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Appendix A

Appendix A
Steam Reforming Process

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ACRONYMS AND ABBREVIATIONS

CEM	continuous emission monitor
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cf	cubic foot
DBE	design basis element
DOE	Department of Energy
DRE	destruction removal efficiency
dscm	dry standard cubic meter
EDF	Engineering Design File
FGE	fissile gram equivalent
GAC	granulated activated carbon
gph	gallons per hour
HEPA	high efficiency particulate air (filter)
HLW	high-level waste
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LDR	land disposal restrictions
LET&D	Liquid Effluent Treatment and Disposal (Facility)
MACT	Maximum Achievable Control Technology
MLLW	mixed low level waste
NAR	nozzle atomizing air to feed ratio
NGLW	newly generated liquid waste
NO_x	an abbreviation for an unspecified mixture of NO and NO2
NRC	Nuclear Regulatory Commission
NSNFP	National Spent Nuclear Fuel Program
NWCF	New Waste Calcining Facility
PCBs	polychlorinated biphenyl compounds
PE-Ci	^{239}Pu-equivalent curies
PFD	process flow diagram
POHC	principal organic hazardous constituents
ppm	parts per million
RH	remote handled
SBW	sodium-bearing waste
scf	standard cubic foot
SNF	Spent Nuclear Fuel (Program)

TEQ	toxicity equivalent quotient
TFF	Tank Farm Facility
TFRs	Technical and functional requirements
THOR	THermal Organic Reduction
TRU	transuranic
TTT	THOR Treatment Technology
TWR	Thermochem Waste Remediation
μg	microgram
VOCs	volatile organic compounds
WAC	Waste Acceptance Criteria
w.c.	water column
WIPP	Waste Isolation Pilot Plant
wscfh	wet standard cubic feet per hour

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Appendix A
Details of the Steam Reforming Process

A-1. BACKGROUND

Steam reforming is the standard industrial process used to produce hydrogen. Steam reforming processes have long been used to generate hydrogen as a feedstock for ammonia production, for petroleum refining steps, for other chemical processes and to generate synthesis gas. More recent uses of steam reforming have been to generate hydrogen for fuel cells, to generate hydrogen from biomass, to treat paper mill black liquor and to destroy various hazardous wastes. These latter applications have led to its development for the treatment of radioactive waste streams.

In the mid-1990's the Department of Energy (DOE)-funded development and demonstrations of steam reforming of both low-level mixed waste and Hanford tank waste (Miller 1995, Voelker 1996; ThermoChem 1998). ThermoChem Waste Remediation (TWR) designed, built and operated a 90 lb/hr steam reformer test unit at the Portsmouth Gaseous Diffusion Plant that was used to demonstrate treatment of wastes containing polychlorinated biphenyl compounds (PCBs) and other hazardous organics (ThermoChem 1998). The test unit included a 42-inch diameter fluidized bed and a thermal oxidizer to treat off-gas. A diverse set of seven surrogate wastes, from soil to heterogeneous debris to aqueous liquids, were tested during several test periods of up to 20 days (ThermoChem 1998). The test program of the TWR system also included a conceptual design of a full-scale unit.

As early as 1994, steam reforming was proposed and tested for treating Hanford Tank waste (Miller 1995). Testing was performed of the Synthetica steam reforming concept. The Synthetica process first contacts the waste with ceramic spheres in a moving bed evaporator operated at 550^{o}C. Waste is fed at the top of the bed, coats the spheres and as they flow downward water and volatile species evaporate and nitrates decompose. Steam and carbon dioxide flow up through the bed, converting sodium hydroxide to sodium carbonate. Waste particles separate from the spheres as they are recycled from the bottom to the top of the bed. A unit at Lawrence Livermore National Laboratory was used to demonstrate the concept at up to about 14 lbs/hr feed. Results of demonstrate tests were inconsistent in the fraction of nitrates destroyed and the composition of off-gas, although high levels of NO and NO_2 were seen in some tests. More recent tests have been performed to demonstrate the use of steam reforming to process Hanford low activity waste (Jantzen 2002, Jantzen 2003).

The first concept for the use of steam reforming in a sodium-bearing waste (SBW) treatment process was as part of a separation process, in which steam reforming would be used to generate an ash from the low activities waste stream (Marshall 2000). The ash would have then been grouted into a final waste form. A bench-scale fluidized bed was used with a simulant similar to SBW composition, and tests with and without reductants and catalysts were performed (Marshall 2000). While the tests demonstrated the concept of waste denitration, data gaps indicated the need for further testing.

In 2001, steam reforming was considered as an alternative to, or complementary process with vitrification for treatment of SBW. The DOE Idaho Operations Office chartered a Tank Focus Area Review Team to conduct an "in-depth evaluation of the technical feasibility and cost incentives, if any, of steam reforming for treating SBW." The conclusions of the Review Team must be viewed in light of the baseline SBW treatment process of that time, namely vitrification. The conclusions of the Review Team were (Gentilucci 2001):

- Steam reforming of SBW will not generate a waste form qualified for direct disposal in a high-level waste (HLW) repository.

- There are marginal technical incentives for steam reforming of SBW to generate a waste form for direct disposal in the Waste Isolation Pilot Plant (WIPP) as a remote-handled (RH) transuranic (TRU) waste. However, uncertainties related to waste type (HLW or TRU), the status of Resource Conservation and Recovery Act requirements at WIPP, the impacts of long-term storage of the steam-reformed product, and cost of a facility that satisfies safety requirements at Idaho National Engineering and Environmental Laboratory (INEEL) appear to outweigh the technical incentives.

- Steam reforming of SBW to produce a solid feed for subsequent vitrification appears to be a technically viable option if the presence of chemicals added or created during reforming is shown to not adversely impact melter reliability and if there is an incentive for partitioning sulfate to the off-gas stream.

Based on DOE guidance in 2002 to develop SBW treatment processes that would dispose of the final waste products at WIPP, testing of steam reforming was resumed. In 2003, two subcontractors, TWR and Thermal Organic Reduction (THOR)^{sm} Treatment Technologies (TTT), each supplied technical recommendations regarding chemical additives and process conditions for treating the SBW in a fluidized bed configuration. The TTT process is in commercial radioactive operations at the Studsvik Processing Facility in Erwin, Tennessee. Additional TTT demonstrations have been implemented specifically for processing DOE nitrate wastes, including tests for treating Hanford waste surrogates as well as those for the INEEL (THOR 2003, Jantzen 2002). The TWR process is being applied commercially to “black liquor,” a caustic liquid containing resin and lignin hydrocarbons plus sodium carbonate. Two series of tests were performed for each of the two steam reforming processes.

A bench-scale reactor and support facility was provided by the INEEL for each contractor to demonstrate their technology. Surrogate SBW (containing non-radioactive or naturally occurring isotopes in their natural isotopic distributions) was used for the tests and each trial lasted for about 100-hours. Specific details of the tests are available in the referenced reports (Marshall 2003a, Marshall 2003b, Soelberg 2004a, Soelberg, 2004b). The objectives of the tests were to:

- Verify the operability of treating SBW in a fluidized bed reactor without shutdown due to bed agglomeration,

- Characterize the waste product for composition, density, flow characteristics, handling characteristics, etc.,

- Determine the composition of the off-gas after particle filtration,

- Determine the fate of volatile radionuclides such as cesium and technetium,

- Determine the fate and speciation of mercury,

- Determine the concentration of NO_x after the reformer.

Both subcontractors successfully completed 100-hour bench-scale tests. Nitrate was destroyed in the steam reformer, with the level of NO_x in the off-gas ranging from about 1000 ppm (for TWR) to 330 ppm (for TTT). The majority of the solid product was captured from the off-gas as fines. When accumulated, the fines formed a free-flowing powder having a low bulk density. Cesium and rhenium (surrogate for technetium) were retained in the solid product and on the bed material.

Results of the bench-scale tests were used to generate a baseline steam reforming process to provide a basis for evaluating steam reforming against other candidate treatments. Material and energy balances were performed using the test results in conjunction with an ASPEN simulation model. It should be pointed out that the equipment provided for the subcontractors was not optimized for either process – a full-scale facility designed by the TTT or TWR may have equipment different than that proposed herein.

The second series of tests were performed in late 2003. Results from the tests were incorporated into the basis for the mass balances shown in later sections of this report.

A feasibility study for treatment of SBW by steam reforming was prepared in 2002 (Williams 2002). The feasibility study included a process design, facility description and drawings, a project cost estimate, project schedule and list of risks and uncertainties. The estimated total project cost shown in the study was $256 million, at an 85% confidence level. Testing since 2002 (described above) has led to updates in the process design, which are contained in this Appendix, and expansion of the list of uncertainties. However, no update of the facility design has been performed since the 2002 Feasibility Study.

A-2. DETAILED PROCESS DESCRIPTION

A-2.1 SBW Retrieval (PFD-1)

Sodium-bearing waste will be stored in the seven existing tanks shown in process flow diagram (PFD)-1. Tanks VES-WM-180 and VES-WM-189 currently contain waste near their capacity limits, while VES-WM-188 is at about 80% capacity. VES-WM-187 has been used as a collection tank for liquids and solids flushed from other tanks that are being permanently closed. VES-WM-187 will receive the contents from one more tank and its collection duties will be completed. After 2005, newly generated liquid waste (NGLW) will be stored in the three tanks VES-WM-101, VES-WM-101, and VES-WM-102.

An engineering study concluded that existing Tank Farm equipment is adequate for transferring waste from the Tank Farm to the New Waste Calcining Facility (NWCF) feed tanks (Wood 2002). Liquids and solids can be transferred from tanks VES-WM-180, VES-WM-187, VES-WM-188, VES-WM-189, VES-WM-100, VES-WM-101, and VES-WM-102 using existing steam jets, and in the case of VES-WM-189, also an existing airlift. It is assumed that the Tank Farm equipment will also be capable of feeding waste to tanks associated with the steam reforming facility.

The engineering study also evaluated several options for processing tank solids including: separate processing of the solids, batch co-processing, and homogeneous mixture co-processing. These options were evaluated against eight criteria and resulted in recommending co-processing the liquids and solids as a homogeneous mix. This option requires installing new mixing pumps in VES-WM-187, VES-WM-188 and VES-WM-189 to promote uniform distribution of heel solids between the four tanks (Wood 2002).

A-2.2 Waste Preparation and Feed (PFD-2A and 2B)

Existing steam jets in tanks VES-WM-187, VES-WM-188 and VES-WM-189 will deliver SBW (a near-uniform suspension of solids dispersed in liquid SBW) to the feed preparation tanks VES-100-1, 2. These tanks will be used to combine chemical additives with the SBW in controlled batches. The tanks are equipped with mixers to maintain well-stirred conditions, plus cooling coils to remove heat. PFD-2A is based on the TTT process and shows a solid additive, sucrose, being combined with the SBW. The sucrose is stored in a hopper, HOP-800, which supplies an auger/feeder, FEED-400, which in turn provides sucrose to the mixer. TWR uses a liquid chemical additive instead of a solid, and therefore, PFD-2B shows a storage tank VES-115 and associated pump P-201 to supply the SBW preparation feed tank (VES-100-1, 2).

Sucrose and SBW surrogates have been observed undergoing reactions after sitting for several hours. The solutions have effervesced and formed some particulate matter. The induction period is believed to be a function of temperature and acid concentration (Marshall 2003c). If the sucrose/SBW reaction proves problematic, an alternate mixing strategy, for example, an in-line mixer or a stirred tank with a short residence time, could be used.

Once prepared, the stream of combined SBW and chemical additives (stream 102) is pumped to the reforming reactor. The feed is injected and dispersed in the reactor through atomizing nozzles. The TTT process uses nitrogen gas to atomize the feed; the TWR fluid is carbon dioxide. The nitrogen is stored in VES-101 as a low temperature liquid and heated prior to its use as the atomizing fluid.

Based on Phase 2 demonstration tests (Soelberg 2004b), the TWR process uses a single liquid chemical, isopropyl alcohol (IPA), as a reductant. The alcohol is mixed with SBW and recycled scrub solution, prior to injecting this combined feed into the reactor. PFD-2B shows the IPA stored in tank VES-115 and charged through pump P-201 to feed preparation tanks (VES-100-1, 2). As noted above, the preparation tanks could be replaced with in-line mixers if deemed desirable by the project.

TWR uses carbon dioxide (CO_2) as the primary gas throughout the system and thereby requires no steam generator (to produce steam for fluidization) or nitrogen source tank (for feed atomization). In the TWR process, the feed is injected into the reactor through spray nozzles using carbon dioxide as the atomization fluid. The carbon dioxide is shown on the PFD as being stored (VES-101) as a low temperature liquid, which must be heated and vaporized prior to use. The TWR process also uses carbon dioxide as the bed fluidization media, which requires heating the carbon dioxide (in HE-301) to near the reactor's operating temperature.

A-2.3 Chemical Additives for the Reformer (PFD-2A and 2B)

In addition to the chemicals added to SBW in the feed preparation tank, solid materials are added directly to the reforming vessel to promote and control the reactions taking place. Hoppers and/or auger feeders are used for storing and transporting these materials. Solid reductant, composed of activated carbon in the TTT process, is stored in HOP-801 and fed via FEED-401 to the reformer. An iron oxide catalyst may also be used in the TTT process, however, if so it will be a relatively small quantity, therefore, no separate storage hopper is required for the catalyst beyond that available as a standard feature on the auger.

Prior to actual waste treatment, starting bed material composed of inert solid particles must be charged to the reactor. Alumina is used in the TTT process and is shown in PFD-2A as being stored in HOP-803. Alumina is only used intermittently: during start-up and possibly on shutdown.

In the bench-scale demonstration, the activated carbon reductant required feeding via a pneumatic injection system due to the low bulk density of the activated carbon. A similar problem was noticed with the reductant used in the FY03 TWR demonstration; however, the solid reductant was eliminated in the FY04 TWR tests and is not present in the current TWR flowsheet. The injection system resulted in a somewhat uneven feed rate (Marshall 2003b). Nonetheless, the PFDs show an injection vessel (VES-

104) for reductant feed, although an alternative feed system warrants study. The alumina and catalyst are both sufficiently dense to allow these to be fed by gravity to the reformer. For TWR, the contingency to add solid reductant (polypropylene beads) has been maintained in the proposed design, even though the FY 2004 pilot-scale tests did not require this feature. The solid reductant is stored in HOP-801 and fed through FEED-401. The polypropylene beads have a low bulk density and would require use of the pressurized injection vessel VES-104. The injection vessel would use carbon dioxide as the transfer gas.

A-2.4 Steam Reformer (PFD-2A and 2B)

The steam reformer VES-103 is a fluidized bed reactor that converts the liquid SBW to a free-flowing particulate solid, plus a portion emitted in the off-gas as nitrogen and steam. The reaction vessel consists of three major sections: (1) the distributor, (2) the fluidized bed, and (3) the disengaging or freeboard section (Perry 1973).

The distributor is located at the bottom of the reactor and is where the fluidization gas enters and is dispersed over the cross-section of the reactor. The TTT process uses a combination of steam and oxygen for fluidization. The distributor section also contains a drain to remove heavy or agglomerated particles (bottoms product).

The fluidized bed section contains the bed material, consisting of inert solid particles suspended in the flowing gas. The waste enters in this section and is injected into the bed through atomizing nozzles. Solid chemical reductant (carbon-bearing material) is also introduced in this section. The TTT process uses nitrogen for atomizing the feed and injecting reductant into the reformer. Numerous potential reactions and combinations of reactions occur in this section of the reactor. The following simplified set of reactions is believed significant in the operation of the reformer.

The solid phase carbon (reductant) reactions include the following:

$$C\ (s) + H_2O \rightarrow CO + H_2 \qquad (1)$$

$$C\ (s) + O_2 \rightarrow CO_2 + \textit{heat} \qquad \text{Carbon oxidation} \qquad (2)$$

$$2C\ (s) + NO_x \rightarrow N_2 + CO + CO_2 \qquad \text{Solid phase } NO_x \text{ reduction} \qquad (3)$$

The hydrogen reduces NO_x to nitrogen via the following reactions:

$$H_2 + NO_2 \rightarrow H_2O + NO \qquad (4)$$

$$2H_2 + 2NO \rightarrow 2H_2O + N_2 \qquad (5)$$

Carbon monoxide may react with numerous other species as shown below. Reaction (6) is desirable since it results in increased hydrogen levels, and hydrogen is believed to be more effective in reducing NO_x than carbon monoxide. Suppression of the methanation reaction (7) is desirable since hydrogen is consumed in this reaction. Reactions (8) and (9) show a potential path for carbon monoxide to reduce NO_x to nitrogen gas.

$$CO + H_2O \rightarrow CO_2 + H_2 \qquad \text{Water-gas shift} \qquad (6)$$

$$CO + 3H_2 \rightarrow CH_4 + H_2O \qquad \text{Methanation reaction} \qquad (7)$$

$$CO + NO_2 \rightarrow CO_2 + NO \qquad (8)$$

$$2CO + 2NO \rightarrow 2CO_2 + N_2 \quad (9)$$

The primary mineral forming constituents in SBW are sodium and aluminum. These may undergo the following denitration reactions and reform the corresponding solid products:

$$4Al(NO_3)_3 \rightarrow 2Al_2O_3\,(s) + 12NO_2 + 3O_2 \quad \text{Aluminum nitrate decomp.} \quad (10)$$

$$4NaNO_3 \rightarrow 2Na_2O\,(s) + 4NO_2 + O_2 \quad \text{Sodium nitrate decomp.} \quad (11)$$

$$Na_2O + CO_2 \rightarrow Na_2CO_3\,(s) \quad \text{Sodium carbonate formation} \quad (12)$$

It is desirable to maintain the fluidizing bed section within a defined operating temperature range (about 700°C for the TTT process) to minimize detrimental side reactions and prevent bed agglomeration. Similarly, it is desirable to control key gas phase constituents within desired limits to optimize reactor performance (minimize NO_x emissions, solid product character, etc.).

The upper section of the reformer is the disengaging or freeboard section. This section is wider in diameter than the fluidizing bed section and results in a reduced gas velocity. The reduced velocity causes larger entrained particles to disengage from the gas stream and return to the fluidizing section. The disengaging section also contains an internal cyclone, which captures fine entrained particles and also returns these to the fluidized bed. This results in increasing the average residence time of the particles and should minimize carbon content in the fines product.

The TWR process operates at about 600°C and uses carbon dioxide as the fluidization gas and to inject/atomize the feed. Isopropyl alcohol (IPA) is the carbon-bearing reductant used by TWR. Although different chemical amendments are used by TWR and results in a somewhat different reactor chemistry, the desired products from the reaction vessel are similar to those listed above for TTT – nitrates and NO_x are reduced to nitrogen, and mineral-forming constituents (sodium, potassium, aluminum, etc.) converted to carbonates and oxides. Numerous combinations of reactions are possible between IPA and metal-nitrates, however the simplified overall reactions may proceed as follows (using Na+ as a typical cation):

$$2C_3H_8O + 2NaNO_3 + CO_2 \rightarrow Na_2CO_3 + N_2 + 6CO + 7H_2 + H_2O \quad (13)$$

$$C_3H_8O + 2NaNO_3 + CO_2 \rightarrow Na_2CO_3 + N_2 + 2CO + 4H_2O + C\,(s) \quad (14)$$

$$C_3H_8O + 2NaNO_3 + CO_2 \rightarrow Na_2CO_3 + N_2 + 3CO + 3H_2O + H_2 \quad (15)$$

$$C_3H_8O + 2NaNO_3 + CO_2 \rightarrow Na_2CO_3 + N_2 + 3CO_2 + 4H_2 \quad (16)$$

$$C_3H_8O + 6NaNO_3 + 3CO_2 \rightarrow 3Na_2CO_3 + 3N_2 + 6CO_2 + 4H_2O + 4H_2 \quad (17)$$

A-2.5 Product Collection and Processing (PFD-2A, PFD-2B, and PFD-4)

Solid product may be drawn from the reactor bottom or from the overhead fines collection filter (F-100-1, 2). Flow sheets PFD-2A and 2B show bottom product and fines being transported by gravity to a common set of collection hoppers (HOP-804-1, 2, 3). Fresh product will be hot (400 to 650°C) and requires cooling prior to being processed into canisters. The proposed design uses cooling gas (nitrogen for the TTT process) being routed directly through the collection hoppers. Three hoppers are used, thereby allowing two to cool while the third is being used for product processing. The cooling gas emerging from the collection hoppers may carry some fines; therefore, the gas is routed through a small cyclone (CYC-100-1, 2, 3) to remove this carry-over.

The bench-scale demonstration tests produced overhead product that was free flowing, but having a very low bulk density of 0.15 to 0.35 g/cm^3 (Marshall 2003a, Marshall 2003b). Therefore, once the product is sufficiently cooled, it is sent to an auger/densification device FEED-404, prior to being discharged to canisters. The densification device may be a compactor, pelletizer, or even a simple shaker table. Further study is required to determine the type of densification device recommended and to determine if the added complexity and cost of this equipment and processing is justified.

Canister filling and subsequent processing is shown in PFD-4. Each canister is filled with about 0.8 m^3 of product, equivalent to about 85 to 90% of the canister volume. The filled canister is then visually inspected followed by the lid being placed in position and locked. The sealed canister is then surveyed, decontaminated, and placed in lag storage or a transport cask.

A-2.6 Off-Gas System (PFD-2A, PFD-2B, PFD-3A, PFD-3B)

The off-gas system consists of a series of unit operations to control radionuclide, hazardous, and particulate emissions. Maximum Achievable Control Technology (MACT) standards are assumed to apply to the off-gas and the proposed design addresses contaminants that will likely be problematic, most notably mercury.

Immediately after leaving the reaction vessel, the off-gas is cooled by introducing relatively cool gases in mixing chamber VES-113. Additional cooling is provided by heat exchanger HE-305, located downstream from the mixing vessel. The off-gas then enters the sintered metal filter vessel (F-100-1, 2), where most of the fines are removed. The filter elements are sintered metal “candles” that retain fine particles. These are periodically pulsed with jets of gas to remove the particles, which are collected and removed from the bottom of the filter vessel. Cooling of the off-gas to about 400°C prior to entering the filter is believed to promote removal of volatile metals such as cesium, cadmium, chromium, and lead.

The off-gas emerging from the reformer vessel will contain significant levels of flammable gases, primarily hydrogen, carbon monoxide, and methane, along with trace quantities of organics. An off-gas oxidizer, VES-105, is used to destroy these and is shown immediately downstream of the sintered metal filter. Because of the flammable gas levels and their associated heating values, a flameless thermal oxidation unit is recommended. These units function by passing off-gas fumes through a refractory-lined reactor filled with inert ceramic packing. Air or oxygen is added to the reaction chamber along with any supplementary fuel, if necessary. This type of oxidizer does not use a burner and thereby avoids extreme temperature gradients in the reactor. This leads to improved control of the process chemistry and minimizes generation of undesirable by-products such as nitrogen oxides, un-reacted organics, and products of incomplete combustion. Units ranging in size up to 30,000 scfm are available (Freeman 1998).

After leaving the oxidizer, the gas is routed to the quench and wet scrub system. This system consists of a quench tower (VES-106), the scrubber/absorber (VES-107), a mist eliminator (VES-108), and a solution hold tank (VES-110) plus cooler (HE-303). Provisions are also available to recycle the scrub back to the feed tank. Water is introduced in the quench tower to lower the off-gas temperature.

The gas is then routed to a wet scrubber to remove mercury and chlorine. It is currently proposed to operate the scrubber in a manner similar to that used for the calciner. A recirculating nitric acid solution is used to solubilize mercury until the solution reaches a pre-determined mercury concentration – this value was set at 60 g/L mercury. The pH of the scrub solution tank (VES-110) is maintained within the desired range by a control loop with a feed make-up of nitric acid (VES-112 and P-204). A second control loop (VES-114 and P-205) is included that uses an aluminum nitrate solution to minimize corrosion due to fluoride and chlorine, however, this loop may be eliminated if the anticipated corrosion is deemed acceptable. The spent scrub solution is discharged to a blow down hold tank (VES-111), where the solution is treated, solidified with cement, and disposed of.

A packed tower is currently proposed, although an alternate device may be specified during detailed design. A packed tower is a departure from the venturi scrubber used in the calcine system. The venturi is more commonly used for removing particulate matter from gases. It is anticipated that the sintered metal filter proposed for the reformer will remove over 98% of the fines generated; therefore the need for particulate removal by the absorber is reduced. A packed tower typically provides more efficient gas/liquid contact and improved mass transfer compared to a venturi (Treybal 1968, Kohl 1979).

After leaving the packed bed scrubber, the gas is routed through a mist eliminator (VES-108), a heater (HE-304) to raise the gas temperature above its dew point, and then onto a bank of high-efficiency particulate air (HEPA) filters (F-101-1, 2, 3). The filtered gas then passes to a sulfur-impregnated activated carbon bed (VES-109, plus a shallow auxiliary bed), which removes residual mercury and chlorine. Compliance with MACT emission standards is verified by a continuous emission monitoring system on the effluent. Pressure control in the off-gas system is set by adjusting the make-up air to the off-gas blower (BLO-200). From the blower, the off-gas is finally vented to the atmosphere through the stack.

A-2.7 Spent Scrub Solution (PFD-3A, PFD-3B)

Scrub solution is periodically purged from the scrub hold tank (VES-110) when solubilized mercury accumulates to about 60 g/L. Scrub purge treatment would not be a continuous operation; batch treatment could be performed during reforming operations or during scheduled shutdowns.

Spent scrub solution is discharged to the blow down hold tank (VES-111). This solution will be acidic and contain high levels of dissolved mercury. Information from the demonstration tests suggests that transuranic nuclide levels will be low; therefore, the solution will presumably be classified as a mixed low-level waste. The proposed treatment includes pH adjustment to a value near 3 by hydrated lime addition, followed by calcium sulfide to precipitate mercury. The resulting solution/sludge is then combined (in mixer MIX-100) with Portland cement, or similar blended cement, to form a solidified product suitable for disposal as low-level waste.

A-3. PROCESS OPERATION

This section describes a possible operation scenario.

Prior to processing, mixing pumps would have been installed in Tanks WM-187, WM-188 and WM-189, and the solids initially in Tank WM-187 would be distributed between these three tanks by a series of waste transfers between these tanks. After these transfers, all concentrated NGLW in tanks WM-100, WM-101 and WM-102 would be transferred to WM-187. This NGLW transfer is needed to be able to continue using these smaller tanks to receive and collect NGLW. The four waste tanks – WM-180, WM-187, WM-188 and WM-189 - would then be sampled and the analytical results used to support qualification of the wastes from the treatment process.

After plant start-up activities are complete, waste from Tank WM-187 would be processed. Processing this tank first would free it up to receive flush water from the other tanks after they are emptied. Following the completion of processing Tank WM-187 waste, waste from one of the other tanks (WM-180, WM-188 or WM-189) would be processed. When waste has been withdrawn to heel level, estimated to be about 3000 gallons, processing of waste from a second of these three tanks would begin. Simultaneously, heel from the emptied tank would be flushed with water to Tank WM-187. After this sequence is repeated for another tank, the treatment process will be processing waste from the last tank, and heels from two tanks will have been collected in WM-187.

The contents of Tank WM-187, mostly flush water, would then be evaporated, with the concentrate sent to WM-100, WM-101 or WM-102 to be held for treatment. After completing treatment of waste in the final waste tank, its heel would be flushed to WM-187, which initially contains a dilute heel. The final evaporation of WM-187 would produce about 3000-4000 gallons of concentrate, which would either be treated in the SBW treatment facility or dispositioned with other NGLW collected during 2012. The heel in WM-187, dilute to begin with, would be flushed using multiple washes to the NGLW tanks. This waste, if concentrated separately from other wastes, would produce only an estimated 300 gallons of concentrate. Thus, flush from WM-187 would more likely be evaporated with other NGLW collected in late 2012, and the concentrate dispositioned with this NGLW.

Transfers of about 3,750 gallons from the Tank Farm to the Steam Reforming Facility would be made about once a day. At a rate of 50 gpm, the transfer would take about 1.5 hours. Waste qualification would be based on analysis of samples taken from the Tank Farm tanks, hence no holdup is designed into the treatment facility feed tank for sample turnaround.

Waste processing in the treatment facility would be continuous, 24-hours per day. Waste from each Tank Farm tank would be processed in "campaigns," with no planned shutdown until the tank was empty. Assuming no unscheduled shutdowns, the campaigns for each of the full Tank Farm tanks would take about 125 days (based on a feed rate of 96 gph SBW).

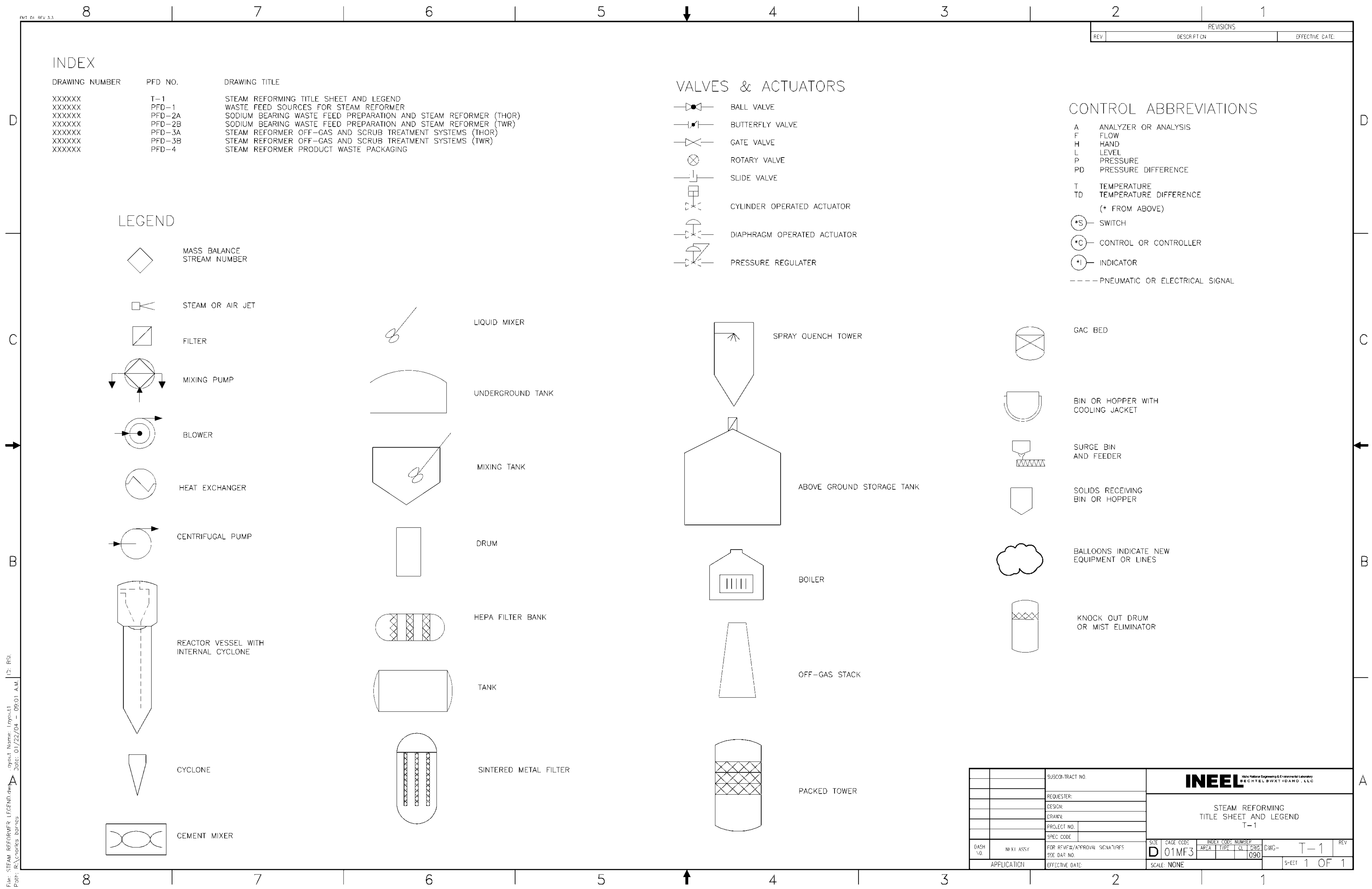
Consumable chemicals will be stored on-site in quantities that an adequate inventory (typically 7-day supply) will be available to maintain constant operation. Similarly, the packaging facility has been designed with enough storage capacity (3 storage bins – each with a 2 day accumulation capacity) so that it will not constrain operations. Redundant HEPAs and product-sintered metal filtering systems are currently being recommended. Finally, no change out of refractory from the thermal oxidizer or carbon from the granulated activated carbon (GAC) bed is anticipated during operation.

