73E-03	1.79E-03	6.07E-03		4.54E-02
Y-90	1.06E-03	3.90E-02	1.70E-03	3.36E-03	1.73E-03	1.79E-03	6.07E-03		4.54E-02
Zr-93	3.12E-08	2.27E-06	9.06E-08	9.06E-08	9.06E-08	8.52E-08	2.22E-08		2.66E-06
Nb-93m	2.41E-08	1.75E-06	6.98E-08	6.98E-08	6.98E-08	6.57E-08	1.71E-08		2.05E-06
Nb-94	5.10E-07	1.44E-06	7.40E-08	2.17E-06	1.15E-07	3.15E-07	7.17E-06		1.37E-06
Tc-98	3.63E-14	2.64E-12	1.05E-13	1.05E-13	1.05E-13	9.92E-14	2.58E-14		3.10E-12
Tc-99	4.43E-06	2.02E-05	8.64E-07	1.90E-05	1.22E-06	2.94E-06	6.21E-05		2.10E-05
Ru-106	4.27E-07	1.18E-06	6.10E-08	1.82E-06	9.50E-08	2.63E-07	6.01E-06		1.12E-06
Rh-102	4.14E-07	2.28E-07	2.30E-08	1.78E-06	5.70E-08	2.27E-07	6.00E-06		5.52E-09
Pd-107	2.33E-10	1.69E-08	6.75E-10	6.75E-10	6.75E-10	6.35E-10	1.66E-10		1.98E-08
Cd-113m	4.68E-08	3.40E-06	1.36E-07	1.36E-07	1.36E-07	1.28E-07	3.33E-08		3.99E-06
In-115	1.42E-18	1.03E-16	4.12E-18	4.12E-18	4.12E-18	3.87E-18	1.01E-18		1.21E-16
Sn-121m	9.42E-10	6.85E-08	2.73E-09	2.73E-09	2.73E-09	2.57E-09	6.70E-10		8.03E-08
Sn-126	1.87E-07	5.20E-07	2.68E-08	7.96E-07	4.17E-08	1.15E-07	2.63E-06		4.95E-07
Sb-125	5.93E-04	3.38E-04	3.37E-05	2.56E-03	8.24E-05	3.26E-04	8.59E-03		2.19E-05
Sb-126	8.10E-10	5.89E-08	2.35E-09	2.35E-09	2.35E-09	2.21E-09	5.76E-10		6.90E-08
Te-123	5.40E-21	3.93E-19	1.57E-20	1.57E-20	1.57E-20	1.47E-20	3.84E-21		4.60E-19
Te-125m	4.44E-08	3.23E-06	1.29E-07	1.29E-07	1.29E-07	1.21E-07	3.16E-08		3.78E-06
I-129	2.42E-08	6.75E-08	3.49E-09	1.03E-07	5.42E-09	1.49E-08	3.40E-07		6.42E-08
Cs-134	4.92E-05	3.02E-05	3.61E-06	2.09E-04	7.58E-06	2.74E-05	7.02E-04		4.81E-06
Cs-135	3.49E-07	1.07E-06	5.39E-08	1.49E-06	8.16E-08	2.17E-07	4.90E-06		1.04E-06
Cs-137	1.98E-02	1.65E-02	1.91E-03	8.33E-02	3.49E-03	1.13E-02	2.78E-01		7.26E-03
Ba-137m	1.88E-02	1.56E-02	1.81E-03	7.88E-02	3.30E-03	1.07E-02	2.63E-01		6.87E-03
La-138	2.69E-18	1.96E-16	7.80E-18	7.80E-18	7.80E-18	7.34E-18	1.91E-18		2.29E-16
Ce-142	4.21E-13	3.06E-11	1.22E-12	1.22E-12	1.22E-12	1.15E-12	3.00E-13		3.59E-11
Ce-144	2.90E-07	7.96E-07	4.12E-08	1.24E-06	6.43E-08	1.78E-07	4.08E-06		7.55E-07
Nd-144	2.27E-17	1.65E-15	6.57E-17	6.57E-17	6.57E-17	6.18E-17	1.61E-17		1.93E-15
Pm-146	7.17E-10	5.21E-08	2.08E-09	2.08E-09	2.08E-09	1.96E-09	5.10E-10		6.11E-08
Pm-147	7.68E-05	2.15E-04	1.11E-05	3.28E-04	1.72E-05	4.74E-05	1.08E-03		2.05E-04
Sm-146	3.89E-15	2.83E-13	1.13E-14	1.13E-14	1.13E-14	1.06E-14	2.76E-15		3.31E-13
Sm-147	1.04E-13	7.55E-12	3.01E-13	3.01E-13	3.01E-13	2.83E-13	7.38E-14		8.84E-12
Sm-148	5.33E-19	3.88E-17	1.55E-18	1.55E-18	1.55E-18	1.46E-18	3.79E-19		4.54E-17
Sm-149	4.73E-20	3.44E-18	1.37E-19	1.37E-19	1.37E-19	1.29E-19	3.37E-20		4.03E-18
Sm-151	1.53E-04	4.25E-04	2.20E-05	6.54E-04	3.42E-05	9.44E-05	2.16E-03		4.05E-04
Eu-152	5.55E-07	2.86E-06	1.32E-07	2.34E-06	1.74E-07	3.82E-07	7.56E-06		3.03E-06
Eu-154	2.44E-05	3.11E-05	5.24E-06	9.35E-05	6.95E-06	1.51E-05	3.02E-04		2.33E-05
Eu-155	3.50E-05	2.57E-05	3.06E-06	1.48E-04	5.85E-06	1.97E-05	4.92E-04		8.68E-06
Gd-152	2.00E-20	1.46E-18	5.81E-20	5.81E-20	5.81E-20	5.47E-20	1.42E-20		1.71E-18
Ho-166m	6.49E-13	4.72E-11	1.88E-12	1.88E-12	1.88E-12	1.77E-12	4.61E-13		5.53E-11
Co-60	2.81E-06	4.96E-06	1.14E-06	9.01E-06	1.29E-06	1.95E-06	2.71E-05		4.64E-06
Ni-63	1.48E-05	4.01E-05	2.55E-06	6.15E-05	3.69E-06	9.26E-06	2.01E-04		3.83E-05

Table B-10. Tank WM-188 mass balance (continued).

PFD Sheet #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Rate, gal/hr	95.0	7800	7705	95.0	95.0	95.0	95.0	0.5
Rate, lb/hr	1054	86569	85515	1054	1054	1054	1054	5
Rate, peak, gpm	1.58	130	128	1.58	1.58	1.58	1.58	2.99
Operation	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Batch
Temperature, °F	70	70	70	70	70	70	70	70
Pressure, psia	12.8	35.0	35.0	24.8	20.8	16.8	12.8	12.8
Specific Gravity	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.07
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
H+	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	1.01E-01
Al+3	4.60E-01	4.75E-01	4.75E-01	4.59E-01	4.59E-01	4.59E-01	4.59E-01	9.29E-02
Am+4	5.75E-08	5.75E-08	5.75E-08	5.75E-08	5.75E-08	5.75E-08	5.75E-08	1.16E-08
Sb+5	4.53E-06	1.37E-05	1.38E-05	4.38E-06	4.38E-06	4.38E-06	4.38E-06	8.86E-07
As+5	7.32E-06	8.44E-05	8.54E-05	6.08E-06	6.08E-06	6.08E-06	6.08E-06	1.23E-06
Ba+2	5.43E-05	7.06E-05	7.08E-05	5.40E-05	5.40E-05	5.40E-05	5.40E-05	1.09E-05
Be+2	1.24E-05	1.61E-05	1.62E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	2.49E-06
B+3	1.44E-02	1.47E-02	1.47E-02	1.44E-02	1.44E-02	1.44E-02	1.44E-02	2.91E-03
Br-	3.01E-07	3.01E-07	3.01E-07	3.01E-07	3.01E-07	3.01E-07	3.01E-07	6.08E-08
Cd+2	2.09E-03	2.14E-03	2.14E-03	2.09E-03	2.09E-03	2.09E-03	2.09E-03	4.22E-04
Ca+2	4.42E-02	4.50E-02	4.50E-02	4.42E-02	4.42E-02	4.42E-02	4.42E-02	8.93E-03
Ce+4	2.41E-05	3.24E-05	3.25E-05	2.40E-05	2.40E-05	2.40E-05	2.40E-05	4.85E-06
Cs+	2.50E-05	5.84E-05	5.88E-05	2.44E-05	2.44E-06	2.44E-07	2.44E-08	4.94E-09
Cl-	2.21E-02	2.39E-02	2.39E-02	2.20E-02	2.20E-02	2.20E-02	2.20E-02	4.45E-03
Cr+3	4.03E-03	4.35E-03	4.35E-03	4.03E-03	4.03E-03	4.03E-03	4.03E-03	8.14E-04
Co+2	2.34E-04	2.37E-04	2.37E-04	2.34E-04	2.34E-04	2.34E-04	2.34E-04	4.73E-05
Cu+2	5.33E-04	6.26E-04	6.27E-04	5.31E-04	5.31E-04	5.31E-04	5.31E-04	1.07E-04
Eu+3	4.98E-07	4.98E-07	4.98E-07	4.98E-07	4.98E-07	4.98E-07	4.98E-07	1.01E-07
F-	1.60E-02	3.21E-02	3.23E-02	1.57E-02	1.57E-02	1.57E-02	1.57E-02	3.17E-03
Gd+3	1.31E-04	1.48E-04	1.48E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	2.65E-05
Ge+4	8.67E-09	8.67E-09	8.67E-09	8.67E-09	8.67E-09	8.67E-09	8.67E-09	1.75E-09
In+3	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	1.54E-06	3.12E-07
I-	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06	2.50E-06	5.04E-07
Fe+3	1.75E-02	2.38E-02	2.39E-02	1.74E-02	1.74E-02	1.74E-02	1.74E-02	3.52E-03
La+3	9.06E-06	9.06E-06	9.06E-06	9.06E-06	9.06E-06	9.06E-06	9.06E-06	1.83E-06
Pb+2	8.24E-04	8.52E-04	8.53E-04	8.23E-04	8.23E-04	8.23E-04	8.23E-04	1.66E-04
Li+	2.54E-04	4.46E-04	4.49E-04	2.51E-04	2.51E-04	2.51E-04	2.51E-04	5.07E-05
Mg+2	1.75E-02	1.80E-02	1.81E-02	1.75E-02	1.75E-02	1.75E-02	1.75E-02	3.53E-03
Mn+4	1.35E-02	1.37E-02	1.37E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02	2.73E-03
Hg+2	4.99E-03	5.00E-03	5.00E-03	4.99E-03	4.99E-03	4.99E-03	4.99E-03	1.01E-03
Mo+6	1.99E-04	7.37E-04	7.44E-04	1.90E-04	1.90E-04	1.90E-04	1.90E-04	3.85E-05
Nd+3	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	5.90E-06
Np+4	2.34E-06	2.34E-06	2.34E-06	2.34E-06	2.34E-06	2.34E-06	2.34E-06	4.73E-07
Ni+2	1.53E-03	1.64E-03	1.64E-03	1.53E-03	1.53E-03	1.53E-03	1.53E-03	3.09E-04
Nb+5	3.46E-05	9.26E-04	9.38E-04	2.03E-05	2.03E-05	2.03E-05	2.03E-05	4.10E-06
NO3-	5.65E+00	5.65E+00	5.65E+00	5.65E+00	5.65E+00	5.65E+00	5.65E+00	1.14E+00
O-2	2.17E-03	1.37E-01	1.39E-01					
Pd+4	2.84E-04	1.77E-03	1.79E-03	2.61E-04	2.61E-04	2.61E-04	2.61E-04	5.27E-05
PO4-3	1.74E-03	8.55E-02	8.66E-02	3.90E-04	3.90E-04	3.90E-04	3.90E-04	7.88E-05
Pu+4	3.98E-06	3.98E-06	3.98E-06	3.98E-06	3.98E-06	3.98E-06	3.98E-06	8.05E-07
K+	3.14E-01	3.23E-01	3.24E-01	3.13E-01	3.13E-01	3.13E-01	3.13E-01	6.33E-02
Pr+4	8.23E-06	8.23E-06	8.23E-06	8.23E-06	8.23E-06	8.23E-06	8.23E-06	1.66E-06
Rh+4	3.55E-06	3.55E-06	3.55E-06	3.55E-06	3.55E-06	3.55E-06	3.55E-06	7.18E-07

Table B-10. Tank WM-188 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
Rb+	5.47E-06	5.47E-06	5.47E-06	5.47E-06	5.47E-06	5.47E-06	5.47E-06	1.11E-06
Ru+3	1.31E-04	7.52E-04	7.60E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04	2.44E-05
Sm+3	5.41E-06	5.41E-06	5.41E-06	5.41E-06	5.41E-06	5.41E-06	5.41E-06	1.09E-06
Se+4	7.59E-06	2.39E-04	2.42E-04	3.87E-06	3.87E-06	3.87E-06	3.87E-06	7.83E-07
Si+4	1.72E-03	7.77E-02	7.87E-02	4.96E-04	4.96E-04	4.96E-04	4.96E-04	1.00E-04
Ag+	8.67E-06	3.64E-04	3.69E-04	2.95E-06	2.95E-06	2.95E-06	2.95E-06	5.96E-07
Na+	3.22E+00	3.23E+00	3.23E+00	3.22E+00	3.22E+00	3.22E+00	3.22E+00	6.50E-01
Sr+2	7.00E-05	7.51E-05	7.51E-05	6.99E-05	6.99E-05	6.99E-05	6.99E-05	1.41E-05
SO4-2	2.33E-02	2.33E-02	2.33E-02	2.33E-02	2.33E-02	2.33E-02	2.33E-02	4.71E-03
Tc+7	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	2.26E-06
Te+4	3.26E-06	3.26E-06	3.26E-06	3.26E-06	3.26E-06	3.26E-06	3.26E-06	6.59E-07
Tb+4	2.08E-09	2.08E-09	2.08E-09	2.08E-09	2.08E-09	2.08E-09	2.08E-09	4.21E-10
Th+4	2.31E-05	2.31E-05	2.31E-05	2.31E-05	2.31E-05	2.31E-05	2.31E-05	4.67E-06
Sn+4	5.86E-05	1.65E-03	1.67E-03	3.30E-05	3.30E-05	3.30E-05	3.30E-05	6.67E-06
Ti+4	5.75E-05	8.37E-04	8.47E-04	4.50E-05	4.50E-05	4.50E-05	4.50E-05	9.09E-06
U+4	7.28E-04	7.47E-04	7.47E-04	7.27E-04	7.27E-04	7.27E-04	7.27E-04	1.47E-04
V+5	2.03E-05	2.49E-05	2.50E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	4.10E-06
Y+3	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	1.36E-06
Zn+2	6.74E-04	7.27E-04	7.28E-04	6.73E-04	6.73E-04	6.73E-04	6.73E-04	1.36E-04
Zr+4	2.64E-03	3.49E-02	3.54E-02	2.12E-03	2.12E-03	2.12E-03	2.12E-03	4.28E-04
H2O	4.81E+01	4.71E+01	4.71E+01	4.81E+01	4.81E+01	4.81E+01	4.81E+01	5.37E+01
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Ra-226	8.81E-12	8.81E-12	8.81E-12	8.81E-12	8.81E-12	8.81E-12	8.81E-12	1.78E-12
Ac-227	4.15E-11	4.15E-11	4.15E-11	4.15E-11	4.15E-11	4.15E-11	4.15E-11	8.39E-12
Th-228	3.44E-09	3.44E-09	3.44E-09	3.44E-09	3.44E-09	3.44E-09	3.44E-09	6.96E-10
Th-230	8.88E-10	1.08E-09	1.09E-09	8.85E-10	8.85E-10	8.85E-10	8.85E-10	1.79E-10
Th-232	7.62E-16	6.67E-11	7.62E-16	7.62E-16	7.62E-16	7.62E-16	7.62E-16	1.54E-16
Pa-231	9.61E-11	9.61E-11	9.61E-11	9.61E-11	9.61E-11	9.61E-11	9.61E-11	1.94E-11
Pa-233	3.15E-06	3.15E-06	3.15E-06	3.15E-06	3.15E-06	3.15E-06	3.15E-06	6.37E-07
U-232	2.14E-09	2.55E-09	2.56E-09	2.14E-09	2.14E-09	2.14E-09	2.14E-09	4.32E-10
U-233	8.61E-11	9.31E-11	9.32E-11	8.60E-11	8.60E-11	8.60E-11	8.60E-11	1.74E-11
U-234	9.58E-07	1.08E-06	1.08E-06	9.56E-07	9.56E-07	9.56E-07	9.56E-07	1.93E-07
U-235	7.99E-08	8.63E-08	8.64E-08	7.98E-08	7.98E-08	7.98E-08	7.98E-08	1.61E-08
U-236	3.72E-08	4.56E-08	4.57E-08	3.70E-08	3.70E-08	3.70E-08	3.70E-08	7.49E-09
U-237	6.92E-09	6.92E-09	6.92E-09	6.92E-09	6.92E-09	6.92E-09	6.92E-09	1.40E-09
U-238	1.15E-08	1.20E-08	1.20E-08	1.15E-08	1.15E-08	1.15E-08	1.15E-08	2.32E-09
Np-236	3.31E-12	3.31E-12	3.31E-12	3.31E-12	3.31E-12	3.31E-12	3.31E-12	6.68E-13
Np-237	3.92E-07	4.29E-07	4.29E-07	3.91E-07	3.91E-07	3.91E-07	3.91E-07	7.90E-08
Pu-236	2.96E-09	3.66E-09	3.67E-09	2.95E-09	2.95E-09	2.95E-09	2.95E-09	5.97E-10
Pu-238	4.63E-04	8.39E-04	8.44E-04	4.57E-04	4.57E-04	4.57E-04	4.57E-04	9.23E-05
Pu-239	5.49E-05	9.49E-05	9.54E-05	5.42E-05	5.42E-05	5.42E-05	5.42E-05	1.10E-05
Pu-240	1.10E-05	1.37E-05	1.37E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05	2.21E-06
Pu-241	2.90E-04	5.87E-04	5.91E-04	2.86E-04	2.86E-04	2.86E-04	2.86E-04	5.77E-05
Pu-242	8.57E-09	1.06E-08	1.06E-08	8.53E-09	8.53E-09	8.53E-09	8.53E-09	1.72E-09
Pu-244	7.22E-16	8.97E-16	8.99E-16	7.20E-16	7.20E-16	7.20E-16	7.20E-16	1.45E-16
Am-241	4.83E-05	5.81E-05	5.82E-05	4.81E-05	4.81E-05	4.81E-05	4.81E-05	9.72E-06
Am-242m	1.68E-08	1.68E-08	1.68E-08	1.68E-08	1.68E-08	1.68E-08	1.68E-08	3.40E-09
Am-243	2.38E-08	2.73E-08	2.73E-08	2.37E-08	2.37E-08	2.37E-08	2.37E-08	4.79E-09
Cm-242	3.68E-08	3.68E-08	3.68E-08	3.68E-08	3.68E-08	3.68E-08	3.68E-08	7.44E-09