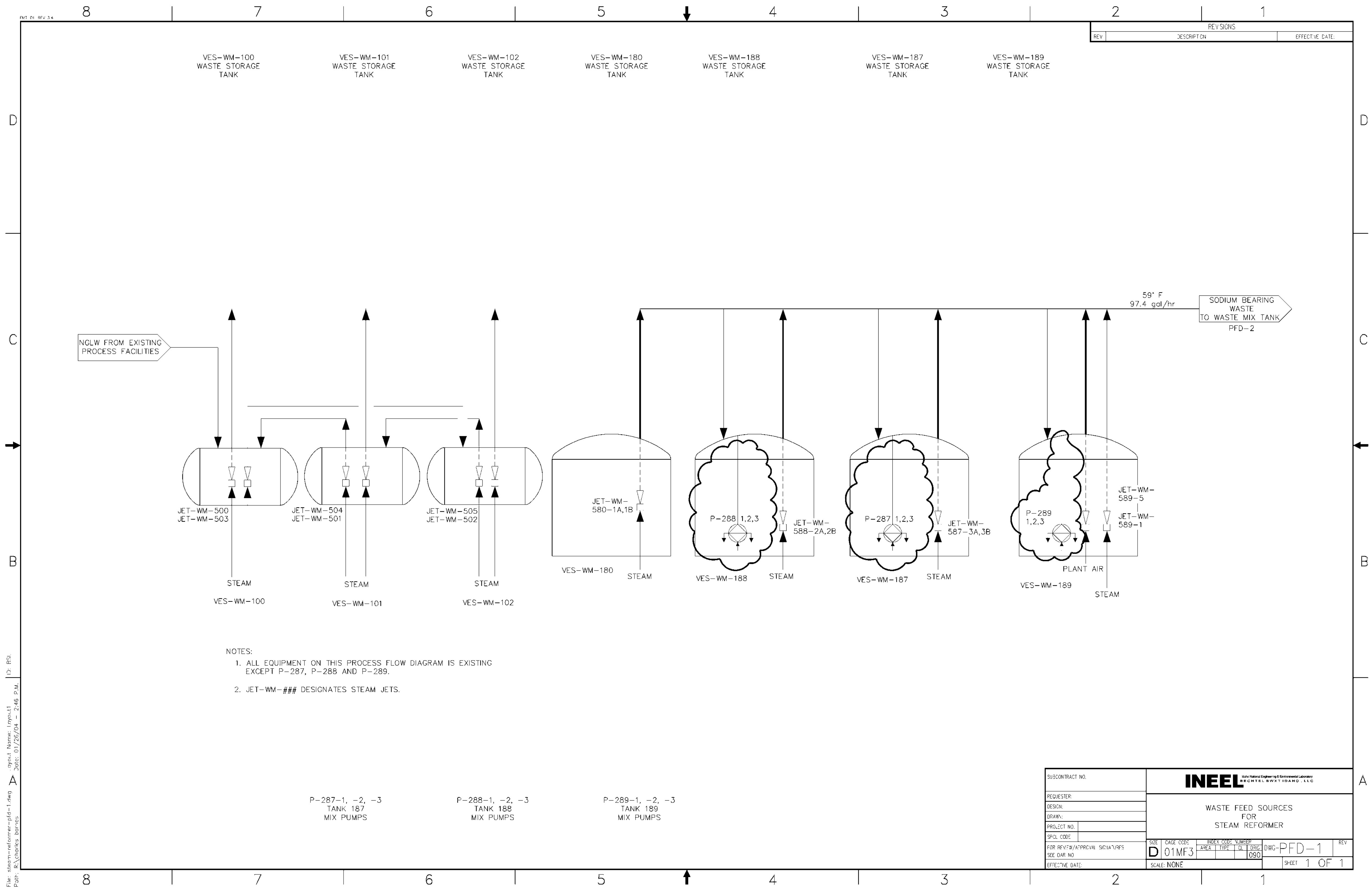
The spent scrub solution will require periodic treatment. However, the blow down hold tank has been sized to accumulate spent scrub from an entire tank campaign; therefore, treatment can be undertaken during scheduled shutdowns.

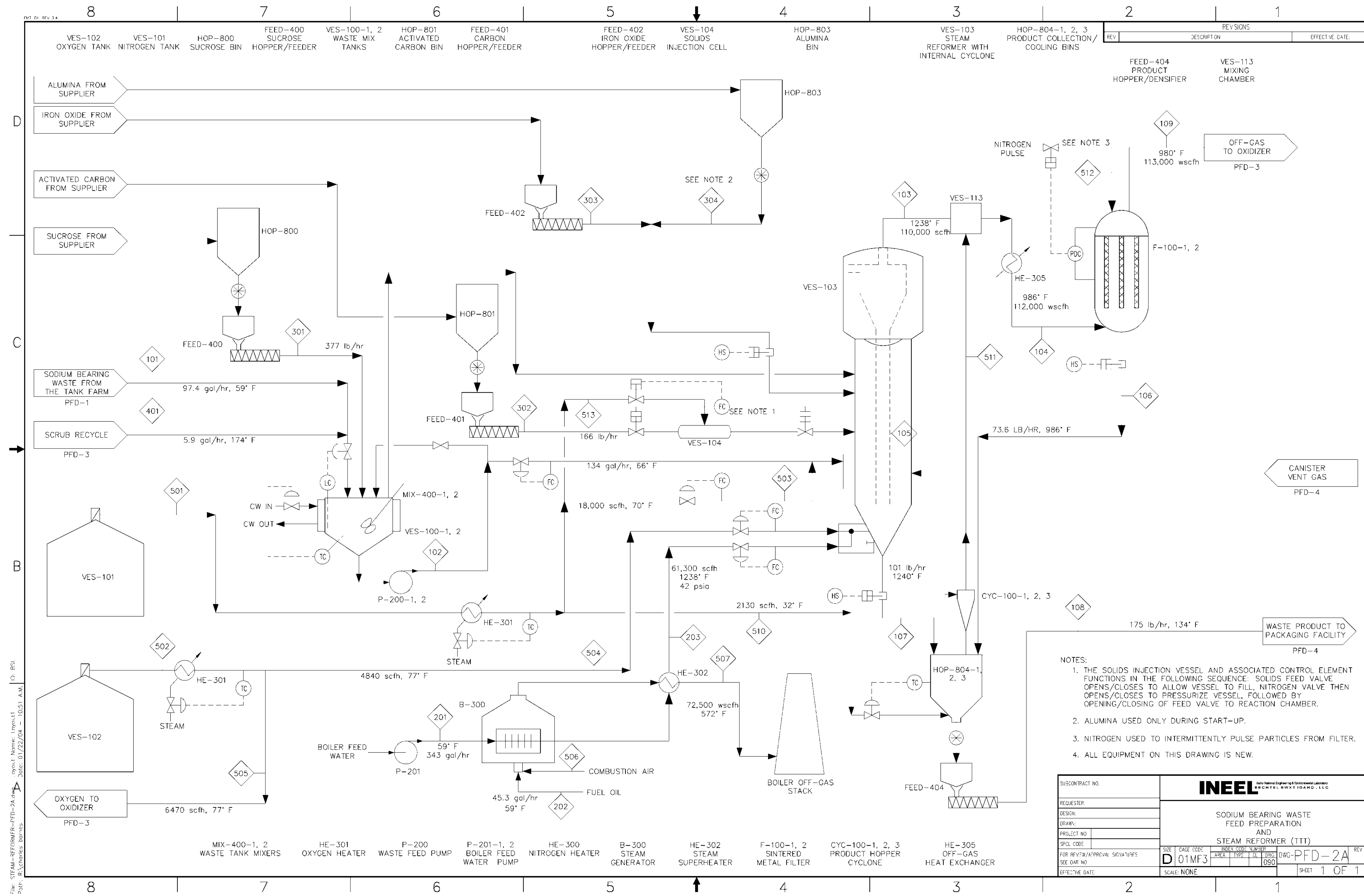
A-4. PROCESS FLOW DIAGRAMS

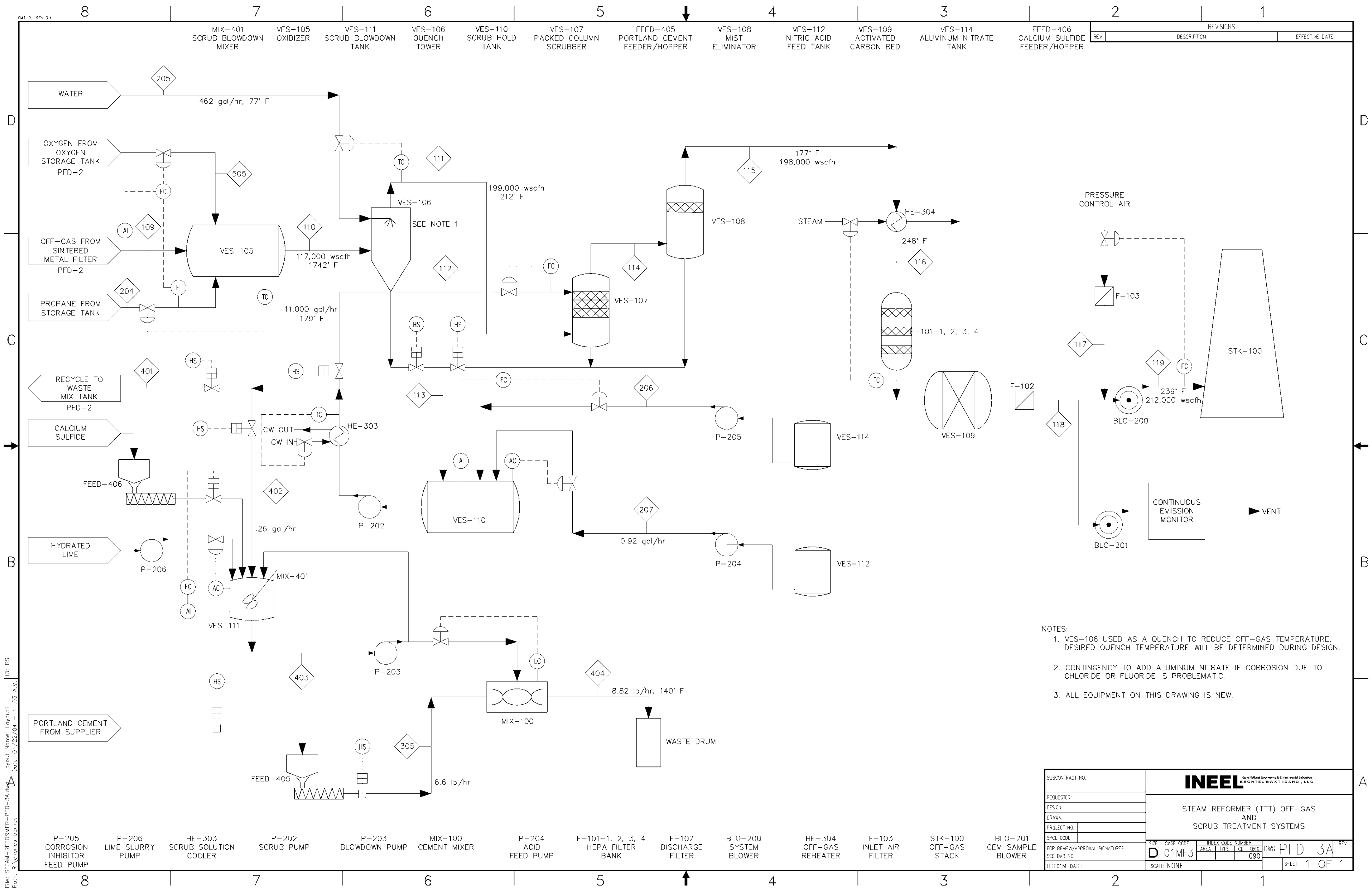
Sets of PFDs have been prepared based on the bench-scale tests of TTT and TWR. Single diagrams appear for SBW retrieval (PFD-1) and product packaging (PFD-4) since these activities are independent of the reforming process. Although the TTT and TWR use many of the same unit operations and associated equipment, there are enough differences that separate flow diagrams are warranted. The TTT-based process appears on PFD-2A and -3A and the TWR process appears on PFD-2B and -3B. The PFDs shown on the following pages thus include:

T-1	Steam Reforming Title Set and Legend
PFD-1	Waste Feed Sources for Steam Reformer
PFD-2A	Sodium-Bearing Waste Feed Preparation and Steam Reformer (TTT)

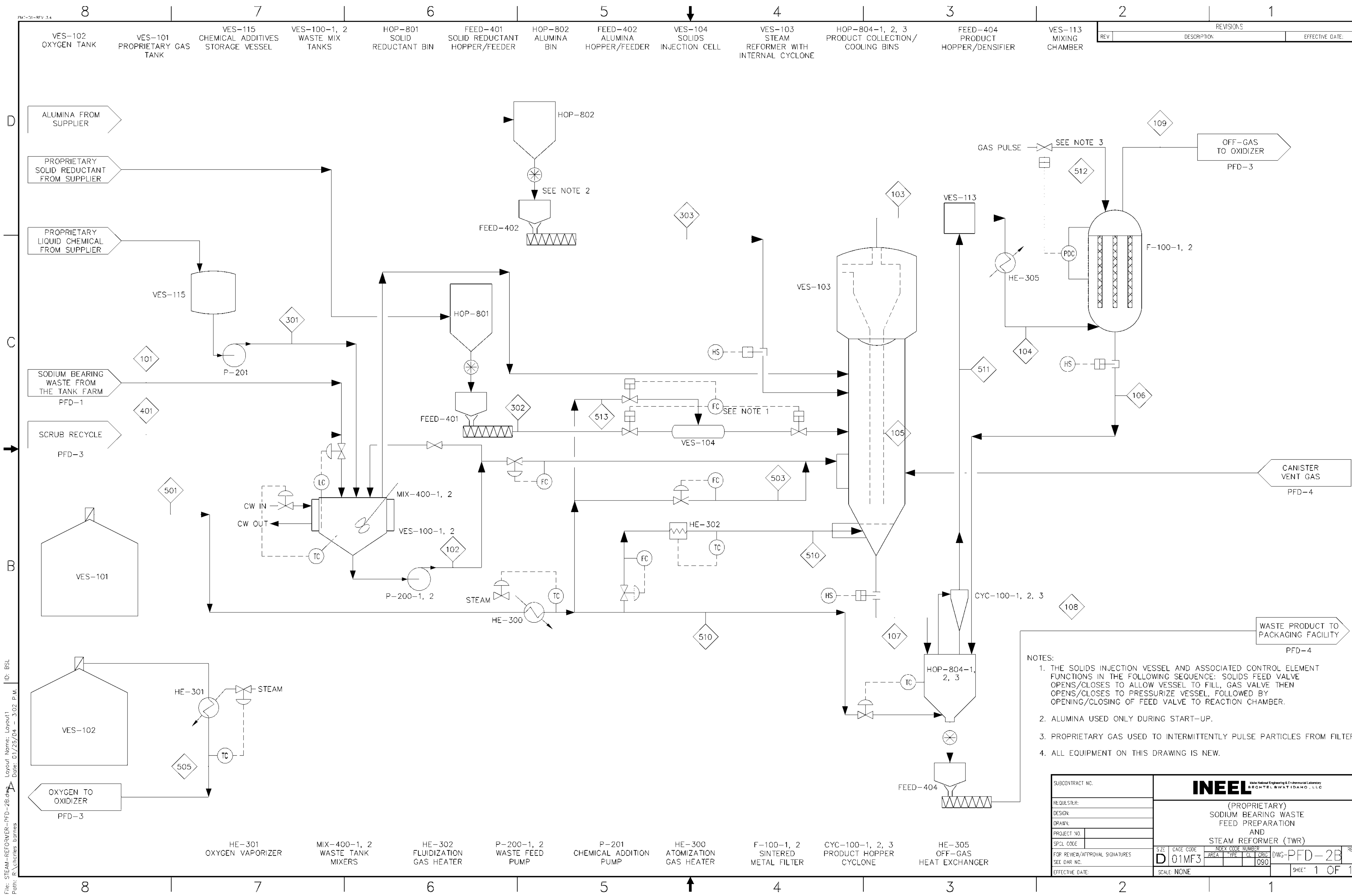

INDEX
DRAWING NUMBER PFD NO. DRAWING TITLE
XXXXXX T-1 STEAM REFORMING TITLE SHEET AND LEGEND
XXXXXX PFD-1 WASTE FEED SOURCES FOR STEAM REFORMER
XXXXXX PFD-2A SODIUM BEARING WASTE FEED PREPARATION AND STEAM REFORMER (THOR)
XXXXXX PFD-2B SODIUM BEARING WASTE FEED PREPARATION AND STEAM REFORMER (TWR)
XXXXXX PFD-3A STEAM REFORMER OFF-GAS AND SCRUB TREATMENT SYSTEMS (THOR)
XXXXXX PFD-3B STEAM REFORMER OFF-GAS AND SCRUB TREATMENT SYSTEMS (TWR)
XXXXXX PFD-4 STEAM REFORMER PRODUCT WASTE PACKAGING
LEGEND
MASS BALANCE STREAM NUMBER
STEAM OR AIR JET
FILTER
MIXING PUMP
BLOWER
HEAT EXCHANGER
CENTRIFUGAL PUMP
REACTOR VESSEL WITH INTERNAL CYCLONE
CYCLONE
CEMENT MIXER
LIQUID MIXER
UNDERGROUND TANK
MIXING TANK
DRUM
HEPA FILTER BANK
TANK
SINTERED METAL FILTER
VALVES & ACTUATORS
BALL VALVE
BUTTERFLY VALVE
GATE VALVE
ROTARY VALVE
SLIDE VALVE
CYLINDER OPERATED ACTUATOR
DIAPHRAGM OPERATED ACTUATOR
PRESSURE REGULATER
SPRAY QUENCH TOWER
ABOVE GROUND STORAGE TANK
BOILER
OFF-GAS STACK
PACKED TOWER
CONTROL ABBREVIATIONS
A ANALYZER OR ANALYSIS
F FLOW
H HAND
L LEVEL
P PRESSURE
PD PRESSURE DIFFERENCE
T TEMPERATURE
TD TEMPERATURE DIFFERENCE
(* FROM ABOVE)
*S SWITCH
*C CONTROL OR CONTROLLER
*I INDICATOR
PNEUMATIC OR ELECTRICAL SIGNAL
GAC BED
BIN OR HOPPER WITH COOLING JACKET
SURGE BIN AND FEEDER
SOLIDS RECEIVING BIN OR HOPPER
BALLOONS INDICATE NEW EQUIPMENT OR LINES
KNOCK OUT DRUM OR MIST ELIMINATOR
REVISIONS
REV DESCRIPTION EFFECTIVE DATE
SUBCONTRACT NO.
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPEC CODE
DASH NO.
NEXT ASSY
APPLICATION
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:
INEEL
Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC
STEAM REFORMING
TITLE SHEET AND LEGEND
T-1
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER
AREA TYPE CL ORIG
090
DWG- T-1
REV
SCALE: NONE
SHEET 1 OF 1


REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
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
59° F
97.4 gal/hr
SODIUM BEARING WASTE TO WASTE MIX TANK
PFD-2
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
P-288 1,2,3
JET-WM-588-2A,2B
P-287 1,2,3
JET-WM-587-3A,3B
P-289 1,2,3
JET-WM-589-5
JET-WM-589-1
PLANT AIR
STEAM
VES-WM-100
VES-WM-101
VES-WM-102
VES-WM-180
VES-WM-188
VES-WM-187
VES-WM-189
NOTES:
1. ALL EQUIPMENT ON THIS PROCESS FLOW DIAGRAM IS EXISTING EXCEPT P-287, P-288 AND P-289.
2. JET-WM-### DESIGNATES STEAM JETS.
P-287-1, -2, -3 TANK 187 MIX PUMPS
P-288-1, -2, -3 TANK 188 MIX PUMPS
P-289-1, -2, -3 TANK 189 MIX PUMPS
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
WASTE FEED SOURCES FOR STEAM REFORMER
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER
AREA
TYPE
CL
ORIG 090
DWG-PFD-1
REV
SCALE: NONE
SHEET 1 OF 1

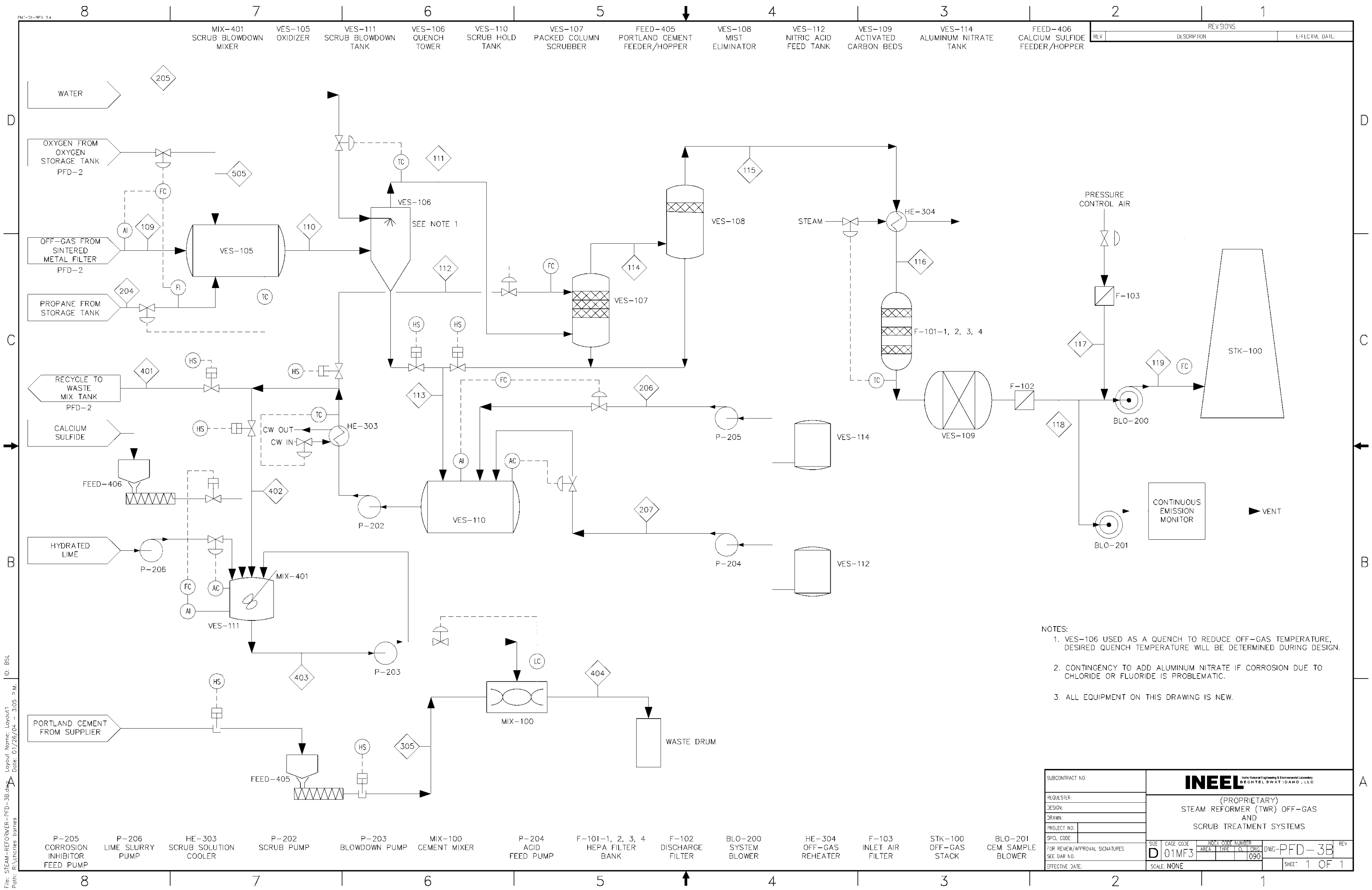

VES-102 OXYGEN TANK
VES-101 NITROGEN TANK
HOP-800 SUCROSE BIN
FEED-400 SUCROSE HOPPER/FEEDER
VES-100-1, 2 WASTE MIX TANKS
HOP-801 ACTIVATED CARBON BIN
FEED-401 CARBON HOPPER/FEEDER
FEED-402 IRON OXIDE HOPPER/FEEDER
VES-104 SOLIDS INJECTION CELL
HOP-803 ALUMINA BIN
VES-103 STEAM REFORMER WITH INTERNAL CYCLONE
HOP-804-1, 2, 3 PRODUCT COLLECTION/ COOLING BINS
FEED-404 PRODUCT HOPPER/DENSIFIER
VES-113 MIXING CHAMBER
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
ALUMINA FROM SUPPLIER
IRON OXIDE FROM SUPPLIER
ACTIVATED CARBON FROM SUPPLIER
SUCROSE FROM SUPPLIER
SODIUM BEARING WASTE FROM THE TANK FARM
PFD-1
SCRUB RECYCLE
PFD-3
97.4 gal/hr, 59° F
5.9 gal/hr, 174° F
377 lb/hr
166 lb/hr
134 gal/hr, 66° F
18,000 scfh, 70° F
1238° F 110,000 scfh
986° F 112,000 wscfh
980° F 113,000 wscfh
OFF-GAS TO OXIDIZER
PFD-3
NITROGEN PULSE
SEE NOTE 3
SEE NOTE 2
SEE NOTE 1
73.6 LB/HR, 986° F
CANISTER VENT GAS
PFD-4
61,300 scfh 1238° F 42 psig
101 lb/hr 1240° F
2130 scfh, 32° F
175 lb/hr, 134° F
WASTE PRODUCT TO PACKAGING FACILITY
PFD-4
4840 scfh, 77° F
72,500 wscfh 572° F
59° F 343 gal/hr
45.3 gal/hr 59° F
BOILER FEED WATER
COMBUSTION AIR
FUEL OIL
BOILER OFF-GAS STACK
OXYGEN TO OXIDIZER
PFD-3
6470 scfh, 77° F
STEAM
CW IN
CW OUT
MIX-400-1, 2
P-200-1, 2
HE-301
HE-302
HE-305
B-300
P-201
F-100-1, 2
CYC-100-1, 2, 3
FEED-404
NOTES:
1. THE SOLIDS INJECTION VESSEL AND ASSOCIATED CONTROL ELEMENT FUNCTIONS IN THE FOLLOWING SEQUENCE: SOLIDS FEED VALVE OPENS/CLOSES TO ALLOW VESSEL TO FILL, NITROGEN VALVE THEN OPENS/CLOSES TO PRESSURIZE VESSEL, FOLLOWED BY OPENING/CLOSING OF FEED VALVE TO REACTION CHAMBER.
2. ALUMINA USED ONLY DURING START-UP.
3. NITROGEN USED TO INTERMITTENTLY PULSE PARTICLES FROM FILTER.
4. ALL EQUIPMENT ON THIS DRAWING IS NEW.
MIX-400-1, 2 WASTE TANK MIXERS
HE-301 OXYGEN HEATER
P-200 WASTE FEED PUMP
P-201-1, 2 BOILER FEED WATER PUMP
HE-300 NITROGEN HEATER
B-300 STEAM GENERATOR
HE-302 STEAM SUPERHEATER
F-100-1, 2 SINTERED METAL FILTER
CYC-100-1, 2, 3 PRODUCT HOPPER CYCLONE
HE-305 OFF-GAS HEAT EXCHANGER
INEEL
SODIUM BEARING WASTE FEED PREPARATION AND STEAM REFORMER (TTT)
D 01MF3
DWG-PFD-2A
SCALE: NONE
SHEET 1 OF 1