Table B-10. Tank WM-188 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Cm-243	3.07E-08	3.79E-08	3.80E-08	3.06E-08	3.06E-08	3.06E-08	3.06E-08	6.18E-09
Cm-244	8.37E-07	1.29E-06	1.29E-06	8.30E-07	8.30E-07	8.30E-07	8.30E-07	1.68E-07
Cm-245	3.22E-10	3.98E-10	3.99E-10	3.21E-10	3.21E-10	3.21E-10	3.21E-10	6.49E-11
Cm-246	2.12E-11	2.62E-11	2.62E-11	2.12E-11	2.12E-11	2.12E-11	2.12E-11	4.28E-12
H-3	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05	1.24E-05	2.51E-06
Be-10	3.23E-12	3.23E-12	3.23E-12	3.23E-12	3.23E-12	3.23E-12	3.23E-12	6.52E-13
C-14	1.30E-10	1.62E-10	1.62E-10	1.29E-10	1.29E-10	1.29E-10	1.29E-10	2.61E-11
Se-79	4.72E-07	5.87E-07	5.89E-07	4.70E-07	4.70E-07	4.70E-07	4.70E-07	9.50E-08
Rb-87	3.15E-11	3.15E-11	3.15E-11	3.15E-11	3.15E-11	3.15E-11	3.15E-11	6.37E-12
Sr-90	4.07E-02	4.09E-02	4.09E-02	4.07E-02	4.07E-02	4.07E-02	4.07E-02	8.22E-03
Y-90	4.07E-02	4.09E-02	4.09E-02	4.07E-02	4.07E-02	4.07E-02	4.07E-02	8.22E-03
Zr-93	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	4.82E-07
Nb-93m	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.84E-06	3.71E-07
Nb-94	1.23E-06	1.53E-06	1.53E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	2.48E-07
Tc-98	2.77E-12	2.77E-12	2.77E-12	2.77E-12	2.77E-12	2.77E-12	2.77E-12	5.61E-13
Tc-99	1.88E-05	2.14E-05	2.14E-05	1.87E-05	1.87E-05	1.87E-05	1.87E-05	3.79E-06
Ru-106	1.00E-06	1.25E-06	1.26E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	2.02E-07
Rh-102	4.95E-09	2.55E-07	2.58E-07	9.27E-10	9.27E-10	9.27E-10	9.27E-10	1.87E-10
Pd-107	1.78E-08	1.78E-08	1.78E-08	1.78E-08	1.78E-08	1.78E-08	1.78E-08	3.59E-09
Cd-113m	3.57E-06	3.57E-06	3.57E-06	3.57E-06	3.57E-06	3.57E-06	3.57E-06	7.22E-07
In-115	1.08E-16	1.08E-16	1.08E-16	1.08E-16	1.08E-16	1.08E-16	1.08E-16	2.19E-17
Sn-121m	7.19E-08	7.19E-08	7.19E-08	7.19E-08	7.19E-08	7.19E-08	7.19E-08	1.45E-08
Sn-126	4.44E-07	5.53E-07	5.54E-07	4.42E-07	4.42E-07	4.42E-07	4.42E-07	8.93E-08
Sb-125	1.97E-05	3.78E-04	3.83E-04	1.39E-05	1.39E-05	1.39E-05	1.39E-05	2.81E-06
Sb-126	6.19E-08	6.19E-08	6.19E-08	6.19E-08	6.19E-08	6.19E-08	6.19E-08	1.25E-08
Te-123	4.12E-19	4.12E-19	4.12E-19	4.12E-19	4.12E-19	4.12E-19	4.12E-19	8.33E-20
Te-125m	3.39E-06	3.39E-06	3.39E-06	3.39E-06	3.39E-06	3.39E-06	3.39E-06	6.85E-07
I-129	5.76E-08	7.17E-08	7.19E-08	5.73E-08	5.73E-08	5.73E-08	5.73E-08	1.16E-08
Cs-134	4.31E-06	3.36E-05	3.39E-05	3.84E-06	3.84E-07	3.84E-08	3.84E-09	7.76E-10
Cs-135	9.28E-07	1.13E-06	1.13E-06	9.25E-07	9.25E-08	9.25E-09	9.25E-10	1.87E-10
Cs-137	6.51E-03	1.81E-02	1.82E-02	6.32E-03	6.32E-04	6.32E-05	6.32E-06	1.28E-06
Ba-137m	6.16E-03	1.71E-02	1.72E-02	5.98E-03	5.98E-03	5.98E-03	5.98E-03	1.21E-03
La-138	2.05E-16	2.05E-16	2.05E-16	2.05E-16	2.05E-16	2.05E-16	2.05E-16	4.15E-17
Ce-142	3.22E-11	3.22E-11	3.22E-11	3.22E-11	3.22E-11	3.22E-11	3.22E-11	6.50E-12
Ce-144	6.77E-07	8.47E-07	8.49E-07	6.74E-07	6.74E-07	6.74E-07	6.74E-07	1.36E-07
Nd-144	1.73E-15	1.73E-15	1.73E-15	1.73E-15	1.73E-15	1.73E-15	1.73E-15	3.50E-16
Pm-146	5.47E-08	5.47E-08	5.47E-08	5.47E-08	5.47E-08	5.47E-08	5.47E-08	1.11E-08
Pm-147	1.84E-04	2.29E-04	2.29E-04	1.83E-04	1.83E-04	1.83E-04	1.83E-04	3.70E-05
Sm-146	2.97E-13	2.97E-13	2.97E-13	2.97E-13	2.97E-13	2.97E-13	2.97E-13	6.00E-14
Sm-147	7.92E-12	7.92E-12	7.92E-12	7.92E-12	7.92E-12	7.92E-12	7.92E-12	1.60E-12
Sm-148	4.07E-17	4.07E-17	4.07E-17	4.07E-17	4.07E-17	4.07E-17	4.07E-17	8.23E-18
Sm-149	3.61E-18	3.61E-18	3.61E-18	3.61E-18	3.61E-18	3.61E-18	3.61E-18	7.30E-19
Sm-151	3.63E-04	4.52E-04	4.53E-04	3.61E-04	3.61E-04	3.61E-04	3.61E-04	7.30E-05
Eu-152	2.71E-06	3.03E-06	3.03E-06	2.71E-06	2.71E-06	2.71E-06	2.71E-06	5.47E-07
Eu-154	2.09E-05	3.35E-05	3.36E-05	2.07E-05	2.07E-05	2.07E-05	2.07E-05	4.19E-06
Eu-155	7.78E-06	2.83E-05	2.86E-05	7.45E-06	7.45E-06	7.45E-06	7.45E-06	1.51E-06
Gd-152	1.53E-18	1.53E-18	1.53E-18	1.53E-18	1.53E-18	1.53E-18	1.53E-18	3.09E-19
Ho-166m	4.95E-11	4.95E-11	4.95E-11	4.95E-11	4.95E-11	4.95E-11	4.95E-11	1.00E-11
Co-60	4.16E-06	5.28E-06	5.29E-06	4.14E-06	4.14E-06	4.14E-06	4.14E-06	8.37E-07
Ni-63	3.43E-05	4.27E-05	4.28E-05	3.42E-05	3.42E-05	3.42E-05	3.42E-05	6.91E-06

Table B-10. Tank WM-188 mass balance (continued).

PFD Sheet #		PFD-4	PFD Sheet #		PFD-4			PFD-4
Stream #	129	130	Stream #	129	130		129	130
Stream Name	Spent IX Media	Grouted Waste	Stream Name	Spent IX Media	Grouted Waste		Spent IX Media	Grouted Waste
Rate, gal/hr	0.13	112		Wt %	Wt %		Ci/kg	Ci/kg
Rate, lb/hr	1.45	1405	Rb+	2.36E-06	2.63E-05	Cm-243	6.18E-09	1.72E-08
Rate, total columns	8	N/A	Ru+3	6.17E-05	6.88E-04	Cm-244	1.68E-07	4.67E-07
Operation	Batch	Cont	Sm+3	4.11E-06	4.58E-05	Cm-245	6.49E-11	1.81E-10
Temperature, °F	70	70	Se+4	1.54E-06	1.72E-05	Cm-246		
Pressure, psia	12.8	12.8	Si+4	7.03E-05	7.84E-04		4.28E-12	1.19E-11
Specific Gravity	1.34	1.50	Ag+	1.61E-06	1.79E-05	H-3	2.51E-06	7.00E-06
Chemical Composition	Wt %	Wt %	Na+	3.73E-01	4.16E+00	Be-10	6.52E-13	1.82E-12
CST	7.27E+01	N/A	Sr+2	3.10E-05	3.45E-04	C-14	2.61E-11	7.27E-11
H+	2.55E-03	N/A	SO4-2	1.13E-02	1.26E-01	Se-79	9.50E-08	2.65E-07
Al+3	6.26E-02	6.98E-01	Tc+7	5.47E-06	6.10E-05	Rb-87	6.37E-12	1.78E-11
Am+4	7.00E-08	7.80E-07	Te+4	2.10E-06	2.34E-05	Sr-90	8.22E-03	2.29E-02
Sb+5	2.70E-06	3.01E-05	Tb+4	1.67E-09	1.87E-08	Y-90	8.22E-03	2.29E-02
As+5	2.30E-06	2.57E-05	Th+4	2.71E-05	3.02E-04	Zr-93	4.82E-07	1.34E-06
Ba+2	3.75E-05	4.18E-04	Sn+4	1.98E-05	2.21E-04	Nb-93m	3.71E-07	1.03E-06
Be+2	5.61E-07	6.26E-06	Ti+4	1.09E-05	1.21E-04	Nb-94	2.48E-07	6.90E-07
B+3	7.86E-04	8.76E-03	U+4	8.74E-04	9.75E-03	Tc-98	5.61E-13	1.56E-12
Br-	1.21E-07	1.35E-06	V+5	5.21E-06	5.81E-05	Tc-99	3.79E-06	1.06E-05
Cd+2	1.19E-03	1.32E-02	Y+3	3.03E-06	3.38E-05	Ru-106	2.02E-07	5.63E-07
Ca+2	8.95E-03	9.97E-02	Zn+2	2.22E-04	2.48E-03	Rh-102	1.87E-10	5.22E-10
Ce+4	1.70E-05	1.89E-04	Zr+4	9.75E-04	1.09E-02	Pd-107	3.59E-09	1.00E-08
Cs+	1.64E-08	1.83E-07	H2O	2.50E+01		Cd-113m	7.22E-07	2.01E-06
Cl-	3.94E-03	4.40E-02	Canisters total	8		In-115	2.19E-17	6.10E-17
Cr+3	1.06E-03	1.18E-02	Drums/day		52	Sn-121m	1.45E-08	4.05E-08
Co+2	6.96E-05	7.76E-04	Radiological Comp.	Ci/kg	Ci/kg	Sn-126	8.93E-08	2.49E-07
Cu+2	1.71E-04	1.90E-03	Ra-226	1.78E-12	4.96E-12	Sb-125	2.81E-06	7.83E-06
Eu+3	3.83E-07	4.26E-06	Ac-227	8.39E-12	2.34E-11	Sb-126	1.25E-08	3.48E-08
F-	1.51E-03	1.68E-02	Th-228	6.96E-10	1.94E-09	Te-123	8.33E-20	2.32E-19
Gd+3	1.04E-04	1.16E-03	Th-230	1.79E-10	4.98E-10	Te-125m	6.85E-07	1.91E-06
Ge+4	3.18E-09	3.54E-08	Th-232	1.54E-16	4.29E-16	I-129	1.16E-08	3.23E-08
In+3	8.95E-07	9.97E-06	Pa-231	1.94E-11	5.41E-11	Cs-134	7.76E-10	2.16E-09
I-	1.60E-06	1.78E-05	Pa-233	6.37E-07	1.78E-06	Cs-135	1.87E-10	5.21E-10
Fe+3	4.91E-03	5.48E-02	U-232	4.32E-10	1.20E-09	Cs-137	1.28E-06	3.56E-06
La+3	6.35E-06	7.08E-05	U-233	1.74E-11	4.84E-11	Ba-137m	1.21E-06	3.37E-06
Pb+2	8.62E-04	9.61E-03	U-234	1.93E-07	5.38E-07	La-138	4.15E-17	1.16E-16
Li+	8.80E-06	9.81E-05	U-235	1.61E-08	4.49E-08	Ce-142	6.50E-12	1.81E-11
Mg+2	2.14E-03	2.39E-02	U-236	7.49E-09	2.09E-08	Ce-144	1.36E-07	3.80E-07
Mn+4	3.75E-03	4.18E-02	U-237	1.40E-09	3.90E-09	Nd-144	3.50E-16	9.74E-16
Hg+2	5.05E-03	5.63E-02	U-238	2.32E-09	6.46E-09	Pm-146	1.11E-08	3.08E-08
Mo+6	9.22E-05	1.03E-03	Np-236	6.68E-13	1.86E-12	Pm-147	3.70E-05	1.03E-04
Nd+3	2.13E-05	2.37E-04	Np-237	7.90E-08	2.20E-07	Sm-146	6.00E-14	1.67E-13
Np+4	2.80E-06	3.12E-05	Pu-236	5.97E-10	1.66E-09	Sm-147	1.60E-12	4.46E-12
Ni+2	4.54E-04	5.06E-03	Pu-238	9.23E-05	2.57E-04	Sm-148	8.23E-18	2.29E-17
Nb+5	9.53E-06	1.06E-04	Pu-239	1.10E-05	3.05E-05	Sm-149	7.30E-19	2.04E-18
NO3-	1.77E+00	1.97E+01	Pu-240	2.21E-06	6.15E-06	Sm-151	7.30E-05	2.03E-04
Pd+4	1.40E-04	1.56E-03	Pu-241	5.77E-05	1.61E-04	Eu-152	5.47E-07	1.52E-06
PO4-3	1.87E-04	2.09E-03	Pu-242	1.72E-09	4.80E-09	Eu-154	4.19E-06	1.17E-05
Pu+4	4.81E-06	5.34E-05	Pu-244	1.45E-16	4.05E-16	Eu-155	1.51E-06	4.20E-06
K+	6.19E-02	6.90E-01	Am-241	9.72E-06	2.71E-05	Gd-152	3.09E-19	8.61E-19
Pr+4	5.86E-06	6.53E-05	Am-242m	3.40E-09	9.47E-09	Ho-166m	1.00E-11	2.79E-11
Rh+4	1.85E-06	2.06E-05	Am-243	4.79E-09	1.34E-08	Co-60	8.37E-07	2.33E-06
			Cm-242	7.44E-09	2.07E-08	Ni-63	6.91E-06	1.92E-05

Table B-10. Tank WM-188 mass balance (continued).

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-3	PFD-3
Stream #	210	211	212	213	220
Stream Name	Solids Flocculent	Steam to Fundabac Filter	Filter Condensate	Nitric Acid	50% Caustic
Rate, gal/hr	0.1	0.8	4.6	TBD	9.9
Rate, lb/hr	1.9	6	38		124
Rate, peak, gpm	10	0	1		10
Operation	Batch	Batch	Batch		Batch
Temperature, °F	75	328	114	0	70
Pressure, psia	12.8	112.8	12.8	0.0	12.8
Specific Gravity	1.51	1.00	1.00	0.00	1.51
Stream Composition	Wt %	Wt %	Wt %	Wt %	Wt %
50% NaOH	100%				100%
HNO3				100%	
Steam		100%			
Water			100%		
CST					
Portland cement					
Ca(OH)2					
Blast furnace slag					

PFD Sheet #	PFD-3	PFD-4	PFD-4	PFD-4	PFD-4
Stream #	221	222	223	224	225
Stream Name	Fresh IX Media	Portland Cement	Calcium Hydroxide	Blast Furnace Slag	Solid Blend
Rate, gal/hr	0.13	16.87	24.60	8.44	41.48
Rate, lb/hr	1.04	169	98	84	351
Rate, peak, gpm	NA	TBD	TBD	TBD	0.69
Operation	Batch	Cont	Cont	Cont	Cont
Temperature, °F	70	70	70	70	70
Pressure, psia	12.8	12.8	12.8	12.8	12.8
Specific Gravity	0.96	1.20	0.48	1.20	1.02
	Wt %	Wt %	Wt %	Wt %	Wt %
Chemical Composition					
NaOH					
H2O					
CST	100%				
Portland cement		100%			
Ca(OH)2			100%		
Blast furnace slag				100%	
No. Replacement col's	8				

Table B-11. Tank WM-189 mass balance.

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2		PFD-3
Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
Rate, gal/hr	65.9	0.8	54.7	14.6	8.3	66.6	6.3		85.2
Rate, lb/hr	571	9	464	137	70	566	36		935
Rate, peak, gpm	50	0.013	50	10	0.14	190	4.32		50.00
Operation	Batch	Cont	Batch	Batch	Batch	Batch	Batch		Batch
Temperature, °F	70	83	70	70	70	70	70		70
Pressure, psia	12.8	12.8	12.8	50.0	12.8	12.8	12.8		12.8
Specific Gravity	1.04	1.32	1.02	1.12	1.02	1.02	0.68		1.32
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
H+	3.13E-02	4.76E-01	3.65E-02	3.65E-02	3.65E-02	3.36E-02	9.01E-04		2.82E+00
Al+3	3.04E-02	5.69E-01	1.28E-02	1.21E-01	1.49E-02	2.51E-02	1.00E+00		6.52E-01
Am+4	8.51E-10	4.84E-08	1.41E-09	1.41E-09	1.41E-09	1.35E-09	8.32E-09		5.69E-08
Sb+5	1.51E-05	1.46E-05	9.31E-07	6.53E-05	2.16E-06	8.38E-06	2.66E-03		7.44E-06
As+5	1.28E-04	7.14E-05	7.21E-06	5.50E-04	1.76E-05	7.00E-05	1.38E-02		2.31E-06
Ba+2	2.76E-05	5.92E-05	2.65E-06	1.17E-04	4.85E-06	1.59E-05	5.35E-03		5.22E-05
Be+2	6.21E-06	1.91E-05	5.43E-07	2.69E-05	1.05E-06	3.60E-06	8.07E-05		1.85E-05
B+3	7.79E-04	1.68E-02	5.00E-04	2.62E-03	5.41E-04	7.25E-04	7.89E-03		1.94E-02
Br-	4.45E-09	2.53E-07	7.37E-09	7.37E-09	7.37E-09	7.05E-09	1.44E-08		2.97E-07
Cd+2	1.50E-04	3.08E-03	1.09E-04	4.53E-04	1.15E-04	1.43E-04	1.34E-02		3.57E-03
Ca+2	2.14E-03	5.77E-02	1.53E-03	7.23E-03	1.64E-03	2.14E-03	7.90E-02		6.69E-02
Ce+4	1.39E-05	3.60E-05	1.34E-06	5.94E-05	2.45E-06	8.05E-06	2.76E-03		3.35E-05
Cs+	5.55E-05	5.19E-05	3.63E-06	2.39E-04	8.13E-06	3.08E-05	1.06E-02		2.56E-05
Cl-	3.23E-03	1.79E-02	5.75E-04	1.34E-02	8.20E-04	2.04E-03	1.55E-01		1.91E-02
Cr+3	5.85E-04	4.80E-03	1.42E-04	2.38E-03	1.85E-04	3.97E-04	3.96E-02		5.30E-03
Co+2	4.86E-06	2.04E-04	2.75E-06	2.29E-05	3.13E-06	5.17E-06	4.08E-04		2.37E-04
Cu+2	1.55E-04	8.24E-04	1.88E-05	6.74E-04	3.14E-05	9.49E-05	1.41E-02		8.69E-04
Eu+3	7.38E-09	4.20E-07	1.22E-08	1.22E-08	1.22E-08	1.17E-08	4.55E-08		4.93E-07
F-	2.82E-02	2.66E-02	3.14E-03	1.17E-01	5.31E-03	1.61E-02	7.32E-01		1.42E-02
Gd+3	2.82E-05	1.25E-04	3.74E-06	1.20E-04	5.96E-06	1.71E-05	6.19E-03		1.29E-04
Ge+4	1.28E-10	7.30E-09	2.12E-10	2.12E-10	2.12E-10	2.03E-10	3.78E-10		8.57E-09
In+3	2.02E-08	1.15E-06	3.35E-08	3.35E-08	3.35E-08	3.20E-08	9.42E-08		1.35E-06
I-	3.70E-08	2.10E-06	6.12E-08	6.12E-08	6.12E-08	5.85E-08	1.90E-07		2.47E-06
Fe+3	1.07E-02	2.67E-02	1.09E-03	4.56E-02	1.94E-03	6.22E-03	8.44E-01		2.47E-02
La+3	1.34E-07	7.62E-06	2.22E-07	2.22E-07	2.22E-07	2.12E-07	7.56E-07		8.96E-06
Pb+2	6.39E-05	9.48E-04	3.00E-05	2.31E-04	3.38E-05	5.20E-05	1.43E-02		1.08E-03
Li+	3.18E-04	4.84E-04	2.19E-05	1.38E-03	4.78E-05	1.79E-04	3.19E-03		3.65E-04
Mg+2	1.23E-03	1.83E-02	5.60E-04	4.52E-03	6.36E-04	9.97E-04	3.30E-02		2.09E-02
Mn+4	4.45E-04	1.60E-02	4.09E-04	1.40E-03	4.28E-04	5.11E-04	1.90E-02		1.87E-02
Hg+2	3.11E-05	5.09E-03	7.69E-05	1.38E-04	7.81E-05	8.47E-05	4.53E-03		5.97E-03
Mo+6	8.91E-04	7.14E-04	5.38E-05	3.84E-03	1.26E-04	4.92E-04	1.23E-01		2.69E-04
Nd+3	4.32E-07	2.46E-05	7.16E-07	7.16E-07	7.16E-07	6.85E-07	2.53E-06		2.89E-05
Np+4	2.47E-07	2.31E-06	2.71E-07	2.71E-07	2.71E-07	2.48E-07	1.58E-06		2.71E-06
Ni+2	2.03E-04	1.92E-03	5.41E-05	8.22E-04	6.88E-05	1.42E-04	1.54E-02		2.14E-03
Nb+5	1.47E-03	8.10E-04	8.31E-05	6.36E-03	2.03E-04	8.09E-04	1.98E-01		7.42E-06
NO3-	6.65E-02	6.09E+00	1.37E-01	1.39E-01	1.37E-01	1.33E-01	2.49E-01		7.16E+00
O-2	2.23E-01	1.23E-01	1.26E-02	9.64E-01	3.08E-02	1.23E-01	5.16E+00		1.06E-03
Pd+4	2.45E-03	1.35E-03	1.38E-04	1.06E-02	3.38E-04	1.35E-03	3.77E-01		1.99E-05
PO4-3	1.39E-01	7.77E-02	7.90E-03	5.97E-01	1.92E-02	7.61E-02	1.90E+01		2.60E-03
Pu+4	7.79E-08	3.18E-06	1.14E-07	1.14E-07	1.14E-07	1.08E-07	6.67E-07		3.73E-06
K+	1.86E-02	2.11E-01	5.43E-03	7.54E-02	6.77E-03	1.34E-02	9.33E-01		2.38E-01
Pr+4	1.22E-07	6.93E-06	2.02E-07	2.02E-07	2.02E-07	1.93E-07	6.97E-07		8.14E-06
Rh+4	5.26E-08	2.99E-06	8.71E-08	8.71E-08	8.71E-08	8.33E-08	2.20E-07		3.51E-06

Table B-11. Tank WM-189 mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from TFF
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
Rb+	8.10E-08	4.60E-06	1.34E-07	1.34E-07	1.34E-07	1.28E-07	2.81E-07		5.41E-06
Ru+3	1.03E-03	7.02E-04	5.98E-05	4.43E-03	1.43E-04	5.66E-04	1.50E-01		1.68E-04
Sm+3	8.02E-08	4.56E-06	1.33E-07	1.33E-07	1.33E-07	1.27E-07	4.89E-07		5.35E-06
Se+4	3.82E-04	2.11E-04	2.15E-05	1.65E-03	5.26E-05	2.10E-04	4.36E-02		3.05E-06
Si+4	1.26E-01	6.92E-02	7.10E-03	5.42E-01	1.73E-02	6.90E-02	5.10E+00		8.87E-04
Ag+	5.89E-04	3.23E-04	3.37E-05	2.54E-03	8.16E-05	3.23E-04	9.16E-02		3.01E-06
Na+	4.19E-02	3.59E+00	5.87E-02	1.71E-01	6.09E-02	7.19E-02	9.09E-01		1.94E+00
Sr+2	8.53E-06	1.18E-04	2.01E-06	3.74E-05	2.68E-06	6.14E-06	1.06E-03		1.33E-04
SO4-2	6.39E-04	8.33E-02	1.61E-03	1.61E-03	1.61E-03	1.58E-03	3.79E-03		9.78E-02
Tc+7	9.40E-08	4.91E-06	1.50E-07	1.50E-07	1.50E-07	1.43E-07	3.58E-07		5.76E-06
Te+4	4.21E-08	5.76E-06	1.09E-07	1.09E-07	1.09E-07	1.08E-07	3.42E-07		6.77E-06
Tb+4	3.09E-11	1.75E-09	5.11E-11	5.11E-11	5.11E-11	4.89E-11	1.99E-10		2.06E-09
Th+4	2.87E-12	2.78E-05	3.26E-07	3.26E-07	3.26E-07	3.39E-07	1.85E-06		3.26E-05
Sn+4	2.63E-03	1.48E-03	1.48E-04	1.13E-02	3.63E-04	1.44E-03	4.51E-01		5.12E-05
Ti+4	1.29E-03	7.66E-04	7.43E-05	5.56E-03	1.79E-04	7.09E-04	8.91E-02		7.49E-05
U+4	3.83E-05	9.54E-04	1.86E-05	1.56E-04	2.13E-05	3.44E-05	1.12E-02		1.10E-03
V+5	1.12E-05	2.59E-05	4.23E-06	3.66E-05	4.85E-06	7.64E-06	5.65E-04		2.56E-05
Y+3	1.00E-07	5.68E-06	1.65E-07	1.65E-07	1.65E-07	1.58E-07	3.61E-07		6.68E-06
Zn+2	8.90E-05	8.90E-04	1.63E-05	3.89E-04	2.34E-05	5.96E-05	8.29E-03		9.90E-04
Zr+4	5.35E-02	2.97E-02	3.11E-03	2.30E-01	7.46E-03	2.94E-02	7.04E+00		6.38E-04
H2O	5.55E+01	4.48E+01	5.55E+01	5.42E+01	5.54E+01	5.47E+01	5.70E+01		4.29E+01
Canisters/day							0.59		
Canisters total							89		
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Ra-226	1.15E-13	6.58E-12	1.91E-13	1.91E-13	1.91E-13	1.83E-13	4.69E-14		7.73E-12
Ac-227	5.43E-13	3.10E-11	9.00E-13	9.00E-13	9.00E-13	8.61E-13	2.21E-13		3.64E-11
Th-228	4.51E-11	2.57E-09	7.47E-11	7.47E-11	7.47E-11	7.15E-11	1.83E-11		3.02E-09
Th-230	3.37E-10	8.39E-10	3.75E-11	1.42E-09	6.40E-11	1.97E-10	4.71E-09		7.77E-10
Th-232	9.98E-18	5.69E-16	1.65E-17	1.65E-17	1.65E-17	1.58E-17	4.05E-18		6.68E-16
Pa-231	1.26E-12	7.17E-11	2.09E-12	2.09E-12	2.09E-12	2.00E-12	5.11E-13		8.43E-11
Pa-233	4.13E-08	2.35E-06	6.84E-08	6.84E-08	6.84E-08	6.55E-08	1.68E-08		2.77E-06
U-232	6.99E-10	1.96E-09	8.42E-11	2.94E-09	1.39E-10	4.13E-10	9.70E-09		1.88E-09
U-233	1.27E-11	7.06E-11	2.52E-12	5.17E-11	3.46E-12	8.14E-12	1.68E-10		7.55E-11
U-234	2.08E-07	1.50E-06	3.85E-08	8.77E-07	5.46E-08	1.35E-07	2.85E-06		1.64E-06
U-235	1.09E-08	5.48E-08	1.41E-09	4.67E-08	2.28E-09	6.66E-09	1.54E-07		5.75E-08
U-236	1.43E-08	7.02E-08	1.98E-09	6.10E-08	3.10E-09	8.79E-09	2.00E-07		7.36E-08
U-237	9.07E-11	5.17E-09	1.50E-10	1.50E-10	1.50E-10	1.44E-10	3.68E-11		6.07E-09
U-238	1.23E-09	3.50E-08	8.76E-10	4.27E-09	9.41E-10	1.24E-09	1.17E-08		4.06E-08
Np-236	6.44E-14	2.47E-12	9.26E-14	9.26E-14	9.26E-14	8.75E-14	2.27E-14		2.90E-12
Np-237	1.02E-07	4.19E-07	4.88E-08	3.09E-07	5.37E-08	7.50E-08	8.94E-07		4.53E-07
Pu-236	1.22E-09	3.26E-09	1.63E-10	5.08E-09	2.57E-10	7.27E-10	1.67E-08		3.09E-09
Pu-238	6.41E-04	7.20E-04	5.86E-05	2.70E-03	1.09E-04	3.63E-04	8.99E-03		4.48E-04
Pu-239	6.72E-05	7.92E-05	5.23E-06	2.87E-04	1.06E-05	3.77E-05	9.56E-04		5.07E-05
Pu-240	4.68E-06	1.22E-05	5.82E-07	1.96E-05	9.45E-07	2.76E-06	6.45E-05		1.14E-05
Pu-241	5.07E-04	6.50E-04	4.78E-05	2.14E-03	8.78E-05	2.88E-04	7.09E-03		4.50E-04
Pu-242	3.69E-09	9.42E-09	6.02E-10	1.49E-08	8.76E-10	2.23E-09	4.87E-08		8.92E-09
Pu-244	2.89E-16	1.95E-16	1.72E-17	1.24E-15	4.07E-17	1.59E-16	4.16E-15		4.41E-17
Am-241	1.71E-05	6.81E-05	2.43E-06	7.14E-05	3.75E-06	1.04E-05	2.35E-04		6.97E-05
Am-242m	2.14E-10	1.22E-08	3.55E-10	3.55E-10	3.55E-10	3.40E-10	8.70E-11		1.44E-08
Am-243	6.07E-09	2.04E-08	8.25E-10	2.54E-08	1.29E-09	3.64E-09	8.34E-08		2.03E-08
Cm-242	2.00E-10	2.41E-08	4.58E-10	5.56E-10	4.60E-10	4.63E-10	4.46E-10		2.82E-08

Table B-11. Tank WM-189 mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Cm-243	1.23E-08	2.93E-08	1.33E-09	5.18E-08	2.30E-09	7.15E-09	1.72E-07		2.69E-08
Cm-244	7.68E-07	1.26E-06	7.64E-08	3.24E-06	1.37E-07	4.41E-07	1.07E-05		1.00E-06
Cm-245	1.30E-10	3.09E-10	1.41E-11	5.50E-10	2.43E-11	7.57E-11	1.82E-09		2.82E-10
Cm-246	8.44E-12	2.03E-11	9.19E-13	3.56E-11	1.58E-12	4.92E-12	1.18E-10		1.86E-11
H-3	3.92E-07	8.01E-06	4.81E-07	4.81E-07	4.81E-07	4.46E-07	1.18E-07		9.41E-06
Be-10	4.23E-14	2.41E-12	7.00E-14	7.00E-14	7.00E-14	6.70E-14	1.72E-14		2.83E-12
C-14	5.49E-11	1.26E-10	5.80E-12	2.32E-10	1.01E-11	3.19E-11	7.69E-10		1.13E-10
Se-79	1.98E-07	4.56E-07	2.10E-08	8.36E-07	3.66E-08	1.15E-07	2.77E-06		4.13E-07
Rb-87	4.13E-13	2.35E-11	6.84E-13	6.84E-13	6.84E-13	6.54E-13	1.68E-13		2.76E-11
Sr-90	1.06E-03	3.16E-02	1.05E-03	2.71E-03	1.08E-03	1.19E-03	5.89E-03		3.68E-02
Y-90	1.06E-03	3.16E-02	1.05E-03	2.71E-03	1.08E-03	1.19E-03	5.89E-03		3.68E-02
Zr-93	3.12E-08	1.78E-06	5.17E-08	5.17E-08	5.17E-08	4.95E-08	1.27E-08		2.09E-06
Nb-93m	2.41E-08	1.37E-06	3.98E-08	3.98E-08	3.98E-08	3.81E-08	9.77E-09		1.61E-06
Nb-94	5.10E-07	1.19E-06	5.44E-08	2.15E-06	9.46E-08	2.96E-07	7.14E-06		1.08E-06
Tc-98	3.63E-14	2.07E-12	6.02E-14	6.02E-14	6.02E-14	5.76E-14	1.48E-14		2.43E-12
Tc-99	4.43E-06	1.06E-05	4.93E-07	1.87E-05	8.41E-07	2.59E-06	6.18E-05		9.69E-06
Ru-106	4.27E-07	9.74E-07	4.50E-08	1.81E-06	7.87E-08	2.48E-07	5.98E-06		8.79E-07
Rh-102	4.14E-07	2.28E-07	2.33E-08	1.78E-06	5.70E-08	2.27E-07	5.98E-06		2.77E-09
Pd-107	2.33E-10	1.33E-08	3.86E-10	3.86E-10	3.86E-10	3.69E-10	9.45E-11		1.56E-08
Cd-113m	4.68E-08	2.67E-06	7.75E-08	7.75E-08	7.75E-08	7.42E-08	1.90E-08		3.13E-06
In-115	1.42E-18	8.08E-17	2.35E-18	2.35E-18	2.35E-18	2.25E-18	5.76E-19		9.50E-17
Sn-121m	9.42E-10	5.37E-08	1.56E-09	1.56E-09	1.56E-09	1.49E-09	3.83E-10		6.31E-08
Sn-126	1.87E-07	4.29E-07	1.98E-08	7.89E-07	3.45E-08	1.08E-07	2.61E-06		3.88E-07
Sb-125	5.93E-04	3.36E-04	3.40E-05	2.56E-03	8.22E-05	3.26E-04	8.56E-03		1.50E-05
Sb-126	8.10E-10	4.62E-08	1.34E-09	1.34E-09	1.34E-09	1.28E-09	3.29E-10		5.42E-08
Te-123	5.40E-21	3.08E-19	8.95E-21	8.95E-21	8.95E-21	8.56E-21	2.19E-21		3.61E-19
Te-125m	4.44E-08	2.53E-06	7.35E-08	7.35E-08	7.35E-08	7.03E-08	1.80E-08		2.97E-06
I-129	2.42E-08	5.56E-08	2.58E-09	1.02E-07	4.48E-09	1.40E-08	3.38E-07		5.04E-08
Cs-134	4.92E-05	5.83E-05	3.93E-06	2.10E-04	7.87E-06	2.76E-05	6.99E-04		3.75E-05
Cs-135	3.49E-07	8.75E-07	3.91E-08	1.47E-06	6.65E-08	2.03E-07	4.88E-06		8.12E-07
Cs-137	1.98E-02	5.02E-02	2.25E-03	8.36E-02	3.80E-03	1.16E-02	2.77E-01		4.68E-02
Ba-137m	1.88E-02	4.75E-02	2.12E-03	7.91E-02	3.60E-03	1.10E-02	2.62E-01		4.42E-02
La-138	2.69E-18	1.53E-16	4.46E-18	4.46E-18	4.46E-18	4.26E-18	1.09E-18		1.80E-16
Ce-142	4.21E-13	2.40E-11	6.98E-13	6.98E-13	6.98E-13	6.68E-13	1.71E-13		2.82E-11
Ce-144	2.90E-07	6.57E-07	3.04E-08	1.23E-06	5.33E-08	1.68E-07	4.06E-06		5.92E-07
Nd-144	2.27E-17	1.29E-15	3.75E-17	3.75E-17	3.75E-17	3.59E-17	9.20E-18		1.52E-15
Pm-146	7.17E-10	4.09E-08	1.19E-09	1.19E-09	1.19E-09	1.14E-09	2.91E-10		4.80E-08
Pm-147	7.68E-05	1.78E-04	8.16E-06	3.25E-04	1.42E-05	4.46E-05	1.08E-03		1.61E-04
Sm-146	3.89E-15	2.21E-13	6.44E-15	6.44E-15	6.44E-15	6.16E-15	1.58E-15		2.60E-13
Sm-147	1.04E-13	5.91E-12	1.72E-13	1.72E-13	1.72E-13	1.65E-13	4.21E-14		6.95E-12
Sm-148	5.33E-19	3.04E-17	8.84E-19	8.84E-19	8.84E-19	8.45E-19	2.17E-19		3.57E-17
Sm-149	4.73E-20	2.70E-18	7.84E-20	7.84E-20	7.84E-20	7.50E-20	1.92E-20		3.17E-18
Sm-151	1.53E-04	3.51E-04	1.62E-05	6.48E-04	2.83E-05	8.89E-05	2.15E-03		3.17E-04
Eu-152	5.55E-07	2.31E-06	8.80E-08	2.30E-06	1.30E-07	3.41E-07	7.52E-06		2.38E-06
Eu-154	2.44E-05	1.57E-04	6.49E-06	9.48E-05	8.18E-06	1.64E-05	3.01E-04		1.71E-04
Eu-155	3.50E-05	1.48E-04	4.43E-06	1.49E-04	7.19E-06	2.11E-05	4.91E-04		1.52E-04
Gd-152	2.00E-20	1.14E-18	3.32E-20	3.32E-20	3.32E-20	3.17E-20	8.13E-21		1.34E-18
Ho-166m	6.49E-13	3.70E-11	1.07E-12	1.07E-12	1.07E-12	1.03E-12	2.63E-13		4.34E-11
Co-60	2.81E-06	2.95E-05	1.38E-06	9.25E-06	1.53E-06	2.21E-06	2.70E-05		3.35E-05
Ni-63	1.48E-05	3.31E-05	2.02E-06	6.09E-05	3.14E-06	8.75E-06	2.00E-04		3.00E-05

Table B-11. Tank WM-189 mass balance (continued).

PFD Sheet #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Rate, gal/hr	95.3	7800	7705	95.3	95.3	95.3	95.3	0.5
Rate, lb/hr	1062	86975	85913	1062	1062	1062	1062	5
Rate, peak, gpm	1.59	130	128	1.59	1.59	1.59	1.59	2.99
Operation	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Batch
Temperature, °F	70	70	70	70	70	70	70	70
Pressure, psia	12.8	35.0	35.0	24.8	20.8	16.8	12.8	12.8
Specific Gravity	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.07
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
H+	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	1.01E-01
Al+3	5.82E-01	5.98E-01	5.98E-01	5.82E-01	5.82E-01	5.82E-01	5.82E-01	1.18E-01
Am+4	5.08E-08	5.08E-08	5.08E-08	5.08E-08	5.08E-08	5.08E-08	5.08E-08	1.03E-08
Sb+5	6.65E-06	1.59E-05	1.60E-05	6.58E-06	6.58E-06	6.58E-06	6.58E-06	1.33E-06
As+5	2.06E-06	8.02E-05	8.12E-05	1.52E-06	1.52E-06	1.52E-06	1.52E-06	3.08E-07
Ba+2	4.67E-05	6.32E-05	6.34E-05	4.66E-05	4.66E-05	4.66E-05	4.66E-05	9.41E-06
Be+2	1.65E-05	2.03E-05	2.03E-05	1.65E-05	1.65E-05	1.65E-05	1.65E-05	3.33E-06
B+3	1.73E-02	1.76E-02	1.76E-02	1.73E-02	1.73E-02	1.73E-02	1.73E-02	3.50E-03
Br-	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	5.37E-08
Cd+2	3.19E-03	3.24E-03	3.24E-03	3.19E-03	3.19E-03	3.19E-03	3.19E-03	6.45E-04
Ca+2	5.98E-02	6.06E-02	6.06E-02	5.98E-02	5.98E-02	5.98E-02	5.98E-02	1.21E-02
Ce+4	3.00E-05	3.83E-05	3.84E-05	2.99E-05	2.99E-05	2.99E-05	2.99E-05	6.05E-06
Cs+	2.28E-05	5.67E-05	5.72E-05	2.26E-05	2.26E-06	2.26E-07	2.26E-08	4.57E-09
Cl-	1.71E-02	1.90E-02	1.90E-02	1.71E-02	1.71E-02	1.71E-02	1.71E-02	3.46E-03
Cr+3	4.74E-03	5.06E-03	5.07E-03	4.74E-03	4.74E-03	4.74E-03	4.74E-03	9.58E-04
Co+2	2.12E-04	2.15E-04	2.15E-04	2.12E-04	2.12E-04	2.12E-04	2.12E-04	4.28E-05
Cu+2	7.77E-04	8.71E-04	8.73E-04	7.76E-04	7.76E-04	7.76E-04	7.76E-04	1.57E-04
Eu+3	4.41E-07	4.41E-07	4.41E-07	4.41E-07	4.41E-07	4.41E-07	4.41E-07	8.90E-08
F-	1.27E-02	2.90E-02	2.92E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02	2.54E-03
Gd+3	1.16E-04	1.32E-04	1.32E-04	1.15E-04	1.15E-04	1.15E-04	1.15E-04	2.33E-05
Ge+4	7.66E-09	7.66E-09	7.66E-09	7.66E-09	7.66E-09	7.66E-09	7.66E-09	1.55E-09
In+3	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	2.44E-07
I-	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	4.46E-07
Fe+3	2.21E-02	2.85E-02	2.85E-02	2.20E-02	2.20E-02	2.20E-02	2.20E-02	4.45E-03
La+3	8.00E-06	8.00E-06	8.00E-06	8.00E-06	8.00E-06	8.00E-06	8.00E-06	1.62E-06
Pb+2	9.69E-04	9.98E-04	9.98E-04	9.68E-04	9.68E-04	9.68E-04	9.68E-04	1.96E-04
Li+	3.26E-04	5.21E-04	5.24E-04	3.25E-04	3.25E-04	3.25E-04	3.25E-04	6.56E-05
Mg+2	1.86E-02	1.92E-02	1.92E-02	1.86E-02	1.86E-02	1.86E-02	1.86E-02	3.77E-03
Mn+4	1.67E-02	1.68E-02	1.68E-02	1.67E-02	1.67E-02	1.67E-02	1.67E-02	3.37E-03
Hg+2	5.33E-03	5.34E-03	5.34E-03	5.33E-03	5.33E-03	5.33E-03	5.33E-03	1.08E-03
Mo+6	2.40E-04	7.86E-04	7.93E-04	2.37E-04	2.37E-04	2.37E-04	2.37E-04	4.78E-05
Nd+3	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	5.22E-06
Np+4	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	4.90E-07
Ni+2	1.91E-03	2.02E-03	2.02E-03	1.91E-03	1.91E-03	1.91E-03	1.91E-03	3.86E-04
Nb+5	6.63E-06	9.11E-04	9.22E-04	3.98E-07	3.98E-07	3.98E-07	3.98E-07	8.05E-08
NO3-	6.40E+00	6.40E+00	6.40E+00	6.40E+00	6.40E+00	6.40E+00	6.40E+00	1.29E+00
O-2	9.44E-04	1.38E-01	1.40E-01					
Pd+4	1.78E-05	1.52E-03	1.54E-03	7.42E-06	7.42E-06	7.42E-06	7.42E-06	1.50E-06
PO4-3	2.32E-03	8.72E-02	8.83E-02	1.74E-03	1.74E-03	1.74E-03	1.74E-03	3.52E-04
Pu+4	3.34E-06	3.34E-06	3.34E-06	3.34E-06	3.34E-06	3.34E-06	3.34E-06	6.75E-07
K+	2.12E-01	2.23E-01	2.23E-01	2.12E-01	2.12E-01	2.12E-01	2.12E-01	4.29E-02
Pr+4	7.28E-06	7.28E-06	7.28E-06	7.28E-06	7.28E-06	7.28E-06	7.28E-06	1.47E-06
Rh+4	3.14E-06	3.14E-06	3.14E-06	3.14E-06	3.14E-06	3.14E-06	3.14E-06	6.35E-07

Table B-11. Tank WM-189 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
Rb+	4.83E-06	4.83E-06	4.83E-06	4.83E-06	4.83E-06	4.83E-06	4.83E-06	9.77E-07
Ru+3	1.50E-04	7.80E-04	7.87E-04	1.45E-04	1.45E-04	1.45E-04	1.45E-04	2.94E-05
Sm+3	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	9.67E-07
Se+4	2.72E-06	2.37E-04	2.40E-04	1.11E-06	1.11E-06	1.11E-06	1.11E-06	2.24E-07
Si+4	7.93E-04	7.78E-02	7.88E-02	2.62E-04	2.62E-04	2.62E-04	2.62E-04	5.29E-05
Ag+	2.69E-06	3.63E-04	3.68E-04	2.06E-07	2.06E-07	2.06E-07	2.06E-07	4.16E-08
Na+	3.75E+00	3.77E+00	3.77E+00	3.75E+00	3.75E+00	3.75E+00	3.75E+00	7.59E-01
Sr+2	1.19E-04	1.24E-04	1.24E-04	1.19E-04	1.19E-04	1.19E-04	1.19E-04	2.41E-05
SO4-2	8.75E-02	8.75E-02	8.75E-02	8.75E-02	8.75E-02	8.75E-02	8.75E-02	1.77E-02
Tc+7	5.15E-06	5.15E-06	5.15E-06	5.15E-06	5.15E-06	5.15E-06	5.15E-06	1.04E-06
Te+4	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	6.05E-06	1.22E-06
Tb+4	1.84E-09	1.84E-09	1.84E-09	1.84E-09	1.84E-09	1.84E-09	1.84E-09	3.72E-10
Th+4	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	2.92E-05	5.90E-06
Sn+4	4.57E-05	1.66E-03	1.68E-03	3.46E-05	3.46E-05	3.46E-05	3.46E-05	7.00E-06
Ti+4	6.70E-05	8.57E-04	8.67E-04	6.15E-05	6.15E-05	6.15E-05	6.15E-05	1.24E-05
U+4	9.83E-04	1.00E-03	1.00E-03	9.83E-04	9.83E-04	9.83E-04	9.83E-04	1.99E-04
V+5	2.29E-05	2.76E-05	2.76E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	4.62E-06
Y+3	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	1.21E-06
Zn+2	8.84E-04	9.38E-04	9.39E-04	8.84E-04	8.84E-04	8.84E-04	8.84E-04	1.79E-04
Zr+4	5.70E-04	3.33E-02	3.37E-02	3.45E-04	3.45E-04	3.45E-04	3.45E-04	6.97E-05
H2O	4.48E+01	4.38E+01	4.38E+01	4.48E+01	4.48E+01	4.48E+01	4.48E+01	5.30E+01
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Ra-226	6.91E-12	6.91E-12	6.91E-12	6.91E-12	6.91E-12	6.91E-12	6.91E-12	1.40E-12
Ac-227	3.25E-11	3.25E-11	3.25E-11	3.25E-11	3.25E-11	3.25E-11	3.25E-11	6.57E-12
Th-228	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	5.45E-10
Th-230	6.95E-10	8.94E-10	8.97E-10	6.93E-10	6.93E-10	6.93E-10	6.93E-10	1.40E-10
Th-232	5.97E-16	6.70E-11	5.97E-16	5.97E-16	5.97E-16	5.97E-16	5.97E-16	1.21E-16
Pa-231	7.53E-11	7.53E-11	7.53E-11	7.53E-11	7.53E-11	7.53E-11	7.53E-11	1.52E-11
Pa-233	2.47E-06	2.47E-06	2.47E-06	2.47E-06	2.47E-06	2.47E-06	2.47E-06	4.99E-07
U-232	1.68E-09	2.09E-09	2.10E-09	1.68E-09	1.68E-09	1.68E-09	1.68E-09	3.39E-10
U-233	6.75E-11	7.46E-11	7.47E-11	6.74E-11	6.74E-11	6.74E-11	6.74E-11	1.36E-11
U-234	1.46E-06	1.58E-06	1.59E-06	1.46E-06	1.46E-06	1.46E-06	1.46E-06	2.96E-07
U-235	5.14E-08	5.79E-08	5.80E-08	5.14E-08	5.14E-08	5.14E-08	5.14E-08	1.04E-08
U-236	6.58E-08	7.43E-08	7.44E-08	6.57E-08	6.57E-08	6.57E-08	6.57E-08	1.33E-08
U-237	5.43E-09	5.43E-09	5.43E-09	5.43E-09	5.43E-09	5.43E-09	5.43E-09	1.10E-09
U-238	3.63E-08	3.68E-08	3.68E-08	3.63E-08	3.63E-08	3.63E-08	3.63E-08	7.34E-09
Np-236	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	5.24E-13
Np-237	4.05E-07	4.43E-07	4.43E-07	4.05E-07	4.05E-07	4.05E-07	4.05E-07	8.18E-08
Pu-236	2.76E-09	3.47E-09	3.48E-09	2.76E-09	2.76E-09	2.76E-09	2.76E-09	5.57E-10
Pu-238	4.00E-04	7.81E-04	7.86E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04	8.04E-05
Pu-239	4.53E-05	8.58E-05	8.64E-05	4.50E-05	4.50E-05	4.50E-05	4.50E-05	9.09E-06
Pu-240	1.02E-05	1.30E-05	1.30E-05	1.02E-05	1.02E-05	1.02E-05	1.02E-05	2.06E-06
Pu-241	4.02E-04	7.03E-04	7.07E-04	4.00E-04	4.00E-04	4.00E-04	4.00E-04	8.08E-05
Pu-242	7.97E-09	1.00E-08	1.01E-08	7.96E-09	7.96E-09	7.96E-09	7.96E-09	1.61E-09
Pu-244	3.94E-17	2.16E-16	2.18E-16	3.82E-17	3.82E-17	3.82E-17	3.82E-17	7.71E-18
Am-241	6.23E-05	7.22E-05	7.23E-05	6.22E-05	6.22E-05	6.22E-05	6.22E-05	1.26E-05
Am-242m	1.28E-08	1.28E-08	1.28E-08	1.28E-08	1.28E-08	1.28E-08	1.28E-08	2.59E-09
Am-243	1.81E-08	2.16E-08	2.17E-08	1.81E-08	1.81E-08	1.81E-08	1.81E-08	3.66E-09
Cm-242	2.52E-08	2.53E-08	2.53E-08	2.52E-08	2.52E-08	2.52E-08	2.52E-08	5.10E-09