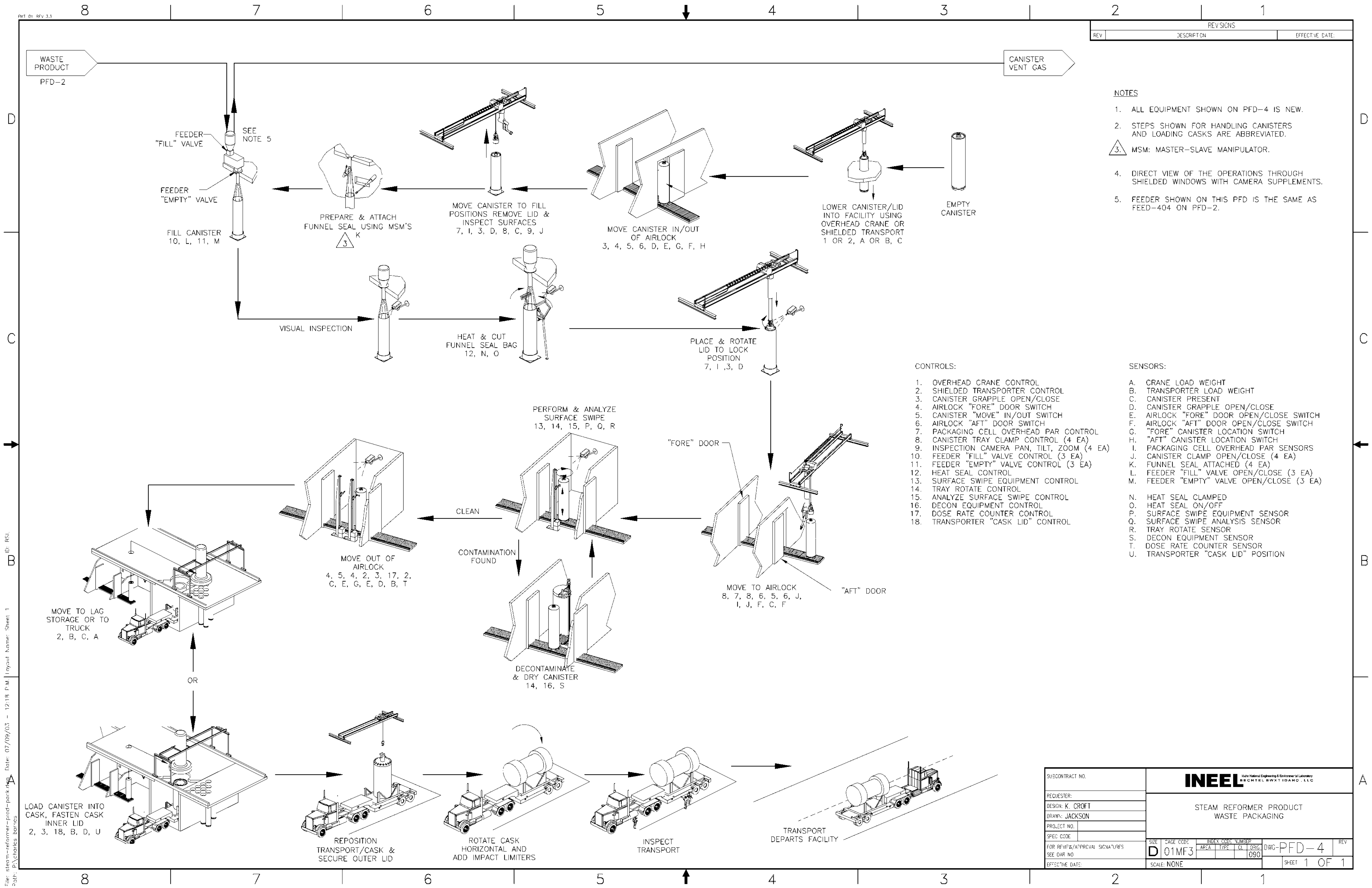


MIX-401 SCRUB BLOWDOWN MIXER
VES-105 OXIDIZER
VES-111 SCRUB BLOWDOWN TANK
VES-106 QUENCH TOWER
VES-110 SCRUB HOLD TANK
VES-107 PACKED COLUMN SCRUBBER
FEED-405 PORTLAND CEMENT FEEDER/HOPPER
VES-108 MIST ELIMINATOR
VES-112 NITRIC ACID FEED TANK
VES-109 ACTIVATED CARBON BED
VES-114 ALUMINUM NITRATE TANK
FEED-406 CALCIUM SULFIDE FEEDER/HOPPER
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
WATER
462 gal/hr, 77° F
OXYGEN FROM OXYGEN STORAGE TANK
PFD-2
OFF-GAS FROM SINTERED METAL FILTER
PFD-2
PROPANE FROM STORAGE TANK
117,000 wscfh
1742° F
11,000 gal/hr
179° F
199,000 wscfh
212° F
SEE NOTE 1
177° F
198,000 wscfh
STEAM
HE-304
248° F
PRESSURE CONTROL AIR
F-103
F-101-1, 2, 3, 4
F-102
BLO-200
239° F
212,000 wscfh
STK-100
RECYCLE TO WASTE MIX TANK
PFD-2
CALCIUM SULFIDE
FEED-406
CW OUT
CW IN
HE-303
P-202
P-205
P-204
0.92 gal/hr
.26 gal/hr
HYDRATED LIME
P-206
MIX-401
VES-111
P-203
MIX-100
8.82 lb/hr, 140° F
WASTE DRUM
PORTLAND CEMENT FROM SUPPLIER
FEED-405
6.6 lb/hr
CONTINUOUS EMISSION MONITOR
VENT
BLO-201
NOTES:
1. VES-106 USED AS A QUENCH TO REDUCE OFF-GAS TEMPERATURE. DESIRED QUENCH TEMPERATURE WILL BE DETERMINED DURING DESIGN.
2. CONTINGENCY TO ADD ALUMINUM NITRATE IF CORROSION DUE TO CHLORIDE OR FLUORIDE IS PROBLEMATIC.
3. ALL EQUIPMENT ON THIS DRAWING IS NEW.
INEEL
STEAM REFORMER (TTT) OFF-GAS AND SCRUB TREATMENT SYSTEMS
D 01MF3 090
PFD-3A
SCALE: NONE
SHEET 1 OF 1
P-205 CORROSION INHIBITOR FEED PUMP
P-206 LIME SLURRY PUMP
HE-303 SCRUB SOLUTION COOLER
P-202 SCRUB PUMP
P-203 BLOWDOWN PUMP
MIX-100 CEMENT MIXER
P-204 ACID FEED PUMP
F-101-1, 2, 3, 4 HEPA FILTER BANK
F-102 DISCHARGE FILTER
BLO-200 SYSTEM BLOWER
HE-304 OFF-GAS REHEATER
F-103 INLET AIR FILTER
STK-100 OFF-GAS STACK
BLO-201 CEM SAMPLE BLOWER



VES-102 OXYGEN TANK
VES-101 PROPRIETARY GAS TANK
VES-115 CHEMICAL ADDITIVES STORAGE VESSEL
VES-100-1, 2 WASTE MIX TANKS
HOP-801 SOLID REDUCTANT BIN
FEED-401 SOLID REDUCTANT HOPPER/FEEDER
HOP-802 ALUMINA BIN
FEED-402 ALUMINA HOPPER/FEEDER
VES-104 SOLIDS INJECTION CELL
VES-103 STEAM REFORMER WITH INTERNAL CYCLONE
HOP-804-1, 2, 3 PRODUCT COLLECTION/ COOLING BINS
FEED-404 PRODUCT HOPPER/DENSIFIER
VES-113 MIXING CHAMBER
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
ALUMINA FROM SUPPLIER
PROPRIETARY SOLID REDUCTANT FROM SUPPLIER
PROPRIETARY LIQUID CHEMICAL FROM SUPPLIER
SODIUM BEARING WASTE FROM THE TANK FARM
PFD-1
SCRUB RECYCLE
PFD-3
GAS PULSE
SEE NOTE 3
OFF-GAS TO OXIDIZER
PFD-3
SEE NOTE 2
SEE NOTE 1
CANISTER VENT GAS
PFD-4
WASTE PRODUCT TO PACKAGING FACILITY
PFD-4
OXYGEN TO OXIDIZER
PFD-3
STEAM
CW IN
CW OUT
MIX-400-1, 2
P-201
P-200-1, 2
HE-300
HE-301
HE-302
HE-305
F-100-1, 2
CYC-100-1, 2, 3
NOTES:
1. THE SOLIDS INJECTION VESSEL AND ASSOCIATED CONTROL ELEMENT FUNCTIONS IN THE FOLLOWING SEQUENCE: SOLIDS FEED VALVE OPENS/CLOSES TO ALLOW VESSEL TO FILL, GAS VALVE THEN OPENS/CLOSES TO PRESSURIZE VESSEL, FOLLOWED BY OPENING/CLOSING OF FEED VALVE TO REACTION CHAMBER.
2. ALUMINA USED ONLY DURING START-UP.
3. PROPRIETARY GAS USED TO INTERMITTENTLY PULSE PARTICLES FROM FILTER.
4. ALL EQUIPMENT ON THIS DRAWING IS NEW.
HE-301 OXYGEN VAPORIZER
MIX-400-1, 2 WASTE TANK MIXERS
HE-302 FLUIDIZATION GAS HEATER
P-200-1, 2 WASTE FEED PUMP
P-201 CHEMICAL ADDITION PUMP
HE-300 ATOMIZATION GAS HEATER
F-100-1, 2 SINTERED METAL FILTER
CYC-100-1, 2, 3 PRODUCT HOPPER CYCLONE
HE-305 OFF-GAS HEAT EXCHANGER
INEEL
(PROPRIETARY) SODIUM BEARING WASTE FEED PREPARATION AND STEAM REFORMER (TWR)
D 01MF3
090
DWG PFD-2B
SCALE NONE
SHEET 1 OF 1


MIX-401 SCRUB BLOWDOWN MIXER
VES-105 OXIDIZER
VES-111 SCRUB BLOWDOWN TANK
VES-106 QUENCH TOWER
VES-110 SCRUB HOLD TANK
VES-107 PACKED COLUMN SCRUBBER
FEED-405 PORTLAND CEMENT FEEDER/HOPPER
VES-108 MIST ELIMINATOR
VES-112 NITRIC ACID FEED TANK
VES-109 ACTIVATED CARBON BEDS
VES-114 ALUMINUM NITRATE TANK
FEED-406 CALCIUM SULFIDE FEEDER/HOPPER
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
WATER
OXYGEN FROM OXYGEN STORAGE TANK PFD-2
OFF-GAS FROM SINTERED METAL FILTER PFD-2
PROPANE FROM STORAGE TANK
RECYCLE TO WASTE MIX TANK PFD-2
CALCIUM SULFIDE
HYDRATED LIME
PORTLAND CEMENT FROM SUPPLIER
SEE NOTE 1
CW OUT
CW IN
STEAM
PRESSURE CONTROL AIR
CONTINUOUS EMISSION MONITOR
VENT
WASTE DRUM
NOTES:
1. VES-106 USED AS A QUENCH TO REDUCE OFF-GAS TEMPERATURE, DESIRED QUENCH TEMPERATURE WILL BE DETERMINED DURING DESIGN.
2. CONTINGENCY TO ADD ALUMINUM NITRATE IF CORROSION DUE TO CHLORIDE OR FLUORIDE IS PROBLEMATIC.
3. ALL EQUIPMENT ON THIS DRAWING IS NEW.
P-205 CORROSION INHIBITOR FEED PUMP
P-206 LIME SLURRY PUMP
HE-303 SCRUB SOLUTION COOLER
P-202 SCRUB PUMP
P-203 BLOWDOWN PUMP
MIX-100 CEMENT MIXER
P-204 ACID FEED PUMP
F-101-1, 2, 3, 4 HEPA FILTER BANK
F-102 DISCHARGE FILTER
BLO-200 SYSTEM BLOWER
HE-304 OFF-GAS REHEATER
F-103 INLET AIR FILTER
STK-100 OFF-GAS STACK
BLO-201 CEM SAMPLE BLOWER
INEEL
(PROPRIETARY)
STEAM REFORMER (TWR) OFF-GAS AND SCRUB TREATMENT SYSTEMS
D
01MF3
090
PFD-3B
SCALE NONE
SHEET 1 OF 1


WASTE PRODUCT
PFD-2
CANISTER VENT GAS
FEEDER "FILL" VALVE
SEE NOTE 5
FEEDER "EMPTY" VALVE
FILL CANISTER 10, L, 11, M
PREPARE & ATTACH FUNNEL SEAL USING MSM'S 3 K
MOVE CANISTER TO FILL POSITIONS REMOVE LID & INSPECT SURFACES 7, I, 3, D, 8, C, 9, J
MOVE CANISTER IN/OUT OF AIRLOCK 3, 4, 5, 6, D, E, G, F, H
LOWER CANISTER/LID INTO FACILITY USING OVERHEAD CRANE OR SHIELDED TRANSPORT 1 OR 2, A OR B, C
EMPTY CANISTER
VISUAL INSPECTION
HEAT & CUT FUNNEL SEAL BAG 12, N, O
PLACE & ROTATE LID TO LOCK POSITION 7, I ,3, D
PERFORM & ANALYZE SURFACE SWIPE 13, 14, 15, P, Q, R
"FORE" DOOR
"AFT" DOOR
MOVE TO AIRLOCK 8, 7, 8, 6, 5, 6, J, I, J, F, C, F
CLEAN
CONTAMINATION FOUND
MOVE OUT OF AIRLOCK 4, 5, 4, 2, 3, 17, 2, C, E, G, E, D, B, T
DECONTAMINATE & DRY CANISTER 14, 16, S
MOVE TO LAG STORAGE OR TO TRUCK 2, B, C, A
OR
LOAD CANISTER INTO CASK, FASTEN CASK INNER LID 2, 3, 18, B, D, U
REPOSITION TRANSPORT/CASK & SECURE OUTER LID
ROTATE CASK HORIZONTAL AND ADD IMPACT LIMITERS
INSPECT TRANSPORT
TRANSPORT DEPARTS FACILITY
REVISIONS
REV DESCRIPTION EFFECTIVE DATE
NOTES
1. ALL EQUIPMENT SHOWN ON PFD-4 IS NEW.
2. STEPS SHOWN FOR HANDLING CANISTERS AND LOADING CASKS ARE ABBREVIATED.
3. MSM: MASTER-SLAVE MANIPULATOR.
4. DIRECT VIEW OF THE OPERATIONS THROUGH SHIELDED WINDOWS WITH CAMERA SUPPLEMENTS.
5. FEEDER SHOWN ON THIS PFD IS THE SAME AS FEED-404 ON PFD-2.
CONTROLS:
1. OVERHEAD CRANE CONTROL
2. SHIELDED TRANSPORTER CONTROL
3. CANISTER GRAPPLE OPEN/CLOSE
4. AIRLOCK "FORE" DOOR SWITCH
5. CANISTER "MOVE" IN/OUT SWITCH
6. AIRLOCK "AFT" DOOR SWITCH
7. PACKAGING CELL OVERHEAD PAR CONTROL
8. CANISTER TRAY CLAMP CONTROL (4 EA)
9. INSPECTION CAMERA PAN, TILT, ZOOM (4 EA)
10. FEEDER "FILL" VALVE CONTROL (3 EA)
11. FEEDER "EMPTY" VALVE CONTROL (3 EA)
12. HEAT SEAL CONTROL
13. SURFACE SWIPE EQUIPMENT CONTROL
14. TRAY ROTATE CONTROL
15. ANALYZE SURFACE SWIPE CONTROL
16. DECON EQUIPMENT CONTROL
17. DOSE RATE COUNTER CONTROL
18. TRANSPORTER "CASK LID" CONTROL
SENSORS:
A. CRANE LOAD WEIGHT
B. TRANSPORTER LOAD WEIGHT
C. CANISTER PRESENT
D. CANISTER GRAPPLE OPEN/CLOSE
E. AIRLOCK "FORE" DOOR OPEN/CLOSE SWITCH
F. AIRLOCK "AFT" DOOR OPEN/CLOSE SWITCH
G. "FORE" CANISTER LOCATION SWITCH
H. "AFT" CANISTER LOCATION SWITCH
I. PACKAGING CELL OVERHEAD PAR SENSORS
J. CANISTER CLAMP OPEN/CLOSE (4 EA)
K. FUNNEL SEAL ATTACHED (4 EA)
L. FEEDER "FILL" VALVE OPEN/CLOSE (3 EA)
M. FEEDER "EMPTY" VALVE OPEN/CLOSE (3 EA)
N. HEAT SEAL CLAMPED
O. HEAT SEAL ON/OFF
P. SURFACE SWIPE EQUIPMENT SENSOR
Q. SURFACE SWIPE ANALYSIS SENSOR
R. TRAY ROTATE SENSOR
S. DECON EQUIPMENT SENSOR
T. DOSE RATE COUNTER SENSOR
U. TRANSPORTER "CASK LID" POSITION
SUBCONTRACT NO.
INEEL Idaho National Engineering & Environmental Laboratory BECHTEL BWXT IDAHO, LLC
REQUESTER:
DESIGN: K. CROFT
DRAWN: JACKSON
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO
EFFECTIVE DATE:
STEAM REFORMER PRODUCT WASTE PACKAGING
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA TYPE CL ORIG 090
DWG-PFD-4
REV
SCALE: NONE
SHEET 1 OF 1

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A-5. PROCESS BASIS

A-5.1 Requirements

A draft Technical and Functional Requirements (TFRs) document has been prepared for the steam reforming option (Beitel 2003). The requirements pertinent to the process design are restated here; other requirements, justifications, and the bases for requirements are given in the TFRs document. That document should be consulted for additional details.

A-5.1.1 System Requirements

A-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.

A-5.1.1.2 Prepare Feed for Treatment. The system shall provide for the addition and mixing additives needed to support production of acceptable waste products and maintaining a uniform suspension of SBW solids in the liquids feed.

A-5.1.1.3 Treat Waste. The top-level requirements for waste treatment are given below.

- Volume: The facility shall be capable of treating at least 1.2 million gallons of waste.

- Throughput: The facility shall be capable of processing all SBW (including solids, liquid and designated NGLW) within 3 years. This 3 years includes 6-months of hot start-up and 2.5 years of SBW/NGLW treatment.

- Location: The waste shall be treated and packaged at the INEEL, within the Idaho Nuclear Technology and Engineering Center (INTEC) security enclosure.

- Reformer product: The solid waste product from the reformer shall comply with the remote-handled transuranic waste acceptance criteria (WAC) for WIPP.

    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. If these radionuclides 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.

    2. 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.

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

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

    5. 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.

6. The loaded payload container shall contain no detectable liquid.

7. The hydrogen gas generation rate within each payload container shall not exceed the limit specified in the applicable content code.

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

9. Concentrations of flammable volatile organic compounds (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.

10. The RH-TRU waste shall be placed in a WIPP approved RH-TRU waste canister.

11. The gross weight of a direct loaded RH-TRU canister shall not exceed 5250 lb.

12. Surface contamination on loaded RH-TRU payload containers, payload assemblies, and packages shall not exceed 20 dpm/100 cm^2 alpha and 200 dpm/100 cm^2 beta-gamma.

- *Off-gas emissions:* The off-gas must be treated to meet MACT emission standards and Prevention of Significant Deterioration (for NO_x emission) levels as shown in Table A-1. Monitoring to demonstrate compliance with the MACT standards shall be performed. NO_2 must be controlled to prevent a visible plume when the off-gas exits the facility stack. Radionuclides in the stack release must also meet provisions of 40 CFR 61 Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from DOE Facilities."

- *Grouted scrub product:* The grouted scrub waste product shall comply with the WAC of its disposal site.

- *Other secondary wastes:* All secondary wastes shall have an acceptable disposal option. Liquid secondary wastes will be either combined with the feed and incorporated into the primary waste product, or stabilized and disposed of as a solid waste.

- *Package waste product:* The treated waste shall be transferred to a remotely operated packaging station. The waste product packaging station shall have adequate bulk waste product storage capacity to accept the maximum steam reformer product output in the event of a loadout problem to avoid shutting down the steam reformer. All transuranic wastes will be sent to WIPP for disposal. Facilities will be provided to transfer certified payload containers to WIPP-supplied transport vehicles. This project will be responsible to load the waste into approved transport casks and prepare those casks for shipment. WIPP will be responsible for providing the casks, trucks, drivers, and receipt of the waste at WIPP in Carlsbad, Mew Mexico.

    1. RH-TRU waste shall be shipped in a RH-TRU 72-B cask.

    2. The maximum number of payload containers in a RH-TRU 72-B cask is one.

    3. The maximum weight of a loaded 72-B cask is 45,000 pounds.

4. Sufficient lag storage of RH-TRU waste shall be provided in order to meet WIPP requirements for waste qualification and shipping/receiving rates.

5. 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 transporter.

6. One of the cask loading facilities shall have the capability to wash road grime from the transporters and shipping casks prior to moving into the loading area.

Table A-1. Off-gas emission and rate limits.

Hazardous Air Pollutant	MACT Emission Standard For New Sources Corrected to 7 percent oxygen	PSD Emission Rate (ton/yr)
Dioxin/furan	0.20 ng TEQ/dscm; TEQ is the toxicity equivalent quotient that relates the toxicity of various dioxin/furan congeners to the toxicity of 2,3,7,8-TCDD.	
Mercury	45 µg/dscm	0.1
Particulate matter	34 mg/dscm (0.015 gr/dscf)	25
Semi volatile metals (cadmium and lead)	120 µg/dscm	0.6 (Pb)
Low volatile metals (arsenic, beryllium and chromium)	97 µg/dscm	0.0004 (Be)
Hydrochloric acid and chlorine gas	21 ppmv	
Hydrocarbons or CO	10 ppmv reported as propane – facilities that elect to continuously comply with the carbon monoxide standard must also demonstrate compliance with the hydrocarbon standard during comprehensive performance testing	100
DRE	99.99% for each principal organic hazardous constituent (POHC) designated	
NO_x	Not Applicable	40
Fluorides	Not Applicable	3

Notes: µg = microgram; DRE = destruction removal efficiency; ppmv = parts per million by volume; ng = nanogram; dscm = dry standard cubic meter; dscf = dry standard cubic foot; gr = grains.

A-5.1.1.4 ***Close Facility.*** The following requirements apply to facility closure:

- All connections between the steam reformer and the tank farm, and any reliance on the tank farm, shall be terminated prior to December 31, 2012.

- Prior to December 31, 2012, the steam reformer and the off-gas treatment subsystem shall be placed in safe shutdown and have all hazardous waste and hazardous waste residues removed and prepared for acceptable disposal.

- The Packaging, Certification, and Transfer subsystems shall be placed in standby following treating all SBW and NGLW wastes.

A-5.1.2 Systems, subsystem, and major components

The steam reforming treatment facility shall utilize major support systems and utilities that are available at the INEEL. These include:

- Analytical services.

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

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

- Steam

- Telephone

- Optical cable

- Security

- Medical

- Radiation records

- Central Facilities maintenance

- Document control

- Configuration management

- 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.

- Roads

- Bus transportation.

A-5.1.3 Boundaries and interfaces

This system may be constructed using some existing structures, systems, and components within INTEC. When completed and operable it will reside wholly within the INTEC security fence.

A-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 SBW shall be contained in Tanks WM-180, WM-187, WM-188, and WM-189, and NGLW in WM-100, WM-101 and WM-102. Any modifications necessary to retrieve the SBW liquids and solids from these tanks will be the responsibility of this project.

A-5.1.3.2 Utility Interfaces. Interfaces include the following:

- 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.

- The project shall tie in to the existing INTEC steam distribution piping at an appropriate location adjacent to the facility. If supplemental steam is required, electrical steam generation is preferred to avoid air permitting issues related to direct fired steam boilers.

- 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.

A-5.1.3.3 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 300,000-gallon Tank Farm tanks WM-180 through 190. The Tank Farm Closure 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 Tank Farm Facility (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.

A-5.1.3.4 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.

A-5.1.3.5 SNF, NSNFP, and Calcine Disposition. The Steam Reformer SBW Treatment Project shall interface with the Spent Nuclear Fuel (SNF), National Spent Nuclear Fuel Program (NSNFP), and Calcine Disposition Project to ensure that waste product handling systems either interface with, or do not interfere with, calcine handling systems planned or required by the SNF, NSNFP, & Calcine Disposition Project.

A-5.2 Assumptions

Process designs considered for the SBW treatments have been based on the following major assumptions. Additional assumptions used in the mass balance are identified in Section A-5.4.

- The SBW, both liquids and solids, and NGLW to be treated are not HLW.

- The reformer waste can be qualified for disposal at the WIPP.

- The existing INTEC evaporators (Process Equipment Waste Evaporator and Evaporator Tank System) and the Liquid Effluent Treatment and Disposal (LET&D) acid fractionator will be available for use if needed to process decontamination solutions and other dilute aqueous wastes from the steam reformer process.

- The grouted scrub waste can be disposed of at a mixed low-level waste disposal site such as Hanford or Envirocare provided that the waste meets the site's WAC.

- Toxic Substance Control Act regulations do not apply.

- MACT or equivalent emission standards will apply.

- The facility will not require Nuclear Regulatory Commission (NRC) licensing.

A-5.3 Process Variations

Numerous variations of the steam reforming process or unit operations within the process are possible, including processes with different:

- Types or modes of operation of the reformer,

- Feed and reformer additives,

- Off-gas treatment unit operations

- Methods of processing secondary waste, including any off-gas scrub wastes

- Methods of collecting, handling and packaging the reformer product.

Both the TTT and TWR processes use fluidized bed reformers. Other types of reformers could be used, such as a moving bed or a gas-phase reactor. The TTT and TWR processes use different fluidization gases, operate at different temperatures, and utilize different methods of achieving the reformer operating temperature. Other differences in operation of a given reformer are possible as well.

Much of the testing of the TTT and TWR processes with SBW simulants has concerned determining and optimizing combinations of feed ingredients and reformer process conditions suitable for treatment of SBW. This optimization is not complete and would need to be done for any steam reforming process. TTT has alternate feed formulations wherein various mineral-forming materials are used in addition to the reductants, with the result that the product characteristics are modified. Tests of steam reforming at Hanford used various reductants such as methane, hydrogen, and ammonia, in addition to sucrose, for reducing nitrates in a fluidized bed reactor configuration (Stegen 1996).

Pretreatment or multiple stage reactors form another set of treatment variations of the steam reforming process. For example, D. Siemer has proposed evaporation of the SBW with an organic such as glycolic acid, followed by a fluidized bed reactor (Siemer 2003). In Siemer's proposed process, the bed is fluidized in part with recycled off-gas, which is primarily steam, but also contains CO_2.

The off-gas treatment system shown on PFDs-3A and -3B is largely based on that used at the NWCF – a wet scrub solution is used to remove a large portion of the off-gas mercury. A dry off-gas system may be possible where only enough water is sprayed into the off-gas to reduce its temperature sufficiently to allow downstream treatment operation. Thus all introduced water is vaporized in the off-gas stream. To effect mercury removal, the gas would then be passed directly to GAC beds. The attraction of this system is that no spent scrub solution would be generated and therefore, a waste stream would be eliminated and the treatment system simplified. However, there have been no demonstrations or published information that indicates that the GAC system can achieve the required mercury removal to meet the MACT emission limits in this manner (Soelberg 2003).

Another variation in off-gas treatment could be the location and type of oxidation unit. Placing the oxidation unit near the reformer eliminates or reduces the need to reheat the off-gas and favors a thermal oxidizer. If placed downstream of reformer off-gas cleanup, the oxidizer is in a much lower radioactive environment, processes a cleaner stream, and could possibly operate at a lower temperature and with a catalyst.

Testing to date of steam reforming for SBW has focused mostly on the reformer and off-gas treatment sections of the process. Once these are well defined, the requirements for treating secondary wastes can be better determined. Depending on how mercury partitions in the off-gas scrub operations, it may be possible to recycle scrub blow down to the reformer and eliminate the scrub waste. Or alternatively mercury could be removed from the blow down by one of several methods and the scrub recycled to the scrubber with a blow down to the reformer. Whether this is economical depends in part on the radionuclides that get carried into the scrub, which ultimately affect the cost of disposal of a grouted scrub and the cost of additional scrub treatment steps.

Because all product handling and packaging operations are remote, they contribute significantly to the cost and complexity of the facility. The low density of the product suggests an economic benefit to densifying it to reduce the total volume of waste. Various methods of densifying the product are possible, but none have been tested to date. Likewise different concepts for packaging the waste have not yet been adequately defined and evaluated to determine an optimum system.

A-5.4 Basis for Process Flow Diagrams

The following documents and data formed the basis upon which the PFDs were generated:

- The Technical and Functional Requirements, which provided the overarching goals and identified the high level requirements of the design (Beitel 2003).

- The bench-scale demonstration tests of TTT and TWR, which identified the major unit operations, feed constituents, and process flows.

- Process experience and data from calcine operations at NWCF, which in particular, provided information on the off-gas scrubbing system, and design studies for an upgraded NWCF MACT-compliant SBW treatment facility.

- Results of process simulations using ASPEN Plus.

A-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 are all existing tanks and currently in use. New mixing pumps would be installed in VES-WM-187, VES-WM-188 and VES-WM-189 to distribute solids evenly between these three tanks. The basis for the number of pumps (3 per tank) and the blending scenario is documented in a tank heels processing report (Wood 2002).

A follow-on study evaluated different mixing pumps and recommended submersible pumps over long shaft pump technology (Morrell 2003). Both studies recommend mockup testing of the mixing pumps. Mockup testing is needed to confirm and further define the basis for the mixing pumps and to verify performance. Based on present estimates of total tank solids, it is anticipated that new pumps will be required in three tanks. If future tank samples indicate the total solids are significantly less than current estimates, pumps would only be installed in two tanks.

A-5.4.2 Feed Preparation and Steam Reforming (TTT) (PFD-2A)

PFD-2A shows the feeds to the reformer, along with the reformer itself and the sintered metal filter on the reformer off-gas. The basis for this section of the process is technology developed by TTT, and demonstration tests in 2003 applying this technology to the treatment of SBW (Marshall 2003b, Soelberg 2004a). One unit operation shown on PFD-2A has not been tested relative to SBW waste treatment – the product densifier. FY 2003 tests, performed on SBW surrogate, showed that the product from the cyclone, contributing 53 wt % to the total product, had a loose density of 0.24 g/cm^3 and the product from the filter, contributing 20 wt % of the total, had a loose density of 0.14 g/cm^3 (Marshall 2003b). Tamping increased the density for both of these products to 0.39 g/cm^3 (Marshall 2003b). Without densification the number of product canisters would increase by a factor greater than 4.

A-5.4.3 Steam Reforming (TTT) Off-Gas and Scrub Treatment (PFD-3A)

FY 2003 SBW steam reforming demonstration tests (Marshall 2003b, Soelberg, 2004a) showed reformer off-gas contained about 1-2% CO. A thermal oxidizer is shown on PFD-3A to reduce the CO concentration, as well as methane and other hydrocarbons, to acceptable levels for release to the atmosphere. The FY 2004 SBW steam reforming demonstration tests included a thermal oxidizer as shown on the PFD. Oxygen rather than air is added to the oxidizer unit to minimize the total volumetric rate of off-gas.

The quench tower and subsequent off-gas treatment unit operations are largely based on the NWCF off-gas treatment system. However a packed bed scrubber is shown on the PFD rather than the venturi scrubber of the NWCF system, and a GAC bed is included for additional mercury removal. As discussed in Section 2.2.6, the venturi scrubber on the NWCF system is primarily a particulate removal device, whereas the steam reforming off-gas is expected to have a low particulate loading. A packed bed scrubber is expected to be more efficient removing the acid gas species expected in the steam reformer off-gas. The GAC bed is required to remove mercury to below MACT emission limits. The design of the GAC bed is based on the design of a GAC bed for an upgraded NWCF MACT-compliant SBW treatment facility (Soelberg 2003).

The scrub blow down treatment equipment shown on PFD-3A is based in part on data from the FY 2003 and FY 2004 demonstration tests (Marshall 2003b, Marshall 2004) and in part on the design of similar equipment for an upgraded NWCF MACT-compliant SBW treatment facility (Barnes 2003a).

A-5.4.4 Steam Reformer Product Waste Packaging (PFD-4)

PFD-4 shows steps to package reformer product into waste canisters, load canisters into casks, and casks onto the transport truck. These steps are a summary of a preliminary concept developed for packaging calcine (Clark 2003).

A-5.4.5 Basis for TWR PFDs (PFD-2B and PFD-3B)

The TWR PFDs are primarily based on demonstration tests performed in FY 2003 and FY 2004. These tests sought to optimize feed additives and reformer operating parameters. The TWR process has a liquid organic feed rather than the solid used in the TTT process, so it requires a feed additive tank rather than a hopper. The TWR process has at most one solid additive, polyethylene, rather than the two solids (reductant and possibly catalyst) added in the TTT process, so it has one less solid hopper than TTT. Although polypropylene was not used in the latest demonstration test, the contingency to add it has been maintained in the flow diagram.