Table B-11. Tank WM-189 mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Cm-243	2.40E-08	3.13E-08	3.14E-08	2.40E-08	2.40E-08	2.40E-08	2.40E-08	4.84E-09
Cm-244	8.94E-07	1.35E-06	1.36E-06	8.91E-07	8.91E-07	8.91E-07	8.91E-07	1.80E-07
Cm-245	2.52E-10	3.29E-10	3.30E-10	2.52E-10	2.52E-10	2.52E-10	2.52E-10	5.09E-11
Cm-246	1.66E-11	2.16E-11	2.17E-11	1.66E-11	1.66E-11	1.66E-11	1.66E-11	3.35E-12
H-3	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06	1.70E-06
Be-10	2.53E-12	2.53E-12	2.53E-12	2.53E-12	2.53E-12	2.53E-12	2.53E-12	5.11E-13
C-14	1.01E-10	1.34E-10	1.34E-10	1.01E-10	1.01E-10	1.01E-10	1.01E-10	2.04E-11
Se-79	3.69E-07	4.86E-07	4.88E-07	3.68E-07	3.68E-07	3.68E-07	3.68E-07	7.44E-08
Rb-87	2.47E-11	2.47E-11	2.47E-11	2.47E-11	2.47E-11	2.47E-11	2.47E-11	4.99E-12
Sr-90	3.29E-02	3.31E-02	3.32E-02	3.29E-02	3.29E-02	3.29E-02	3.29E-02	6.65E-03
Y-90	3.29E-02	3.31E-02	3.32E-02	3.29E-02	3.29E-02	3.29E-02	3.29E-02	6.65E-03
Zr-93	1.87E-06	1.87E-06	1.87E-06	1.87E-06	1.87E-06	1.87E-06	1.87E-06	3.78E-07
Nb-93m	1.44E-06	1.44E-06	1.44E-06	1.44E-06	1.44E-06	1.44E-06	1.44E-06	2.91E-07
Nb-94	9.63E-07	1.27E-06	1.27E-06	9.61E-07	9.61E-07	9.61E-07	9.61E-07	1.94E-07
Tc-98	2.17E-12	2.17E-12	2.17E-12	2.17E-12	2.17E-12	2.17E-12	2.17E-12	4.40E-13
Tc-99	8.66E-06	1.13E-05	1.13E-05	8.64E-06	8.64E-06	8.64E-06	8.64E-06	1.75E-06
Ru-106	7.86E-07	1.04E-06	1.04E-06	7.84E-07	7.84E-07	7.84E-07	7.84E-07	1.58E-07
Rh-102	2.48E-09	2.56E-07	2.59E-07	7.27E-10	7.27E-10	7.27E-10	7.27E-10	1.47E-10
Pd-107	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.39E-08	2.82E-09
Cd-113m	2.80E-06	2.80E-06	2.80E-06	2.80E-06	2.80E-06	2.80E-06	2.80E-06	5.66E-07
In-115	8.49E-17	8.49E-17	8.49E-17	8.49E-17	8.49E-17	8.49E-17	8.49E-17	1.72E-17
Sn-121m	5.64E-08	5.64E-08	5.64E-08	5.64E-08	5.64E-08	5.64E-08	5.64E-08	1.14E-08
Sn-126	3.47E-07	4.58E-07	4.59E-07	3.46E-07	3.46E-07	3.46E-07	3.46E-07	7.00E-08
Sb-125	1.34E-05	3.77E-04	3.81E-04	1.09E-05	1.09E-05	1.09E-05	1.09E-05	2.20E-06
Sb-126	4.85E-08	4.85E-08	4.85E-08	4.85E-08	4.85E-08	4.85E-08	4.85E-08	9.80E-09
Te-123	3.23E-19	3.23E-19	3.23E-19	3.23E-19	3.23E-19	3.23E-19	3.23E-19	6.53E-20
Te-125m	2.66E-06	2.66E-06	2.66E-06	2.66E-06	2.66E-06	2.66E-06	2.66E-06	5.37E-07
I-129	4.50E-08	5.94E-08	5.95E-08	4.49E-08	4.49E-08	4.49E-08	4.49E-08	9.08E-09
Cs-134	3.35E-05	6.32E-05	6.36E-05	3.33E-05	3.33E-06	3.33E-07	3.33E-08	6.73E-09
Cs-135	7.26E-07	9.33E-07	9.36E-07	7.25E-07	7.25E-08	7.25E-09	7.25E-10	1.46E-10
Cs-137	4.18E-02	5.35E-02	5.37E-02	4.17E-02	4.17E-03	4.17E-04	4.17E-05	8.43E-06
Ba-137m	3.95E-02	5.06E-02	5.08E-02	3.95E-02	3.95E-02	3.95E-02	3.95E-02	7.97E-03
La-138	1.61E-16	1.61E-16	1.61E-16	1.61E-16	1.61E-16	1.61E-16	1.61E-16	3.25E-17
Ce-142	2.52E-11	2.52E-11	2.52E-11	2.52E-11	2.52E-11	2.52E-11	2.52E-11	5.09E-12
Ce-144	5.30E-07	7.02E-07	7.04E-07	5.28E-07	5.28E-07	5.28E-07	5.28E-07	1.07E-07
Nd-144	1.36E-15	1.36E-15	1.36E-15	1.36E-15	1.36E-15	1.36E-15	1.36E-15	2.74E-16
Pm-146	4.29E-08	4.29E-08	4.29E-08	4.29E-08	4.29E-08	4.29E-08	4.29E-08	8.67E-09
Pm-147	1.44E-04	1.89E-04	1.90E-04	1.44E-04	1.44E-04	1.44E-04	1.44E-04	2.90E-05
Sm-146	2.33E-13	2.33E-13	2.33E-13	2.33E-13	2.33E-13	2.33E-13	2.33E-13	4.70E-14
Sm-147	6.21E-12	6.21E-12	6.21E-12	6.21E-12	6.21E-12	6.21E-12	6.21E-12	1.26E-12
Sm-148	3.19E-17	3.19E-17	3.19E-17	3.19E-17	3.19E-17	3.19E-17	3.19E-17	6.45E-18
Sm-149	2.83E-18	2.83E-18	2.83E-18	2.83E-18	2.83E-18	2.83E-18	2.83E-18	5.73E-19
Sm-151	2.84E-04	3.75E-04	3.76E-04	2.83E-04	2.83E-04	2.83E-04	2.83E-04	5.72E-05
Eu-152	2.12E-06	2.44E-06	2.45E-06	2.12E-06	2.12E-06	2.12E-06	2.12E-06	4.29E-07
Eu-154	1.53E-04	1.65E-04	1.65E-04	1.52E-04	1.52E-04	1.52E-04	1.52E-04	3.08E-05
Eu-155	1.36E-04	1.57E-04	1.57E-04	1.36E-04	1.36E-04	1.36E-04	1.36E-04	2.74E-05
Gd-152	1.20E-18	1.20E-18	1.20E-18	1.20E-18	1.20E-18	1.20E-18	1.20E-18	2.42E-19
Ho-166m	3.88E-11	3.88E-11	3.88E-11	3.88E-11	3.88E-11	3.88E-11	3.88E-11	7.84E-12
Co-60	2.99E-05	3.11E-05	3.11E-05	2.99E-05	2.99E-05	2.99E-05	2.99E-05	6.05E-06
Ni-63	2.69E-05	3.53E-05	3.54E-05	2.68E-05	2.68E-05	2.68E-05	2.68E-05	5.42E-06

Table B-11. Tank WM-189 mass balance (continued).

PFD Sheet #		PFD-4	PFD Sheet #		PFD-4			PFD-4
Stream #	129	130	Stream #	129	130		129	130
Stream Name	Spent IX Media	Grouted Waste	Stream Name	Spent IX Media	Grouted Waste		Spent IX Media	Grouted Waste
Rate, gal/hr	0.12	113		Wt %	Wt %		Ci/kg	Ci/kg
Rate, lb/hr	1.29	1416	Rb+	2.09E-06	2.32E-05	Cm-243	4.84E-09	1.34E-08
Rate, total columns	7	N/A	Ru+3	7.42E-05	8.23E-04	Cm-244	1.80E-07	4.99E-07
Operation	Batch	Cont	Sm+3	3.63E-06	4.03E-05	Cm-245	5.09E-11	1.41E-10
Temperature, °F	70	70	Se+4	4.42E-07	4.90E-06	Cm-246		
Pressure, psia	12.8	12.8	Si+4	3.71E-05	4.12E-04		3.35E-12	9.29E-12
Specific Gravity	1.34	1.50	Ag+	1.12E-07	1.24E-06	H-3	1.70E-06	4.71E-06
Chemical Composition	Wt %	Wt %	Na+	4.36E-01	4.84E+00	Be-10	5.11E-13	1.42E-12
CST	7.23E+01	N/A	Sr+2	5.28E-05	5.85E-04	C-14	2.04E-11	5.67E-11
H+	2.55E-03	N/A	SO4-2	4.24E-02	4.71E-01	Se-79	7.44E-08	2.06E-07
Al+3	7.94E-02	8.80E-01	Tc+7	2.52E-06	2.80E-05	Rb-87	4.99E-12	1.38E-11
Am+4	6.19E-08	6.86E-07	Te+4	3.90E-06	4.33E-05	Sr-90	6.65E-03	1.84E-02
Sb+5	4.05E-06	4.49E-05	Tb+4	1.48E-09	1.64E-08	Y-90	6.65E-03	1.84E-02
As+5	5.76E-07	6.39E-06	Th+4	3.42E-05	3.79E-04	Zr-93	3.78E-07	1.05E-06
Ba+2	3.23E-05	3.59E-04	Sn+4	2.08E-05	2.30E-04	Nb-93m	2.91E-07	8.07E-07
Be+2	7.50E-07	8.32E-06	Ti+4	1.49E-05	1.65E-04	Nb-94	1.94E-07	5.38E-07
B+3	9.46E-04	1.05E-02	U+4	1.18E-03	1.31E-02	Tc-98	4.40E-13	1.22E-12
Br-	1.07E-07	1.19E-06	V+5	5.88E-06	6.53E-05	Tc-99	1.75E-06	4.84E-06
Cd+2	1.81E-03	2.01E-02	Y+3	2.68E-06	2.97E-05	Ru-106	1.58E-07	4.39E-07
Ca+2	1.21E-02	1.34E-01	Zn+2	2.92E-04	3.24E-03	Rh-102	1.47E-10	4.07E-10
Ce+4	2.12E-05	2.35E-04	Zr+4	1.59E-04	1.76E-03	Pd-107	2.82E-09	7.81E-09
Cs+	1.52E-08	1.68E-07	H2O	2.50E+01		Cd-113m	5.66E-07	1.57E-06
Cl-	3.06E-03	3.40E-02	Canisters total	7		In-115	1.72E-17	4.76E-17
Cr+3	1.24E-03	1.38E-02	Drums/day		53	Sn-121m	1.14E-08	3.16E-08
Co+2	6.30E-05	6.99E-04	Radiological Comp.	Ci/kg	Ci/kg	Sn-126	7.00E-08	1.94E-07
Cu+2	2.49E-04	2.76E-03	Ra-226	1.40E-12	3.87E-12	Sb-125	2.20E-06	6.10E-06
Eu+3	3.38E-07	3.75E-06	Ac-227	6.57E-12	1.82E-11	Sb-126	9.80E-09	2.72E-08
F-	1.21E-03	1.34E-02	Th-228	5.45E-10	1.51E-09	Te-123	6.53E-20	1.81E-19
Gd+3	9.17E-05	1.02E-03	Th-230	1.40E-10	3.89E-10	Te-125m	5.37E-07	1.49E-06
Ge+4	2.81E-09	3.12E-08	Th-232	1.21E-16	3.35E-16	I-129	9.08E-09	2.52E-08
In+3	7.01E-07	7.78E-06	Pa-231	1.52E-11	4.22E-11	Cs-134	6.73E-09	1.87E-08
I-	1.41E-06	1.57E-05	Pa-233	4.99E-07	1.39E-06	Cs-135	1.46E-10	4.06E-10
Fe+3	6.21E-03	6.89E-02	U-232	3.39E-10	9.39E-10	Cs-137	8.43E-06	2.34E-05
La+3	5.62E-06	6.23E-05	U-233	1.36E-11	3.78E-11	Ba-137m	7.97E-06	2.21E-05
Pb+2	1.01E-03	1.12E-02	U-234	2.96E-07	8.20E-07	La-138	3.25E-17	9.02E-17
Li+	1.14E-05	1.26E-04	U-235	1.04E-08	2.88E-08	Ce-142	5.09E-12	1.41E-11
Mg+2	2.29E-03	2.54E-02	U-236	1.33E-08	3.68E-08	Ce-144	1.07E-07	2.96E-07
Mn+4	4.63E-03	5.14E-02	U-237	1.10E-09	3.04E-09	Nd-144	2.74E-16	7.60E-16
Hg+2	5.40E-03	6.00E-02	U-238	7.34E-09	2.04E-08	Pm-146	8.67E-09	2.40E-08
Mo+6	1.15E-04	1.27E-03	Np-236	5.24E-13	1.45E-12	Pm-147	2.90E-05	8.05E-05
Nd+3	1.88E-05	2.09E-04	Np-237	8.18E-08	2.27E-07	Sm-146	4.70E-14	1.30E-13
Np+4	2.90E-06	3.22E-05	Pu-236	5.57E-10	1.54E-09	Sm-147	1.26E-12	3.48E-12
Ni+2	5.67E-04	6.29E-03	Pu-238	8.04E-05	2.23E-04	Sm-148	6.45E-18	1.79E-17
Nb+5	1.87E-07	2.07E-06	Pu-239	9.09E-06	2.52E-05	Sm-149	5.73E-19	1.59E-18
NO3-	2.00E+00	2.22E+01	Pu-240	2.06E-06	5.72E-06	Sm-151	5.72E-05	1.59E-04
Pd+4	3.99E-06	4.42E-05	Pu-241	8.08E-05	2.24E-04	Eu-152	4.29E-07	1.19E-06
PO4-3	8.34E-04	9.26E-03	Pu-242	1.61E-09	4.46E-09	Eu-154	3.08E-05	8.55E-05
Pu+4	4.03E-06	4.45E-05	Pu-244	7.71E-18	2.14E-17	Eu-155	2.74E-05	7.60E-05
K+	4.19E-02	4.65E-01	Am-241	1.26E-05	3.49E-05	Gd-152	2.42E-19	6.72E-19
Pr+4	5.18E-06	5.75E-05	Am-242m	2.59E-09	7.19E-09	Ho-166m	7.84E-12	2.18E-11
Rh+4	1.63E-06	1.81E-05	Am-243	3.66E-09	1.01E-08	Co-60	6.05E-06	1.68E-05
			Cm-242	5.10E-09	1.42E-08	Ni-63	5.42E-06	1.50E-05

Table B-11. Tank WM-189 mass balance (continued).

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-3	PFD-3
Stream #	210	211	212	213	220
Stream Name	Solids Flocculent	Steam to Fundabac Filter	Filter Condensate	Nitric Acid	50% Caustic
Rate, gal/hr	0.1	0.8	4.6	TBD	10.1
Rate, lb/hr	2	6	38		127
Rate, peak, gpm	10	0	1		10
Operation	Batch	Batch	Batch		Batch
Temperature, °F	75	328	114	0	70
Pressure, psia	12.8	112.8	12.8	0.0	12.8
Specific Gravity	1.51	1.00	1.00	0.00	1.51
Stream Composition	Wt %	Wt %	Wt %	Wt %	Wt %
50% NaOH	100%				100%
HNO3				100%	
Steam		100%			
Water			100%		
CST					
Portland cement					
Ca(OH)2					
Blast furnace slag					

PFD Sheet #	PFD-3	PFD-4	PFD-4	PFD-4	PFD-4
Stream #	221	222	223	224	225
Stream Name	Fresh IX Media	Portland Cement	Calcium Hydroxide	Blast Furnace Slag	Solid Blend
Rate, gal/hr	0.12	17.00	24.79	8.50	41.79
Rate, lb/hr	0.93	170	99	85	354
Rate, peak, gpm	NA	TBD	TBD	TBD	0.70
Operation	Batch	Cont	Cont	Cont	Cont
Temperature, °F	70	70	70	70	70
Pressure, psia	12.8	12.8	12.8	12.8	12.8
Specific Gravity	0.96	1.20	0.48	1.20	1.02
	Wt %	Wt %	Wt %	Wt %	Wt %
Chemical Composition					
NaOH					
H2O					
CST	100%				
Portland cement		100%			
Ca(OH)2			100%		
Blast furnace slag				100%	
No. Replacement col's	7				

Table B-12. NGLW mass balance.