The TWR flowsheet uses carbon dioxide gas as the primary fluid as it provides fluidization of the bed, atomization of the feed, pneumatic fluid for the injection cell, and pulsing gas for the sintered metal filter. As for the TTT flowsheet, oxygen and propane are used as feeds to the off-gas oxidizing unit.

Carbon dioxide, oxygen and propane are available as low temperature liquids stored under pressure at near their boiling points. As liquids they are transported in cryogenic tank trailers or railroad cars. On-site storage tanks are designed to minimize boil-off of the liquid and typically consist of a storage contained within another tank. The annular space between tanks is evacuated and filled with an insulating material. Properly designed, the boil-off rates can be very low.

An alternative to receiving liquefied carbon dioxide from a vendor is to produce it on-site. Carbon dioxide can be derived from directly combusting a fuel such as from the INTEC boiler off-gas; however, the most economical way to produce carbon dioxide is usually to recover it as a byproduct from other companies' manufacturing processes or from natural wells. An engineering study to evaluate on-site production versus purchasing/storing carbon dioxide should be performed to determine the most economical CO_2 source.

A-5.5 Basis for Mass Balances

Mass balances were developed for the Steam Reforming alternative 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. Sections A-5.5.1 through A-5.5.10 apply to the TTT process mass balances and to elements that are common to both the TTT and TWR processes. Unique aspects of the TWR process are discussed in Section 5.5.11

Results from the Phase 2 SBW treatment demonstration tests of the TTT and TWR processes (Soelberg, 2004a; Soelberg, 2004b) were used extensively in defining input to the mass balance models. The Phase 2 TTT tests included two major series – those producing a carbonate product and those producing a mineralized product. For SBW treatment, the carbonate product is assumed and hence results from only the carbonate tests were used as a basis for the TTT mass balances in this Appendix.

A-5.5.1 Feeds

Feeds to the Steam Reforming process include NGLW and SBW from the INTEC TFF.

A-5.5.1.1 Tank Farm Waste Feeds. According to Tank Farm management plans (Barnes 2002), 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. Shortly before treatment, transfers will be made between tanks to distribute solids that have been collected in WM-187 between the three tanks WM-187, WM-188 and WM-189.

DBE #1: Solids that have been collected in Tank WM-187 will be distributed between Tanks WM-188, WM-189 and WM-187 by waste transfers between these tanks prior to feeding to the treatment process.

Pumps will be installed in these three tanks to homogeneously mix the solids with the tank liquid. Approximately equal amounts of waste from WM-188 and WM-189 will first be transferred to Tank WM-187, and then similar volumes of the mixed solids/liquid slurry in WM-187 will be returned to Tanks WM-188 and WM-189 to restore these tanks to their full capacity. The referenced reports describe the tank-blending scenario in more detail (Wood 2002, Barnes 2003b). Mass balances are shown in Section 2.6 for four feed cases. The feed cases correspond to present estimates of waste quantities and compositions that would be transferred from Tanks WM-180, WM-187, WM-188 and WM-189 after waste in these tanks is blended. The WM-187 mass balance case represents a blend of the waste in WM-187, after transfers to Tanks WM-188 and WM-189, with NGLW. Whether the NGLW is added to WM-187 or sent directly from WM-100, WM-101 or WM-102 to the SBW Treatment Facility feed tanks is of no consequence to the mass balance.

DBE #2: Four waste compositions, corresponding to waste in Tanks WM-180, WM-188, WM-189 and a combined residual in WM-187 plus NGLW, are assumed to adequately envelope the waste fed to the SBW Treatment Facility for conceptual design purposes.

Table A-2 shows the variability of feed composition between the tanks for major species. Additional variation in feed composition is possible due to: (1) uncertainties in sample analyses, (2) uncertainties in the amount of waste solids in the feed, (3) uncertainties in solids composition, (4) uncertainties in NGLW quantity and composition, and (5) potential changes in the tank mixing or management scenario. The magnitude of some of these uncertainties is known or can be estimated, and is generally within the range shown in Table A-2. Feed composition uncertainties and expected composition ranges are discussed in more detail in the referenced report (Barnes 2003b).

Table A-2. Feed concentration variations.

	Minimum	**Maximum**	**Max/Min**
H+	1.07E+00	2.42E+00	2.27
Al+3	3.34E-01	6.07E-01	1.82
B+3	1.00E-02	1.83E-02	1.82
Ca+2	3.20E-02	6.13E-02	1.92
Cs+	2.57E-05	7.37E-05	2.86
Cl-	1.62E-02	2.86E-02	1.76
Cr+3	3.36E-03	5.14E-03	1.53
F-	3.32E-02	4.98E-02	1.50
Fe+3	1.92E-02	2.97E-02	1.54
Mg+2	1.10E-02	1.94E-02	1.76
Hg+2	1.46E-03	5.44E-03	3.73
NO_3-	4.93E+00	6.63E+00	1.34
PO_4-3	1.95E-02	1.46E-01	7.50

	Minimum	Maximum	Max/Min
K+	1.76E-01	2.84E-01	1.61
Na+	1.36E+00	1.89E+00	1.39
SO_4-2	4.04E-02	9.08E-02	2.25
Zr+4	1.32E-03	5.58E-02	42.17

A-5.5.1.2 Chemical Feeds. In the TTT process, sucrose is dissolved and blended with the SBW prior to injecting this feed into the reactor. Additional carbon, in the form of activated carbon, is added directly to the reactor. The carbonaceous materials promote reduction of the nitrates to nitrogen, and convert mineral-forming species, such as sodium, aluminum, and potassium, to non-agglomerating solids. It is expected that in the full-scale treatment facility alumina would be added at the beginning of operations and during shutdowns or for off-normal conditions, and function as an inert bed material.

DBE # 3: Sufficient sucrose is added to the feed to result in a carbon to nitrate mole ratio of 2.7.

The sucrose carbon-to-nitrate mole ratio of 2.7 is based on late 2003 bench-scale testing of the TTT flowsheet, specifically tests 3.3 and 3.4 (Soelberg, 2004). Other tests used sucrose to nitrate ratios of 0 to 4.0. The tests showed that sugar ratios lower than 2.7 are feasible with at least partial compensation with increased carbon; however, the low sugar tests were of comparatively short duration.

DBE #4: Sufficient carbon is be added to the bed to result in a carbon to nitrate in the feed mole ratio of 2.6.

The solid carbon addition rate is based on that used in tests 3.3 and 3.4 of Phase 2 testing of the TTT process (Soelberg, 2004).

DBE #5: Alumina will be used as the starting bed media, with bed media addition assumed to be equal to 0.01 wt fraction of the solid product during operation.

For the TTT mass process, the starting bed media is alumina. During the SBW steam reforming demonstration tests in January 2003, additional bed was added at a rate of about 0.04 kg alumina per kg of product collected during the test (Marshall 2003b). Typically, bed media will only be added at startup and for process upsets, so less bed media will be required for full-scale operation and a value of 0.01 is assumed for the model. Future testing may provide a different value for bed media usage.

DBE #6: No addition of solid catalyst is needed for the TTT process.

The first series of tests of SBW treatment using the TTT process utilized a solid catalyst to promote NO_x destruction (Marshall 2003b). Tests were successful in the second series (Soelberg, 2004) with no catalyst. Based on the results of the second test series, the mass balances assume no addition of solid catalyst.

A-5.5.1.3 Fuels. Two fuels are required in the TTT process. The steam boiler will use fuel oil to generate high temperature steam for the process and the oxidizer will use propane to boost the heating value of the steam reformer off-gas. Addition of propane to the oxidizer will allow operation at a temperature of about 1000oC to ensure destruction of organics and oxidation of CO in the reformer off-gas stream.

DBE #7: Fuel oil will be fed to the steam boiler at 42-45 gph based on a required steam flow rate of 2640-2860 lb/hr.

The fuel oil consumption was calculated assuming combustion with air in a boiler to produce 30-psig steam for fluidizing gas for the steam reformer. It was assumed that a recuperator in the boiler off-gas would be used to superheat the steam to the bed temperature of 670^{o}C.

DBE #8: Propane is fed to the oxidizer at a rate of 34-35 lb/hr to boost the heating value of the reformer off-gas to obtain an oxidizer temperature of 1000^{o}C and ensure 99.9% destruction of organics and CO in the off-gas.

The reformer off-gas has some heating value due to its methane, hydrogen and CO content; however, additional fuel will be needed to boost the oxidizer temperature to 1000^{o}C. The oxidizer will use propane to boost the heating value of the steam reformer off-gas such that a temperature of 1000^{o}C can be reached in the oxidizer. This temperature is recommended for destruction of organic species, while minimizing formation of thermal NO_x. In addition, a residence time of 1 to 2 seconds in the oxidizer is needed to ensure adequate organic destruction. Propane was selected as the multi-stage combustor fuel because of: (1) availability, (2) ease of storage and handling, (3) purity, i.e., lack of sulfur present in alternate fuels, and (4) lack of higher hydrocarbons to ensure that the fuel does not add new organic compounds to the off-gas.

A-5.5.1.4 Oxygen and Nitrogen. Oxygen is used rather than air as feed to the oxidizer to minimize the increase in volume of off-gas and to minimize total mass flow of gas to heat up to the oxidizer temperature of 1000°C.

Nitrogen is used to atomize the feed in the reformer, and also to purge process lines upstream of the oxidizer as this piping may contain combustible levels of H_2 and CO. Nitrogen will also be used for direct cooling of the steam reformer product in the collection hopper.

DBE #9: Oxygen will be fed to the steam reformer with the fluidizing steam at a rate of about 320-400 lb /hr.

Oxygen is fed to the steam reformer with the fluidizing steam to partially oxidize the organic reductant and carbon feeds. This provides the heat to evaporate the water in the feed and provide energy for the endothermic steam reforming reactions. For the bench-scale tests, the oxygen was adjusted to maintain temperature. The oxygen input for the ASPEN model was adjusted to match the off-gas CO/CO_2 ratio of 0.164 mol/mol measured during the Phase 2 bench scale tests (Soelberg, 2004). When this was done, the predicted hydrogen concentration in the reformer off-gas was close to the value of about 4% hydrogen measured during the tests. This value and the carbon input will have to be varied to balance heat loss from the vessel with the desired hydrogen concentration in the reformer off-gas.

DBE #10: The mass balance assumes a rate of 278-300 scfm of nitrogen for feed atomization in the feed nozzles.

During the Phase 2 tests, the nozzle atomizing air to feed ratio (NAR) was increased in stages from 500 in early tests to 1100 in later tests. The higher ratios were used in the tests to help maintain fluidization of the bed. For the mass balance, the average of these two values was assumed. It is expected that during production the buildup of bed material can be controlled, although this has not yet been demonstrated.

A-5.5.1.5 Fluidizing Gas. Steam preheated to 670°C is used to fluidize the bed media in the steam reformer. Based on the Phase 2 SBW demonstration tests (Soelberg, 2004), the mass balance assumes a fluidizing gas to SBW mass ratio of 2.75. During the Phase 2 tests, the steam rate was increased in stages because of the growth of bed particles. For production, it is expected this growth can be controlled. The rate used for the mass balance is an average of the initial and final steam rates used in the Phase 2 tests.

DBE # 11: The mass balance assumes a rate of fluidizing steam to the steam reformer of 2.75 times the mass rate of SBW, or 2640-2860 lb/hr.

A-5.5.2 Stream Factor, Operating Schedule and Feed Rate

The Technical and Functional Requirements (Beitel, 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 average feed rate is thus:

1,062,000 gal / (2.5 yrs * 200 d/yr * 24 hr/day) = 88.5 gal/hr or 1.5 gal/min

DBE #12: The total SBW waste inventory will be processed over 2.5 years, during 200 24-hr operating days per year and an average feed rate of 1.5 gpm.

A-5.5.3 Tank Mixing and Feed Transfer from Tank Farm

In an evaluation of options for processing solids in the calciner, it was recommended to mix the solids in the INTEC TFF tanks (Wood 2002, Morrell 2003). This recommendation is equally valid for steam reforming. The concept of mix pumps in the tanks was taken from an earlier conceptual design for tank heel removal (ICF Kaiser 1995). While mock-up tests are recommended to validate the effectiveness of this mix scheme, the studies by Wood and Morrell included an assessment of mixing pump performance and issues (see Section 3 of Wood).

Transfers of waste to the treatment facility will be made using existing steam jets. The mass balance assumed that the volume of waste increases by 5% due to steam used in the jets. This increase is based on past transfers of waste to the NWCF.

DBE #13: Mix pumps installed in TFF tanks are assumed to keep solids uniformly distributed throughout the tank waste. Waste will be transferred to the treatment facility using existing steam jets, diluting the waste by 5%.

SBW from the TFF will contain solids up to about 50 g solids per liter. The SBW is received and blended with scrub recycle and feed additive solutions in the feed tanks, and then transferred to the reformer.

DBE #14: Scrub recycle will be blended with SBW and feed makeup chemical solutions in the feed tanks such that the scrub solution portion of the steam reformer feed is equivalent to 5% of the SBW volumetric feed rate.

Solids buildup in the acid scrub is slow due to the efficient capture of non-volatiles by the sintered metal filters (also called candle filters). A small amount of acid scrub is purged to the reformer in order to minimize the about of scrub blow down that needs to be treated for disposal. The acidity in the scrub tank continuously decreases due to dissolution of solids. Fresh 13 M HNO_3 is added to maintain an acidity of at least 1 molar to ensure partial dissolution of mercury in the scrub. Scrub solution is recycled to the steam reformer at a rate equivalent to 5 vol % of the SBW feed. A nominal recycle of 5 vol % of the feed was chosen to purge dissolved solids from the scrub system. This flow rate is small (~0.05 wt %) compared to the scrub recirculation flow.

DBE #15: Air sparging is used to keep solids in feed tanks uniformly suspended in the reformer feed.

Air sparging has been used effectively at INTEC to keep solids suspended in scrub at the NWCF, and based on this experience, this should be adequate for keeping solids in suspension in the steam reformer scrub tank.

A-5.5.4 Steam Reforming

A-5.5.4.1 Normal Operating Conditions. All Phase 2 carbonate tests were conducted at a nominal reformer bed temperature of 670°C, and hence this temperature was assumed for the mass balances.

DBE # 16: The normal operating temperature of the TTT steam reformer will be 670°C.

Based on a 2.5-yr operating schedule, an average 200 operating days per year, and 24- hrs/day operation, the required SBW feed rate is 88.5 gph. Including scrub recycle (see DBE-14) and sugar (DBE-3), the rate of total feed to the reformer is 132-137 gph.

DBE # 17: The blended feed rate to the reformer is 130 gph.

The steam reformer will be operated under vacuum to control contamination, and the reformer will be at local atmospheric pressure at the distributor. For a bed depth of 3.5 ft (equal to the bed diameter) and a fluidized density of 1.0 to 1.8 (density of Na_2CO_3 vs. startup bed material), the pressure drop through the bed will be 42 inches water column (w.c.). Thus, 42 inches w.c. vacuum will be required in the SR vessel above the bed. Vacuum will be increased briefly during nozzle change-outs or bed addition.

DBE # 18: The Steam reformer vessel will be operated at a vacuum of 42 inches w.c.. Atmospheric pressure at INTEC is 12.27 psia.

A-5.5.4.2 Steam Reforming Chemistry. The steam reformer operates at conditions that vaporize the feed and provide reducing conditions favorable for decomposition of sodium nitrate and other metal nitrates and for reduction of NO_x in the off-gas. Metal nitrates in the SBW decompose at the high temperature in the steam reformer to produce metal oxide and/or carbonates and NO_x. The gaseous NO_x then reacts with H_2, CO, and organics to produce nitrogen, H_2O, and CO_2.

Partial oxidation of the sucrose and solid carbon additive generates CO, CO_2, and H_2O while providing heat to drive the endothermic reforming reactions. The partial oxidation also produces small amounts of products of incomplete combustion.

Steam reforming of the organic feeds in the reformer produces H_2, CO, and CO_2. The carbonaceous process additives (sucrose and carbon) facilitate decomposition of nitrates in the SBW feed, and reduction of NO_x to elemental nitrogen. The pyrolized sucrose and carbon react with the process steam to produce carbon monoxide and hydrogen gas via the water-gas reaction:

$$C_S + H_2O \rightarrow CO + H_2 \qquad (18)$$

A significant portion of the carbon monoxide subsequently reacts with other gaseous species. Examples of this are the water-gas shift reaction that forms hydrogen, the methanation reaction, and reactions with NO_x to form nitrogen gas.

$$\begin{aligned} CO + H_2O &\rightarrow CO_2 + H_2 \\ CO + 3H_2 &\rightarrow CH_4 + H_2O \\ CO + NO_2 &\rightarrow CO_2 + NO \\ CO + NO &\rightarrow CO_2 + \tfrac{1}{2}N_2 \end{aligned} \tag{19}$$

Hydrogen is believed to be more effective in reducing NO_x to elemental nitrogen than CO although reactions with intermediate sugar pyrolysis products may also contribute significantly to NO_x destruction. Examples of the hydrogen reactions are as follows:

$$\begin{aligned} H_2 + NO_2 &\rightarrow H_2O + NO \\ H_2 + NO &\rightarrow H_2O + \tfrac{1}{2}N_2 \end{aligned} \tag{20}$$

A-5.5.4.3 Reformer Product. In the Phase 2 SBW demonstration tests, bed product, as well as fines from the cyclone and sintered metal filter were collected and analyzed. The results of these analyses were used to define separation factors by chemical specie for input into the mass balance model. These separation factors are shown in Table A-9 (see Section 2.6.2). Based on these factors about 58% of the total product will be from the bed and the remainder from the filter. The mass balance shows a total product rate of 146-175 lb/hr.

DBE # 19: Separation factors input in the mass balance model result in a product rate of 146-175 lb/hr.

DBE # 20: The mass balance model shows that about 58% of the total reformer product is from the bed and the remainder from the filter.

A-5.5.5 Solids Removal

A-5.5.5.1 Cyclone. Solids separated by the cyclone were recycled to the reformer bed. This achieves more complete utilization of carbon than if the cyclone solids were collected with the product material. Based on individual specie separation factors shown in Table A-9, the overall cyclone solids removal efficiency is about 62%.

DBE # 21: The mass balance shows an efficiency of 61-62% for the cyclone.

DBE # 22: The cyclone fines will be continuously recycled to the bed at a rate of about 100 lb/hr.

DBE # 23: The mass balances assume a 5 inches w.c. pressure drop across the cyclone.

A-5.5.5.2 Sintered Metal Filter. The temperature of the sintered metal filter in the Phase 2 TTT demonstration tests (Soelberg, 2004) was 986°F (530°C), and this temperature was assumed for the mass balances. A temperature of 747°F (400°C) at the sintered metal filters is specified by the vendor to capture semi-volatile metals while preventing mercury from condensing and plugging the filters. During the demonstration tests, the temperature drop between the reformer, cyclone and sintered metal filter did not reduce the temperature as much as planned (actual heat loss was less than predicted). Heat loss is expected to be less for a larger scale system, so it is expected that a cooler will be required to reduce the temperature prior to the sintered metal filters.

DBE # 24: An off-gas cooler will be necessary to drop the off-gas temperature to 747°F (400°C) before the filter vessel. However, the mass balance, consistent with Phase 2 demonstration test results, assumes a filter temperature of 530°C.

Capture of solids and chemical species by the sintered metal filter is based on the Phase 2 demonstration test results as shown in Table A-9.

DBE # 25: The mass balance assumes non-volatile solids removal by the sintered metal filters of 99.85% and a cesium removal of 99.9% for the sintered metal filters.

DBE # 26: The filter fines will all be continuously drained at a rate of 62-74 lb/hr.

Pressure drop across the sintered metal filters is estimated at 20 inches w.c. The pressure drop during the short demonstration tests was less, but it was assumed the filter pressure drop would increase with on-line time.

DBE # 27: The mass balances assume a 20 inches w.c. pressure drop across the sintered metal filters.

A-5.5.6 Oxidizer

Demonstration tests of staged combustion using NWCF simulated off-gas were performed in 2000-2001 (Wood 2000, MSE 2000, MSE 2001) and form much of the basis for the mass balance around the combustor. The Phase 2 TTT demonstration test scheme also included an oxidizer. Based on the Phase 2 tests, the mass balance assumed an oxidizer temperature of 1742°F (950°C). This temperature is sufficient for the destruction of residual H_2, CO and hydrocarbons to the required emission limits while minimizing thermal NO_x formation from oxidization of N_2. Lower temperatures may not result in complete oxidation, while higher temperatures can lead to thermal NO_x formation. The oxidizer is modeled by the Gibbs routine in ASPEN. As such, the model calculates equilibrium for CO, NO and NO_2 in the reactor. Based on test data the model results for NO_x destruction should be viewed as approximate only.

DBE # 28: The mass balance assumes an oxidizer exit temperature of 1742°F (950°C) in the reduction chamber of the multi-stage combustor.

The pressure drop through the oxidizer vessel was assumed to be low (3 inches w.c.) since it is has no internals to restrict flow.

DBE # 29: The mass balance assumes a pressure drop of 3 inches w.c. through the oxidizer.

The oxidizer effluent oxygen concentration is set at 2 mol % oxygen (wet basis) based on MSE tests (MSE 2000, MSE 2001).

DBE #30: The mass balance assumes an oxidizer effluent concentration of 2 mol % oxygen.

A-5.5.7 Downstream Off-gas Treatment

A-5.5.7.1 Quench Tower. Water spray injection is used to reduce the temperature of the off-gas out of the oxidizer to a temperature where the gas is still superheated, but low enough to minimize high temperature effects on the downstream off-gas piping and scrubber. A temperature above the dew point is desirable to prevent condensation into the scrub solution such that there is no net increase in the scrub volume. A temperature of 212°F (100°C) was chosen for the outlet of the quench tower.

DBE # 31: The quench water spray flow is 316 gal/hr for the TTT process and a quench vessel outlet temperature of 100°C .

A pressure drop of 5 inches w.c. was estimated for the quench vessel.

DBE # 32: The mass balance assumes a quench vessel pressure drop of 5 inches w.c.

A-5.5.7.2 Scrubber. The oxidizer will convert nearly all the mercury in the off-gas to elemental mercury. Therefore, a nitric acid scrubber is included in the process to oxidize and remove a portion of the mercury prior to the GAC beds to ensure that the MACT emission limit can be met. The Phase 2 demonstration test scheme included a venturi scrubber that used water as the scrubbing agent. Based on analysis of the scrub solution, very little (~2%) removal of mercury was observed (Soelberg 2004).

A packed-bed scrubber was chosen for good gas-liquid contact for removal of elemental mercury vapor. For the mass balance, it was assumed that the same fraction of mercury (0.437) would be removed by the nitric acid scrub as assumed for the CMACT Upgrade treatment system (Soelberg 2003). This low capture of mercury in the scrub system is reasonable given that the kinetics for dissolution of elemental mercury in nitric acid is slow.

DBE # 33: The mass balance assumes a packed bed scrubber (VES-107) with two theoretical stages will be required to remove a portion of the elemental mercury from the off-gas.

DBE # 34: The mass balance assumes that 43.7% of the mercury in the off-gas is removed by the scrub system.

The process flowsheet includes the capability to add 13 molar nitric acid to maintain acidity of the scrub solution at whatever level is desired. The scrub solution composition and temperature are similar to the scrub system at the NWCF, which satisfactorily collects mercury from off-gas. A high scrub acid concentration would be desirable for mercury capture and dissolution, but would require addition of more carbon to destroy the added nitrate and more lime for neutralization of the scrub blow-down stream.

DBE # 35: The mass balance assumes that 13 molar nitric acid is added to maintain acidity in the scrub at 1 molar.

Neither modeling nor test data are sufficient to adequately establish the scrub blow down rate. In the NWCF, scrub analyses have shown that mercury has accumulated in the scrub system to concentrations as high as 50-60 g/L. The effect on the process of higher levels is not known. The steam reforming demonstration tests have not recycled scrub or run for long enough periods to predict mercury build up in the scrub. Development of models to accurately predict the chemistry and vapor liquid equilibrium of the scrub system was started in 2003 (Nichols, 2003; Taylor, 2003) but relative to mercury is not complete. For these reasons, the mass balances assume a nominal blow down of 0.26 gph (1 kg/hr).

DBE # 36: The mass balance assumes that scrub tank is purged to control mercury concentration as a blow down rate of 0.26 gph.

A pressure drop of 20 inches w.c. was estimated for the packed-bed scrubber.

DBE # 37: The mass balance assumes a pressure drop of 20 inches w.c. across the packed-bed scrubber.

The required gas-to-liquid ratio for the scrubber was estimated to be similar to that for the quench tower in a vitrification off-gas treatment facility design (Wood 2001). The value of 135 scf/cf is within the typical range for packed bed designs.

DBE # 38: The mass balance assumes a gas to liquid ratio of 135 standard cubic feet of gas per cubic foot of liquid, for a scrub solution flow of 7,030 gph.

A demister is placed downstream of the scrubber to reduce liquid entrainment from the packed-bed scrubber. Mist carryover from the packed-bed scrubber will be minimal as compared to the venturi scrubber used at the NWCF.

A-5.5.7.3 Demister.

DBE # 39: The mass balance assumes no liquid entrainment to the off-gas from the scrubber or demister.

The demister pressure drop was estimated to be 5 inches w.c..

DBE # 40: The mass balance assumes a pressure drop of 5 inches w.c. across the demister.

The demister (VES-102) is modeled as adiabatic, where any condensed liquid is recirculated to the scrub tank.

DBE # 41: The mass balance assumes a heat duty of 0 BTU/hr for the demister (VES-108).

A-5.5.7.4 Reheater. The reheater temperature is based on maintaining a temperature of 120°C at the GAC bed inlet.

DBE # 42: The mass balance assumes reheater (HE-304) will raise the temperature of the off-gas from to 120°C prior to the GAC beds.

The reheater pressure drop is estimated at 20 inches w.c. A similar reheater for the NWCF has a pressure drop of 40 inches w.c.; however, it is assumed that a new reheater can be designed with a lower pressure drop.

DBE # 43: The mass balance assumes a reheater pressure drop of 20 inches w.c.

A-5.5.7.5 GAC Beds. The mercury removal efficiency in the GAC bed is based on Phase 2 demonstration tests (Soelberg, 2004), laboratory testing (Del Debbio 2003, Herbst 2002) and discussions with carbon vendors. A total Hg removal efficiency of 99.9% would lower the total Hg concentration to about 30 ug/dscm (dry, corrected to 7% O_2). This outlet total mercury concentration is about 67% of the MACT limit of 45 ug/dscm (dry, 7% O_2). This level should provide assurance of MACT compliance during performance tests and incidental process variations in the event that steam reformer system operation varies from the design parameters. In the Phase 2 demonstration tests, the total mercury removal efficiency of the carbon bed exceeded 99.9% (Soelberg, 2004).

DBE # 44: The mass balance assumes a mercury removal efficiency of 99.9% in the GAC beds. The mass balance also assumes the 90% removal of particulate from the off-gas in the GAC beds.

A loading of 95.75 g mercury per kg of virgin GAC was achieved in the first bed during Phase I TTT demonstration tests and this loading was assumed for the mass balance. The portion of GAC that is not fully loaded will be dependent on the GAC bed configuration, e.g., parallel versus sequential.

DBE # 45: The mass balance assumes a mercury loading of to 95.75 g per kg of virgin GAC.

The total amount of mercury to be absorbed should be very similar to that for the CMACT upgrade alternative, so the GAC bed sizing is assumed to be similar, and the pressure drop is assumed to be 15 inches w.c.. This pressure drop is based on 3 mm carbon particles and other design parameters discussed in EDF-3292 (Soelberg 2003).

The requirements, basis, performance and design of a GAC bed are discussed in EDF-3292 (Soelberg 2003b). The GAC bed operating conditions are based on operation of two beds in series. The operating temperature is set at 120°C to ensure that there is no condensation in the beds. This temperature also provides an adequate margin compared within the vendor-specified temperature limit (150°C) for effective mercury capture and retention of sulfur on the carbon.

DBE # 46: The mass balance assumes a GAC bed pressure drop of 15 in water per bed and an operating temperature of 120°C.

The final HEPA filter particulate removal efficiency is based on design requirements for new filtration systems in the DOE-ID AE standards. These are to take credit for 99.9% removal for the first stage HEPA, and 99.8% removal for the second stage. No credit is taken for the prefilter.

A-5.5.7.6 HEPA Filter and Blower.

DBE # 47: The final HEPA filter is assumed to have a DF for particulate of 500,000 (or removal efficiency of 99.9998%

The blower outlet temperature is calculated in the ASPEN model assuming isentropic compression of the off-gas. The blower outlet pressure is assumed to be 12.4 psia (atmospheric pressure at INTEC is 12.3 psia) and based on a stack sized for negligible back-pressure on the blower.

DBE # 48: The mass balance assumes a blower (BLO-200) outlet pressure of 12.4 psia.

The mass balance assumes that pressure control air equal to 10% of the total flow rate is bled into the off-gas to allow adjustment to maintain constant vacuum on the off-gas system.

DBE # 49: The blower (BLO-200) pressure control bleed air rate is specified at 10% of the total flow rate.

A-5.5.8 Scrub Purge Treatment

The mass balances in Section 2.6 show scrub purge rates assuming continuous production. Because the mercury concentration in WM-180 will be much lower than in the other tanks, no scrub would be purged when treating Tank WM-180 waste. The mass balance shows purge rates for the tanks of 0.26 gph. Because of this low rate, scrub purge treatment would not be a continuous operation.

Several scenarios are possible and should be further evaluated in conjunction with sizing the treatment equipment. One treatment scenario is to collect the scrub as each SBW tank is depleted and then process it in a short campaign, producing about 32 drums of grouted mixed low level waste (MLLW) per SBW tank. Scrub treatment could be performed either during steam reformer operation, or during scheduled turnarounds.

The mass balance estimates for the scrub purge contain large uncertainties. While the mass balance model is largely based on mercury capture in NWCF scrub, the data does not provide a tight closure for mercury material balances. Because of this uncertainty, the scrub treatment design and schedule will need to be sufficiently robust to process as much as 2-3 times more scrub than estimates in present mass balances. Alternatively, proper operation of the scrub system to maximize mercury concentration could reduce the scrub volume.

The scrub purge will be collected and neutralized in the Spent Scrub Neutralization Tank. The purge will be neutralized with lime slurry to a pH of 7. The use of lime slurry is based upon: (1) commercial availability of lime, (2) minimization of water addition, and (3) compatibility with the grout. Sulfide will be added in a stoichiometric amount to precipitate the mercury as insoluble mercury sulfide to ensure that the waste will meet RCRA waste treatment requirements after grouting. The scrub must be neutralized prior to sulfide addition to prevent evolution of H_2S gas.

$$2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O \qquad \text{Acid neutralization} \qquad (21)$$

$$Hg(NO_3)_2 + CaS \rightarrow Ca(NO_3)_2 + HgS \downarrow \qquad \text{Sulfide precipitation} \qquad (22)$$

DBE # 50: The mass balance assumes neutralization of the scrub purge with lime slurry to a pH of 7 and treatment with calcium sulfide to precipitate all the mercury as mercury sulfide.