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2		PFD-3
Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from Tank WM-180
Rate, gal/hr	65.9	9.9	65.9	15.7	8.9	79.0	6.8		85.2
Rate, lb/hr	571	109	559	147	75	671	38		935
Rate, peak, gpm	50	0.165	50	10	0.15	190	4.32		50.00
Operation	Batch	Cont	Batch	Batch	Batch	Batch	Batch		Batch
Temperature, °F	70	83	70	70	70	70	70		70
Pressure, psia	12.8	12.8	12.8	50.0	12.8	12.8	12.8		12.8
Specific Gravity	1.04	1.33	1.02	1.12	1.02	1.02	0.68		1.32
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
H+	3.13E-02	4.76E-01	8.98E-02	8.98E-02	8.98E-02	8.17E-02	2.22E-03		3.91E+00
Al+3	3.04E-02	1.25E-01	2.01E-02	1.29E-01	2.24E-02	3.12E-02	1.01E+00		1.38E-01
Am+4	8.51E-10	4.12E-08	6.16E-09	6.16E-09	6.16E-09	5.61E-09	3.64E-08		5.08E-08
Sb+5	1.51E-05	1.74E-05	1.97E-06	6.64E-05	3.29E-06	9.40E-06	2.66E-03		1.22E-05
As+5	1.28E-04	9.84E-05	1.02E-05	5.54E-04	2.13E-05	7.34E-05	1.38E-02		4.28E-05
Ba+2	2.76E-05	3.45E-05	4.49E-06	1.19E-04	6.84E-06	1.76E-05	5.36E-03		2.59E-05
Be+2	6.21E-06	5.52E-06	5.99E-07	2.70E-05	1.14E-06	3.66E-06	8.07E-05		2.99E-06
B+3	7.79E-04	3.44E-03	6.86E-04	2.80E-03	7.30E-04	8.74E-04	7.94E-03		3.93E-03
Br-	4.45E-09	2.15E-07	3.22E-08	3.22E-08	3.22E-08	2.94E-08	6.31E-08		2.66E-07
Cd+2	1.50E-04	5.72E-04	1.34E-04	4.79E-04	1.41E-04	1.62E-04	1.35E-02		6.55E-04
Ca+2	2.14E-03	1.17E-02	2.21E-03	7.92E-03	2.33E-03	2.68E-03	7.97E-02		1.37E-02
Ce+4	1.39E-05	3.51E-05	4.53E-06	6.26E-05	5.72E-06	1.10E-05	2.77E-03		3.48E-05
Cs+	5.55E-05	4.73E-05	5.25E-06	2.41E-04	1.01E-05	3.26E-05	1.06E-02		2.43E-05
Cl-	3.23E-03	9.90E-03	1.43E-03	1.43E-02	1.69E-03	2.81E-03	1.55E-01		1.04E-02
Cr+3	5.85E-04	3.54E-03	5.07E-04	2.74E-03	5.53E-04	7.26E-04	4.00E-02		4.05E-03
Co+2	4.86E-06	3.26E-03	4.29E-04	4.49E-04	4.29E-04	3.94E-04	1.02E-03		4.02E-03
Cu+2	1.55E-04	1.59E-04	1.89E-05	6.75E-04	3.23E-05	9.47E-05	1.41E-02		1.01E-04
Eu+3	7.38E-09	3.57E-07	5.34E-08	5.34E-08	5.34E-08	4.87E-08	1.99E-07		4.40E-07
F-	2.82E-02	4.18E-02	6.24E-03	1.20E-01	8.57E-03	1.91E-02	7.33E-01		3.51E-02
Gd+3	2.82E-05	1.32E-04	1.76E-05	1.34E-04	2.00E-05	2.98E-05	6.25E-03		1.46E-04
Ge+4	1.28E-10	6.21E-09	9.29E-10	9.29E-10	9.29E-10	8.46E-10	1.65E-09		7.66E-09
In+3	2.02E-08	1.03E-06	1.54E-07	1.54E-07	1.54E-07	1.40E-07	4.32E-07		1.28E-06
I-	3.70E-08	1.79E-06	2.67E-07	2.67E-07	2.67E-07	2.44E-07	8.32E-07		2.21E-06
Fe+3	1.07E-02	1.05E-02	1.38E-03	4.59E-02	2.30E-03	6.52E-03	8.44E-01		6.55E-03
La+3	1.34E-07	6.49E-06	9.71E-07	9.71E-07	9.71E-07	8.84E-07	3.30E-06		8.00E-06
Pb+2	6.39E-05	5.20E-04	8.19E-05	2.83E-04	8.61E-05	9.83E-05	1.45E-02		6.12E-04
Li+	3.18E-04	4.43E-04	5.16E-05	1.41E-03	7.94E-05	2.07E-04	3.19E-03		3.50E-04
Mg+2	1.23E-03	1.45E-02	2.15E-03	6.11E-03	2.23E-03	2.42E-03	3.39E-02		1.73E-02
Mn+4	4.45E-04	1.73E-02	2.46E-03	3.45E-03	2.48E-03	2.36E-03	2.18E-02		2.12E-02
Hg+2	3.11E-05	1.59E-03	2.24E-04	2.85E-04	2.25E-04	2.11E-04	5.25E-03		1.95E-03
Mo+6	8.91E-04	6.65E-04	6.89E-05	3.86E-03	1.47E-04	5.10E-04	1.23E-01		2.71E-04
Nd+3	4.32E-07	2.09E-05	3.13E-06	3.13E-06	3.13E-06	2.85E-06	1.11E-05		2.58E-05
Np+4	2.47E-07	3.70E-06	7.02E-07	7.02E-07	7.02E-07	6.38E-07	4.08E-06		4.57E-06
Ni+2	2.03E-04	7.50E-04	1.15E-04	8.84E-04	1.30E-04	1.95E-04	1.55E-02		8.14E-04
Nb+5	1.47E-03	8.16E-04	7.51E-05	6.36E-03	2.04E-04	8.10E-04	1.98E-01		9.71E-05
NO3-	6.65E-02	5.78E+00	8.18E-01	8.20E-01	8.18E-01	7.46E-01	1.28E+00		7.13E+00
O-2	2.23E-01	1.23E-01	1.12E-02	9.64E-01	3.08E-02	1.23E-01	5.16E+00		1.35E-02
Pd+4	2.45E-03	1.43E-03	1.35E-04	1.06E-02	3.49E-04	1.36E-03	3.77E-01		2.52E-04
PO4-3	1.39E-01	7.72E-02	7.20E-03	5.97E-01	1.93E-02	7.62E-02	1.90E+01		9.90E-03
Pu+4	7.79E-08	3.69E-06	5.53E-07	5.53E-07	5.53E-07	5.04E-07	3.23E-06		4.55E-06
K+	1.86E-02	5.71E-01	7.67E-02	1.47E-01	7.81E-02	7.82E-02	1.00E+00		6.94E-01
Pr+4	1.22E-07	5.90E-06	8.82E-07	8.82E-07	8.82E-07	8.04E-07	3.05E-06		7.28E-06
Rh+4	5.26E-08	2.54E-06	3.81E-07	3.81E-07	3.81E-07	3.47E-07	9.60E-07		3.14E-06

Table B-12. NGLW mass balance (continued).

Stream #	110	111	112	113	114	115	116		120
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste		Liquid SBW from TFF
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt %		Mol/liter
Rb+	8.10E-08	3.92E-06	5.86E-07	5.86E-07	5.86E-07	5.34E-07	1.23E-06		4.83E-06
Ru+3	1.03E-03	6.75E-04	6.66E-05	4.44E-03	1.56E-04	5.77E-04	1.50E-01		1.99E-04
Sm+3	8.02E-08	3.88E-06	5.80E-07	5.80E-07	5.80E-07	5.29E-07	2.14E-06		4.78E-06
Se+4	3.82E-04	2.18E-04	2.03E-05	1.65E-03	5.37E-05	2.11E-04	4.36E-02		3.32E-05
Si+4	1.26E-01	6.92E-02	6.37E-03	5.42E-01	1.74E-02	6.90E-02	5.10E+00		7.89E-03
Ag+	5.89E-04	3.26E-04	3.05E-05	2.54E-03	8.19E-05	3.24E-04	9.16E-02		3.91E-05
Na+	4.19E-02	4.28E+00	5.76E-01	6.89E-01	5.78E-01	5.39E-01	1.20E+00		1.94E+00
Sr+2	8.53E-06	9.05E-05	1.19E-05	4.74E-05	1.26E-05	1.51E-05	1.08E-03		1.06E-04
SO4-2	6.39E-04	1.14E-02	2.06E-03	2.06E-03	2.06E-03	1.87E-03	4.85E-03		1.41E-02
Tc+7	9.40E-08	6.43E-06	9.28E-07	9.28E-07	9.28E-07	8.46E-07	2.21E-06		7.93E-06
Te+4	4.21E-08	3.25E-06	4.65E-07	4.65E-07	4.65E-07	4.24E-07	1.45E-06		4.01E-06
Tb+4	3.09E-11	1.49E-09	2.23E-10	2.23E-10	2.23E-10	2.04E-10	8.70E-10		1.84E-09
Th+4	2.87E-12	1.61E-05	2.13E-06	2.13E-06	2.13E-06	1.94E-06	1.21E-05		1.99E-05
Sn+4	2.63E-03	1.46E-03	1.35E-04	1.13E-02	3.65E-04	1.45E-03	4.51E-01		1.85E-04
Ti+4	1.29E-03	7.54E-04	7.18E-05	5.56E-03	1.85E-04	7.14E-04	8.91E-02		1.35E-04
U+4	3.83E-05	8.27E-03	1.09E-03	1.23E-03	1.10E-03	1.01E-03	1.75E-02		1.02E-02
V+5	1.12E-05	5.10E-05	9.66E-06	4.21E-05	1.03E-05	1.26E-05	5.72E-04		5.82E-05
Y+3	1.00E-07	4.84E-06	7.23E-07	7.23E-07	7.23E-07	6.59E-07	1.58E-06		5.97E-06
Zn+2	8.90E-05	3.90E-04	5.07E-05	4.24E-04	5.83E-05	9.02E-05	8.34E-03		4.26E-04
Zr+4	5.35E-02	3.04E-02	2.91E-03	2.31E-01	7.58E-03	2.95E-02	7.04E+00		4.53E-03
H2O	5.55E+01	4.59E+01	5.23E+01	5.10E+01	5.22E+01	5.19E+01	5.56E+01		4.33E+01
Canisters/day							0.59		
Canisters total							13		
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg		Ci/liter
Ra-226	1.15E-13	5.91E-12	8.78E-13	8.78E-13	8.78E-13	8.00E-13	2.15E-13		7.29E-12
Ac-227	5.43E-13	2.78E-11	4.13E-12	4.13E-12	4.13E-12	3.77E-12	1.01E-12		3.43E-11
Th-228	4.51E-11	2.31E-09	3.43E-10	3.43E-10	3.43E-10	3.13E-10	8.41E-11		2.85E-09
Th-230	3.37E-10	7.72E-10	1.04E-10	1.49E-09	1.33E-10	2.59E-10	4.72E-09		7.51E-10
Th-232	9.98E-18	5.11E-16	7.59E-17	7.59E-17	7.59E-17	6.92E-17	1.86E-17		6.30E-16
Pa-231	1.26E-12	6.44E-11	9.57E-12	9.57E-12	9.57E-12	8.72E-12	2.35E-12		7.95E-11
Pa-233	4.13E-08	2.11E-06	3.14E-07	3.14E-07	3.14E-07	2.86E-07	7.70E-08		2.61E-06
U-232	6.99E-10	1.80E-09	2.47E-10	3.11E-09	3.05E-10	5.62E-10	9.75E-09		1.81E-09
U-233	1.27E-11	6.40E-11	9.15E-12	5.84E-11	1.02E-11	1.42E-11	1.69E-10		7.18E-11
U-234	2.08E-07	1.12E-06	1.53E-07	9.92E-07	1.70E-07	2.38E-07	2.88E-06		1.26E-06
U-235	1.09E-08	5.61E-08	7.37E-09	5.28E-08	8.30E-09	1.21E-08	1.56E-07		6.27E-08
U-236	1.43E-08	5.36E-08	7.16E-09	6.62E-08	8.37E-09	1.35E-08	2.02E-07		5.76E-08
U-237	9.07E-11	4.64E-09	6.90E-10	6.90E-10	6.90E-10	6.28E-10	1.69E-10		5.72E-09
U-238	1.23E-09	2.09E-08	3.11E-09	6.51E-09	3.18E-09	3.23E-09	1.23E-08		2.53E-08
Np-236	6.44E-14	2.31E-12	3.60E-13	3.60E-13	3.60E-13	3.28E-13	8.83E-14		2.85E-12
Np-237	1.02E-07	6.52E-07	1.20E-07	3.81E-07	1.26E-07	1.40E-07	9.12E-07		7.67E-07
Pu-236	1.22E-09	2.75E-09	3.96E-10	5.32E-09	4.97E-10	9.42E-10	1.68E-08		2.68E-09
Pu-238	6.41E-04	7.45E-04	1.01E-04	2.75E-03	1.56E-04	4.05E-04	9.00E-03		5.36E-04
Pu-239	6.72E-05	8.73E-05	1.09E-05	2.93E-04	1.67E-05	4.32E-05	9.58E-04		6.69E-05
Pu-240	4.68E-06	1.03E-05	1.44E-06	2.04E-05	1.83E-06	3.56E-06	6.47E-05		9.92E-06
Pu-241	5.07E-04	5.14E-04	7.08E-05	2.16E-03	1.14E-04	3.11E-04	7.10E-03		3.32E-04
Pu-242	3.69E-09	7.95E-09	1.26E-09	1.56E-08	1.55E-09	2.84E-09	4.88E-08		7.74E-09
Pu-244	2.89E-16	4.80E-16	5.73E-17	1.29E-15	8.25E-17	1.97E-16	4.17E-15		4.15E-16
Am-241	1.71E-05	6.03E-05	8.31E-06	7.74E-05	9.72E-06	1.57E-05	2.36E-04		6.44E-05
Am-242m	2.14E-10	1.11E-08	1.65E-09	1.65E-09	1.65E-09	1.50E-09	4.04E-10		1.37E-08
Am-243	6.07E-09	1.88E-08	2.61E-09	2.72E-08	3.12E-09	5.28E-09	8.39E-08		1.97E-08
Cm-242	2.00E-10	2.08E-08	2.89E-09	2.99E-09	2.90E-09	2.65E-09	1.04E-09		2.57E-08

Table B-12. NGLW mass balance (continued).

Stream #	110	111	112	113	114	115	116
Stream Name	Slurry from TFF Tank WM-187	Crossflow Filter Recirc Purge	Decant Liquid	Solids Treatment Filter Feed	Solids Treatment Filtrate	Combined Waste Water	Dried Solids Waste
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/kg
Cm-243	1.23E-08	2.70E-08	3.64E-09	5.42E-08	4.68E-09	9.29E-09	1.72E-07
Cm-244	7.68E-07	1.16E-06	1.58E-07	3.33E-06	2.23E-07	5.18E-07	1.08E-05
Cm-245	1.30E-10	2.84E-10	3.83E-11	5.75E-10	4.93E-11	9.82E-11	1.83E-09
Cm-246	8.44E-12	1.87E-11	2.52E-12	3.73E-11	3.23E-12	6.40E-12	1.18E-10
H-3	3.92E-07	1.09E-05	1.78E-06	1.78E-06	1.78E-06	1.62E-06	4.35E-07
Be-10	4.23E-14	2.16E-12	3.22E-13	3.22E-13	3.22E-13	2.93E-13	7.88E-14
C-14	5.49E-11	1.16E-10	1.55E-11	2.42E-10	2.02E-11	4.09E-11	7.71E-10
Se-79	1.98E-07	4.20E-07	5.64E-08	8.72E-07	7.32E-08	1.48E-07	2.78E-06
Rb-87	4.13E-13	2.11E-11	3.14E-12	3.14E-12	3.14E-12	2.86E-12	7.70E-13
Sr-90	1.06E-03	2.80E-02	4.25E-03	5.91E-03	4.29E-03	4.07E-03	6.67E-03
Y-90	1.06E-03	2.80E-02	4.25E-03	5.91E-03	4.29E-03	4.07E-03	6.67E-03
Zr-93	3.12E-08	1.60E-06	2.37E-07	2.37E-07	2.37E-07	2.16E-07	5.82E-08
Nb-93m	2.41E-08	1.23E-06	1.83E-07	1.83E-07	1.83E-07	1.67E-07	4.48E-08
Nb-94	5.10E-07	1.09E-06	1.47E-07	2.25E-06	1.90E-07	3.82E-07	7.16E-06
Tc-98	3.63E-14	1.86E-12	2.76E-13	2.76E-13	2.76E-13	2.52E-13	6.77E-14
Tc-99	4.43E-06	1.31E-05	1.77E-06	2.00E-05	2.15E-06	3.76E-06	6.21E-05
Ru-106	4.27E-07	8.98E-07	1.20E-07	1.88E-06	1.57E-07	3.18E-07	6.00E-06
Rh-102	4.14E-07	2.28E-07	2.09E-08	1.78E-06	5.71E-08	2.27E-07	5.98E-06
Pd-107	2.33E-10	1.19E-08	1.77E-09	1.77E-09	1.77E-09	1.61E-09	4.34E-10
Cd-113m	4.68E-08	2.39E-06	3.56E-07	3.56E-07	3.56E-07	3.24E-07	8.72E-08
In-115	1.42E-18	7.26E-17	1.08E-17	1.08E-17	1.08E-17	9.83E-18	2.64E-18
Sn-121m	9.42E-10	4.82E-08	7.16E-09	7.16E-09	7.16E-09	6.53E-09	1.76E-09
Sn-126	1.87E-07	3.95E-07	5.31E-08	8.24E-07	6.89E-08	1.39E-07	2.62E-06
Sb-125	5.93E-04	3.34E-04	3.14E-05	2.56E-03	8.32E-05	3.27E-04	8.56E-03
Sb-126	8.10E-10	4.15E-08	6.16E-09	6.16E-09	6.16E-09	5.62E-09	1.51E-09
Te-123	5.40E-21	2.76E-19	4.11E-20	4.11E-20	4.11E-20	3.74E-20	1.01E-20
Te-125m	4.44E-08	2.27E-06	3.37E-07	3.37E-07	3.37E-07	3.08E-07	8.27E-08
I-129	2.42E-08	5.04E-08	6.78E-09	1.06E-07	8.83E-09	1.79E-08	3.39E-07
Cs-134	4.92E-05	3.93E-05	4.85E-06	2.11E-04	9.07E-06	2.87E-05	6.99E-04
Cs-135	3.49E-07	8.05E-07	1.09E-07	1.55E-06	1.39E-07	2.68E-07	4.90E-06
Cs-137	1.98E-02	3.17E-02	4.37E-03	8.59E-02	6.04E-03	1.36E-02	2.77E-01
Ba-137m	1.88E-02	3.00E-02	4.13E-03	8.12E-02	5.71E-03	1.29E-02	2.62E-01
La-138	2.69E-18	1.38E-16	2.05E-17	2.05E-17	2.05E-17	1.86E-17	5.01E-18
Ce-142	4.21E-13	2.16E-11	3.20E-12	3.20E-12	3.20E-12	2.92E-12	7.85E-13
Ce-144	2.90E-07	6.06E-07	8.13E-08	1.28E-06	1.06E-07	2.15E-07	4.07E-06
Nd-144	2.27E-17	1.16E-15	1.72E-16	1.72E-16	1.72E-16	1.57E-16	4.22E-17
Pm-146	7.17E-10	3.67E-08	5.45E-09	5.45E-09	5.45E-09	4.97E-09	1.34E-09
Pm-147	7.68E-05	1.64E-04	2.20E-05	3.39E-04	2.85E-05	5.74E-05	1.08E-03
Sm-146	3.89E-15	1.99E-13	2.96E-14	2.96E-14	2.96E-14	2.69E-14	7.24E-15
Sm-147	1.04E-13	5.31E-12	7.89E-13	7.89E-13	7.89E-13	7.19E-13	1.93E-13
Sm-148	5.33E-19	2.73E-17	4.06E-18	4.06E-18	4.06E-18	3.70E-18	9.94E-19
Sm-149	4.73E-20	2.42E-18	3.60E-19	3.60E-19	3.60E-19	3.28E-19	8.82E-20
Sm-151	1.53E-04	3.23E-04	4.34E-05	6.76E-04	5.64E-05	1.14E-04	2.15E-03
Eu-152	5.55E-07	2.10E-06	2.96E-07	2.51E-06	3.41E-07	5.31E-07	7.57E-06
Eu-154	2.44E-05	7.60E-05	1.27E-05	1.01E-04	1.45E-05	2.20E-05	3.03E-04
Eu-155	3.50E-05	8.35E-05	1.11E-05	1.56E-04	1.41E-05	2.72E-05	4.92E-04
Gd-152	2.00E-20	1.03E-18	1.52E-19	1.52E-19	1.52E-19	1.39E-19	3.73E-20
Ho-166m	6.49E-13	3.32E-11	4.93E-12	4.93E-12	4.93E-12	4.49E-12	1.21E-12
Co-60	2.81E-06	1.25E-05	2.44E-06	1.03E-05	2.60E-06	3.14E-06	2.73E-05
Ni-63	1.48E-05	3.25E-05	4.80E-06	6.38E-05	6.01E-06	1.13E-05	2.01E-04

Table B-12. NGLW mass balance (continued).

PFD Sheet #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Rate, gal/hr	99.9	7800	7700	99.9	99.9	99.9	99.9	0.5
Rate, lb/hr	1121	87554	86433	1121	1121	1121	1121	5
Rate, peak, gpm	1.66	130	128	1.66	1.66	1.66	1.66	2.99
Operation	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Batch
Temperature, °F	70	70	70	70	70	70	70	70
Pressure, psia	12.8	35.0	35.0	24.8	20.8	16.8	12.8	12.8
Specific Gravity	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.07
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
H+	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01	1.01E-01
Al+3	1.18E-01	1.32E-01	1.32E-01	1.16E-01	1.16E-01	1.16E-01	1.16E-01	2.35E-02
Am+4	4.33E-08	4.33E-08	4.33E-08	4.33E-08	4.33E-08	4.33E-08	4.33E-08	8.74E-09
Sb+5	1.04E-05	1.90E-05	1.91E-05	9.58E-06	9.58E-06	9.58E-06	9.58E-06	1.94E-06
As+5	3.64E-05	1.09E-04	1.10E-04	2.98E-05	2.98E-05	2.98E-05	2.98E-05	6.03E-06
Ba+2	2.20E-05	3.74E-05	3.76E-05	2.06E-05	2.06E-05	2.06E-05	2.06E-05	4.17E-06
Be+2	2.55E-06	6.08E-06	6.13E-06	2.23E-06	2.23E-06	2.23E-06	2.23E-06	4.50E-07
B+3	3.35E-03	3.63E-03	3.63E-03	3.32E-03	3.32E-03	3.32E-03	3.32E-03	6.71E-04
Br-	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	4.57E-08
Cd+2	5.58E-04	6.04E-04	6.04E-04	5.53E-04	5.53E-04	5.53E-04	5.53E-04	1.12E-04
Ca+2	1.16E-02	1.24E-02	1.24E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02	2.34E-03
Ce+4	2.97E-05	3.74E-05	3.76E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	5.85E-06
Cs+	2.07E-05	5.22E-05	5.26E-05	1.78E-05	1.78E-06	1.78E-07	1.78E-08	3.61E-09
Cl-	8.82E-03	1.05E-02	1.06E-02	8.66E-03	8.66E-03	8.66E-03	8.66E-03	1.75E-03
Cr+3	3.45E-03	3.75E-03	3.75E-03	3.42E-03	3.42E-03	3.42E-03	3.42E-03	6.91E-04
Co+2	3.42E-03	3.42E-03	3.42E-03	3.42E-03	3.42E-03	3.42E-03	3.42E-03	6.91E-04
Cu+2	8.63E-05	1.74E-04	1.75E-04	7.84E-05	7.84E-05	7.84E-05	7.84E-05	1.58E-05
Eu+3	3.75E-07	3.75E-07	3.75E-07	3.75E-07	3.75E-07	3.75E-07	3.75E-07	7.58E-08
F-	2.99E-02	4.51E-02	4.53E-02	2.85E-02	2.85E-02	2.85E-02	2.85E-02	5.77E-03
Gd+3	1.25E-04	1.40E-04	1.40E-04	1.23E-04	1.23E-04	1.23E-04	1.23E-04	2.49E-05
Ge+4	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	1.32E-09
In+3	1.09E-06	1.09E-06	1.09E-06	1.09E-06	1.09E-06	1.09E-06	1.09E-06	2.19E-07
I-	1.88E-06	1.88E-06	1.88E-06	1.88E-06	1.88E-06	1.88E-06	1.88E-06	3.80E-07
Fe+3	5.57E-03	1.15E-02	1.16E-02	5.03E-03	5.03E-03	5.03E-03	5.03E-03	1.02E-03
La+3	6.81E-06	6.81E-06	6.81E-06	6.81E-06	6.81E-06	6.81E-06	6.81E-06	1.38E-06
Pb+2	5.21E-04	5.48E-04	5.49E-04	5.19E-04	5.19E-04	5.19E-04	5.19E-04	1.05E-04
Li+	2.98E-04	4.79E-04	4.82E-04	2.81E-04	2.81E-04	2.81E-04	2.81E-04	5.69E-05
Mg+2	1.47E-02	1.52E-02	1.52E-02	1.46E-02	1.46E-02	1.46E-02	1.46E-02	2.96E-03
Mn+4	1.81E-02	1.82E-02	1.82E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02	3.65E-03
Hg+2	1.66E-03	1.67E-03	1.67E-03	1.66E-03	1.66E-03	1.66E-03	1.66E-03	3.36E-04
Mo+6	2.31E-04	7.38E-04	7.46E-04	1.85E-04	1.85E-04	1.85E-04	1.85E-04	3.74E-05
Nd+3	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.20E-05	2.20E-05	4.44E-06
Np+4	3.89E-06	3.89E-06	3.89E-06	3.89E-06	3.89E-06	3.89E-06	3.89E-06	7.86E-07
Ni+2	6.93E-04	7.96E-04	7.97E-04	6.84E-04	6.84E-04	6.84E-04	6.84E-04	1.38E-04
Nb+5	8.27E-05	9.23E-04	9.35E-04	6.78E-06	6.78E-06	6.78E-06	6.78E-06	1.37E-06
NO3-	6.07E+00	6.07E+00	6.07E+00	6.07E+00	6.07E+00	6.07E+00	6.07E+00	1.23E+00
O-2	1.15E-02	1.39E-01	1.41E-01					
Pd+4	2.14E-04	1.61E-03	1.63E-03	8.81E-05	8.81E-05	8.81E-05	8.81E-05	1.78E-05
PO4-3	8.43E-03	8.74E-02	8.85E-02	1.30E-03	1.30E-03	1.30E-03	1.30E-03	2.62E-04
Pu+4	3.87E-06	3.87E-06	3.87E-06	3.87E-06	3.87E-06	3.87E-06	3.87E-06	7.83E-07
K+	5.91E-01	6.00E-01	6.00E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	1.19E-01
Pr+4	6.19E-06	6.19E-06	6.19E-06	6.19E-06	6.19E-06	6.19E-06	6.19E-06	1.25E-06
Rh+4	2.67E-06	2.67E-06	2.67E-06	2.67E-06	2.67E-06	2.67E-06	2.67E-06	5.40E-07