The scrub grout is expected to contain very low concentrations of transuranic radionuclides, and thus will likely be classified as mixed-low-level waste. As such it will need to be treated to meet land disposal restriction (LDR) standards for disposal at a MLLW disposal site such as Hanford. It will also need to meet NRC requirements for performance grout. A grout formulation of 25 wt % neutralized scrub and 75 wt % grout mix (Portland cement, blast furnace slag, and calcium hydroxide) was assumed in the mass balance. This low waste load will be necessary to ensure that the grout meets compression strength and mercury leach-ability.

DBE # 51: The mass balance assumes a waste loading of 25 wt % neutralized scrub with the balance a mixture of Portland cement, blast furnace slag and calcium hydroxide.

The neutralized and treated scrub blow down stream will be mixed with dry grout mix in a screw mixer and poured directly into drums. The waste will then be allowed to cure prior to shipment to an off-site MLLW disposal site. It was assumed that each waste drum would be filled with 0.2 m^3 of grouted waste scrub.

DBE # 52: Each scrub waste drum will be filled with 0.2 m^3 of grouted waste scrub.

A-5.5.9 Steam Reformer Product Packaging

The reformer bed product and filter fines will be mixed in a hopper and product auger/mixer prior to filling the canister. After densification and cooling, the product will be loaded into canisters. Each canister will be filled with 0.8 m^3 of reformer waste, equivalent to between 85% and 90% of the canister volume.

The maximum temperature of the reformer product is limited by a seal at the top of the waste canisters. The material used for this seal cannot withstand a waste temperature greater than 56°C. The RH-TRU 72-B Cask SAR lists the maximum temperatures for components of the 72-B cask (WIPP 2003). The maximum waste centerline is 102.7°C (217°F). The maximum canister shell temperature during transport (the surface of the 2x10 canister) is 56°C (132°F). This means the SR product will need to be cooled before it can be loaded into the 72-B cask.

DBE # 53: The mass balance assumes the reformer product will be cooled to a temperature of 56°C in the reformer product load-out bins prior to loading into canisters.

The product and fines are cooled in a hopper by direct contact with oxygen-free gas and then transferred using a screw auger that compresses the fluffy material as it is fed into waste canisters. It was assumed that the filter fines bulk density can be increased by a factor of three in the screw auger as it mixes with the bed product. No increase in bulk density is assumed for the bed product. For the TTT process, the reformer bed product has a bulk density of 1.46 g/cc, and the filter fines were assumed to be compressed from 0.38 g/cc up to 80% of the particle density of 1.44 g/cc. The mixture density is estimated to be 1.33 g/cc from a graph for mixtures of calcine fines and product in ENICO-1100 (Childs 1982).

DBE # 54: The mass balance assumes the reformer product will have a bulk density of 1.33 g/cc.

Following cooling, the SR product will be placed in a WIPP-approved RH TRU waste canister, Type A or equivalent. The RH TRU waste canisters must meet the requirements of the 72-B Cask SAR (WIPP 2003). The canister is ten feet tall and two feet in diameter. Filling each canister with 0.8 m^3 of SR product utilizes 85-90% of the canister volume. The amount or SR product then must be determined as part of waste form qualification requirements. The weight will be obtained by subtraction of the tare weight of the canister from the final weight of the filled canister. The canister will be smeared to detect the level of external contamination and decontaminated if needed. Removable surface contamination on RH TRU waste payload containers, payload assemblies, and packaging must not exceed 20 disintegrations per minute (dpm) per 100 square centimeters (cm^2) alpha and 200 dpm/100 cm^2 beta-gamma. The radiation dose from the canister will be measured. The external radiation dose equivalent rate of individual payload containers must be >200 milliroentgen equivalent man per hour (mrem/h), and <1,000 roentgen equivalent man per hour (rem/h) at the surface of the payload container.

DBE # 55: Each canister will be filled with 0.8 m3 of steam reformer product.

A-5.5.10 Utilities

A-5.5.10.1 Cooling Water. Cooling water is assumed to be available from the INTEC raw water supply at 20°C and 100 psig.

A-5.5.10.2 Steam. Steam is assumed available from the INTEC steam headers at 35 psig and 150 psig for general building heating.

Process steam at 30 psig and 670°C is provided by a new high-temperature low-pressure fuel-oil-fired boiler.

A-5.5.10.3 Air. Air for tank sparging and air purges was assumed to be available from the INTEC plant air supply, at 100 psig and 50 psig with a -40°F dew point. This air will be filtered and regulated to 20 psig for instrument air. Ambient air temperature is assumed to be 77°F (25°C).

A-5.5.10.4 Electricity. The existing electrical supply system is assumed to have adequate capacity for process equipment such as pumps and the off-gas compressor, general equipment, lighting, and building use.

A-5.5.11 Basis for TWR Mass Balance

Mass balances were developed for the TWR process to provide a basis for sizing equipment, determine feed chemical requirements, determine utility requirements, estimate emissions and determine waste volumes, compositions and properties. The sections below document the basis for the mass balances for the TWR flowsheet where it differs from the TTT flowsheet. The basis is capsulated in succinct statements, called 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.

A-5.5.11.1 Feeds. Feeds to the calcination process include waste feeds from the TFF, isopropanol as a chemical reductant, carbon dioxide in various uses, and propane for combustion in the oxidation unit. Nitrogen is assumed in the mass balance as the coolant for reformer product, although alternatively CO_2 could be used. CO_2 is shown as the coolant on the current PFD.

The amount of liquid reductant was based on Phase 2 bench-scale demonstration tests using simulated WM-180 feed performed in October, 2003 (Soelberg, 2004b).

DBE #56: Isopropyl alcohol (IPA) is added to the SBW feed in the ratio 0.7 lb IPA per lb SBW.

In Phase 1 of the TWR demonstration tests, performed in December 2002 (Marshall, 2003a; Marshall 2003c), a solid reductant, polypropylene, was also fed to the reformer. However, successful tests were completed during phase 2 without the solid reductant (Soelberg, 2004b), and hence the mass balances in this addendum assume no solid reductant.

DBE #57: No solid organic additive is needed in the TWR flowsheet to obtain the desired NO_x destruction.

For the TWR process, the starting bed media is 300 μm AGSCO white alumina grit. During the bench-scale tests, no bed media was drained and the bed mass was allowed to build during the run. As an estimate, total bed media addition of 0.01 fraction of the solids produced was assumed for the mass balance.

DBE # 58: Starting bed media for the TWR flowsheet will be white AGSCO Alumina grit, with the bed media amount estimated at 0.01 wt fraction of the solid product during operation.

A-5.5.11.2 Steam Reformer Heating and Process Fuels. The mass balance shows that external heating supplying total input of 1.4-1.8 MM Btu/hr will be required to maintain the process temperature of 600°C in the TWR reformer. This is based on the energy balance in the ASPEN model. This heat could be supplied by external heaters, or by adding sufficient oxygen or air to combust with excess IPA in the reformer feed.

The oxidizer will use propane to boost the heating value of the reformer off-gas. Addition of propane to the oxidizer will allow operation at a temperature of 1000°C to ensure destruction of organics and oxidation of CO in the reformate stream. Initial runs of the ASPEN model indicate that because of the products of incomplete combustion present in the reformer off-gas, no fuel is required in the oxidizer. Since the Phase 2 demonstration tests had a positive oxidizer fuel rate, the mass balance model was revised with the fuel rate based on the test data. The fuel rate for a relevant portion of the Phase 2 tests averaged 2.9 kg/hr. Scaling this rate up to a full-scale facility and adjusting for a lower heat loss for a full-scale oxidizer, the expected propane rate would be about 133 kg/hr. Further "tuning" of the model and analysis of the Phase 2 test data could result in optimization of this rate, as well as reducing or eliminating the reformer duty. Because of specifying both the oxidizer temperature and the feed fuel rate, the ASPEN model necessarily resulted in a required cooling duty for the oxidizer. Further development of the model and/or additional test data is needed to eliminate this cooling duty (see additional discussion at end of Section A-6.1).

DBE # 59: The mass balance assumes a fuel rate of 133 kg/hr propane to the oxidizer based on Phase 2 demonstration test data.

DBE # 60: The oxidizer will operate at a temperature of 1000°C to ensure adequate destruction of organics and CO in the reformer off-gas.

A-5.5.11.3 Carbon Dioxide and Oxygen. Carbon dioxide is used to atomize the feed in the TWR flowsheet, and will be used for purges in the steam reformer process lines up until the oxidizer, as these points in the piping may contain combustible levels of H_2 and CO. Carbon dioxide could also be used for direct cooling of the SR product in the collection hopper, although the mass balance assumes nitrogen is used.

The hydrogen and carbon monoxide concentrations in the off-gas from the reformer were observed to be quite low during both Phase 1 and Phase 2 demonstration tests (Marshall, 2003a, Soelberg, 2004b). The mass balance model predicts large amounts of hydrogen, carbon monoxide, unreacted or partially reacted IPA, and amorphous carbon in the reformer off-gas, somewhat contrary to the results of the tests. Some air in-leakage was suspected during the testing, either into the vessel or, more likely, into the off-gas sampling system lines prior to the analyzers. However, the observed low concentration of nitrogen in the off-gas shows that the air in-leakage was small. In an effort to match the test data as close as possible, the concentration of organics in the off-gas was allowed to increase to match more closely observed concentrations of hydrogen, CO and methane. (See discussion at end of Section A-6.1).

DBE # 61: The mass balances assume no air in-leakage.

A NAR of 470 was used during the Phase 2 bench-scale tests.

DBE # 62: Carbon dioxide for feed atomization will be fed to the feed nozzles at a ratio of 470 standard cubic feet per cubic foot of blended feed.

Carbon dioxide gas preheated to the reformer temperature is used to fluidize the bed media in the steam reformer. Based on the Phase 2 demonstration tests, the fluidization gas mass flow rate will need to be about 1.3 times the SBW feed rate.

DBE #63: The mass balance assumes a fluidizing gas mass flow rate of 1.3 times the SBW feed rate.

A-5.5.11.4 Feed Rate. The feed to the reformer includes SBW plus heels, the organic feed additive, and scrub recycle. The scrub recycle rate is assumed to be 5 vol % of the SBW rate.

DBE # 64: The required SBW minimum throughput to meet a 2.5-yr processing schedule is 88.5 gph (334.8 lph). The scrub recycle rate is assumed to be 5 vol % of the SBW rate.

A-5.5.11.5 Steam Reforming.

A-5.5.11.5.1 Normal Operating Conditions—The operating temperature of the steam reformer during Phase 2 bench-scale tests of the TWR flowsheet was 600°C.

DBE # 65: The normal operating temperature of the TWR Steam reformer will be 600°C.

A-5.5.11.5.2 Steam Reforming Chemistry—In the TWR reformer, nitrates are directly reduced to carbonates by the organic additives. Some of the possible reactions are shown in Section A-2.4 (Reactions 1-5). Equilibrium concentrations of the reactants and products are dependant upon the reformer temperature, and were determined by a routine in ASPEN that finds the equilibrium composition by minimizing Gibbs free energy of formation for the products. In reality, some reactions in the reformer do not reach equilibrium, with some of the hydrocarbons, carbon, and NO_x remaining in the off-gas and solids. To approximate H_2, CO, NO_x and CH_4 observed in the off-gas during the Phase 2 tests, a portion of the IPA was bypassed in the mass balance model around the Gibbs reactor step, and also certain reactions with set conversions were specified a second reactor step. These are shown in Table A-3.

A-5.5.11.6 SR Product Carryover, Separation and Rate. The fraction of reformer product carried into the cyclone, sintered metal filter vessel, and scrub system was calculated from the Phase 2 bench-scale tests material balance data. Separation factors based on these calculations are shown in Table A-4. Using these separation factors, the mass balance model shows that 93.7 wt % of the product comes from the bed and the remainder from the filter.

Table A-3. Reformer parameters.

Bypass of Gibbs reactor	Fraction Bypassed	
Nitric acid	0.207	
Reactions	**Fractional Conversion**	**Conversion Based on**
2 NAF + H_2O + CO_2 --> 2 HF + NA_2CO_3	0.0626	NaF
2 HNO_3 + 3 H_2 --> 2 NO + 4 H_2O	0.9906	HNO_3
2 NAOH + CO_2 --> NA_2CO_3 + H_2O	1.0000	NaOH
2 NAOH(S) + CO_2 --> NA_2CO_3 + H_2O	1.0000	NAOH(S)
2 HNO3 + H2 --> 2 NO_2 + 2 H_2O	1.0000	HNO_3
CO + H_2O --> CO_2 + H_2	0.9500	CO
Carbon + 2 H2 --> CH_4	0.0600	H_2
16 Carbon + 17 H2 --> N-HEX-01	1.0000	Carbon
2 H_2 + O_2 --> 2 H_2O	1.0000	O_2
2 NACL + H_2O + CO_2 --> 2 HCL + NA_2CO_3	0.0037	NACL
2 KCL + H_2O + CO_2 --> 2 HCL + K_2CO_3	0.0037	KCL

A-5.5.11.7 Sintered Metal Filters. Solids and chemical species capture by the sintered metal filter is based on results from the Phase 2 TWR demonstration tests. The separation factors used in the mass balance are shown in Table A-4.

A-5.5.11.8 Oxidizer Temperature and Outlet Oxygen Concentration. Based on the Phase 2 TWR demonstration test, the oxidizer temperature is 1000°C. The mass balance assumed an outlet oxygen concentration of 3 mole %.

DBE # 66: The oxidizer effluent gas temperature is 1832°F (1000°C). The mass balance assumed an outlet oxygen concentration of about 3 mole %.

Table A-4. Bed, cyclone, and sintered metal filter separation factors.

Component	Product[a]	Filter[a]	Component	Product[a]	Filter[a]
HG	0.001	0.001	NA_2SO_3	0.945	1.000
$HGCL_2$	0.001	0.001	$NAHCO_3$	0.945	1.000
NA_2CO_3	0.945	1.000	NAF	0.945	1.000
K_2CO_3	0.915	1.000	K_2SO_4	0.915	1.000
$CACO_3$	0.948	1.000	$KHSO_4$	0.915	1.000
NA_2O	0.945	1.000	$KHCO_3$	0.915	1.000
K_2O	0.915	1.000	N-HEX-01	0.000	0.001
CAO	0.948	1.000	CH4	0.000	0.000
$NAALO_2$	0.945	1.000	TRIT-OXD	0.000	0.000
AL_2O_3	0.942	1.000	C_3H8	0.000	0.000
SIO_2	0.781	1.000	CS_2CO_3	0.611	1.000
FE_2O_3	0.915	0.997	NA_3PO_4 (S)	0.945	1.000
NACL	0.945	1.000	K_3PO_4	0.915	1.000
KCL	0.915	1.000	$ALPO_4$	0.942	1.000
CAF_2	0.948	1.000	PLUS1	0.945	1.000
$NANO_3$	0.945	1.000	PBO	0.766	1.000
KNO_3	0.915	1.000	CR_2O_3	0.920	1.000
$CA(NO_3)_2$	0.948	1.000	PLUS4	0.942	1.000
TCO_3	0.475	0.998	PLUS5	0.942	1.000
$AL(NO_3)_3$	0.942	1.000	PLUS6	0.942	1.000
CDO	0.766	1.000	MINUS1	0.712	0.981
$NAHSO_4$	0.945	1.000	CAOH+	1.000	0.000
NA_2SO_4	0.945	1.000	HGOH+	1.000	0.000
NAHS	0.945	1.000	$HG(OH)_2$	0.001	0.002
NA_2S	0.945	1.000	$CASO_4$ (S)	0.948	1.000
NAOH	0.945	1.000	$CACL_2$ (S)	0.948	1.000
C_3H_8O-2	0.000	0.000	KOH(S)	0.915	1.000
CARBON	0.000	0.000	NAOH(S)	0.945	1.000

[a]Factors shown are fractions of specie removed from the bed or by the cyclone or filter.

A-5.5.11.9 Remainder of Off-gas and Scrub Treatment and Reformer Product Packaging. Model input parameters for the remainder of the off-gas treatment system and the scrub recycle and treatment system were assumed the same for the TWR process as for the TTT process. Refer to the forgoing discussion of the TTT process for these parameters, including***:***

DBE #29: Oxidizer pressure drop

DBE #31: Quench tower temperature

DBE #32: Quench tower pressure drop

DBE #33: Packed bed scrubber stages

DBE #34: Fraction of mercury removed in the scrubber

DBE #35: Control of scrub acidity

DBE #36: Scrub purge rate

DBE #37: Scrubber pressure drop

DBE #38: Scrubber gas to liquid ratio

DBE #39: Demister entrainment

DBE #40: Demister pressure drop

DBE #41: Demister duty

DBE #42: Reheater temperature

DBE #43: Reheater pressure drop

DBE #44: GAC bed Hg and particulate removal efficiency

DBE #45: GAC bed Hg loading

DBE #46: GAC bed pressure drop and temperature

DBE #47: HEPA filter efficiency

DBE #48: Blower outlet pressure

DBE #49: Compressor control air flow rate

DBE #50: Scrub purge neutralization

DBE #51: Scrub grout formulation

DBE #52: Grout waste drum volume

DBE #53: Product cooler temperature

DBE #54: Product density after densification

DBE #55: Waste canister volume.

The utilities available for the TWR process were assumed the same as for the TTT process.

A-6. MASS BALANCES

A-6.1 Mass Balance Model

The material balance for chemical species was performed using ASPEN Plus, a computer program that is part of the ASPEN Engineering Suite 11.1 (ASPEN 2002). ASPEN provides a broad framework for process modeling, including extensive thermodynamic databases, electrolyte solution chemistry models, numerous equation-of-state models, and a comprehensive unit operation library. To simplify the model, many minor species were grouped together based on valence, as shown in Table A-5. Results from the ASPEN Plus model were transferred to a Microsoft Excel spreadsheet, and the grouped species were subsequently separated back into individual components. The ASPEN flow scheme developed for the material balances for the TTT process is shown in Figure A-1. Except where otherwise indicated, the comments below apply to this process (TTT). The model initially developed for steam reforming calculations for EDF-2273 (Barnes 2002a) and EDF-3827 (Haefner, 2003) was modified to reflect updates to the PFDs, and to incorporate the data from Phase 2 bench-scale testing with simulated SBW.

Radionuclides for streams other than the SBW feed stream were calculated from the ratios of radionuclide to non-radioactive element in the SBW feed. Ditritium oxide (T_2O) was simulated in ASPEN as a separate compound having the same properties as water. This allowed tritium to be tracked throughout the process.

Table A-5. ASPEN model chemical specie inputs.

Aspen Model Compound	Actual Species Represented
$HgCl_2$	Hg, Cl
CaF_2	F, Ca
$NaHSO_4$	SO_4^{2-}
NaCl	Cl, Na
Na_3PO_4	Na, PO_4^{3-}
$NaNO_3$	Na, NO_3^-, remaining +1 cations
KNO_3	K, NO_3^-
$Ca(NO_3)_2$	Ca, NO_3^-, remaining +2 cations
$Al(NO_3)_3{\bullet}9H_2O$	Al^{+3}, NO_3^-, H_2O, remaining +3 cations
ZrO_2	Zr, O, remaining +4 cations
V_2O_5	V, remaining +5 cations, O
MoO_3	Mo, O
HCl	remaining Cl, remaining -1 anions, H^+
HNO_3	remaining H^+, NO_3^-
CdO	Cd, O
Cs_2CO_3	Cs, C, O
PbO	Pb, O
Cr_2O_3	Cr, O
TcO_3	Tc, O
Ditritium oxide	Tritium, O
Carbon	C
Sucrose	Sucrose
Fe_2O_3	Fe, O
SiO_2	Si, O
Radionuclides	Ratioed from original element composition in the SBW to chemical element compositions in the SBW
H_2O	Remaining H_2O
NO_3^-	Remaining NO_3^-

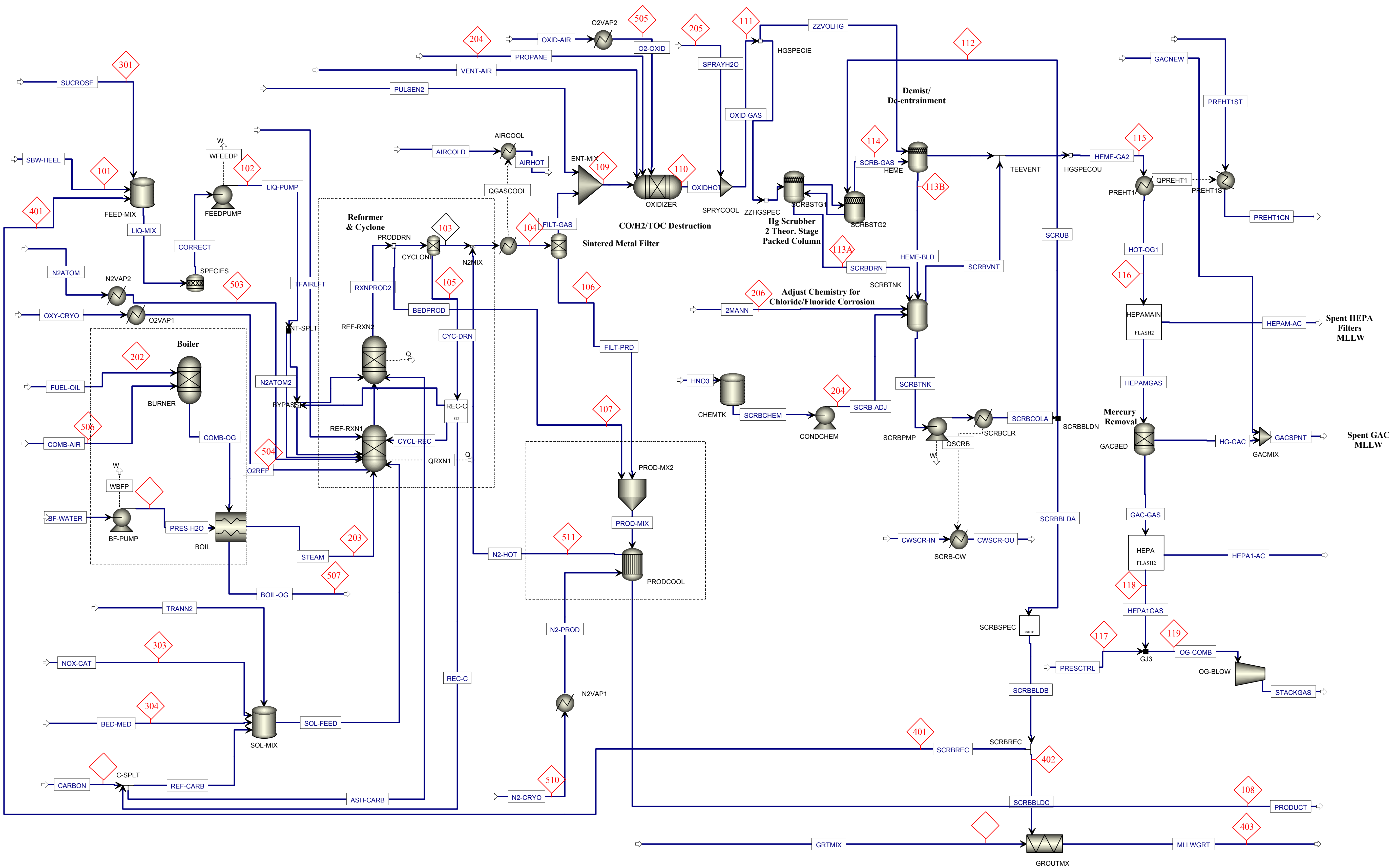

Figure A-1. Aspen flow scheme for the TTT process.

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In order to increase confidence in the ASPEN model results, the model was tuned using data from steam reforming demonstration tests (Marshall 2003a, Marshall 2003b, Soelberg 2004a). The Phase 2 demonstration test was similar to the current flowsheet and data from this test was used to the maximum extent. The bench-scale tests used a simulated (non-radioactive) WM-180 feed which included toxic metals, non-radioactive cesium, and non-radioactive rhenium (as a technetium surrogate). Product, and filter fines were collected separately and cyclone fines (which were recycled to the reformer) were sampled. The feed, product, and scrub streams were analyzed. A continuous emission monitoring system was used to analyze the off-gas for O_2, CO_2, H_2, CO and CH_4.

Impurities in the carbon from analyses for the demonstration tests were included in the mass balance. The composition of the carbon as analyzed and input to the ASPEN model is provided in Table A-6.

Table A-6. Carbon composition used for ASPEN model of the TTT flowsheet.

	Concentration (mg/Kg)	**Input Specie for ASPEN**	**Concentration of Specie (mol/g)**	**Concentration of Specie (wt%)**
Al	1527	Al_2O_3	5.66E-05	0.289%
Ca	18431	$CaCO_3$	4.60E-04	4.60%
Fe	867	$Fe2O_3$	1.55E-05	0.124%
Hg	1.91	Hg	9.52E-09	0.000191%
P	733	K_3PO_4	2.37E-05	0.502%
K	7107	$K2CO_3$	1.82E-04	0.712%
Si	6233	SiO_2	2.22E-04	1.33%
Na	739	Na_2S	3.21E-05	0.125%
S	598	H_2S	1.86E-05	0.00881%
Sum of Impurities	39107		1.09E-3	7.70%
C (balance)	960893	C	8.00E-02	92.3%
O			2.48E-03	3.96%

When the feed, additives, and feed gas (O_2, steam) flows for the tests were initially tried in the ASPEN model, the resulting H_2 and CO concentrations in the off-gas differed from those observed during the tests. Therefore the feed oxygen rate adjusted in the model to match the hydrogen concentrations measured in the Phase 2 demonstration tests and the CO yield was adjusted by inputting a reaction that converted a small amount of CO_2 to CO.

Equilibrium concentrations of the reactants and products are dependent upon the reformer temperature, and were determined by a routine in ASPEN that determines the final mixture that minimizes Gibbs free energy of formation. The reactions in the reformer do not reach equilibrium, with some of the hydrocarbons, and NO_x remaining in the off-gas and solids. These fractions of unreacted hydrocarbon and NO_x are modeled by bypassing equivalent fractions around the reformer. Based on the organic carbon and NO_x in the products and off-gas, the fractions of hydrocarbon and nitric acid in the feed that are not fully reacted are presented in Table A-7.

Table A-7. Fraction of reformer feeds bypassing the reformer.

Component	Fraction Not Reacted in Reformer
Sugar-HC	0.113
Nitrates	0.084-0.21 (varied with feed case)

The predicted concentrations were adjusted to match the volatile species and products found downstream of the reformer during the FY 2003 demonstration tests. This was done by specifying the following additional reactions in the model:

Table A-8. Additional reactions in the mass balance model.

Stoichiometry	Fractional Conversion	of Specie	Basis for Conversion
$2\ NaCl + H_2O + CO_2 \rightarrow 2\ HCL + Na_2CO_3$	0.018	NaCl	Based on volatility observed in demonstration tests.
$2\ NaF + H_2O + CO_2 \rightarrow 2\ HF + Na_2CO_3$	0.018	NaF	Estimate.
$2\ HNO_3 + 3\ H_2 \rightarrow 2\ NO + 4\ H_2O$	0.9375	HNO_3	From NO/NO_2 ratio observed in demonstration tests
$2\ HNO_3 + H_2 \rightarrow 2\ NO_2 + 2\ H_2O$	0.059659	HNO_3	From NO/NO_2 ratio observed in demonstration tests
$2\ NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$	0.96	NaOH	Estimate based on Carbonate/Hydroxide Equilibrium predicted by HSC
$2\ NaOH_{(S)} + CO_2 \rightarrow Na_2CO_3 + H_2O$	0.96	$NaOH_{(S)}$	Estimate based on Carbonate/Hydroxide Equilibrium predicted by HSC
$CO_2 + 2\ H_2O \rightarrow CH_4 + O_2$	0.00855	CO_2	From CH_4 observed in tests
$2\ CO_2 \rightarrow 2\ CO + O_2$	0.107	CO_2	From CO observed in tests

The fraction of reformer product carried over into to the cyclone, sintered metal filter vessel, and scrub system was calculated from the material balance data from the demonstration tests. Mass fractions of reformer product collected in the bed drain product, cyclone fines, and filter fines for bulk TOCs, Al, Ca, Cr, Cs, Cr, Fe, Pb, K, Re (as a surrogate for Tc), Si, Na, Zr, Cl, F, nitrate, phosphate and sulfate were matched to the those obtained during the tests. The mass fraction of each species collected in the reformer bed drain product was split from the overall amount coming out of the reformer. The fractions of inputs to the reformer, cyclone, filter, and scrub that were retained by each unit for the TTT process are presented in Table A-9.

Table A-9. Solids capture for the TTT material balance model (fraction of species into each unit captured by that unit)

Component	Bed	Cyclone Fines	Filter Fines	Component	Bed	Cyclone Fines	Filter Fines
Hg	0	0.00081	0.00119	Na_2S	0.532742	0.4483	0.9985
$HgCl_2$	0	0.00081	0.00119	NaOH	0.532742	0.4483	0.9985
Na_2CO_3	0.532742	0.4483	0.9985	Sucrose	0.0488	0.4855	0.9985
K_2CO_3	0.296577	0.55	0.9985	Carbon	0	0.95	0.9985
$CaCO_3$	0.55104	0.4615	0.9985	Na_2SO_3	0.532742	0.4483	0.9985
Na_2O	0.532742	0.4483	0.9985	$NaHCO_3$	0.532742	0.4483	0.9985
K2O	0.296577	0.55	0.9985	NaF	0.0703	0.362	0.9315
CaO	0.55104	0.4615	0.9985	K_2SO_4	0.4078	0.335	0.9985
$NaAlO_2$	0.567821	0.484	0.9985	$KHSO_4$	0.4078	0.4483	0.9985
Al_2O_3	0.567821	0.484	0.9985	$KHCO_3$	0.296577	0.55	0.9985
SiO_2	0.488108	0.75	0.9985	Cs_2CO_3	0.03	0.59	0.999
Fe_2O_3	0.706408	0.435	0.9985	Na_3PO_4	0.396	0.645	0.9985
NaCl	0.158205	0.483	0.9985	K_3PO_4	0.396	0.645	0.9985
KCl	0.158205	0.483	0.9985	$AlPO_4$	0.396	0.645	0.9985
CaF_2	0.0703	0.362	0.9985	Other +1 cations	0.296577	0.55	0.9985
$NaNO_3$	0.2695	0.351	0.9985	PbO	0.0342	0.233	0.9985
KNO_3	0.2695	0.351	0.9985	Cr_2O_3	0.5488	0.4145	0.9985
$Ca(NO_3)_2$	0.2695	0.351	0.9985	+4 cations	0.548	0.5176	0.9985
TcO_3	0.039	0.62539	0.9985	+5 cations	0.548	0.5176	0.9985
$Al(NO_3)_3$	0.567821	0.484	0.9985	+6 cations	0.548	0.5176	0.9985
CdO	0.5	0.5	0.9985	-1 anions	0.1582	0.483	
$NaHSO_4$	0.4078	0.335	0.9985	$CaSO_4$	0.4078	0.335	0.9985
Na_2SO_4	0.4078	0.335	0.9985	$CaCl_2$	0.1582	0.483	0.9985
NaHS	0.532742	0.4483	0.9985	KOH	0.5	0.4483	0.9985
Hg	0	0.00081	0.00119	Na_2S	0.532742	0.4483	0.9985

Finally it should be noted that while all attempts were made to utilize results from the Phase 2 TTT demonstration test, the test data was still being analyzed and reviewed when the mass balance runs were made. Thus the final Phase 2 test report (Soelberg 2004a) may contain some discrepancies from what was used in the mass balance model.