Table B-12. NGLW mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Mol/liter
Rb+	4.11E-06	4.11E-06	4.11E-06	4.11E-06	4.11E-06	4.11E-06	4.11E-06	8.31E-07
Ru+3	1.70E-04	7.55E-04	7.63E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.36E-05
Sm+3	4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06	4.07E-06	8.23E-07
Se+4	2.83E-05	2.46E-04	2.49E-04	8.64E-06	8.64E-06	8.64E-06	8.64E-06	1.75E-06
Si+4	6.71E-03	7.83E-02	7.94E-02	2.47E-04	2.47E-04	2.47E-04	2.47E-04	4.98E-05
Ag+	3.33E-05	3.69E-04	3.73E-04	3.00E-06	3.00E-06	3.00E-06	3.00E-06	6.06E-07
Na+	4.48E+00	4.49E+00	4.49E+00	4.48E+00	4.48E+00	4.48E+00	4.48E+00	9.05E-01
Sr+2	9.07E-05	9.54E-05	9.55E-05	9.02E-05	9.02E-05	9.02E-05	9.02E-05	1.82E-05
SO4-2	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	2.42E-03
Tc+7	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	6.75E-06	1.36E-06
Te+4	3.42E-06	3.42E-06	3.42E-06	3.42E-06	3.42E-06	3.42E-06	3.42E-06	6.90E-07
Tb+4	1.57E-09	1.57E-09	1.57E-09	1.57E-09	1.57E-09	1.57E-09	1.57E-09	3.17E-10
Th+4	1.70E-05	1.70E-05	1.70E-05	1.70E-05	1.70E-05	1.70E-05	1.70E-05	3.43E-06
Sn+4	1.57E-04	1.66E-03	1.68E-03	2.20E-05	2.20E-05	2.20E-05	2.20E-05	4.44E-06
Ti+4	1.15E-04	8.50E-04	8.60E-04	4.86E-05	4.86E-05	4.86E-05	4.86E-05	9.81E-06
U+4	8.67E-03	8.69E-03	8.69E-03	8.67E-03	8.67E-03	8.67E-03	8.67E-03	1.75E-03
V+5	4.96E-05	5.39E-05	5.40E-05	4.92E-05	4.92E-05	4.92E-05	4.92E-05	9.94E-06
Y+3	5.08E-06	5.08E-06	5.08E-06	5.08E-06	5.08E-06	5.08E-06	5.08E-06	1.03E-06
Zn+2	3.63E-04	4.13E-04	4.14E-04	3.59E-04	3.59E-04	3.59E-04	3.59E-04	7.25E-05
Zr+4	3.85E-03	3.43E-02	3.47E-02	1.10E-03	1.10E-03	1.10E-03	1.10E-03	2.23E-04
H2O	4.58E+01	4.49E+01	4.49E+01	4.59E+01	4.59E+01	4.59E+01	4.59E+01	5.33E+01
Radiological Composition	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Ra-226	6.20E-12	6.20E-12	6.20E-12	6.20E-12	6.20E-12	6.20E-12	6.20E-12	1.25E-12
Ac-227	2.92E-11	2.92E-11	2.92E-11	2.92E-11	2.92E-11	2.92E-11	2.92E-11	5.90E-12
Th-228	2.42E-09	2.42E-09	2.42E-09	2.42E-09	2.42E-09	2.42E-09	2.42E-09	4.90E-10
Th-230	6.39E-10	8.25E-10	8.28E-10	6.23E-10	6.23E-10	6.23E-10	6.23E-10	1.26E-10
Th-232	5.36E-16	6.74E-11	5.36E-16	5.36E-16	5.36E-16	5.36E-16	5.36E-16	1.08E-16
Pa-231	6.76E-11	6.76E-11	6.76E-11	6.76E-11	6.76E-11	6.76E-11	6.76E-11	1.37E-11
Pa-233	2.22E-06	2.22E-06	2.22E-06	2.22E-06	2.22E-06	2.22E-06	2.22E-06	4.49E-07
U-232	1.54E-09	1.92E-09	1.93E-09	1.50E-09	1.50E-09	1.50E-09	1.50E-09	3.04E-10
U-233	6.11E-11	6.77E-11	6.78E-11	6.05E-11	6.05E-11	6.05E-11	6.05E-11	1.22E-11
U-234	1.07E-06	1.18E-06	1.18E-06	1.06E-06	1.06E-06	1.06E-06	1.06E-06	2.14E-07
U-235	5.34E-08	5.94E-08	5.95E-08	5.28E-08	5.28E-08	5.28E-08	5.28E-08	1.07E-08
U-236	4.90E-08	5.69E-08	5.70E-08	4.83E-08	4.83E-08	4.83E-08	4.83E-08	9.76E-09
U-237	4.87E-09	4.87E-09	4.87E-09	4.87E-09	4.87E-09	4.87E-09	4.87E-09	9.85E-10
U-238	2.15E-08	2.20E-08	2.20E-08	2.15E-08	2.15E-08	2.15E-08	2.15E-08	4.34E-09
Np-236	2.43E-12	2.43E-12	2.43E-12	2.43E-12	2.43E-12	2.43E-12	2.43E-12	4.90E-13
Np-237	6.53E-07	6.88E-07	6.88E-07	6.50E-07	6.50E-07	6.50E-07	6.50E-07	1.31E-07
Pu-236	2.28E-09	2.94E-09	2.95E-09	2.22E-09	2.22E-09	2.22E-09	2.22E-09	4.49E-10
Pu-238	4.56E-04	8.11E-04	8.16E-04	4.24E-04	4.24E-04	4.24E-04	4.24E-04	8.58E-05
Pu-239	5.69E-05	9.46E-05	9.52E-05	5.35E-05	5.35E-05	5.35E-05	5.35E-05	1.08E-05
Pu-240	8.44E-06	1.10E-05	1.10E-05	8.21E-06	8.21E-06	8.21E-06	8.21E-06	1.66E-06
Pu-241	2.83E-04	5.62E-04	5.66E-04	2.57E-04	2.57E-04	2.57E-04	2.57E-04	5.20E-05
Pu-242	6.58E-09	8.50E-09	8.53E-09	6.41E-09	6.41E-09	6.41E-09	6.41E-09	1.30E-09
Pu-244	3.53E-16	5.17E-16	5.20E-16	3.38E-16	3.38E-16	3.38E-16	3.38E-16	6.83E-17
Am-241	5.48E-05	6.40E-05	6.42E-05	5.40E-05	5.40E-05	5.40E-05	5.40E-05	1.09E-05
Am-242m	1.17E-08	1.17E-08	1.17E-08	1.17E-08	1.17E-08	1.17E-08	1.17E-08	2.36E-09
Am-243	1.67E-08	2.00E-08	2.01E-08	1.64E-08	1.64E-08	1.64E-08	1.64E-08	3.32E-09
Cm-242	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	4.42E-09

Table B-12. NGLW mass balance (continued).

Stream #	121	122	123	124	125	126	127	128
Stream Name	Neutralized Feed	SBW Liquid Filter Feed	Filter Recirculation	IX Column Feed	Column 1 Effluent	Column 2 Effluent	Column 3 Effluent	Spent IX Rinse
	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter	Ci/liter
Cm-243	2.21E-08	2.89E-08	2.90E-08	2.15E-08	2.15E-08	2.15E-08	2.15E-08	4.35E-09
Cm-244	8.32E-07	1.26E-06	1.26E-06	7.94E-07	7.94E-07	7.94E-07	7.94E-07	1.60E-07
Cm-245	2.32E-10	3.04E-10	3.05E-10	2.26E-10	2.26E-10	2.26E-10	2.26E-10	4.57E-11
Cm-246	1.53E-11	2.00E-11	2.00E-11	1.49E-11	1.49E-11	1.49E-11	1.49E-11	3.01E-12
H-3	1.14E-05	1.14E-05	1.14E-05	1.14E-05	1.14E-05	1.14E-05	1.14E-05	2.31E-06
Be-10	2.27E-12	2.27E-12	2.27E-12	2.27E-12	2.27E-12	2.27E-12	2.27E-12	4.59E-13
C-14	9.36E-11	1.24E-10	1.24E-10	9.09E-11	9.09E-11	9.09E-11	9.09E-11	1.84E-11
Se-79	3.41E-07	4.50E-07	4.51E-07	3.31E-07	3.31E-07	3.31E-07	3.31E-07	6.68E-08
Rb-87	2.22E-11	2.22E-11	2.22E-11	2.22E-11	2.22E-11	2.22E-11	2.22E-11	4.48E-12
Sr-90	2.92E-02	2.94E-02	2.94E-02	2.91E-02	2.91E-02	2.91E-02	2.91E-02	5.89E-03
Y-90	2.92E-02	2.94E-02	2.94E-02	2.91E-02	2.91E-02	2.91E-02	2.91E-02	5.89E-03
Zr-93	1.68E-06	1.68E-06	1.68E-06	1.68E-06	1.68E-06	1.68E-06	1.68E-06	3.39E-07
Nb-93m	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	1.29E-06	2.61E-07
Nb-94	8.88E-07	1.17E-06	1.17E-06	8.63E-07	8.63E-07	8.63E-07	8.63E-07	1.74E-07
Tc-98	1.95E-12	1.95E-12	1.95E-12	1.95E-12	1.95E-12	1.95E-12	1.95E-12	3.95E-13
Tc-99	1.15E-05	1.40E-05	1.40E-05	1.13E-05	1.13E-05	1.13E-05	1.13E-05	2.29E-06
Ru-106	7.25E-07	9.61E-07	9.65E-07	7.04E-07	7.04E-07	7.04E-07	7.04E-07	1.42E-07
Rh-102	2.20E-08	2.58E-07	2.61E-07	6.53E-10	6.53E-10	6.53E-10	6.53E-10	1.32E-10
Pd-107	1.25E-08	1.25E-08	1.25E-08	1.25E-08	1.25E-08	1.25E-08	1.25E-08	2.53E-09
Cd-113m	2.51E-06	2.51E-06	2.51E-06	2.51E-06	2.51E-06	2.51E-06	2.51E-06	5.08E-07
In-115	7.62E-17	7.62E-17	7.62E-17	7.62E-17	7.62E-17	7.62E-17	7.62E-17	1.54E-17
Sn-121m	5.06E-08	5.06E-08	5.06E-08	5.06E-08	5.06E-08	5.06E-08	5.06E-08	1.02E-08
Sn-126	3.20E-07	4.23E-07	4.25E-07	3.11E-07	3.11E-07	3.11E-07	3.11E-07	6.29E-08
Sb-125	4.03E-05	3.78E-04	3.83E-04	9.78E-06	9.78E-06	9.78E-06	9.78E-06	1.98E-06
Sb-126	4.35E-08	4.35E-08	4.35E-08	4.35E-08	4.35E-08	4.35E-08	4.35E-08	8.80E-09
Te-123	2.90E-19	2.90E-19	2.90E-19	2.90E-19	2.90E-19	2.90E-19	2.90E-19	5.86E-20
Te-125m	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.38E-06	4.82E-07
I-129	4.06E-08	5.39E-08	5.41E-08	3.94E-08	3.94E-08	3.94E-08	3.94E-08	7.96E-09
Cs-134	1.59E-05	4.34E-05	4.38E-05	1.34E-05	1.34E-06	1.34E-07	1.34E-08	2.70E-09
Cs-135	6.68E-07	8.60E-07	8.63E-07	6.51E-07	6.51E-08	6.51E-09	6.51E-10	1.32E-10
Cs-137	2.32E-02	3.41E-02	3.43E-02	2.22E-02	2.22E-03	2.22E-04	2.22E-05	4.50E-06
Ba-137m	2.20E-02	3.23E-02	3.24E-02	2.10E-02	2.10E-02	2.10E-02	2.10E-02	4.25E-03
La-138	1.45E-16	1.45E-16	1.45E-16	1.45E-16	1.45E-16	1.45E-16	1.45E-16	2.92E-17
Ce-142	2.26E-11	2.26E-11	2.26E-11	2.26E-11	2.26E-11	2.26E-11	2.26E-11	4.57E-12
Ce-144	4.89E-07	6.49E-07	6.51E-07	4.74E-07	4.74E-07	4.74E-07	4.74E-07	9.59E-08
Nd-144	1.22E-15	1.22E-15	1.22E-15	1.22E-15	1.22E-15	1.22E-15	1.22E-15	2.46E-16
Pm-146	3.85E-08	3.85E-08	3.85E-08	3.85E-08	3.85E-08	3.85E-08	3.85E-08	7.79E-09
Pm-147	1.33E-04	1.75E-04	1.76E-04	1.29E-04	1.29E-04	1.29E-04	1.29E-04	2.61E-05
Sm-146	2.09E-13	2.09E-13	2.09E-13	2.09E-13	2.09E-13	2.09E-13	2.09E-13	4.22E-14
Sm-147	5.58E-12	5.58E-12	5.58E-12	5.58E-12	5.58E-12	5.58E-12	5.58E-12	1.13E-12
Sm-148	2.87E-17	2.87E-17	2.87E-17	2.87E-17	2.87E-17	2.87E-17	2.87E-17	5.79E-18
Sm-149	2.54E-18	2.54E-18	2.54E-18	2.54E-18	2.54E-18	2.54E-18	2.54E-18	5.14E-19
Sm-151	2.62E-04	3.46E-04	3.48E-04	2.54E-04	2.54E-04	2.54E-04	2.54E-04	5.14E-05
Eu-152	1.93E-06	2.23E-06	2.23E-06	1.91E-06	1.91E-06	1.91E-06	1.91E-06	3.85E-07
Eu-154	6.89E-05	8.08E-05	8.09E-05	6.79E-05	6.79E-05	6.79E-05	6.79E-05	1.37E-05
Eu-155	6.98E-05	8.92E-05	8.94E-05	6.81E-05	6.81E-05	6.81E-05	6.81E-05	1.38E-05
Gd-152	1.08E-18	1.08E-18	1.08E-18	1.08E-18	1.08E-18	1.08E-18	1.08E-18	2.18E-19
Ho-166m	3.49E-11	3.49E-11	3.49E-11	3.49E-11	3.49E-11	3.49E-11	3.49E-11	7.04E-12
Co-60	1.22E-05	1.32E-05	1.32E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	2.44E-06
Ni-63	2.69E-05	3.48E-05	3.49E-05	2.61E-05	2.61E-05	2.61E-05	2.61E-05	5.28E-06

Table B-12. NGLW mass balance (continued).

PFD Sheet #		PFD-4	PFD Sheet #		PFD-4			PFD-4
Stream #	129	130	Stream #	129	130		129	130
Stream Name	Spent IX Media	Grouted Waste	Stream Name	Spent IX Media	Grouted Waste		Spent IX Media	Grouted Waste
Rate, gal/hr	0.12	120		Wt %	Wt %		Ci/kg	Ci/kg
Rate, lb/hr	1.29	1494	Rb+	1.78E-06	1.96E-05	Cm-243	4.35E-09	1.20E-08
Rate, total columns	1	N/A	Ru+3	5.95E-05	6.56E-04	Cm-244	1.60E-07	4.42E-07
Operation	Batch	Cont	Sm+3	3.09E-06	3.41E-05	Cm-245	4.57E-11	1.26E-10
Temperature, °F	70	70	Se+4	3.45E-06	3.80E-05	Cm-246		
Pressure, psia	12.8	12.8	Si+4	3.50E-05	3.86E-04		3.01E-12	8.29E-12
Specific Gravity	1.34	1.50	Ag+	1.63E-06	1.80E-05	H-3	2.31E-06	6.37E-06
Chemical Composition	Wt %	Wt %	Na+	5.20E-01	5.73E+00	Be-10	4.59E-13	1.26E-12
CST	7.24E+01	N/A	Sr+2	3.99E-05	4.40E-04	C-14	1.84E-11	5.06E-11
H+	2.55E-03	N/A	SO4-2	5.82E-03	6.42E-02	Se-79	6.68E-08	1.84E-07
Al+3	1.59E-02	1.75E-01	Tc+7	3.31E-06	3.65E-05	Rb-87	4.48E-12	1.24E-11
Am+4	5.26E-08	5.80E-07	Te+4	2.20E-06	2.43E-05	Sr-90	5.89E-03	1.62E-02
Sb+5	5.89E-06	6.50E-05	Tb+4	1.26E-09	1.39E-08	Y-90	5.89E-03	1.62E-02
As+5	1.13E-05	1.24E-04	Th+4	1.99E-05	2.19E-04	Zr-93	3.39E-07	9.34E-07
Ba+2	1.43E-05	1.58E-04	Sn+4	1.32E-05	1.45E-04	Nb-93m	2.61E-07	7.20E-07
Be+2	1.01E-07	1.12E-06	Ti+4	1.17E-05	1.29E-04	Nb-94	1.74E-07	4.80E-07
B+3	1.81E-04	2.00E-03	U+4	1.04E-02	1.15E-01	Tc-98	3.95E-13	1.09E-12
Br-	9.13E-08	1.01E-06	V+5	1.27E-05	1.39E-04	Tc-99	2.29E-06	6.31E-06
Cd+2	3.14E-04	3.46E-03	Y+3	2.28E-06	2.51E-05	Ru-106	1.42E-07	3.92E-07
Ca+2	2.34E-03	2.58E-02	Zn+2	1.18E-04	1.31E-03	Rh-102	1.32E-10	3.63E-10
Ce+4	2.05E-05	2.26E-04	Zr+4	5.08E-04	5.60E-03	Pd-107	2.53E-09	6.96E-09
Cs+	1.20E-08	1.32E-07	H2O	2.50E+01		Cd-113m	5.08E-07	1.40E-06
Cl-	1.55E-03	1.71E-02	Canisters total	1		In-115	1.54E-17	4.24E-17
Cr+3	8.98E-04	9.90E-03	Drums/day		56	Sn-121m	1.02E-08	2.82E-08
Co+2	1.02E-03	1.12E-02	Radiological Comp.	Ci/kg	Ci/kg	Sn-126	6.29E-08	1.73E-07
Cu+2	2.52E-05	2.77E-04	Ra-226	1.25E-12	3.45E-12	Sb-125	1.98E-06	5.44E-06
Eu+3	2.88E-07	3.17E-06	Ac-227	5.90E-12	1.63E-11	Sb-126	8.80E-09	2.42E-08
F-	2.74E-03	3.02E-02	Th-228	4.90E-10	1.35E-09	Te-123	5.86E-20	1.62E-19
Gd+3	9.78E-05	1.08E-03	Th-230	1.26E-10	3.47E-10	Te-125m	4.82E-07	1.33E-06
Ge+4	2.39E-09	2.64E-08	Th-232	1.08E-16	2.99E-16	I-129	7.96E-09	2.19E-08
In+3	6.30E-07	6.94E-06	Pa-231	1.37E-11	3.77E-11	Cs-134	2.70E-09	7.45E-09
I-	1.20E-06	1.33E-05	Pa-233	4.49E-07	1.24E-06	Cs-135	1.32E-10	3.62E-10
Fe+3	1.42E-03	1.57E-02	U-232	3.04E-10	8.38E-10	Cs-137	4.50E-06	1.24E-05
La+3	4.78E-06	5.27E-05	U-233	1.22E-11	3.37E-11	Ba-137m	4.25E-06	1.17E-05
Pb+2	5.43E-04	5.98E-03	U-234	2.14E-07	5.90E-07	La-138	2.92E-17	8.05E-17
Li+	9.87E-06	1.09E-04	U-235	1.07E-08	2.94E-08	Ce-142	4.57E-12	1.26E-11
Mg+2	1.80E-03	1.98E-02	U-236	9.76E-09	2.69E-08	Ce-144	9.59E-08	2.64E-07
Mn+4	5.01E-03	5.52E-02	U-237	9.85E-10	2.71E-09	Nd-144	2.46E-16	6.78E-16
Hg+2	1.68E-03	1.86E-02	U-238	4.34E-09	1.20E-08	Pm-146	7.79E-09	2.14E-08
Mo+6	8.97E-05	9.89E-04	Np-236	4.90E-13	1.35E-12	Pm-147	2.61E-05	7.18E-05
Nd+3	1.60E-05	1.76E-04	Np-237	1.31E-07	3.62E-07	Sm-146	4.22E-14	1.16E-13
Np+4	4.65E-06	5.13E-05	Pu-236	4.49E-10	1.24E-09	Sm-147	1.13E-12	3.10E-12
Ni+2	2.03E-04	2.23E-03	Pu-238	8.58E-05	2.36E-04	Sm-148	5.79E-18	1.60E-17
Nb+5	3.18E-06	3.51E-05	Pu-239	1.08E-05	2.98E-05	Sm-149	5.14E-19	1.42E-18
NO3-	1.90E+00	2.10E+01	Pu-240	1.66E-06	4.57E-06	Sm-151	5.14E-05	1.41E-04
Pd+4	4.73E-05	5.22E-04	Pu-241	5.20E-05	1.43E-04	Eu-152	3.85E-07	1.06E-06
PO4-3	6.22E-04	6.86E-03	Pu-242	1.30E-09	3.57E-09	Eu-154	1.37E-05	3.78E-05
Pu+4	4.68E-06	5.13E-05	Pu-244	6.83E-17	1.88E-16	Eu-155	1.38E-05	3.79E-05
K+	1.17E-01	1.28E+00	Am-241	1.09E-05	3.00E-05	Gd-152	2.18E-19	5.99E-19
Pr+4	4.41E-06	4.86E-05	Am-242m	2.36E-09	6.50E-09	Ho-166m	7.04E-12	1.94E-11
Rh+4	1.39E-06	1.53E-05	Am-243	3.32E-09	9.16E-09	Co-60	2.44E-06	6.72E-06
			Cm-242	4.42E-09	1.22E-08	Ni-63	5.28E-06	1.46E-05

Table B-12. NGLW mass balance (continued).