As for the TTT process, material balances were generated for TWR for chemical species using ASPEN Plus. Much of the discussion above regarding the TTT ASPEN model applies to the TWR process as well. Several organic chemical components (species) such as IPA and propane were added to the TWR model. Results from the Aspen Plus model were transferred to MS Excel, and the grouped species were subsequently separated back into individual components. The ASPEN flow scheme used to generate the TWR material balances is shown in Figure A-2. Most input parameters to the model were discussed in Sections A-5.4.5 and A-5.5.11.

Haefner[1] provides documentation of the ASPEN model as tuned after Phase 1 of the TWR demonstration tests. Data from the tests was used to set "design specifications" in the model, i.e., allowing the program one parameter, such as a feed flow rate, to achieve another, such as a effluent composition or reactor temperature. The following is a list of design specifications in the model based on Phase 2 tests:

1. *Airlift:* varied the feed rate of air used to transfer SBW to the treatment facility; specification: mass flow rate of air rate = 0.0032 x SBW mass rate.

2. *Bed-Med:* varied the feed rate of alumina bed material to the reformer; specification: bed media make-up flow rate = 1 wt % of the total reformer mass effluent rate (solid plus gas).

3. *C-Bed:* varied the flow of carbon distributed to the bed product to achieve a mass fraction of 0.1% in the bed product.

4. *C-Fines:* varied the flow of carbon distributed to the filter product to achieve a mass fraction of 6.5% in the filter product.

5. *Dilu-Air:* varied the feed rate of compressor pressure control air; specification: air rate = 10 wt % of off-gas flow rate.

6. *Gacuse:* varied the rate of make up GAC; specification: spent GAC mercury loading of 95.75 g Hg/kg GAC.

7. *Grtmix:* varied the rate of grout additives; specification: grout waste loading of 25 wt %.

8. *NAR:* varied the rate of atomizing gas; specification: NAR = 470.

9. *NOX-1:* varied the fraction of HNO_3 bypassed around the Gibbs reformer reactor to achieve 1800 ppm NO in the reformer off-gas.

10. *NOX-2:* varied the fraction of NO in the oxidizer that was treated as inert to achieve an NO concentration of 250 ppm at the oxidizer outlet.

11. *Ogcool:* varied the rate of air to the off-gas air cooler; specification: effluent air temperature of 80^{o}C.

12. *Prht1st:* varied the rate of steam to the off-gas preheater; specification: off-gas exchanger effluent temperature =120^{o}C.

13. *Prodcool:* varied the rate of gas to the product cooler; specification: product temperature of 56^{o}C.

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[1] Haefner, D., B. O'Brien, S. O. Bates, 2003, "Steam Reforming Process Design," *Engineering Design File EDF-3827*, September 30, 2003.

14. *Propane:* varied the flow of oxygen to the thermal oxidizer to achieve an outlet O_2 concentration of 3 mol.% (wet basis).

15. *PulseN2:* varied the rate of pulse gas to the sintered metal filter; specification: pulse gas rate = 1 wt % of off-gas rate.

16. *Recvol:* varied the rate of scrub recycle to the reformer; specification: recycle scrub rate = 5 vol 5 of SBW rate.

17. *Scrbcw:* varied the rate of cooling water to the scrub cooler; specification: outlet CW temperature of 60°C.

18. *Scrbflo:* varied the scrub rate to the scrubber; specification: gas to liquid flow in scrubber = 135.

19. *Spryqch:* varied the rate of water to the quench tower; specification: quench temperature of 100°C.

20. *Tranair1:* varied the flow of nitrogen used for transporting bed media to the reformer to equal 10 wt.% of the solids being transferred.

The model used to simulate the TWR process after Phase 1 testing adjusted air in-leakage to meet a CO to CO_2 off-gas ratio. This resulted in a feed air rate greater than the total CO_2 fluidization and atomization rate. This specification was deleted and the air in-leakage set to a small value. However, this resulted in large quantities of organics – unreacted IPA and incomplete products of IPA combustion – in the reformer effluent. This result motivated a more in-depth analysis of the reported data.

The first step in the analysis was to perform mass balance calculations for oxygen for the Phase 2 testing. Using measured quantities of CO, CO_2, and CO_3 in the reformer products together with measured flow rates of feed and products, the amount of O_2 leaving the system was found to exceed the amount input by a significant amount. In the absence of air in-leakage the only other apparent source for O_2 is decomposition of H_2O. Allowing for this possibility, a hydrogen balance was next performed, accounting for the H_2 that would be generated in decomposing H_2O to satisfy O_2 balance. The results indicated the presence in the off-gas of either 20 times the amount of H_2 that was measured, or of a hydrocarbon (HC) with an H:C ratio of about 16. The validity of this result was examined by considering the heating value that would be represented by the unaccounted H_2 or HC. Performing a heat balance on the downstream oxidizer it was found that the measured fuel (propane) input was insufficient to provide the measured temperature rise in the oxidizer unless the unaccounted H_2 (or HC) was assumed present in the steam reformer off-gas that enters the oxidizer.

This result seemed to confirm the above speculation that the true H_2 and/or HC content of the reformer off-gas was not measured. However, both high postulated H_2 concentration (~30%) and the high H:C ratio in the postulated HC appeared outside the realm of experience. Nonetheless, the data on which the analysis was based appears valid. Thus, there is a clear need for additional consideration of the TWR test data in order to better model the process, as the model currently has two significant deficiencies. First, the excess organics in the reformer product would result in no propane required in a full-scale oxidizer. This, however, is contrary to the test results and intuition. Second, an excessive organic concentration is calculated in the reformer product. To attempt to address these deficiencies, the Aspen model was adjusted to force the product composition to be comparable with that measured in the Phase 2 tests. Also, in the model the propane rate to the oxidizer was scaled from the test data. As expected from the above analysis, this resulted in an unreasonable cooling duty required in the oxidizer to limit the temperature to the target value. These adjustments clearly do not resolve the problem but were done in order to provide a reasonable mass balance for comparison with other candidate processes. The need for additional development is, however, clearly indicated.

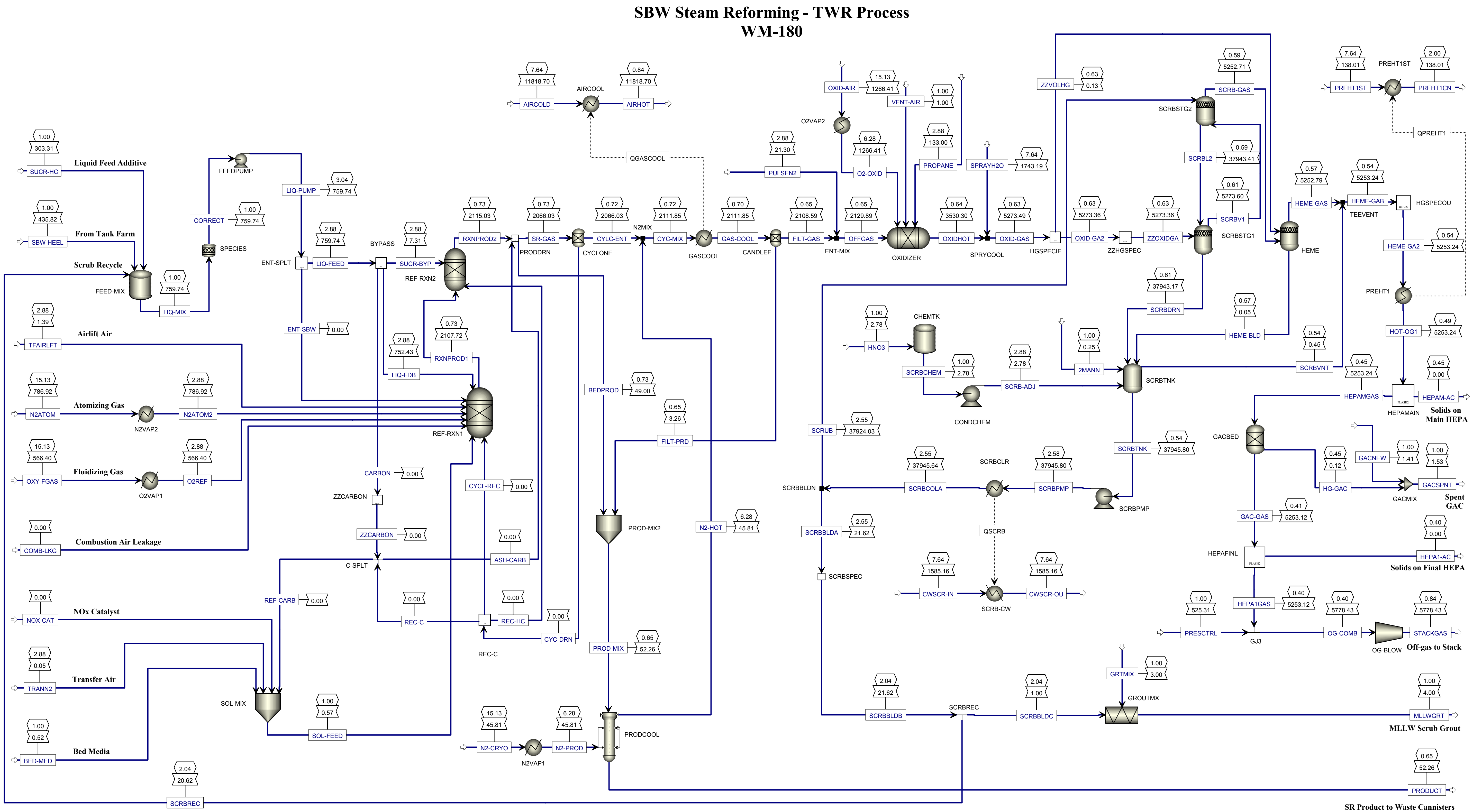

Figure A-2. ASPEN flow scheme for the TWR process.

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A-6.2 Mass Balance Results

Table A-10 lists the major chemicals consumed for reforming SBW with the TTT process. Entries in the body of the table are consumption rates for processing individual tanks, while the final column shows the total accumulated material used for complete processing. An iron or iron oxide catalyst may be recommended, however, the quantity called for would be small (no more than several pounds) and would not be costly. Finally, alumina is used as starting bed material and a total of 4 bed change-outs would require about 10,500 pounds.

Table A-10. Consumable chemicals estimate for TTT processing of SBW.

Stream	WM-180	WM-187	WM-188	WM-189	Total
SBW (gal/hr)	96.0	95.8	96.6	97.4	1.16×10^6 gal
Gases:					
Nitrogen (lb/hr)	1410	1360	1340	1460	16.7×10^6 lbs
Oxygen (lb/hr)	840	825	843	937	10.4×10^6 lbs
Fuels:					
Propane (lb/hr)	34.5	33.9	35.0	34.5	0.41×10^6 lbs
Fuel oil (lb/hr)	268	268	275	291	3.31×10^6 lbs
Reductants:					
Sucrose (lb/hr)	314	314	325	377	4.01×10^6 lbs
Carbon (lb/hr)	138	138	143	166	1.76×10^6 lbs
Water:					
Boiler feed (lb/hr)	2640	2640	2700	2860	32.6×10^6 lbs
Quench (lb/hr)	3570	3530	3620	3850	43.8×10^6 lbs
Nitric acid (lb/hr)	4.02	8.65	8.63	9.82	9.2×10^4 lbs
Process time (hours)	3280	2100	3380	3240	1.2×10^4 hours

Table A-11 summarizes the production rate of reformer product from the TTT process and the associated packaging rate. The values in the table assume a densification operation is used to increase the product's bulk density from about 0.15 to 1.33 g/ml (83 lb/ft^3). The table also summarizes the estimated decay heat and TRU activity of the final waste.

Table A-11. Summary of estimated waste product quantities and properties for TTT processing of SBW.

	WM-189	WM-187	WM-188	WM-189	Total
Product mass rate (lb/hr)	146	165	147	175	
Processing time (hr)	3280	2100	3380	3240	12,000
Canister filling rate (can/day)[a]	1.5	1.7	1.5	1.8	
Number of canisters[a,b]	205	149	211	243	808
Heat generation (W/m^3)	1.99	2.62	2.70	2.92	
Heat per canister (W/can)	1.59	2.09	2.16	2.34	
TRU specific activity (nCi/g)	6040	5500	5010	4360	

a - Waste specific gravity assumed as 1.33.

b – A canister contains 0.8 m^3 of waste.

Table A-12 summarizes the chemicals used to treat spent scrub solution to the TTT process. The values in the table are mass amounts (as opposed to rates) since the spent scrub will be blown down in batches and will presumably be treated in batch mode. The lime additions are used to neutralize the acid associated with the waste and are based on a scrub containing 1.02 molar free acid. The lime is assumed to be added as a 50 wt % slurry. Calcium sulfide is used as a precipitant for mercury, which is assumed present at 60 g Hg/l. The final treatment step is to add Portland cement (enough to achieve 75 wt % cement) for stabilization/solidification of the waste.

Table A-12. Consumable chemicals estimate for spent scrub treatment.

Stream	WM-180 (lbs)	WM-187 (lbs)	WM-188 (lbs)	WM-189 (lbs)	Total (lbs)
Spent scrub	7180	4610	7420	7090	26,300
Lime-50wt% $Ca(OH)_2$	537	345	555	531	1970
Calcium sulfide	153	98.5	158	151	561
Portland cement	23,600	15,200	24,400	23300	86,500
Total mass of stabilized scrub	31,500	20,200	32,500	31,100	115,000

Tables A-13 to A-16 constitute the complete mass balances for the TTT carbonate flowsheet.

Table A-13. Mass balance, Tank WM-180 waste.

PFD #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
WM-180, Stream #	101	102	103	104	105	106	107	108	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Cyclone Drain	Filter Drain	Bed Drain	Cooled Product	Product Shipping Canisters
Rate or Volume	9.60E+01	1.32E+02	4.56E+05	4.11E+05	9.84E+01	6.22E+01	8.38E+01	1.46E+02	1.49E+00
Volume Flow (standard, wet			1.02E+05	1.04E+05					
Volume Flow (standard, dry			3.09E+04	3.29E+04					
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr	lb/hr	can's/day
Rate or Volume, metric	363	501	2.90E+03	2.95E+03	45	28.2	38.0	66.2	66.2
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	19	670	530	670	530	670	56	56
Temperature, °F	59	67	1238	986	1238	986	1238	133	133
Pressure, psia	14.7	44.7	10.6	10.2	10.6	9.5	10.8	9.5	9.5
Specific Gravity	1.20	1.20	1.98E-04	2.26E-04	0.24	1.15	1.46	1.33	1.33
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	1.02E+00	7.89E-01	8.63E-07	8.47E-07	4.55E-06	8.84E-06	1.36E-05	1.16E-05	1.16E-05
Al+3	5.37E-01	3.90E-01	3.50E-05	3.44E-05	3.55E-02	5.75E-02	1.08E-01	8.63E-02	8.63E-02
Sb+5	1.28E-06	9.31E-07	3.48E-10	3.41E-10	3.53E-07	5.71E-07	1.07E-06	8.57E-07	8.57E-07
As+3	4.12E-04	2.99E-04	6.87E-08	6.75E-08	6.98E-05	1.13E-04	2.11E-04	1.69E-04	1.69E-04
Ba+2	4.61E-05	3.35E-05	1.51E-08	1.48E-08	1.35E-05	2.48E-05	4.21E-05	3.47E-05	3.47E-05
Be+2	7.21E-06	5.23E-06	1.55E-10	1.52E-10	1.38E-07	2.55E-07	4.32E-07	3.56E-07	3.56E-07
B+3	9.59E-03	6.96E-03	2.31E-07	2.26E-07	2.34E-04	3.79E-04	7.09E-04	5.68E-04	5.68E-04
Cd+2	6.60E-04	4.79E-04	1.94E-07	1.90E-07	2.01E-04	3.18E-04	4.73E-04	4.07E-04	4.07E-04
Ca+2	3.41E-02	2.47E-02	1.09E-05	1.07E-05	9.70E-03	1.79E-02	3.03E-02	2.50E-02	2.50E-02
Cr+3	3.10E-03	2.25E-03	4.10E-07	4.02E-07	3.02E-04	6.74E-04	1.04E-03	8.84E-04	8.84E-04
Co+2	1.69E-05	1.22E-05	2.21E-09	2.17E-09	2.24E-06	3.63E-06	6.80E-06	5.45E-06	5.45E-06
Cs+	2.37E-05	2.02E-05	2.69E-08	2.64E-08	4.03E-05	4.42E-05	2.48E-06	2.09E-05	2.09E-05
Cu+2	5.83E-04	4.23E-04	8.84E-08	8.67E-08	7.88E-05	1.45E-04	2.46E-04	2.03E-04	2.03E-04
Fe+3	1.77E-02	1.29E-02	1.70E-06	1.67E-06	1.36E-03	2.79E-03	8.83E-03	6.26E-03	6.26E-03
Pb+2	1.16E-03	8.44E-04	1.80E-06	1.77E-06	5.70E-04	2.96E-03	1.02E-04	1.32E-03	1.32E-03
Hg+2	1.35E-03	1.39E-03	3.00E-06	2.95E-06	2.53E-06	5.88E-06		2.51E-06	2.51E-06
Mn+4	1.17E-02	8.52E-03	1.43E-06	1.41E-06	1.46E-03	2.36E-03	4.41E-03	3.54E-03	3.54E-03
Ni+2	1.28E-03	9.29E-04	1.79E-07	1.76E-07	1.60E-04	2.95E-04	4.99E-04	4.12E-04	4.12E-04
K+	1.62E-01	1.18E-01	3.10E-05	3.04E-05	3.91E-02	5.09E-02	3.46E-02	4.16E-02	4.16E-02
Se+4	7.08E-05	5.17E-05	1.25E-08	1.23E-08	1.40E-05	2.06E-05	3.85E-05	3.09E-05	3.09E-05
Ag+	5.60E-06	4.07E-06	1.62E-09	1.59E-09	1.35E-06	2.66E-06	3.81E-06	3.32E-06	3.32E-06
Na+	1.74E+00	1.27E+00	1.08E-04	1.06E-04	9.00E-02	1.77E-01	2.53E-01	2.20E-01	2.20E-01
Tl+3	2.53E-05	1.84E-05	1.15E-08	1.13E-08	1.17E-05	1.89E-05	3.54E-05	2.84E-05	2.84E-05
U+4	3.33E-04	2.43E-04	1.78E-07	1.75E-07	1.99E-04	2.92E-04	5.46E-04	4.38E-04	4.38E-04
V+3	8.08E-04	5.86E-04	9.16E-08	8.99E-08	1.02E-04	1.51E-04	2.81E-04	2.26E-04	2.26E-04
Zn+2	8.77E-04	6.37E-04	1.37E-07	1.34E-07	1.22E-04	2.25E-04	3.81E-04	3.14E-04	3.14E-04
Zr+4	1.22E-03	8.92E-04	2.50E-07	2.45E-07	2.79E-04	4.10E-04	7.67E-04	6.15E-04	6.15E-04
Cl-	2.64E-02	1.92E-02	5.44E-06	5.34E-06	5.13E-03	8.67E-03	2.34E-03	5.04E-03	5.04E-03
F-	3.71E-02	2.76E-02	5.08E-06	4.98E-06	2.90E-03	7.53E-03	7.11E-04	3.61E-03	3.61E-03
SO4-2	4.58E-02	3.41E-02	2.00E-08	1.96E-08	1.05E-05	3.28E-05	2.53E-05	2.85E-05	2.85E-05
NO3-	4.48E+00	3.29E+00	8.33E-06	8.17E-06	1.22E-03	3.51E-03	2.70E-03	3.05E-03	3.05E-03
PO4-3	1.80E-02	1.31E-02	5.78E-06	5.67E-06	1.09E-02	9.50E-03	1.30E-02	1.15E-02	1.15E-02
Am+4	2.91E-08	2.11E-08	1.58E-11	1.55E-11	1.60E-08	2.59E-08	4.84E-08	3.88E-08	3.88E-08
Br-	1.43E-07	1.05E-07	6.66E-11	6.54E-11	6.29E-08	1.06E-07	2.87E-08	6.18E-08	6.18E-08
Ce+4	4.02E-05	2.92E-05	1.25E-08	1.23E-08	1.27E-05	2.06E-05	3.85E-05	3.09E-05	3.09E-05
Eu+3	2.38E-07	1.72E-07	8.04E-11	7.89E-11	8.16E-08	1.32E-07	2.47E-07	1.98E-07	1.98E-07
Gd+3	1.48E-04	1.07E-04	5.18E-08	5.09E-08	5.26E-05	8.52E-05	1.59E-04	1.28E-04	1.28E-04
Ge+4	4.13E-09	3.02E-09	6.73E-13	6.61E-13	7.52E-10	1.11E-09	2.07E-09	1.66E-09	1.66E-09
In+3	6.50E-07	4.72E-07	1.66E-10	1.63E-10	1.69E-07	2.73E-07	5.11E-07	4.10E-07	4.10E-07
I-	1.24E-06	9.07E-07	9.18E-10	9.01E-10	8.66E-07	1.46E-06	3.95E-07	8.50E-07	8.50E-07
La+3	4.32E-06	3.13E-06	1.33E-09	1.31E-09	1.35E-06	2.19E-06	4.10E-06	3.29E-06	3.29E-06

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+	4.10E-04	2.97E-04	7.63E-09	7.49E-09	6.37E-06	1.25E-05	1.79E-05	1.56E-05	1.56E-05
Mg+2	1.01E-02	7.36E-03	5.88E-07	5.77E-07	5.24E-04	9.66E-04	1.64E-03	1.35E-03	1.35E-03
Mo+6	1.51E-03	1.11E-03	3.27E-07	3.21E-07	3.65E-04	5.37E-04	1.00E-03	8.05E-04	8.05E-04
Nd+3	1.39E-05	1.01E-05	4.47E-09	4.39E-09	4.54E-06	7.34E-06	1.37E-05	1.10E-05	1.10E-05
Np+4	8.05E-06	5.84E-06	4.25E-09	4.17E-09	4.31E-06	6.98E-06	1.30E-05	1.05E-05	1.05E-05
Nb+5	4.12E-04	2.99E-04	8.52E-08	8.36E-08	9.51E-05	1.40E-04	2.62E-04	2.10E-04	2.10E-04
Pd+4	2.89E-05	2.10E-05	7.33E-09	7.19E-09	6.53E-06	1.20E-05	2.04E-05	1.68E-05	1.68E-05
Pu+4	9.29E-06	6.79E-06	5.09E-09	4.99E-09	5.68E-06	8.36E-06	1.56E-05	1.25E-05	1.25E-05
Pr+4	3.93E-06	2.85E-06	1.23E-09	1.21E-09	1.25E-06	2.02E-06	3.78E-06	3.03E-06	3.03E-06
Pm+3	5.95E-10	4.31E-10	1.92E-13	1.88E-13	1.95E-10	3.15E-10	5.90E-10	4.73E-10	4.73E-10
Rh+4	1.69E-06	1.23E-06	3.88E-10	3.81E-10	3.94E-07	6.37E-07	1.19E-06	9.56E-07	9.56E-07
Rb+	2.61E-06	1.89E-06	5.98E-10	5.87E-10	4.99E-07	9.80E-07	1.40E-06	1.22E-06	1.22E-06
Ru+3	1.16E-04	8.44E-05	2.62E-08	2.57E-08	2.66E-05	4.30E-05	8.04E-05	6.45E-05	6.45E-05
Sm+3	2.58E-06	1.87E-06	8.64E-10	8.48E-10	8.77E-07	1.42E-06	2.66E-06	2.13E-06	2.13E-06
Si+4	2.84E-03	2.09E-03	1.93E-06	1.90E-06	5.68E-03	3.18E-03	8.72E-03	6.36E-03	6.36E-03
Sr+2	9.92E-05	7.21E-05	2.08E-08	2.04E-08	1.85E-05	3.41E-05	5.78E-05	4.77E-05	4.77E-05
Tc+7	4.88E-06	3.55E-06	3.38E-09	3.32E-09	5.87E-06	5.56E-06	4.47E-07	2.62E-06	2.62E-06
Te+4	1.36E-06	9.91E-07	3.88E-10	3.81E-10	4.34E-07	6.38E-07	1.19E-06	9.56E-07	9.56E-07
Tb+4	9.94E-10	7.21E-10	3.51E-13	3.45E-13	3.57E-10	5.78E-10	1.08E-09	8.66E-10	8.66E-10
Th+4	9.69E-11	7.08E-11	5.04E-14	4.95E-14	5.63E-11	8.29E-11	1.55E-10	1.24E-10	1.24E-10
Sn+4	6.81E-05	4.98E-05	1.81E-08	1.78E-08	2.02E-05	2.98E-05	5.57E-05	4.46E-05	4.46E-05
Ti+4	1.24E-04	9.06E-05	1.33E-08	1.31E-08	1.49E-05	2.19E-05	4.09E-05	3.28E-05	3.28E-05
Y+3	3.22E-06	2.34E-06	6.37E-10	6.25E-10	6.46E-07	1.05E-06	1.96E-06	1.57E-06	1.57E-06
OH-		3.57E-04	2.93E-06	2.88E-06	2.48E-03	4.82E-03	7.37E-03	6.28E-03	6.28E-03
H2O	4.68E+01	3.63E+01	3.27E-02	3.21E-02	7.61E-04	1.51E-03	2.30E-03	1.97E-03	1.97E-03
SO2		4.34E-07	2.85E-09	2.80E-09					
H2S			1.26E-05	1.23E-05					
CO		8.38E-12	7.65E-04	7.51E-04					
CO2		1.34E-05	7.33E-03	7.20E-03					
H2		1.43E-11	2.10E-04	2.06E-04					
N2		5.88E-07	1.30E-02	1.41E-02					
NO		9.83E-09	4.49E-05	4.41E-05					
NO2		1.23E-07	4.66E-06	4.57E-06					
O2		1.42E-07	4.27E-04	4.19E-04					
S (other)		5.79E-09	2.18E-07	2.14E-07	1.84E-04	3.58E-04	5.50E-04	4.68E-04	4.68E-04
CO3	1.19E-05	1.01E-05	1.60E-04	1.57E-04	1.46E-01	2.64E-01	3.78E-01	3.29E-01	3.29E-01
C (reductant)			2.19E-05	2.15E-05	4.33E-01	3.60E-02		1.53E-02	1.53E-02
O (oxides)	5.00E-02	3.65E-02	3.67E-05	3.61E-05	3.99E-02	6.04E-02	1.18E-01	9.34E-02	9.34E-02
C (organic)	1.64E-02	9.98E+00	9.19E-05	9.02E-05	7.25E-02	1.21E-01	8.99E-03	5.69E-02	5.69E-02
H (organic)	3.01E-02	1.83E+01	1.74E-05	1.71E-05	1.12E-02	1.87E-02	1.38E-03	8.75E-03	8.75E-03
O (organic)	1.51E-02	9.15E+00	9.02E-05	8.85E-05	8.85E-02	1.48E-01	1.10E-02	6.94E-02	6.94E-02
Mass Flow (kg/hr):	4.36E+02	6.01E+02	2.56E+03	2.62E+03	4.46E+01	2.82E+01	3.80E+01	6.62E+01	6.62E+01
Total Canisters Generated								204	
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/Canister
Heat Generation, w/m3	2.68E-01	1.98E-01			2.05E-01	1.45E+00	2.44E+00	1.99E+00	1.59E+00

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/canister
H-3	1.59E-05	1.15E-05	1.99E-06	1.95E-06					
C-14	5.71E-11	4.14E-11	6.96E-12	6.83E-12	9.39E-11	3.69E-11	1.48E-11	2.42E-11	2.58E-08
Co-60	3.66E-06	2.65E-06	1.30E-07	1.28E-07	8.26E-06	1.34E-05	2.50E-05	2.01E-05	2.13E-02
Ni-59	8.42E-08	6.12E-08	3.22E-09	3.16E-09	1.79E-07	3.30E-07	5.60E-07	4.62E-07	4.91E-04
Ni-63	2.22E-05	1.61E-05	8.49E-07	8.34E-07	4.73E-05	8.71E-05	1.48E-04	1.22E-04	1.30E-01
Se-79	2.08E-07	1.52E-07	7.47E-09	7.33E-09	5.20E-07	7.66E-07	1.43E-06	1.15E-06	1.22E-03
Sr-90	1.79E-02	1.30E-02	6.86E-04	6.74E-04	3.82E-02	7.04E-02	1.19E-01	9.85E-02	1.05E+02
Y-90	1.79E-02	1.30E-02	6.40E-04	6.28E-04	4.05E-02	6.56E-02	1.23E-01	9.84E-02	1.05E+02
Zr-93	1.00E-06	7.35E-07	3.61E-08	3.55E-08	2.52E-06	3.71E-06	6.92E-06	5.55E-06	5.90E-03
Nb-93m	7.74E-07	5.62E-07	2.76E-08	2.71E-08	1.93E-06	2.83E-06	5.29E-06	4.25E-06	4.51E-03
Nb-94	5.42E-07	3.93E-07	1.93E-08	1.90E-08	1.35E-06	1.98E-06	3.70E-06	2.97E-06	3.16E-03
Tc-99	8.30E-06	6.03E-06	9.40E-07	9.22E-07	1.02E-04	9.64E-05	7.76E-06	4.55E-05	4.84E-02
Ru-106	4.43E-07	3.21E-07	1.58E-08	1.55E-08	1.00E-06	1.62E-06	3.03E-06	2.43E-06	2.58E-03
Rh-102	3.91E-10	2.84E-10	1.39E-11	1.37E-11	8.83E-10	1.43E-09	2.67E-09	2.14E-09	2.28E-06
Rh-106	4.43E-07	3.21E-07	1.58E-08	1.55E-08	1.00E-06	1.62E-06	3.03E-06	2.43E-06	2.58E-03
Pd-107	7.49E-09	5.44E-09	2.87E-10	2.81E-10	1.59E-08	2.94E-08	4.98E-08	4.11E-08	4.37E-05
Cd-113m	1.51E-06	1.09E-06	6.29E-08	6.18E-08	4.09E-06	6.46E-06	9.60E-06	8.26E-06	8.78E-03
Sn-121m	3.03E-08	2.22E-08	1.09E-09	1.07E-09	7.60E-08	1.12E-07	2.09E-07	1.68E-07	1.78E-04
Sn-126	1.95E-07	1.43E-07	7.02E-09	6.89E-09	4.90E-07	7.21E-07	1.35E-06	1.08E-06	1.15E-03
Sb-125	7.28E-06	5.28E-06	2.60E-07	2.55E-07	1.64E-05	2.66E-05	4.98E-05	3.99E-05	4.24E-02
Sb-126	2.61E-08	1.89E-08	9.30E-10	9.13E-10	5.89E-08	9.54E-08	1.78E-07	1.43E-07	1.52E-04
Te-125m	1.43E-06	1.04E-06	5.14E-08	5.04E-08	3.58E-06	5.27E-06	9.84E-06	7.89E-06	8.39E-03
I-129	2.21E-08	1.61E-08	2.06E-09	2.02E-09	1.21E-07	2.05E-07	5.54E-08	1.19E-07	1.27E-04
Cs-134	4.72E-06	4.02E-06	6.45E-07	6.33E-07	6.03E-05	6.62E-05	3.71E-06	3.13E-05	3.32E-02
Cs-135	4.07E-07	3.46E-07	5.56E-08	5.45E-08	5.19E-06	5.70E-06	3.20E-07	2.69E-06	2.86E-03
Cs-137	2.38E-02	2.03E-02	3.26E-03	3.20E-03	3.04E-01	3.34E-01	1.87E-02	1.58E-01	1.68E+02
Ba-137m	2.25E-02	1.64E-02	8.62E-04	8.46E-04	4.80E-02	8.84E-02	1.50E-01	1.24E-01	1.31E+02
Ce-144	2.98E-07	2.17E-07	1.06E-08	1.04E-08	6.74E-07	1.09E-06	2.04E-06	1.64E-06	1.74E-03
Pr-144	2.98E-07	2.17E-07	1.06E-08	1.04E-08	6.74E-07	1.09E-06	2.04E-06	1.64E-06	1.74E-03
Pm-146	2.31E-08	1.67E-08	8.23E-10	8.08E-10	5.21E-08	8.44E-08	1.58E-07	1.27E-07	1.35E-04
Pm-147	8.10E-05	5.88E-05	2.89E-06	2.83E-06	1.83E-04	2.96E-04	5.54E-04	4.44E-04	4.72E-01
Sm-151	1.60E-04	1.16E-04	5.69E-06	5.59E-06	3.61E-04	5.84E-04	1.09E-03	8.76E-04	9.31E-01
Eu-152	1.16E-06	8.39E-07	4.12E-08	4.04E-08	2.61E-06	4.23E-06	7.91E-06	6.34E-06	6.74E-03
Eu-154	4.15E-05	3.01E-05	1.48E-06	1.45E-06	9.37E-05	1.52E-04	2.84E-04	2.27E-04	2.42E-01
Eu-155	7.54E-05	5.47E-05	2.69E-06	2.64E-06	1.70E-04	2.76E-04	5.16E-04	4.14E-04	4.40E-01
Th-230	3.96E-10	2.89E-10	1.42E-11	1.40E-11	9.91E-10	1.46E-09	2.73E-09	2.19E-09	2.32E-06
Pa-233	1.33E-06	9.72E-07	4.78E-08	4.69E-08	3.33E-06	4.90E-06	9.16E-06	7.35E-06	7.81E-03
U-232	9.54E-10	6.97E-10	3.43E-11	3.36E-11	2.39E-09	3.52E-09	6.57E-09	5.27E-09	5.60E-06
U-233	3.72E-11	2.72E-11	1.34E-12	1.31E-12	9.31E-11	1.37E-10	2.56E-10	2.05E-10	2.18E-07
U-234	9.55E-07	6.98E-07	3.43E-08	3.37E-08	2.39E-06	3.52E-06	6.58E-06	5.28E-06	5.61E-03
U-235	3.49E-08	2.55E-08	1.25E-09	1.23E-09	8.74E-08	1.29E-07	2.40E-07	1.93E-07	2.05E-04
U-236	5.18E-08	3.79E-08	1.86E-09	1.83E-09	1.30E-07	1.91E-07	3.57E-07	2.86E-07	3.04E-04
U-237	2.92E-09	2.13E-09	1.05E-10	1.03E-10	7.31E-09	1.08E-08	2.01E-08	1.61E-08	1.71E-05
U-238	2.06E-08	1.51E-08	7.42E-10	7.28E-10	5.17E-08	7.61E-08	1.42E-07	1.14E-07	1.21E-04
Np-237	1.34E-06	9.76E-07	4.79E-08	4.70E-08	3.04E-06	4.92E-06	9.20E-06	7.37E-06	7.84E-03
Pu-236	1.91E-09	1.40E-09	6.88E-11	6.75E-11	4.80E-09	7.06E-09	1.32E-08	1.06E-08	1.12E-05
Pu-238	8.73E-04	6.38E-04	3.14E-05	3.08E-05	2.19E-03	3.22E-03	6.01E-03	4.82E-03	5.13E+00
Pu-239	1.32E-04	9.68E-05	4.76E-06	4.67E-06	3.32E-04	4.88E-04	9.12E-04	7.32E-04	7.78E-01
Pu-240	7.19E-06	5.25E-06	2.58E-07	2.54E-07	1.80E-05	2.65E-05	4.95E-05	3.97E-05	4.22E-02
Pu-241	5.26E-04	3.84E-04	1.89E-05	1.86E-05	1.32E-03	1.94E-03	3.62E-03	2.91E-03	3.09E+00
Pu-242	5.54E-09	4.05E-09	1.99E-10	1.95E-10	1.39E-08	2.04E-08	3.82E-08	3.06E-08	3.25E-05
Pu-244	4.75E-16	3.47E-16	1.71E-17	1.67E-17	1.19E-15	1.75E-15	3.27E-15	2.62E-15	2.79E-12
Am-241	6.32E-05	4.59E-05	2.25E-06	2.21E-06	1.43E-04	2.31E-04	4.32E-04	3.47E-04	3.69E-01
Am-242m	6.90E-09	5.01E-09	2.46E-10	2.41E-10	1.56E-08	2.52E-08	4.72E-08	3.78E-08	4.02E-05

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/Canister
Am-243	1.00E-08	7.27E-09	3.57E-10	3.50E-10	2.26E-08	3.66E-08	6.85E-08	5.49E-08	5.84E-05
Cm-242	5.69E-09	4.16E-09	2.05E-10	2.01E-10	1.43E-08	2.10E-08	3.92E-08	3.14E-08	3.34E-05
Cm-243	1.64E-08	1.20E-08	5.88E-10	5.77E-10	4.10E-08	6.04E-08	1.13E-07	9.04E-08	9.61E-05
Cm-244	1.02E-06	7.44E-07	3.66E-08	3.59E-08	2.55E-06	3.75E-06	7.01E-06	5.62E-06	5.97E-03
Cm-245	1.72E-10	1.26E-10	6.19E-12	6.08E-12	4.32E-10	6.35E-10	1.19E-09	9.52E-10	1.01E-06
Cm-246	1.13E-11	8.27E-12	4.07E-13	3.99E-13	2.83E-11	4.17E-11	7.79E-11	6.25E-11	6.64E-08
TRU	1.09E-03	7.99E-04	3.93E-05	3.86E-05	2.72E-03	4.03E-03	7.53E-03	6.04E-03	6.42E+00
TRU, nCi/gm	9.11E+02							6.04E+03	
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			69.76%	68.47%					
O2, mol %			0.51%	0.50%					
N2, mol %			17.88%	19.40%					
H2, mol %			4.01%	3.93%					
CO2, mol %			6.41%	6.29%					
CO, ppmv			1.05E+04	1.03E+04					
NO, ppmv			5.76E+02	5.65E+02					
NO2, ppmv			3.90E+01	3.82E+01					
SO2, ppmv			1.71E-02	1.68E-02					
Cl, ppmv			5.90E+01	5.79E+01					
F, ppmv			1.03E+02	1.01E+02					
C (organic), ppmv			2.94E+03	2.89E+03					
H (organic), ppmv			6.65E+03	6.52E+03					
Hg, ug/wscm			4.81E+04	4.72E+04					
PM, mg/wscm			9.89E+03	9.71E+03					
SVM, ug/wscm			3.20E+04	3.14E+04					
LVM, ug/wscm			7.68E+03	7.53E+03					
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			1.6962%	1.5963%					
N2, mol %, dry basis			59.12%	61.53%					
H2, mol %, dry basis			13.25%	12.47%					
CO2, mol %, dry basis			21.18%	19.94%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			4.86E+03	4.58E+03					
NO, ppmv, dry basis			2.67E+02	2.51E+02					
NO2, ppmv, dry basis			1.80E+01	1.70E+01					
SO2, ppmv, dry basis			7.93E-03	7.46E-03					
Cl, ppmv, dry basis			2.73E+01	2.57E+01					
F, ppmv, dry basis			4.76E+01	4.48E+01					
C (organic), ppmv, dry basis			1.36E+03	1.28E+03					
H (organic), ppmv, dry basis			3.08E+03	2.90E+03					
Hg, ug/dscm			2.23E+04	2.10E+04					
PM, mg/dscm			4.58E+03	4.31E+03					
SVM, ug/dscm			1.06E+05	1.04E+05					
LVM, ug/dscm			2.54E+04	2.49E+04					

Table A-13. Mass balance, Tank WM-180 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-180, Stream #	109	110	111	112	113A	113B	114	115	116
Stream Name	Off-Gas from Filter to Oxidizer	Oxidizer Effluent	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Scrubber Effluent Gas	Demister Effluent Gas	GAC Bed Feed
Rate or Volume	4.44E+05	7.13E+05	3.72E+05	1.02E+04	1.02E+04	0.00E+00	3.80E+05	3.89E+05	4.72E+05
Volume Flow (standard, wet)*	1.05E+05	1.09E+05	1.85E+05				1.84E+05	1.85E+05	1.85E+05
Volume Flow (standard, dry)*	3.35E+04	3.22E+04	3.21E+04				3.21E+04	3.22E+04	3.22E+04
Rate Units	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.97E+03	3.09E+03	5.23E+03	3.87E+04	3.88E+04	0.00	5.20E+03	5.22E+03	5.22E+03
Rate Units	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	527	950	100	82	83	0	82	81	120
Temperature, °F	980	1742	212	179	181	32	179	178	248
Pressure, psia	9.5	9.4	9.3	38.1	9.0	8.4	8.6	8.4	7.7
Specific Gravity	2.09E-04	1.42E-04	4.25E-04	1.01	1.01	1.01	4.15E-04	4.06E-04	3.34E-04
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
H+	8.35E-07	2.46E-08	2.51E-08	1.02E+00	1.02E+00	1.02E+00	2.22E-07	2.21E-07	2.21E-07
Al+3	5.12E-08	4.92E-08	2.91E-08	1.78E-03	1.78E-03	1.78E-03			
Sb+5	5.08E-13	4.89E-13	2.89E-13	3.93E-09	3.93E-09	3.93E-09			
As+3	1.00E-10	9.66E-11	5.71E-11	1.26E-06	1.26E-06	1.26E-06			
Ba+2	2.21E-11	2.12E-11	4.05E-13	2.52E-07	2.51E-07	2.51E-07			
Be+2	2.27E-13	2.18E-13	4.16E-15	3.93E-08	3.93E-08	3.93E-08			
B+3	3.37E-10	3.24E-10	1.92E-10	2.93E-05	2.93E-05	2.93E-05			
Cd+2	2.83E-10	2.72E-10	1.61E-10	1.97E-06	1.97E-06	1.97E-06			
Ca+2	1.59E-08	1.53E-08	2.92E-10	6.21E-04	6.20E-04	6.20E-04			
Cr+3	5.99E-10	5.76E-10	3.41E-10	7.94E-06	7.94E-06	7.94E-06			
Co+2	3.23E-12	3.11E-12	1.84E-12	5.16E-08	5.16E-08	5.16E-08			
Cs+	2.62E-11	2.52E-11	1.49E-11	6.66E-05	6.65E-05	6.65E-05			
Cu+2	1.29E-10	1.24E-10	2.37E-12	3.18E-06	3.18E-06	3.18E-06			
Fe+3	2.48E-09	2.39E-09	1.41E-09	9.87E-05	9.86E-05	9.86E-05			
Pb+2	2.64E-09	2.54E-09	1.50E-09	6.90E-06	6.90E-06	6.90E-06			
Hg+2	2.92E-06	2.81E-06	1.66E-06	9.22E-03	9.21E-03	9.21E-03		9.36E-07	9.36E-07
Mn+4	2.10E-09	2.02E-09	1.19E-09	3.59E-05	3.59E-05	3.59E-05			
Ni+2	2.62E-10	2.52E-10	4.81E-12	6.99E-06	6.98E-06	6.98E-06			
K+	4.53E-08	4.36E-08	2.57E-08	1.53E-03	1.53E-03	1.53E-03			
Se+4	1.83E-11	1.76E-11	1.04E-11	8.75E-06	8.74E-06	8.74E-06			
Ag+	8.21E-12	1.24E-11	7.31E-12	5.16E-08	5.17E-08	5.17E-08			
Na+	5.45E-07	5.24E-07	3.10E-07	5.95E-02	5.95E-02	5.95E-02			
Tl+3	1.68E-11	1.62E-11	9.57E-12	7.75E-08	7.75E-08	7.75E-08			
U+4	2.60E-10	2.50E-10	1.48E-10	4.12E-05	4.11E-05	4.11E-05			
V+3	1.34E-10	1.29E-10	7.61E-11	3.83E-06	3.82E-06	3.82E-06			
Zn+2	2.00E-10	1.92E-10	3.67E-12	4.79E-06	4.78E-06	4.78E-06			
Zr+4	3.65E-10	3.51E-10	2.07E-10	1.51E-04	1.51E-04	1.51E-04			
Cl-	1.64E-07	1.58E-07	9.34E-08	2.67E-03	2.67E-03	2.67E-03	1.34E-08	1.34E-08	1.34E-08
F-	4.91E-07	4.73E-07	2.79E-07	1.61E-02	1.61E-02	1.61E-02	6.72E-07	6.69E-07	6.69E-07
SO4-2	2.92E-11	6.15E-07	3.63E-07	2.12E-02	2.11E-02	2.11E-02			
NO3-	6.03E-06	4.34E-09	2.56E-09	1.04E+00	1.04E+00	1.04E+00	1.14E-05	1.14E-05	1.14E-05
PO4-3	8.44E-09	8.12E-09	4.80E-09	5.54E-04	5.53E-04	5.53E-04			
Am+4	2.30E-14	2.22E-14	1.31E-14	8.92E-11	8.92E-11	8.92E-11			
Br-	2.02E-12	1.94E-12	1.15E-12	1.45E-08	1.45E-08	1.45E-08	1.64E-13	1.64E-13	1.64E-13
Ce+4	1.83E-11	1.76E-11	1.04E-11	1.23E-07	1.23E-07	1.23E-07			
Eu+3	1.17E-13	1.13E-13	6.68E-14	7.27E-10	7.27E-10	7.27E-10			
Gd+3	7.57E-11	7.28E-11	4.30E-11	4.53E-07	4.53E-07	4.53E-07			
Ge+4	9.84E-16	9.46E-16	5.59E-16	5.11E-10	5.10E-10	5.10E-10			
In+3	2.43E-13	2.34E-13	1.38E-13	1.99E-09	1.99E-09	1.99E-09			
I-	2.77E-11	2.67E-11	1.58E-11	1.26E-07	1.26E-07	1.26E-07	2.26E-12	2.26E-12	2.26E-12
La+3	1.95E-12	1.88E-12	1.11E-12	1.32E-08	1.32E-08	1.32E-08			

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
Li+	3.86E-11	5.82E-11	3.44E-11	3.77E-06	3.78E-06	3.78E-06			
Mg+2	8.59E-10	8.26E-10	1.58E-11	5.53E-05	5.53E-05	5.53E-05			
Mo+6	4.78E-10	4.60E-10	2.72E-10	2.54E-04	2.54E-04	2.54E-04			
Nd+3	6.53E-12	6.28E-12	3.71E-12	4.26E-08	4.26E-08	4.26E-08			
Np+4	6.20E-12	5.97E-12	3.53E-12	2.46E-08	2.46E-08	2.46E-08			
Nb+5	1.24E-10	1.20E-10	7.08E-11	1.95E-06	1.95E-06	1.95E-06			
Pd+4	1.07E-11	1.03E-11	1.96E-13	1.58E-07	1.57E-07	1.57E-07			
Pu+4	7.43E-12	7.15E-12	4.22E-12	1.15E-06	1.15E-06	1.15E-06			
Pr+4	1.80E-12	1.73E-12	1.02E-12	1.20E-08	1.20E-08	1.20E-08			
Pm+3	2.80E-16	2.70E-16	1.59E-16	1.82E-12	1.82E-12	1.82E-12			
Rh+4	5.67E-13	5.45E-13	3.22E-13	5.18E-09	5.18E-09	5.18E-09			
Rb+	3.03E-12	4.56E-12	2.69E-12	2.40E-08	2.40E-08	2.40E-08			
Ru+3	3.82E-11	3.68E-11	2.17E-11	3.56E-07	3.56E-07	3.56E-07			
Sm+3	1.26E-12	1.21E-12	7.18E-13	7.90E-09	7.90E-09	7.90E-09			
Si+4	2.83E-09	2.72E-09	1.61E-09	6.65E-04	6.64E-04	6.64E-04			
Sr+2	3.03E-11	2.92E-11	5.56E-13	5.42E-07	5.41E-07	5.41E-07			
Tc+7	4.94E-12	4.75E-12	2.81E-12	5.04E-08	5.04E-08	5.04E-08			
Te+4	5.67E-13	5.46E-13	3.23E-13	1.68E-07	1.67E-07	1.67E-07			
Tb+4	5.14E-16	4.94E-16	2.92E-16	3.04E-12	3.04E-12	3.04E-12			
Th+4	7.37E-17	7.09E-17	4.19E-17	1.20E-11	1.20E-11	1.20E-11			
Sn+4	2.65E-11	2.55E-11	1.51E-11	8.42E-06	8.41E-06	8.41E-06			
Ti+4	1.95E-11	1.87E-11	1.11E-11	1.53E-05	1.53E-05	1.53E-05			
Y+3	9.30E-13	8.95E-13	5.29E-13	9.85E-09	9.85E-09	9.85E-09			
OH-	4.28E-09	1.19E-07	2.49E-07	4.06E-07	4.07E-07	4.07E-07			
H2O	3.18E-02	3.30E-02	3.88E-02	5.24E+01	5.23E+01	5.23E+01	3.87E-02	3.86E-02	3.86E-02
SO2	2.78E-09	2.17E-05	1.28E-05	9.75E-06	9.78E-06	9.78E-06	1.29E-05	1.29E-05	1.29E-05
H2S	1.22E-05	2.71E-21							
CO	7.45E-04	1.48E-09	8.75E-10	1.88E-10	1.90E-10	1.90E-10	8.80E-10	8.77E-10	8.77E-10
CO2	7.14E-03	9.01E-03	5.32E-03	3.00E-04	3.09E-04	3.09E-04	5.35E-03	5.33E-03	5.33E-03
H2	2.05E-04	6.16E-10	3.64E-10	3.21E-10	5.06E-10	5.06E-10	7.70E-09		
N2	1.46E-02	1.40E-02	8.30E-03	1.32E-05	2.52E-05	2.52E-05	8.34E-03	8.31E-03	8.31E-03
NO	4.38E-05	4.76E-05	2.81E-05	2.21E-07	2.77E-07	2.77E-07	2.83E-05	2.82E-05	2.82E-05
NO2	4.54E-06	2.60E-07	1.53E-07	2.77E-06	2.76E-06	2.76E-06	1.54E-07	1.54E-07	1.54E-07
O2	4.16E-04	1.83E-03	1.08E-03	3.19E-06	4.88E-06	4.88E-06	1.08E-03	1.08E-03	1.08E-03
S (other)	3.18E-10	1.60E-25		1.30E-07	1.31E-07	1.31E-07			
CO3	2.34E-07	1.46E-11	3.36E-12	3.33E-05	3.32E-05	3.32E-05			
C (reductant)	3.20E-08	1.30E-18							
O (oxides)	5.37E-08	5.01E-08	2.96E-08	4.92E-03	4.91E-03	4.91E-03			
C (organic)	1.77E-05	1.66E-34							
H (organic)	5.93E-06	5.59E-35							
O (organic)	1.32E-07								
Mass Flow (kg/hr):	2.62E+03	2.87E+03	4.49E+03	3.92E+04	3.93E+04		4.47E+03	4.47E+03	4.47E+03
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				7.26E-02	7.25E-02				

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
H-3	1.94E-06	1.87E-06	1.10E-06	1.64E-06	1.63E-06	1.63E-06	1.10E-06	1.10E-06	1.10E-06
C-14	6.43E-12	6.24E-12	3.69E-12	6.34E-16	6.51E-16	6.51E-16	3.71E-12	3.69E-12	3.69E-12
Co-60	1.91E-10	1.83E-10	1.08E-10	1.12E-08	1.12E-08	1.12E-08			
Ni-59	4.71E-12	4.53E-12	8.63E-14	4.60E-10	4.59E-10	4.59E-10			
Ni-63	1.24E-09	1.19E-09	2.28E-11	1.21E-07	1.21E-07	1.21E-07			
Se-79	1.09E-11	1.05E-11	6.20E-12	2.57E-08	2.56E-08	2.56E-08			
Sr-90	1.00E-06	9.65E-07	1.84E-08	9.80E-05	9.79E-05	9.79E-05			
Y-90	9.35E-07	9.00E-07	5.32E-07	5.49E-05	5.49E-05	5.49E-05			
Zr-93	5.28E-11	5.08E-11	3.00E-11	1.24E-07	1.24E-07	1.24E-07			
Nb-93m	4.04E-11	3.88E-11	2.30E-11	3.67E-09	3.67E-09	3.67E-09			
Nb-94	2.82E-11	2.72E-11	1.61E-11	2.57E-09	2.56E-09	2.56E-09			
Tc-99	1.37E-09	1.32E-09	7.81E-10	8.57E-08	8.57E-08	8.57E-08			
Ru-106	2.31E-11	2.22E-11	1.31E-11	1.35E-09	1.35E-09	1.35E-09			
Rh-102	2.04E-14	1.96E-14	1.16E-14	1.20E-12	1.20E-12	1.20E-12			
Rh-106	2.31E-11	2.22E-11	1.31E-11	1.35E-09	1.35E-09	1.35E-09			
Pd-107	4.19E-13	4.03E-13	7.68E-15	4.09E-11	4.09E-11	4.09E-11			
Cd-113m	9.20E-11	8.85E-11	5.23E-11	4.50E-09	4.50E-09	4.50E-09			
Sn-121m	1.59E-12	1.53E-12	9.06E-13	3.75E-09	3.74E-09	3.74E-09			
Sn-126	1.03E-11	9.87E-12	5.83E-12	2.42E-08	2.41E-08	2.41E-08			
Sb-125	3.79E-10	3.65E-10	2.16E-10	2.23E-08	2.23E-08	2.23E-08			
Sb-126	1.36E-12	1.31E-12	7.72E-13	7.98E-11	7.98E-11	7.98E-11			
Te-125m	7.50E-11	7.22E-11	4.27E-11	1.77E-07	1.76E-07	1.76E-07			
I-129	6.23E-11	5.99E-11	3.54E-11	2.24E-09	2.24E-09	2.24E-09	5.08E-12	5.07E-12	5.07E-12
Cs-134	6.29E-10	6.05E-10	3.57E-10	1.33E-05	1.32E-05	1.32E-05			
Cs-135	5.41E-11	5.21E-11	3.08E-11	1.14E-06	1.14E-06	1.14E-06			
Cs-137	3.17E-06	3.05E-06	1.80E-06	6.69E-02	6.68E-02	6.68E-02			
Ba-137m	1.26E-06	1.21E-06	2.31E-08	1.23E-04	1.23E-04	1.23E-04			
Ce-144	1.55E-11	1.50E-11	8.83E-12	9.13E-10	9.13E-10	9.13E-10			
Pr-144	1.55E-11	1.50E-11	8.83E-12	9.13E-10	9.13E-10	9.13E-10			
Pm-146	1.20E-12	1.16E-12	6.83E-13	7.06E-11	7.06E-11	7.06E-11			
Pm-147	4.22E-09	4.06E-09	2.40E-09	2.48E-07	2.48E-07	2.48E-07			
Sm-151	8.32E-09	8.00E-09	4.73E-09	4.89E-07	4.89E-07	4.89E-07			
Eu-152	6.02E-11	5.79E-11	3.42E-11	3.54E-09	3.54E-09	3.54E-09			
Eu-154	2.16E-09	2.08E-09	1.23E-09	1.27E-07	1.27E-07	1.27E-07			
Eu-155	3.93E-09	3.78E-09	2.23E-09	2.31E-07	2.31E-07	2.31E-07			
Th-230	2.08E-14	2.00E-14	1.18E-14	4.89E-11	4.89E-11	4.89E-11			
Pa-233	6.98E-11	6.72E-11	3.97E-11	1.64E-07	1.64E-07	1.64E-07			
U-232	5.01E-14	4.82E-14	2.85E-14	1.18E-10	1.18E-10	1.18E-10			
U-233	1.95E-15	1.88E-15	1.11E-15	4.60E-12	4.59E-12	4.59E-12			
U-234	5.02E-11	4.83E-11	2.85E-11	1.18E-07	1.18E-07	1.18E-07			
U-235	1.83E-12	1.76E-12	1.04E-12	4.31E-09	4.31E-09	4.31E-09			
U-236	2.72E-12	2.62E-12	1.55E-12	6.40E-09	6.39E-09	6.39E-09			
U-237	1.53E-13	1.48E-13	8.72E-14	3.61E-10	3.60E-10	3.60E-10			
U-238	1.08E-12	1.04E-12	6.16E-13	2.55E-09	2.55E-09	2.55E-09			
Np-237	7.00E-11	6.74E-11	3.98E-11	4.11E-09	4.11E-09	4.11E-09			
Pu-236	1.01E-13	9.67E-14	5.72E-14	2.37E-10	2.36E-10	2.36E-10			
Pu-238	4.59E-08	4.41E-08	2.61E-08	1.08E-04	1.08E-04	1.08E-04			
Pu-239	6.96E-09	6.69E-09	3.96E-09	1.64E-05	1.64E-05	1.64E-05			
Pu-240	3.78E-10	3.63E-10	2.15E-10	8.89E-07	8.88E-07	8.88E-07			
Pu-241	2.76E-08	2.66E-08	1.57E-08	6.50E-05	6.49E-05	6.49E-05			
Pu-242	2.91E-13	2.80E-13	1.65E-13	6.85E-10	6.84E-10	6.84E-10			
Pu-244	2.49E-20	2.40E-20	1.42E-20	5.87E-17	5.86E-17	5.86E-17			
Am-241	3.29E-09	3.17E-09	1.87E-09	1.93E-07	1.93E-07	1.93E-07			
Am-242m	3.59E-13	3.46E-13	2.04E-13	2.11E-11	2.11E-11	2.11E-11			

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	5.22E-13	5.02E-13	2.97E-13	3.06E-11	3.06E-11	3.06E-11			
Cm-242	2.99E-13	2.88E-13	1.70E-13	7.04E-10	7.03E-10	7.03E-10			
Cm-243	8.60E-13	8.27E-13	4.89E-13	2.02E-09	2.02E-09	2.02E-09			
Cm-244	5.34E-11	5.14E-11	3.04E-11	1.26E-07	1.26E-07	1.26E-07			
Cm-245	9.05E-15	8.70E-15	5.14E-15	2.13E-11	2.13E-11	2.13E-11			
Cm-246	5.94E-16	5.72E-16	3.38E-16	1.40E-12	1.40E-12	1.40E-12			
TRU	5.74E-08	5.52E-08	3.26E-08	1.27E-04	1.27E-04	1.27E-04			
TRU, nCi/gm									
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	68.11%	70.52%	82.64%				82.54%	82.54%	82.54%
O2, mol %	0.50%	2.20%	1.29%				1.30%	1.30%	1.30%
N2, mol %	20.06%	19.32%	11.37%				11.43%	11.43%	11.43%
H2, mol %	3.91%	0.00001%	0.00001%				0.0001%		0.00%
CO2, mol %	6.25%	7.89%	4.64%				4.67%	4.67%	4.67%
CO, ppmv	1.03E+04	2.04E-02	1.20E-02				1.21E-02	1.21E-02	1.21E-02
NO, ppmv	5.62E+02	6.11E+02	3.60E+02				3.62E+02	3.62E+02	3.62E+02
NO2, ppmv	3.80E+01	2.17E+00	1.28E+00				1.29E+00	1.29E+00	1.29E+00
SO2, ppmv	1.67E-02	1.31E+02	7.70E+01				7.73E+01	7.73E+01	7.73E+01
Cl, ppmv	1.79E+00	1.72E+00	1.01E+00				1.45E-01	1.45E-01	1.45E-01
F, ppmv	9.97E+00	9.59E+00	5.65E+00				1.36E+01	1.36E+01	1.36E+01
C (organic), ppmv	5.68E+02	5.34E-27							
H (organic), ppmv	2.27E+03	2.14E-26							
Hg, ug/wscm	4.68E+04	4.50E+04	2.66E+04					1.50E+04	1.50E+04
PM, mg/wscm	4.44E+02	7.00E+01	4.90E+01				1.19E+01	2.68E+01	2.68E+01
SVM, ug/wscm	4.68E+01	4.50E+01	2.66E+01						
LVM, ug/wscm	1.12E+01	1.08E+01	6.37E+00						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	1.5705%	7.4569%	7.4567%				7.4538%	7.4534%	7.4534%
N2, mol %, dry basis	62.91%	65.53%	65.53%				65.50%	65.50%	65.50%
H2, mol %, dry basis	12.27%	0.00004%	0.00004%				0.00084%		0.00%
CO2, mol %, dry basis	19.61%	26.76%	26.76%				26.74%	26.74%	26.74%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis	4.50E+03	9.68E-03	9.68E-03				9.68E-03	9.68E-03	9.68E-03
NO, ppmv, dry basis	2.47E+02	2.90E+02	2.90E+02				2.90E+02	2.90E+02	2.90E+02
NO2, ppmv, dry basis	1.67E+01	1.03E+00	1.03E+00				1.03E+00	1.03E+00	1.03E+00
SO2, ppmv, dry basis	7.34E-03	6.21E+01	6.21E+01				6.21E+01	6.21E+01	6.21E+01
Cl, ppmv, dry basis	7.85E-01	8.17E-01	8.17E-01				1.17E-01	1.17E-01	1.17E-01
F, ppmv, dry basis	4.38E+00	4.56E+00	4.56E+00				1.09E+01	1.09E+01	1.09E+01
C (organic), ppmv, dry basis	2.50E+02								
H (organic), ppmv, dry basis	9.95E+02								
Hg, ug/dscm	2.06E+04	2.14E+04	2.15E+04					1.20E+04	1.20E+04
PM, mg/dscm	1.95E+02	3.33E+01	3.95E+01				9.56E+00	2.15E+01	2.15E+01
SVM, ug/dscm	1.55E+02	1.49E+02	8.80E+01						
LVM, ug/dscm	3.71E+01	3.57E+01	2.11E+01						