PFD Sheet #	PFD-2	PFD-2	PFD-2	PFD-3	PFD-3
Stream #	210	211	212	213	220
Stream Name	Solids Flocculent	Steam to Fundabac Filter	Filter Condensate	Nitric Acid	50% Caustic
Rate, gal/hr	0.3	0.8	4.6	TBD	14.9
Rate, lb/hr	4	6	38		187
Rate, peak, gpm	10	0	1		10
Operation	Batch	Batch	Batch		Batch
Temperature, °F	75	328	114	0	70
Pressure, psia	12.8	112.8	12.8	0.0	12.8
Specific Gravity	1.51	1.00	1.00	0.00	1.51
Stream Composition	Wt %	Wt %	Wt %	Wt %	Wt %
50% NaOH	100%				100%
HNO3				100%	
Steam		100%			
Water			100%		
CST					
Portland cement					
Ca(OH)2					
Blast furnace slag					

PFD Sheet #	PFD-3	PFD-4	PFD-4	PFD-4	PFD-4
Stream #	221	222	223	224	225
Stream Name	Fresh IX Media	Portland Cement	Calcium Hydroxide	Blast Furnace Slag	Solid Blend
Rate, gal/hr	0.12	17.94	26.17	8.97	44.11
Rate, lb/hr	0.93	179	105	90	374
Rate, peak, gpm	NA	TBD	TBD	TBD	0.74
Operation	Batch	Cont	Cont	Cont	Cont
Temperature, °F	70	70	70	70	70
Pressure, psia	12.8	12.8	12.8	12.8	12.8
Specific Gravity	0.96	1.20	0.48	1.20	1.02
	Wt %	Wt %	Wt %	Wt %	Wt %
Chemical Composition					
NaOH					
H2O					
CST	100%				
Portland cement		100%			
Ca(OH)2			100%		
Blast furnace slag				100%	
No. Replacement col's	1				

Dose rates and heat generation rates have not been calculated for waste compositions shown in the present mass balances. However, the grout dose rate is expected to be very similar to that calculated in 2003 (Durante, 2003). Based on a previous mass balance, Durante and Kimmitt estimated surface dose rates of 11-21 mR/hr for grout from WM-180 waste and 74-84 mR/hr for grout from WM-188 waste, based on decay to 2010. Durante concluded that one-third of the waste drums from the CsIX process would have a surface dose rate less than 50 mR/hr and two-thirds between 50 and 100 MR/hr if shipped in the 2010-2012 time period (Durante, 2003). The estimated heat generation rate for the grouted waste is 0.04 Watts (Bohn, 2002). Table B-13 shows properties for the CH grout product, including activities and masses of major radionuclides per drum, the fissile gram equivalent, ^{239}Pu equivalent activity, and TRU content.

Shielding calculations for the spent ion exchange media waste were performed in 2003 (Kimmitt, 2003b). The canister surface with 0.5-inch of steel shielding would have a surface dose rate of 758 R/hr, and a normal cask with 0.5-inch of steel shielding would have a 1-meter dose of 5.8 mR/hr (Kimmitt, 2003b). Properties of the spent ion exchange media are shown in Table B-14.

The estimated average surface dose rate for the waste solids canisters in 2010 is 86 R/hr and heat generation rate 3.2 Watts/canister (Bohn, 2002). Table B-15 shows properties for the tank solids waste product. Properties are very similar for the different TFF tanks because a high percentage of the solids are from a single tank, WM-187, and the solids are assumed homogeneous in this tank.

Table B-16 shows the estimated chemicals and materials consumption.

Table B-13. Grouted Waste Properties

Major Radionuclides	WM-180 (Ci/drum)	WM-188 (Ci/drum)	WM-189 (Ci/drum)	NGLW (Ci/drum)
Am-241	1.16E-02	8.12E-03	1.05E-02	9.01E-03
Pu-238	9.34E-02	7.72E-02	6.69E-02	7.09E-02
Pu-239	1.35E-02	9.16E-03	7.57E-03	8.94E-03
Pu-240	9.03E-04	1.85E-03	1.71E-03	1.37E-03
Pu-242	7.05E-07	1.44E-06	1.34E-06	1.07E-06
U-233	2.84E-07	5.82E-07	4.54E-07	4.05E-07
U-234	7.29E-08	1.49E-07	1.17E-07	1.04E-07
U-238	3.87E-06	1.94E-06	6.11E-06	3.59E-06
Sr-90	3.46E+00	6.87E+00	5.53E+00	4.87E+00
Cs-137	4.31E-03	1.07E-03	7.01E-03	3.72E-03
Y-90	3.46E+00	6.87E+00	5.53E+00	4.87E+00
Ba-137	4.08E-03	1.01E-03	6.63E-03	3.51E-03
Total of above 12	7.04E+00	1.38E+01	1.12E+01	9.83E+00
Total of all nuclides	7.15E+00	1.40E+01	1.14E+01	9.97E+00
Fraction	9.86E-01	9.88E-01	9.82E-01	9.86E-01
	g/drum	**g/drum**	**g/drum**	**g/drum**
Am-241	3.38E-03	2.37E-03	3.05E-03	2.63E-03
Pu-238	5.46E-03	4.51E-03	3.91E-03	4.14E-03
Pu-239	2.17E-01	1.47E-01	1.22E-01	1.44E-01
Pu-240	3.96E-03	8.10E-03	7.52E-03	6.02E-03
Pu-242	1.85E-04	3.78E-04	3.50E-04	2.80E-04
U-233	2.93E-05	6.01E-05	4.69E-05	4.18E-05
U-234	1.17E-05	2.39E-05	1.87E-05	1.66E-05
U-238	1.15E+01	5.76E+00	1.82E+01	1.07E+01
Sr-90	2.54E-02	5.04E-02	4.06E-02	3.57E-02
Cs-137	4.96E-05	1.23E-05	8.06E-05	4.27E-05
Y-90	6.36E-06	1.26E-05	1.02E-05	8.94E-06
Ba-137	7.58E-12	1.88E-12	1.23E-11	6.53E-12
Fissile Gram Equivalent (FGE), g/drum				
Total FGE	3.3	6.4	4.1	4.2
Pu-239 Equivalent Curies (PE-Ci), Ci/drum				
PE Ci	1.1E-01	9.0E-02	8.2E-02	8.5E-02
TRU nCi/g	399	321	289	301

Table B-14. Spent Ion Exchange Media Properties

Major Radionuclides	WM-180 (Ci/column)	WM-188 (Ci/column)	WM-189 (Ci/column)	NGLW (Ci/column)
Am-241	3.95E-03	2.95E-03	3.83E-03	3.32E-03
Pu-238	3.19E-02	2.80E-02	2.45E-02	2.61E-02
Pu-239	4.59E-03	3.32E-03	2.77E-03	3.29E-03
Pu-240	3.08E-04	6.70E-04	6.28E-04	5.05E-04
Pu-242	2.40E-07	5.23E-07	4.90E-07	3.95E-07
U-233	9.68E-08	2.11E-07	1.66E-07	1.49E-07
U-234	2.49E-08	5.42E-08	4.27E-08	3.83E-08
U-238	1.32E-06	7.03E-07	2.24E-06	1.32E-06
Sr-90	1.18E+00	2.49E+00	2.03E+00	1.79E+00
Cs-137	6.10E+03	5.24E+02	4.43E+03	6.24E+03
Y-90	1.18E+00	2.49E+00	2.03E+00	1.79E+00
Ba-137	5.77E+03	4.96E+02	4.19E+03	5.91E+03
Total of above 12	1.19E+04	1.02E+03	8.62E+03	1.22E+04
Total of all nuclides	1.19E+04	1.03E+03	8.62E+03	1.22E+04
Fraction	1.000	1.000	1.000	1.000
	g/column	**g/column**	**g/column**	**g/column**
Am-241	1.15E-03	8.59E-04	1.12E-03	9.68E-04
Pu-238	1.86E-03	1.64E-03	1.43E-03	1.53E-03
Pu-239	7.39E-02	5.35E-02	4.46E-02	5.30E-02
Pu-240	1.35E-03	2.94E-03	2.76E-03	2.22E-03
Pu-242	6.30E-05	1.37E-04	1.28E-04	1.03E-04
U-233	1.00E-05	2.18E-05	1.72E-05	1.54E-05
U-234	3.98E-06	8.68E-06	6.83E-06	6.13E-06
U-238	3.93E+00	2.09E+00	6.65E+00	3.93E+00
Sr-90	8.65E-03	1.83E-02	1.49E-02	1.31E-02
Cs-137	7.01E+01	6.03E+00	5.09E+01	7.18E+01
Y-90	2.17E-06	4.58E-06	3.72E-06	3.29E-06
Ba-137	1.07E-05	9.22E-07	7.79E-06	1.10E-05
Fissile Gram Equivalent (FGE), g/column				
Total FGE	1.1	2.3	1.5	1.6
Pu-239 Equivalent Curies (PE-Ci), Ci/column				
PE Ci	3.8E-02	3.3E-02	3.0E-02	3.1E-02
TRU content, nCi/g	135	115	104	109

Table B-15. Dried Tank Solids Properties.

Major Radionuclides	WM-180 (Ci/column)	WM-188 (Ci/column)	WM-189 (Ci/column)	NGLW (Ci/column)
Am-241	1.28E-01	1.28E-01	1.28E-01	1.28E-01
Pu-238	4.89E+00	4.91E+00	4.89E+00	4.89E+00
Pu-239	5.20E-01	5.22E-01	5.20E-01	5.21E-01
Pu-240	3.51E-02	3.52E-02	3.51E-02	3.52E-02
Pu-242	2.65E-05	2.66E-05	2.65E-05	2.66E-05
U-233	9.11E-08	9.17E-08	9.11E-08	9.20E-08
U-234	1.55E-03	1.56E-03	1.55E-03	1.57E-03
U-238	6.37E-06	6.39E-06	6.38E-06	6.67E-06
Sr-90	3.20E+00	3.30E+00	3.20E+00	3.63E+00
Cs-137	1.50E+02	1.51E+02	1.50E+02	1.51E+02
Y-90	3.20E+00	3.30E+00	3.20E+00	3.63E+00
Ba-137	1.42E+02	1.43E+02	1.42E+02	1.43E+02
Total of above 12	3.05E+02	3.06E+02	3.05E+02	3.06E+02
Total of all nuclides	3.16E+02	3.17E+02	3.16E+02	3.17E+02
Fraction	0.964	0.964	0.964	0.964
	g/column	**g/column**	**g/column**	**g/column**
Am-241	3.72E-02	3.74E-02	3.72E-02	3.74E-02
Pu-238	2.86E-01	2.87E-01	2.86E-01	2.86E-01
Pu-239	8.37E+00	8.40E+00	8.37E+00	8.38E+00
Pu-240	1.54E-01	1.55E-01	1.54E-01	1.54E-01
Pu-242	6.93E-03	6.97E-03	6.93E-03	6.96E-03
U-233	9.41E-06	9.47E-06	9.42E-06	9.51E-06
U-234	2.48E-01	2.50E-01	2.48E-01	2.51E-01
U-238	1.89E+01	1.90E+01	1.90E+01	1.99E+01
Sr-90	2.34E-02	2.42E-02	2.35E-02	2.66E-02
Cs-137	1.73E+00	1.74E+00	1.73E+00	1.73E+00
Y-90	5.87E-06	6.07E-06	5.89E-06	6.67E-06
Ba-137	2.65E-07	2.66E-07	2.65E-07	2.65E-07
Fissile Gram Equivalent (FGE), g/column				
Total FGE	47.3	47.6	47.3	47.7
Pu-239 Equivalent Curies (PE-Ci), Ci/column				
PE Ci	5.2E+00	5.2E+00	5.2E+00	5.2E+00
TRU content, nCi/g	1.02E+04	1.03E+04	1.02E+04	1.03E+04

Table B-16. Chemicals and materials consumption.

	WM-180	WM-188	WM-189	NGLW	Total
50% NaOH, gallons	12,900	38,600	38,500	22,400	112,400
CST, gallons	420	720	720	180	2,040
Portland cement, lb	530,000	624,000	618,000	93,000	1,865,000
BFS, lb	265,000	312,000	309,000	47,000	933,000
Calcium Hydroxide, lb	309,000	364,000	360,000	54,000	1,087,000

B-7. UTILITIES USAGE

The CsIX TRU grout process requires steam, cooling water and electricity. Process equipment that uses electricity includes various pumps, the vent gas heater and the vent gas blower. All of these services are small. In the CsIX TRU Grout treatment facility, the only cooling water services are two intermittent users, the SBW Feed Tank cooling jacket[b] and the Solids Drying Steam Condenser. The SBW Feed Tank cooling jacket (or coil) will use cooling water at a rate of 50 gpm and have a duty of 590,000 Btu/hr. The Solids Drying Steam Condenser will use about cooling water at a rate of 27 gpm and have a duty of 370,000 Bu/hr.

Steam is also used only intermittently in the new treatment facility. An estimated rate of 400 lb/hr of low-pressure steam will be required to dry the solids filter cake on the Fundabac filters prior to discharge into waste canisters. Steam would also be used to jet waste water to the ETS, at an estimated peak rate of 200 lb/hr.

Other steam uses are existing equipment at INTEC, including the jets would that transfer SBW to the CsIX TRU grout facility and reboilers for the EVS, PEWE and LET&D fractionator. All of these services are intermittent. Estimated steam rates for these services when operated are shown in Table B-17.

Table B-17. Estimated Steam Rates.

Steam Services	Lb/hr
Steam to jet liquid SBW to treatment facility:	35
Steam to jet tank heel slurry to treatment facility	27
ETS reboiler steam	2900
PEWE reboiler steam	1400
LET&D reboiler steam	6000.

Condenser duties for the ETS, PEWE and LET&D reboiler are estimated to be 3.7 million, 1.7 million and 2.6 million Btu/hr respectively, corresponding to cooling water rates of 270, 120 and 190 gpm.

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[b] Coiling coils could be used rather than a cooling jacket to provide more heat transfer area

B-8. EQUIPMENT LIST AND SCALE DISCUSSION

The equipment list is shown in Table B-18, based on a 2.5-yr operating schedule.

Table B-18. Equipment list.

Tanks					
Tank	Size (gal)	Diameter (ft)	Height (ft) Note 1	Material	Function/Features
VES-101 1& 2 – SBW Receiving Tank	4000	8.4	14.5	304L	Receiver Tank (2). Receive liquid waste from TFF tank and adjust acid with NaOH. Dish top and bottom, jet mixer on pump discharge, instrument wells, vent outlet, bottom pump suction, ports. Water-cooling coils or jacket required for removing heat of neutralization. Located on ground level.
VES-102 – Crossflow Filter Feed Tank	500	4.2	8.3	304L	Cross-Flow Filter Feed/Surge Tank. Dish bottom, instrument wells, bottom feed outlet, vent, cooling water jacket, jet well. Inlets for feed and recirculation. Located on ground level.
VES-103 – Filtrate Receiver Tank	4000	8.4	14.5	304L	Surge for crossflow permeate. Dish top and bottom, instrument wells, vent outlet, bottom drain/pump suction. Located on ground level.
VES-104-1,2,3,4 – IX Effluent Tank	2500	7.0	13.0	304L	Surge for ion exchange effluent. Dish top and bottom, instrument wells, vent outlet, bottom drain/pump suction. Located on ground level. Multiple tanks to allow for sampling and analysis for ^{137}Cs.
VES-105 – NaOH Feed Tank	1780	6.4	11.6	304L	Caustic feed for VES-101. Instrument wells, inlet port, bottom outlet, vent. Located on 2nd floor
VES-106 1&2 – Solids Tank	4000	8.5	15.1	304L	Batch Settling Tank (2). 30° cone bottom, sludge level detector, instrument wells, cone bottom pump outlet, side penetrations for decantate withdraw. Located on ground level.
VES-107 – Decant Surge Tank	250	3.3	7.0	304L	VES-106 decant surge tank. Instrument wells, inlet port, jet port top outlet, vent. Located on ground level
VES-109 – New Column Flush Tank	200	3.1	6.6	CS	Collect flush water from new IX column flushing. Dome bottom/top, instrument wells, bottom pump outlet, vent. Located on 2nd floor.
VES-110 – Flush Water Receiver/Feed Tank	250	3.3	7.0	304L	Grout Mixer Flush Receiver. Receives flush liquid from flushing mixer M-101 with liquid from VES-104 and feeds back into mixer. Located on ground level in grout area.
VES-111 – Waste Water Tank	4000	8.4	14.5	304L	Receive Fundabac filtrate and clarifier decantate. Dish bottom, instrument wells, vent, bottom drain/pump suction. Located on ground level.
VES-112 – Filter Aid Tank	200	3	7	CS	Tank for adding chemicals and operations for flocculent or filter aides, Fundabac filter. May not be required. Located on 2nd floor.
VES-113 – Process Water Tank	200	3	7	CS	Tank for adding chemicals and operations for flocculent or filter aides, Fundabac filter. May not be required. Located on 2nd floor.
VES-114 – Nitric Acid Tank	200	3	7	304L	Tank for adding nitric acid to adjust pH for the ETS Evaporator. May not be required. Located on 2nd floor.
VES-116 – Vent Demister	~5	1	2	304L	Pre-HEPA mist eliminator. Standard industrial demister, 0.7 ft^2 flow area minimum.
HOP-101 – Portland Cement Hopper	3000	7.8	13.9	CS	Portland Cement Feed Hopper. Cone bottom, 30°, instrument wells, vent, bottom feed system. Locate on 2nd floor above grout mixer MIX-103/104. Has Acrison 105z supply hopper and 407-105 weigh feeder.
HOP-102 – $Ca(OH)_2$ Hopper	4500	8.9	15.7	CS	Lime Hopper. Cone bottom, 30°, instrument wells, vent, bottom feed system. Locate on 2nd floor above grout mixer MIX-103/104. Has Acrison 105z supply hopper and 407-105 weigh feeder.
HOP-103 – Blast Furnace Slag Hopper	1500	6.2	11.5	CS	Blast Furnace Slag. Cone bottom, 30°, instrument wells, vent, bottom feed screw auger system. Locate on 2nd floor above grout mixer MIX-103/104. Has Acrison 101-0 supply hopper and 407-101-0 weigh feeder.

Note 1: Height is overall, including legs, barrel, and top

Table B-18. Equipment list (continued)

Other Equipment

Filters

Part	Filter Area (ft2)	Skid Height, ft	Skid Footprint, ft x ft	Function/Features
F-101-1&2 – SBW Filter	21	TBD	2x12	Cross-flow Filtration (2). Remove particles from feed to ion exchange. 6-in. diameter x 120-in. Located on ground level.
F-102-1&2 – Solids Filter	32	8	5x10	Fundabac Type Filter (2). Removes particles from WM-187 settled solids from the underflow of VES-106. Located on ground level above canister loading.
F-104-1&2 – HEPA Filter	50 SCFM, 5.5 in by 5.5 in or larger			Two 3-filter standard banks in parallel

Ion Exchange Columns

Part	Size (ft3)	Diameter, ft	Height (ft)	Function/Features
VES-108-x – Cs Ion Exchange Columns	15.4	1.5	8.7	Cs ion exchange (Note 2). Top inlet, bottom outlet. CST sorbent. Wells on top and bottom for air and water. Instrument wells. Located on ground level

Pumps

Part	Flow, gpm	Sp.G	Wt% Solids	Function/Features
P-101-1&2 – SBW Pump	15	1.3	0.5	Pump acid-adjusted feed to cross-flow filter feed tank (2). Ground level.
P-102-1&2 – Neutralized SBW Pump	130	1.3	2.15	Crossflow filter feed (2). Ground level.
P-103a 1&2 – Crossflow Backwash Pump	TBD	1.3	0	Crossflow back wash (2). Ground level.
P-103b 1&2 – Ion Exchange Feed Pump	1.58	1.3	0	Ion Exchange Feed (2) Ground level.
P-104 1&2 – IX Effluent Pump	1.58	1.3	0	Grout process feed (2) Ground level.
P-105-1&2 – NaOH Feed Pump	50	1.5	0	NaOH liquid feed pump (2). 2nd Floor.
P-106-1&2 – Tank Solids Slurry Pump	10	1.13	20	Fundabac slurry feed (2) Ground level.
P-109 – IX Media Wash Effluent Pump	10	1.0	0.01	IX Flush collection to service waste header. 2nd Floor.
P-110-1&2 – Grout Mixer Flush Pump	10	1.3	0	MIX-104 flush pump (2) Ground level.
P-112 – Filter Aid Slurry Pump	TBD	TBD	TBD	Pumps for chemical additive, filters. 2nd Floor.
P-113 – Process Water Pump	TBD	TBD	TBD	Pumps for chemical additive, filters. 2nd Floor.
P-114 – pH Adjustment Pump	TBD	TBD	TBD	Pumps for pH adjustment. 2nd Floor.

Note 2: 4 columns installed at any one time. 24 total required

Table B-18. Equipment list (continued)

				Mixers
Part	**Width (in)**	**Length (in)**	**Height (in)**	**Function/Features**
MIX-103 – Ribbon Mixer	22	58	18	Mixer. Blends 3 grout solid ingredients. Located on 2nd floor below HOP-102. Acrison M350. Has Acrison 105z supply hopper and 407-105 weigh feeder.
MIX-104 – Autocon Mixer	20	48	48	Mixer. Mixes solid grout formulation with liquid effluent and feeds to drums. Located on ground level below HOP-104. Autocon specified, no substitutions. 2nd floor.
				Feeders
Feed-101 – Portland Cement Feeder	31	50	32	Volumetric feeder, Acrison 105z. Feeds Portland cement. 2nd Floor.
Feed-102 – Lime Feeder	31	50	32	Volumetric feeder, Acrison 105z. Feeds lime. 2nd Floor.
Feed-103 – Blast Furnace Slag Feeder	24	32	30	Volumetric feeder, Acrison 101-0. Feeds blast furnace slag. 2nd Floor.
Feed-104 – Mixed Blend Feeder	24	32	30	Volumetric feeder, Acrison 105z. Feeds grout blend. 2nd Floor.
Weigh Feeders for Feed-101,-102,-104	23	43	34.5	Weigh feeders (3), Acrison 407-105, goes with 105z. Feeds cement, lime, and blend. 2nd Floor.
Weigh Feeders for Feed-103	25	40	48	Weigh feeder, Acrison 407-101-0. Goes with 101-0. Feeds slag. 2nd Floor.
				Jets
JET	**Flow (gpm)**	**Lift (ft)**	**Pressure (psi)**	**Function/Features**
JET-101 – Filter Drain Jet	<1	N/A	25	Provides motive force for draining Fundabac filter prior to solids drying.
JET-MIX-101 – Jet Mixer	12	N/A	N/A	Jet mixer on discharge of P-101. Decreases mix time in neutralization of VES-101.
JET-102 – Solids Slurry Jet	5	10	100	Jet pump for removing slurry from VES-102. 1 1/2 inch with control orifice to control flow and keep solids concentration in VES-102 relatively constant.
JET-107 – Decant Water Jet	50	5	100	1 1/2 inch Jet pump for transferring decant from VES-106 to VES-111.
JET-111 – Waste Water Jet	50	15	100	2 1/2 inch Jet pump for transferring VES-111 to high level waste evaporator.
				Other Equipment
BLO-101-1&2 – Vent Gas Blower	50 scfm	12 in. water vacuum		Vessel ventilation blower (2)
HE-101 – Solids Drying Steam Condenser	18 kg/hr	50,000 Btu/hr		Water cooled shell and tube heat exchanger, condensing steam in tubes. Peak steam rate 10 kg/hr
HTR-102	50 scfm	0.3 kW		HEPA filter pre-heater. Electric.

The CsIX TRU Grout Facility includes waste loading and canister handling operations in the lower level; hot cell process equipment for both liquid and solids processing on the ground floor and cold activities on the second floor. The control room, offices, a decontamination room, a manipulator repair room and other support activities are also located on the ground floor. Changing the scale of the process, i.e., designing for a shorter treatment schedule, would primarily affect two areas of the facility – the process hot cell and the grouting operation floor space. Minimal effects are expected in the basement with waste packaging and canister handling and canister storage, although this conclusion will need to be confirmed in conceptual design.

Equipment in the process hot cell includes the ion exchange columns, seven tanks and both the crossflow and Fundabac filters. A maximum of about a 40% increase in capacity of the ion exchange columns could be achieved without exceeding the column dimension that would fit a RH 2-ft by 10-ft canister. Thus reducing the operating schedule up to about 1.8 years would have no effect on the ion exchange columns, reducing the schedule further would mean more frequent change-out of columns.

Keeping all other factors equal, decreasing the processing schedule would increase the floor space required for process tanks by the ratio of the decrease to the two-thirds power. For example if the schedule was decreased from 2.5 years to 1 year, the floor space would increase by $(2.5/1)^{0.667} = 1.84$ or an 84% increase. Approximately the same increase in space requirements could be expected for the filters, although a trade off study would be needed to better evaluate whether to increase the filter size or install multiple smaller filters.

For the 2.5-year operating schedule, 24,000 drums of grout are produced, equivalent to an average of two drums per hour. If in-drum mixing were used, multiple grouting lines would be required. The FY 2000 feasibility study for the CsIX TRU grout process (Raytheon, 2000) included three grouting lines. However, by using an out-of-drum mixer, a single line could meet the production rate in 2.5 years or a shorter schedule as well. The area required for grouting equipment would increase by the ratio of the schedule decrease to the two-thirds power. However, the area required for storage of grouted waste drums depends only on the lag storage requirement. The lag storage in turn depends of the rate at which WIPP can receive shipments and the initial lag between start of production and sending the first shipment. The expected shipping rate of CH grout to WIPP is 17 shipments (357 drums) per week for 71 weeks for the 2.5-year operating schedule (DOE-ID, 2003). If the treatment schedule is shortened, it is likely WIPP could receive additional shipments per week. Thus, additional storage is not requiring because of shipping rate limitations. Also, the initial lag time for sending shipments to WIPP could likely be shortened for a shorter schedule, resulting in no dependency of drum storage area on processing schedule.

Insufficient design work has been performed on the RH packaging systems for the CsIX process to evaluate the effect of reducing schedule on basement floor space. The number of ion exchange columns would decrease for a shorter schedule because each would hold more ion media, hence it is unlikely there would be any significant change in floor space for spent ion exchange column packaging. For the same 1-year processing schedule, the rate of production of solids canisters would increase from one per 43 hours to one per 17 hours. Whether this higher rate would require multiple packaging lines has yet to be determined.

Finally, the interim storage for packaged waste is dependent on the initial lag period between producing the first container of waste and having approval to ship that container to WIPP, and also on the rate at which WIPP can accept waste. While the process will generate, for a 2.5 year schedule, an average of 800 drums of grout and 9 canisters of solids per month, it will take about 3-months to generate the second spent IX column. Perhaps this period could be shortened by starting up on waste with the highest cesium content. However, it is not certain how long a production WIPP would require before qualifying the spent ion exchange media waste canisters. The area shown below is based on a production of two spent ion exchange columns.

Based on discussion with WIPP, it is expected that the disposal facility can receive at least 6 RH canisters per week from the INEEL, or about 300 per year. The total number of RH canisters generated for a 2.5-year production schedule is 302, while for a shorter schedule would be less than 302. HENCE, WIPP could receive waste without any increase in storage at the INEEL for any treatment schedule of a year or longer. A summary of plot space estimates is given in Table B-19.

Table B-19. Plot Space Estimates.

	2.5-year treatment schedule	**1-year treatment schedule**
Process equipment (Process cell and pump and valve corridor, no change assumed in P&V corridor)	2,000 ft^2	3,400 ft^2
Grouting equipment and drum storage	13,000 ft^2	21,000 ft^2
Waste packaging & canister handling (assumes no change, to be verified in conceptual design)	5,800 ft^2	5,800 ft^2
Lag storage for RH canisters (to be verified in conceptual design)	800 ft^2	800 ft^2

B-9. LAYOUT DRAWINGS

Layout drawings for each floor of the CsIX TRU Grout Treatment Facility are shown on the following pages. The primary purpose of these drawings is to estimate floor space requirements needed in the facility. Equipment and room arrangements have not been optimized, nor has sufficient engineering design been performed to provide a basis for all of the areas of the facility. The layout drawings were based on those prepared for the Direct Evaporation Feasibility Study (Kimmitt, 2003f) and the Raytheon CsIX TRU Grout feasibility study (Raytheon, 2000).

The basement shows significantly more space for canister storage than is estimated to be required for lag storage. The storage space shown is based on provided structural integrity, that is, the storage area walls are a lower extension of the ground floor hot cell walls.

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REVISIONS

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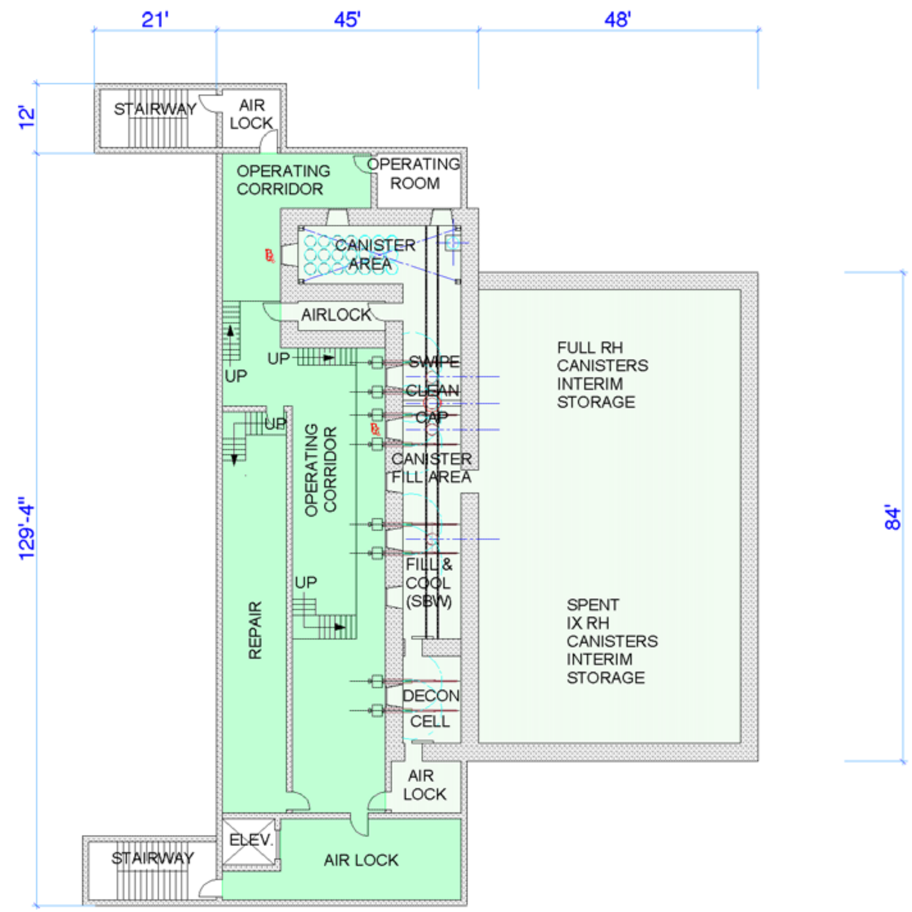


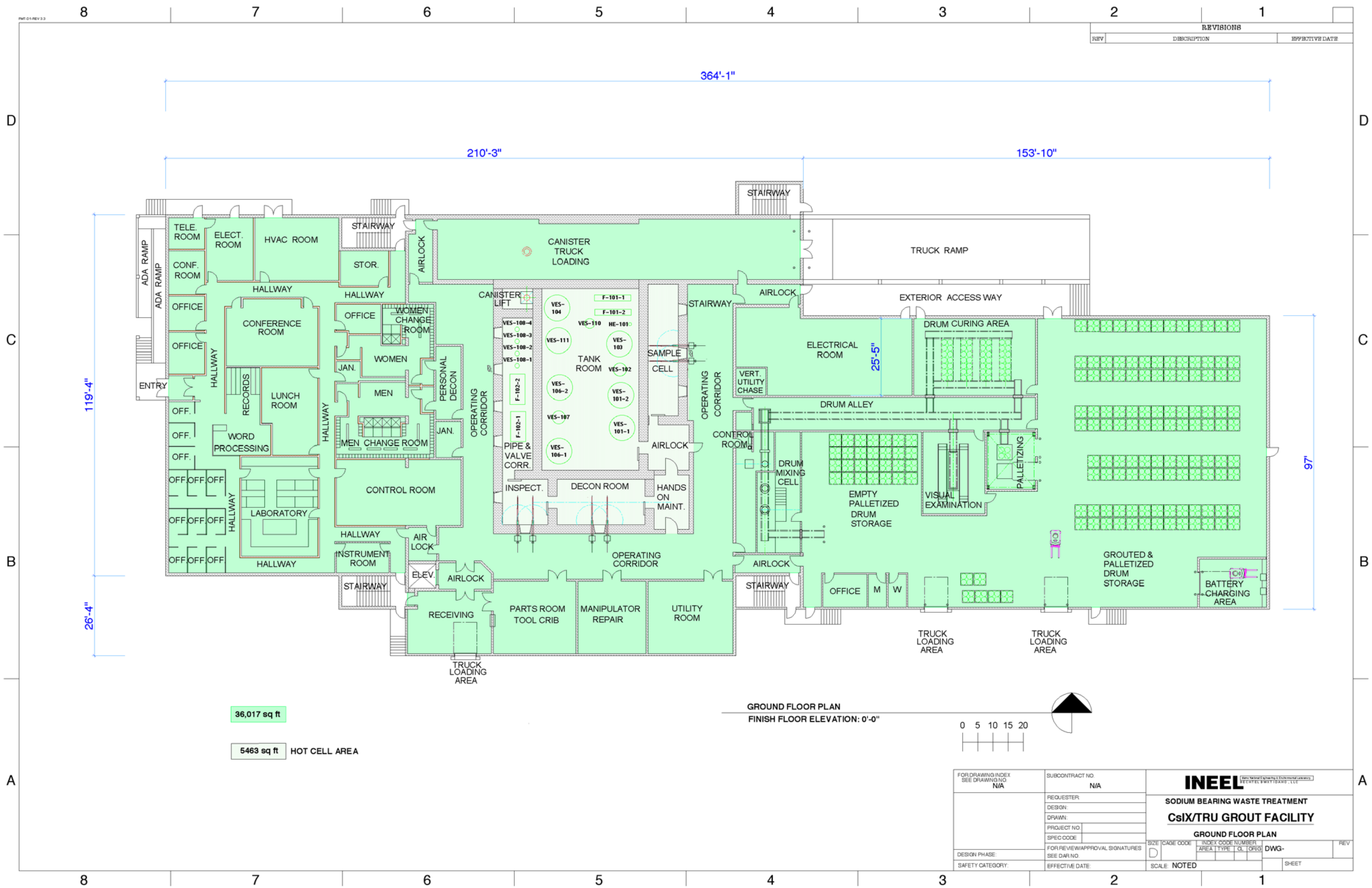
3225 sq ft

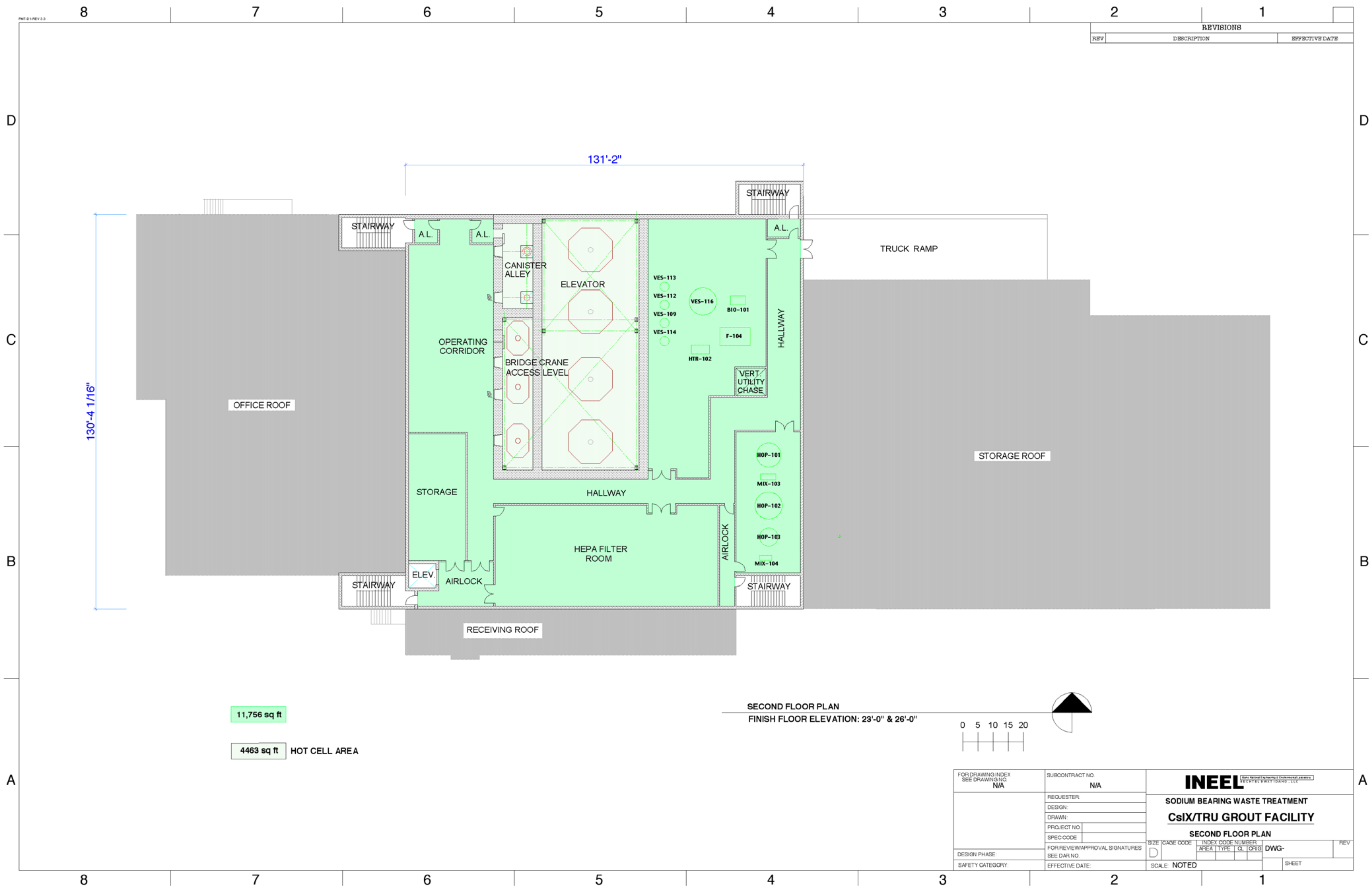
6122 sq ft HOT CELL AREA

BASEMENT FLOOR PLAN
FINISH FLOOR ELEVATION: -30'-0" & -37'-0"

0 5 10 15 20

FOR DRAWING INDEX SEE DRAWING NO. N/A	SUBCONTRACT NO. N/A	**INEEL** Idaho National Engineering & Environmental Laboratory BECHTEL BWXT IDAHO, LLC
	REQUESTER:	**SODIUM BEARING WASTE TREATMENT**
	DESIGN:	**CsIX/TRU GROUT FACILITY**
	DRAWN:	**BASEMENT FLOOR PLAN**
	PROJECT NO.	
	SPEC CODE	
DESIGN PHASE:	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D · CAGE CODE · INDEX CODE NUMBER (AREA, TYPE, CL, ORIG) · DWG- · REV
SAFETY CATEGORY:	EFFECTIVE DATE:	SCALE: NOTED · SHEET


364'-1"
210'-3"
153'-10"
119'-4"
26'-4"
25'-5"
97'
TELE. ROOM
ELECT. ROOM
HVAC ROOM
STAIRWAY
STOR.
AIRLOCK
CANISTER TRUCK LOADING
STAIRWAY
TRUCK RAMP
CONF. ROOM
ADA RAMP
ADA RAMP
HALLWAY
HALLWAY
OFFICE
CONFERENCE ROOM
OFFICE
WOMEN CHANGE ROOM
CANISTER LIFT
TANK ROOM
SAMPLE CELL
STAIRWAY
AIRLOCK
EXTERIOR ACCESS WAY
DRUM CURING AREA
ELECTRICAL ROOM
OFFICE
WOMEN
JAN.
MEN
PERSONAL DECON
OPERATING CORRIDOR
OPERATING CORRIDOR
VERT. UTILITY CHASE
ENTRY
RECORDS
LUNCH ROOM
HALLWAY
DRUM ALLEY
OFF.
OFF.
OFF.
WORD PROCESSING
MEN CHANGE ROOM
JAN.
PIPE & VALVE CORR.
AIRLOCK
CONTROL ROOM
DRUM MIXING CELL
PALLETIZING
VISUAL EXAMINATION
EMPTY PALLETIZED DRUM STORAGE
CONTROL ROOM
INSPECT.
DECON ROOM
HANDS ON MAINT.
OFF OFF OFF
LABORATORY
OFF OFF OFF
OFF OFF OFF
HALLWAY
HALLWAY
HALLWAY
AIR LOCK
INSTRUMENT ROOM
OPERATING CORRIDOR
AIRLOCK
GROUTED & PALLETIZED DRUM STORAGE
ELEV.
AIRLOCK
STAIRWAY
STAIRWAY
OFFICE
M
W
BATTERY CHARGING AREA
RECEIVING
PARTS ROOM TOOL CRIB
MANIPULATOR REPAIR
UTILITY ROOM
TRUCK LOADING AREA
TRUCK LOADING AREA
TRUCK LOADING AREA
36,017 sq ft
5463 sq ft
HOT CELL AREA
GROUND FLOOR PLAN
FINISH FLOOR ELEVATION: 0'-0"
0 5 10 15 20
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
FOR DRAWING INDEX SEE DRAWING NO. N/A
SUBCONTRACT NO. N/A
INEEL
SODIUM BEARING WASTE TREATMENT
CsIX/TRU GROUT FACILITY
GROUND FLOOR PLAN
SCALE NOTED
DWG-


REVISIONS
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DESCRIPTION
EFFECTIVE DATE
131'-2"
130'-4 1/16"
STAIRWAY
STAIRWAY
STAIRWAY
STAIRWAY
STAIRWAY
A.L.
A.L.
A.L.
TRUCK RAMP
CANISTER ALLEY
ELEVATOR
VES-113
VES-112
VES-109
VES-114
VES-116
BIO-101
F-104
HTR-102
HALLWAY
OPERATING CORRIDOR
BRIDGE CRANE ACCESS LEVEL
VERT. UTILITY CHASE
OFFICE ROOF
STORAGE ROOF
HOP-101
MIX-103
HOP-102
HOP-103
MIX-104
STORAGE
HALLWAY
HEPA FILTER ROOM
AIRLOCK
ELEV.
AIRLOCK
RECEIVING ROOF
11,756 sq ft
4463 sq ft HOT CELL AREA
SECOND FLOOR PLAN
FINISH FLOOR ELEVATION: 23'-0" & 26'-0"
0 5 10 15 20
FOR DRAWING INDEX SEE DRAWING NO. N/A
SUBCONTRACT NO. N/A
INEEL
SODIUM BEARING WASTE TREATMENT
CsIX/TRU GROUT FACILITY
SECOND FLOOR PLAN
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:
DESIGN PHASE
SAFETY CATEGORY:
SIZE D
CAGE CODE
INDEX CODE NUMBER
DWG-
REV
SCALE: NOTED
SHEET

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