Table A-13. Mass balance, Tank WM-180 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3
WM-180, Stream #	117	118	119	120	201	202	203	204
Stream Name	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-Gas to Blower	Spent GAC	Boiler Feed Water	Fuel Oil to Boiler	Steam To Reformer	Propane to Oxidizer
Rate or Volume	1.34E+04	6.10E+05	6.43E+05	2.18E+00	3.16E+02	4.18E+01	6.32E+04	1.07E+02
Volume Flow (standard, wet)*	1.31E+04	1.85E+05	1.97E+05				5.66E+04	3.02E+02
Volume Flow (standard, dry)*	1.31E+04	3.22E+04	4.53E+04					3.02E+02
Rate Units	ft3/hr	ft3/hr	ft3/hr	lb/hr	gal/hr	gal/hr	ft3/hr	ft3/hr
Rate or Volume, metric	3.72E+02	5.22E+03	5.59E+03	9.88E-01	1.20E+03	1.58E+02	1.60E+03	8.56E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	kg/hr	L/hr	L/hr	wscm/hr	wscm/hr
Temperature, °C	25	120	115	28	15	15	670	25
Temperature, °F	77	248	239	82	59	59	1238	77
Pressure, psia	14.7	6.0	6.0	14.7	42.3	14.7	42.3	42.3
Specific Gravity	1.18E-03	2.59E-04	2.70E-04	5.86E-01	1.00E+00	7.70E-01	6.70E-04	5.19E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
H+		2.21E-07	2.07E-07	2.90E-05		2.40E-01		
Al+3								
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2								
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3								
Pb+2								
Hg+2		9.36E-10	8.76E-10	7.93E-02				
Mn+4								
Ni+2								
K+								
Se+4								
Ag+								
Na+								
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-		1.34E-09	1.25E-09	1.02E-03				
F-		6.69E-07	6.26E-07					
SO4-2								
NO3-		1.14E-05	1.07E-05					
PO4-3								
Am+4								
Br-		1.64E-14	1.53E-14	1.25E-08				
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-		2.26E-13	2.11E-13	1.72E-07				
La+3								

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4								
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-								
H2O	4.68E-06	3.86E-02	3.61E-02		5.56E+01		4.68E-02	
SO2		1.29E-05	1.20E-05					
H2S						1.20E-01		
CO		8.77E-10	8.20E-10					
CO2		5.33E-03	4.99E-03					
H2								
N2	5.75E-02	8.31E-03	1.16E-02					
NO		2.82E-05	2.63E-05					
NO2		1.54E-07	1.44E-07					
O2	1.74E-02	1.08E-03	2.17E-03					
S (other)								
CO3								
C (reductant)				9.20E-01				
O (oxides)								
C (organic)						5.41E+01		9.35E-02
H (organic)						1.15E+02		2.09E-02
O (organic)								
Mass Flow (kg/hr):	4.47E+02	4.47E+03	4.91E+03	9.88E-01	1.20E+03	1.22E+02	1.20E+03	1.57E+01
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				2.50E-11				

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
H-3		1.10E-06	1.03E-06					
C-14		3.69E-12	3.45E-12	1.46E-10				
Co-60								
Ni-59								
Ni-63								
Se-79								
Sr-90								
Y-90								
Zr-93								
Nb-93m								
Nb-94								
Tc-99								
Ru-106								
Rh-102								
Rh-106								
Pd-107								
Cd-113m								
Sn-121m								
Sn-126								
Sb-125								
Sb-126								
Te-125m								
I-129		5.07E-13	4.74E-13	2.41E-08				
Cs-134								
Cs-135								
Cs-137								
Ba-137m								
Ce-144								
Pr-144								
Pm-146								
Pm-147								
Sm-151								
Eu-152								
Eu-154								
Eu-155								
Th-230								
Pa-233								
U-232								
U-233								
U-234								
U-235								
U-236								
U-237								
U-238								
Np-237								
Pu-236								
Pu-238								
Pu-239								
Pu-240								
Pu-241								
Pu-242								
Pu-244								
Am-241								
Am-242m								

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	117	118	119	120	201	202	203	204
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
Am-243								
Cm-242								
Cm-243								
Cm-244								
Cm-245								
Cm-246								
TRU								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	0.01%	82.55%	77.05%				100.00%	
O2, mol %	20.99%	1.30%	2.61%					
N2, mol %	79.00%	11.43%	15.93%					
H2, mol %								
CO2, mol %		4.67%	4.36%					
CO, ppmv		1.21E-02	1.13E-02					
NO, ppmv		3.62E+02	3.38E+02					
NO2, ppmv		1.29E+00	1.20E+00					
SO2, ppmv		7.73E+01	7.22E+01					
Cl, ppmv		1.45E-02	1.36E-02					
F, ppmv		1.36E+01	1.27E+01					
C (organic), ppmv								3.00E+06
H (organic), ppmv								8.00E+06
Hg, ug/wscm		1.50E+01	1.40E+01					
PM, mg/wscm	1.60E+01	1.19E+01	1.22E+01				1.16E+01	1.83E+06
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	20.9921%	1.0443%	11.3790%					
N2, mol %, dry basis	79.01%	65.50%	69.42%					
H2, mol %, dry basis								
CO2, mol %, dry basis		26.74%	18.99%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis		9.68E-03	6.88E-03					
NO, ppmv, dry basis		2.90E+02	2.06E+02					
NO2, ppmv, dry basis		1.03E+00	7.34E-01					
SO2, ppmv, dry basis		6.21E+01	4.41E+01					
Cl, ppmv, dry basis		1.17E-02	8.28E-03					
F, ppmv, dry basis		1.09E+01	7.74E+00					
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm		1.20E+01	8.57E+00					
PM, mg/dscm	2.25E+00	9.55E+00	7.45E+00					
SVM, ug/dscm								
LVM, ug/dscm								

Table A-13. Mass balance, Tank WM-180 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-2	PFD-3
WM-180, Stream #	205	206	207	301	302	303	304	305
Stream Name	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 Scrub Makeup	Sugar to Feed	Carbon to Reformer	NOx Catalyst	Bed Media	Grout Mix for Scrub Blowdown
Rate or Volume	4.28E+02	3.52E-08	3.77E-01	3.14E+02	1.38E+02	2.20E-05	1.46E+00	6.61E+00
Volume Flow (standard, wet)*								
Volume Flow (standard, dry)*								
Rate Units	gal/hr	gal/hr	gal/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	1.62E+03	1.33E-07	1.43E+00	1.42E+02	6.26E+01	1.00E-05	6.62E-01	3.00E+00
Rate Units	L/hr	L/hr	L/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	25	25	25	15	15	15	15	25
Temperature, °F	77	77	77	59	59	59	59	77
Pressure, psia	112.3	14.7	42.3	14.7	14.7	14.7	14.7	14.7
Specific Gravity	9.97E-01	1.35E+00	1.28E+00	7.50E-01	5.00E-01	2.58E+00	1.58E+00	2.01E-01
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	1.00E-07	3.09E-08	1.39E+01					
Al+3		2.20E+00			1.53E-03		5.29E-01	
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2					1.85E-02			
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3					8.71E-04	6.99E-01		
Pb+2								
Hg+2					1.92E-06			
Mn+4								
Ni+2								
K+					7.14E-03			
Se+4								
Ag+								
Na+					7.42E-04			
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-								
F-								
SO4-2								
NO3-		6.60E+00	1.39E+01					
PO4-3					2.26E-03			
Am+4								
Br-								
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-								
La+3								

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	205	206	207	301	302	303	304	305
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4					6.26E-03			4.67E-01
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-	1.00E-07	3.09E-08						
H2O	5.54E+01	4.89E+01	2.27E+01					
SO2								
H2S								
CO								
CO2								
H2								
N2								
NO								
NO2								
O2								
S (other)					5.18E-04			
CO3					3.11E-02			
C (reductant)					9.22E-01			
O (oxides)					8.88E-03	3.01E-01	4.71E-01	5.33E-01
C (organic)				4.21E-01				
H (organic)				6.48E-02				
O (organic)				5.14E-01				
Mass Flow (kg/hr):	1.62E+03	1.80E-07	1.83E+00	1.42E+02	6.26E+01	1.00E-05	6.62E-01	3.00E+00

Table A-13. Mass balance, Tank WM-180 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3	PFD-2
WM-180, Stream #	401	402	404	404	503	504	505	506
Stream Name	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Reformer	Oxygen to Oxidizer	Air to Boiler
Rate or Volume	5.89E+00	2.60E-01	8.82E+00	2.29E-01	2.79E+03	6.52E+02	9.89E+02	6.19E+04
Volume Flow (standard, wet)*					1.74E+04	4.02E+03	6.11E+03	6.30E+04
Volume Flow (standard, dry)*					1.74E+04	4.02E+03	6.11E+03	6.30E+04
Rate Units	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.23E+01	9.86E-01	4.00E+00	4.00E+00	4.94E+02	1.14E+02	1.73E+02	1.78E+03
Rate Units	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	79	79	60	60	21	25	25	15
Temperature, °F	174	174	140	140	70	77	77	59
Pressure, psia	12.3	12.3	12.3	12.3	92.3	92.3	92.3	14.7
Specific Gravity	1.01E+00	1.01E+00	2.10E+00	2.10E+00	7.29E-03	8.21E-03	8.21E-03	1.22E-03
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
H+	1.03E+00	1.03E+00	2.56E-04	2.56E-04				
Al+3	1.78E-03	1.78E-03	1.19E-05	1.19E-05				
Sb+5	3.93E-09	3.93E-09	1.18E-10	1.18E-10				
As+3	1.26E-06	1.26E-06	2.33E-08	2.33E-08				
Ba+2	2.52E-07	2.52E-07	8.52E-09	8.52E-09				
Be+2	3.93E-08	3.93E-08	8.74E-11	8.74E-11				
B+3	2.93E-05	2.93E-05	7.82E-08	7.82E-08				
Cd+2	1.97E-06	1.97E-06	5.46E-08	5.46E-08				
Ca+2	6.21E-04	6.21E-04	6.13E-06	6.13E-06				
Cr+3	7.94E-06	7.94E-06	1.02E-07	1.02E-07				
Co+2	5.16E-08	5.16E-08	7.50E-10	7.50E-10				
Cs+	6.66E-05	6.66E-05	2.25E-06	2.25E-06				
Cu+2	3.18E-06	3.18E-06	4.98E-08	4.98E-08				
Fe+3	9.87E-05	9.87E-05	1.36E-06	1.36E-06				
Pb+2	6.90E-06	6.90E-06	3.52E-07	3.52E-07				
Hg+2	9.22E-03	9.22E-03	4.56E-04	4.56E-04				
Mn+4	3.59E-05	3.59E-05	4.86E-07	4.86E-07				
Ni+2	6.99E-06	6.99E-06	1.01E-07	1.01E-07				
K+	1.53E-03	1.53E-03	1.48E-05	1.48E-05				
Se+4	8.75E-06	8.75E-06	1.70E-07	1.70E-07				
Ag+	5.16E-08	5.16E-08	1.37E-09	1.37E-09				
Na+	5.95E-02	5.95E-02	3.37E-04	3.37E-04				
Tl+3	7.75E-08	7.75E-08	3.90E-09	3.90E-09				
U+4	4.12E-05	4.12E-05	2.42E-06	2.42E-06				
V+3	3.83E-06	3.83E-06	4.80E-08	4.80E-08				
Zn+2	4.79E-06	4.79E-06	7.72E-08	7.72E-08				
Zr+4	1.51E-04	1.51E-04	3.39E-06	3.39E-06				
Cl-	2.67E-03	2.67E-03	2.33E-05	2.33E-05				
F-	1.61E-02	1.61E-02	7.56E-05	7.56E-05				
SO4-2	2.12E-02	2.12E-02	5.01E-04	5.01E-04				
NO3-	1.04E+00	1.04E+00	1.58E-02	1.58E-02				
PO4-3	5.54E-04	5.54E-04	1.30E-05	1.30E-05				
Am+4	8.92E-11	8.92E-11	5.34E-12	5.34E-12				
Br-	1.45E-08	1.45E-08	2.86E-10	2.86E-10				
Ce+4	1.23E-07	1.23E-07	4.25E-09	4.25E-09				
Eu+3	7.27E-10	7.27E-10	2.72E-11	2.72E-11				
Gd+3	4.53E-07	4.53E-07	1.76E-08	1.76E-08				
Ge+4	5.11E-10	5.11E-10	9.14E-12	9.14E-12				
In+3	1.99E-09	1.99E-09	5.63E-11	5.63E-11				
I-	1.26E-07	1.26E-07	3.94E-09	3.94E-09				
La+3	1.32E-08	1.32E-08	4.52E-10	4.52E-10				

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
Li+	3.77E-06	3.77E-06	6.45E-09	6.45E-09				
Mg+2	5.53E-05	5.53E-05	3.31E-07	3.31E-07				
Mo+6	2.54E-04	2.54E-04	6.02E-06	6.02E-06				
Nd+3	4.26E-08	4.26E-08	1.51E-09	1.51E-09				
Np+4	2.46E-08	2.46E-08	1.44E-09	1.44E-09				
Nb+5	1.95E-06	1.95E-06	4.47E-08	4.47E-08				
Pd+4	1.58E-07	1.58E-07	4.13E-09	4.13E-09				
Pu+4	1.15E-06	1.15E-06	6.91E-08	6.91E-08				
Pr+4	1.20E-08	1.20E-08	4.17E-10	4.17E-10				
Pm+3	1.82E-12	1.82E-12	6.50E-14	6.50E-14				
Rh+4	5.18E-09	5.18E-09	1.31E-10	1.31E-10				
Rb+	2.40E-08	2.40E-08	5.06E-10	5.06E-10				
Ru+3	3.56E-07	3.56E-07	8.87E-09	8.87E-09				
Sm+3	7.90E-09	7.90E-09	2.93E-10	2.93E-10				
Si+4	6.65E-04	6.65E-04	3.51E-01	3.51E-01				
Sr+2	5.42E-07	5.42E-07	1.17E-08	1.17E-08				
Tc+7	5.04E-08	5.04E-08	1.22E-09	1.22E-09				
Te+4	1.68E-07	1.68E-07	5.27E-09	5.27E-09				
Tb+4	3.04E-12	3.04E-12	1.19E-13	1.19E-13				
Th+4	1.20E-11	1.20E-11	6.85E-13	6.85E-13				
Sn+4	8.42E-06	8.42E-06	2.46E-07	2.46E-07				
Ti+4	1.53E-05	1.53E-05	1.81E-07	1.81E-07				
Y+3	9.85E-09	9.85E-09	2.16E-10	2.16E-10				
OH-	8.01E-03	8.01E-03	3.36E-05	3.36E-05				
H2O	5.23E+01	5.23E+01	2.32E-01	2.32E-01				4.68E-06
SO2	9.75E-06	9.75E-06	1.54E-07	1.54E-07				
H2S								
CO	1.88E-10	1.88E-10	1.30E-12	1.30E-12				
CO2	3.00E-04	3.00E-04	3.25E-06	3.25E-06				
H2	3.21E-10	3.21E-10	1.59E-13	1.59E-13				
N2	1.32E-05	1.32E-05	9.11E-08	9.11E-08	7.27E-02			5.74E-02
NO	2.21E-07	2.21E-07	1.63E-09	1.63E-09				
NO2	2.77E-06	2.77E-06	3.14E-08	3.14E-08				
O2	3.19E-06	3.19E-06	2.51E-08	2.51E-08		8.30E-02	8.30E-02	1.74E-02
S (other)	1.30E-07	1.30E-07	1.03E-09	1.03E-09				
CO3	3.33E-05	3.33E-05	4.92E-07	4.92E-07				
C (reductant)								
O (oxides)	4.92E-03	4.92E-03	3.99E-01	3.99E-01				
C (organic)								
H (organic)								
O (organic)								
Mass Flow (kg/hr):	2.26E+01	1.00E+00	4.00E+00	4.00E+00	5.75E+02	1.52E+02	2.30E+02	2.14E+03
Total Drums Generated				31				
	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3	7.26E-02	7.26E-02	3.86E-02	7.73E-03				

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Radiological Composition	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
H-3								
C-14	6.34E-16	6.34E-16	1.56E-16	6.56E-14				
Co-60	1.12E-08	1.12E-08	2.76E-09	1.16E-06				
Ni-59	4.60E-10	4.60E-10	1.13E-10	4.76E-08				
Ni-63	1.21E-07	1.21E-07	2.99E-08	1.26E-05				
Se-79	2.57E-08	2.57E-08	6.33E-09	2.66E-06				
Sr-90	9.80E-05	9.80E-05	2.42E-05	1.01E-02				
Y-90	5.49E-05	5.49E-05	1.35E-05	5.69E-03				
Zr-93	1.24E-07	1.24E-07	3.06E-08	1.29E-05				
Nb-93m	3.67E-09	3.67E-09	9.04E-10	3.80E-07				
Nb-94	2.57E-09	2.57E-09	6.32E-10	2.66E-07				
Tc-99	8.57E-08	8.57E-08	2.11E-08	8.87E-06				
Ru-106	1.35E-09	1.35E-09	3.34E-10	1.40E-07				
Rh-102	1.20E-12	1.20E-12	2.95E-13	1.24E-10				
Rh-106	1.35E-09	1.35E-09	3.34E-10	1.40E-07				
Pd-107	4.09E-11	4.09E-11	1.01E-11	4.24E-09				
Cd-113m	4.50E-09	4.50E-09	1.11E-09	4.66E-07				
Sn-121m	3.75E-09	3.75E-09	9.24E-10	3.88E-07				
Sn-126	2.42E-08	2.42E-08	5.95E-09	2.50E-06				
Sb-125	2.23E-08	2.23E-08	5.49E-09	2.31E-06				
Sb-126	7.98E-11	7.98E-11	1.97E-11	8.26E-09				
Te-125m	1.77E-07	1.77E-07	4.35E-08	1.83E-05				
I-129	2.24E-09	2.24E-09	5.52E-10	2.32E-07				
Cs-134	1.33E-05	1.33E-05	3.36E-06	1.41E-03				
Cs-135	1.14E-06	1.14E-06	2.90E-07	1.22E-04				
Cs-137	6.69E-02	6.69E-02	1.70E-02	7.13E+00				
Ba-137m	1.23E-04	1.23E-04	3.03E-05	1.27E-02				
Ce-144	9.13E-10	9.13E-10	2.25E-10	9.45E-08				
Pr-144	9.13E-10	9.13E-10	2.25E-10	9.45E-08				
Pm-146	7.06E-11	7.06E-11	1.74E-11	7.31E-09				
Pm-147	2.48E-07	2.48E-07	6.11E-08	2.57E-05				
Sm-151	4.89E-07	4.89E-07	1.20E-07	5.06E-05				
Eu-152	3.54E-09	3.54E-09	8.72E-10	3.66E-07				
Eu-154	1.27E-07	1.27E-07	3.13E-08	1.31E-05				
Eu-155	2.31E-07	2.31E-07	5.69E-08	2.39E-05				
Th-230	4.89E-11	4.89E-11	1.21E-11	5.07E-09				
Pa-233	1.64E-07	1.64E-07	4.05E-08	1.70E-05				
U-232	1.18E-10	1.18E-10	2.91E-11	1.22E-08				
U-233	4.60E-12	4.60E-12	1.13E-12	4.76E-10				
U-234	1.18E-07	1.18E-07	2.91E-08	1.22E-05				
U-235	4.31E-09	4.31E-09	1.06E-09	4.47E-07				
U-236	6.40E-09	6.40E-09	1.58E-09	6.63E-07				
U-237	3.61E-10	3.61E-10	8.90E-11	3.74E-08				
U-238	2.55E-09	2.55E-09	6.29E-10	2.64E-07				
Np-237	4.11E-09	4.11E-09	1.01E-09	4.26E-07				
Pu-236	2.37E-10	2.37E-10	5.83E-11	2.45E-08				
Pu-238	1.08E-04	1.08E-04	2.66E-05	1.12E-02				
Pu-239	1.64E-05	1.64E-05	4.04E-06	1.70E-03				
Pu-240	8.89E-07	8.89E-07	2.19E-07	9.20E-05				
Pu-241	6.50E-05	6.50E-05	1.60E-05	6.73E-03				
Pu-242	6.85E-10	6.85E-10	1.69E-10	7.09E-08				
Pu-244	5.87E-17	5.87E-17	1.45E-17	6.08E-15				
Am-241	1.93E-07	1.93E-07	4.77E-08	2.00E-05				
Am-242m	2.11E-11	2.11E-11	5.20E-12	2.19E-09				

Table A-13. Mass balance, Tank WM-180 waste (continued).

Stream #	401	402	404	404	503	504	505	506
	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	3.06E-11	3.06E-11	7.55E-12	3.17E-09				
Cm-242	7.04E-10	7.04E-10	1.73E-10	7.28E-08				
Cm-243	2.02E-09	2.02E-09	4.99E-10	2.09E-07				
Cm-244	1.26E-07	1.26E-07	3.10E-08	1.30E-05				
Cm-245	2.13E-11	2.13E-11	5.25E-12	2.20E-09				
Cm-246	1.40E-12	1.40E-12	3.45E-13	1.45E-10				
TRU	1.27E-04	1.27E-04	3.14E-05	1.32E-02				
TRU, nCi/gm								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %								0.01%
O2, mol %						100.00%	100.00%	20.99%
N2, mol %					100.00%			79.00%
H2, mol %								
CO2, mol %								
CO, ppmv								
NO, ppmv								
NO2, ppmv								
SO2, ppmv								
Cl, ppmv								
F, ppmv								
C (organic), ppmv								
H (organic), ppmv								
Hg, ug/wscm								
PM, mg/wscm					2.00E+01	1.48E-01		1.60E+01
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis								20.99%
N2, mol %, dry basis								79.01%
H2, mol %, dry basis								
CO2, mol %, dry basis								
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis								
NO, ppmv, dry basis								
NO2, ppmv, dry basis								
SO2, ppmv, dry basis								
Cl, ppmv, dry basis								
F, ppmv, dry basis								
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm								
PM, mg/dscm								2.25E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-13. Mass balance, Tank WM-180 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-180, Stream #	507	510	511	512	513	514	515	516
Stream Name	Off-Gas from Boiler	Nitrogen to Cool Product	N2 from Product Cooler	Filter Backpulse N2	Solids Transport Nitrogen	Tank Farm Transfer Airlift Air	Ventilation Air	Fresh GAC
Rate or Volume	1.31E+05	2.88E+02	9.15E+02	2.72E+02	6.55E+01	1.40E+01	2.89E+01	2.00E+00
Volume Flow (standard, wet)*	6.70E+04	1.94E+03	1.94E+03	7.95E+02	1.92E+02	4.11E+01	2.94E+01	
Volume Flow (standard, dry)*	5.92E+04	1.94E+03	1.94E+03	7.95E+02	1.92E+02	4.11E+01	2.94E+01	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	1.90E+03	5.50E+01	5.50E+01	2.25E+01	5.43E+00	1.16E+00	8.34E-01	9.09E-01
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	300	0	594	15	15	15	15	25
Temperature, °F	572	32	1102	59	59	59	59	77
Pressure, psia	14.7	92.3	92.3	42.3	42.3	42.3	14.7	14.7
Specific Gravity	6.10E-04	7.85E-03	2.47E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01
Gas Stream Bulk Composition (Wet Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Wt %
H2O	11.52%					0.01%	0.01%	
O2	3.00%					20.99%	20.99%	
N2	74.11%	100.00%	100.00%	100.00%	100.00%	79.00%	79.00%	
H2	0.05%							
CO2	10.64%							
	ppmv							
CO	2.21E+03							
NO	4.30E+03							
NO2	1.97E+00							
SO2	2.40E+02							
C(organic)								
H(organic)								
Gas Stream Bulk Composition (Dry Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	
O2	3.39%					20.99%	20.99%	
N2	83.77%					79.01%	79.01%	
H2	0.05%							
CO2	12.03%							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)								
	ppmv							
CO	3.49E+02							
NO	6.80E+02							
NO2	3.12E-01							
SO2	3.80E+01							
C(organic)								
H(organic)								
PM, mg/dscm	2.62E+00					2.20E+00	2.20E+00	
Hg, ug/dscm								
GAC								100%

Table A-14. Mass balance, Tank WM-187 waste.

PFD #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
WM-187, Stream #	101	102	103	104	105	106	107	108	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Cyclone Drain	Filter Drain	Bed Drain	Cooled Product	Product Shipping Canisters
Rate or Volume	9.58E+01	1.32E+02	4.49E+05	4.04E+05	1.11E+02	6.93E+01	9.60E+01	1.65E+02	1.69E+00
Volume Flow (standard, wet			1.01E+05	1.03E+05					
Volume Flow (standard, dry			3.03E+04	3.23E+04					
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr	lb/hr	can's/day
Rate or Volume, metric	363	499	2.85E+03	2.91E+03	50	31.4	43.5	75.0	75.0
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	19	670	530	670	530	670	56	56
Temperature, °F	59	66	1238	986	1238	986	1238	134	134
Pressure, psia	14.7	44.7	10.6	10.2	10.6	9.5	10.8	9.5	9.5
Specific Gravity	1.20	1.20	1.99E-04	2.26E-04	0.24	1.15	1.46	1.33	1.33
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	2.71E+00	2.02E+00	8.27E-07	8.11E-07	3.25E-06	6.38E-06	9.54E-06	8.22E-06	8.22E-06
Al+3	3.09E-01	2.24E-01	2.35E-05	2.31E-05	2.74E-02	3.41E-02	5.61E-02	4.69E-02	4.69E-02
Sb+5	2.45E-05	1.78E-05	7.25E-09	7.11E-09	8.44E-06	1.05E-05	1.73E-05	1.44E-05	1.44E-05
As+3	1.43E-04	1.04E-04	2.59E-08	2.55E-08	3.02E-05	3.76E-05	6.19E-05	5.17E-05	5.17E-05
Ba+2	6.00E-05	4.36E-05	1.99E-08	1.96E-08	1.55E-05	2.89E-05	4.77E-05	3.98E-05	3.98E-05
Be+2	1.33E-05	9.65E-06	2.89E-10	2.84E-10	2.25E-07	4.20E-07	6.92E-07	5.78E-07	5.78E-07
B+3	9.26E-03	6.73E-03	2.43E-07	2.38E-07	2.83E-04	3.52E-04	5.79E-04	4.84E-04	4.84E-04
Cd+2	1.48E-03	1.08E-03	4.41E-07	4.33E-07	4.01E-04	6.40E-04	9.26E-04	8.06E-04	8.06E-04
Ca+2	2.96E-02	2.15E-02	1.06E-05	1.04E-05	8.26E-03	1.54E-02	2.54E-02	2.12E-02	2.12E-02
Cr+3	3.83E-03	2.79E-03	5.14E-07	5.05E-07	3.31E-04	7.46E-04	1.12E-03	9.64E-04	9.64E-04
Co+2	1.69E-03	1.23E-03	2.41E-07	2.37E-07	2.81E-04	3.50E-04	5.76E-04	4.81E-04	4.81E-04
Cs+	6.81E-05	5.24E-05	7.08E-08	6.94E-08	9.26E-05	1.03E-04	5.60E-06	5.00E-05	5.00E-05
Cu+2	3.97E-04	2.89E-04	6.11E-08	5.99E-08	4.76E-05	8.86E-05	1.46E-04	1.22E-04	1.22E-04
Fe+3	2.06E-02	1.49E-02	1.96E-06	1.92E-06	1.37E-03	2.84E-03	8.76E-03	6.28E-03	6.28E-03
Pb+2	5.43E-04	3.95E-04	8.54E-07	8.38E-07	2.36E-04	1.24E-03	4.14E-05	5.44E-04	5.44E-04
Hg+2	3.95E-03	3.33E-03	7.29E-06	7.16E-06	5.37E-06	1.26E-05		5.29E-06	5.29E-06
Mn+4	1.52E-02	1.11E-02	2.03E-06	1.99E-06	2.36E-03	2.95E-03	4.84E-03	4.05E-03	4.05E-03
Ni+2	1.15E-03	8.33E-04	1.63E-07	1.60E-07	1.27E-04	2.36E-04	3.89E-04	3.25E-04	3.25E-04
K+	2.62E-01	1.91E-01	4.73E-05	4.64E-05	5.24E-02	6.86E-02	4.60E-02	5.55E-02	5.55E-02
Se+4	3.60E-04	2.62E-04	6.43E-08	6.31E-08	6.27E-05	9.33E-05	1.70E-04	1.38E-04	1.38E-04
Ag+	5.47E-04	3.98E-04	1.63E-07	1.60E-07	1.17E-04	2.35E-04	3.23E-04	2.86E-04	2.86E-04
Na+	1.49E+00	1.09E+00	9.50E-05	9.32E-05	6.86E-02	1.37E-01	1.88E-01	1.67E-01	1.67E-01
Tl+3	4.87E-06	3.54E-06	2.42E-09	2.37E-09	2.81E-06	3.50E-06	5.76E-06	4.81E-06	4.81E-06
U+4	2.29E-04	1.66E-04	1.23E-07	1.21E-07	1.20E-04	1.79E-04	3.25E-04	2.63E-04	2.63E-04
V+3	5.19E-05	3.77E-05	5.97E-09	5.86E-09	5.82E-06	8.66E-06	1.57E-05	1.28E-05	1.28E-05
Zn+2	6.42E-04	4.67E-04	1.02E-07	9.98E-08	7.92E-05	1.48E-04	2.43E-04	2.03E-04	2.03E-04
Zr+4	5.15E-02	3.74E-02	1.06E-05	1.04E-05	1.04E-02	1.54E-02	2.80E-02	2.27E-02	2.27E-02
Cl-	1.50E-02	1.10E-02	3.15E-06	3.09E-06	2.60E-03	4.44E-03	1.17E-03	2.54E-03	2.54E-03
F-	4.60E-02	3.43E-02	6.39E-06	6.27E-06	3.18E-03	8.36E-03	7.68E-04	3.95E-03	3.95E-03
SO4-2	4.21E-02	3.15E-02	1.44E-08	1.42E-08	6.61E-06	2.10E-05	1.57E-05	1.79E-05	1.79E-05
NO3-	5.03E+00	3.70E+00	8.76E-06	8.60E-06	1.41E-03	3.14E-03	3.56E-03	3.39E-03	3.39E-03
PO4-3	1.35E-01	9.82E-02	3.69E-05	3.62E-05	6.09E-02	5.35E-02	7.14E-02	6.39E-02	6.39E-02
Am+4	5.83E-08	4.24E-08	3.43E-11	3.37E-11	4.00E-08	4.98E-08	8.19E-08	6.85E-08	6.85E-08
Br-	2.10E-07	1.54E-07	9.91E-11	9.72E-11	8.19E-08	1.40E-07	3.68E-08	8.01E-08	8.01E-08
Ce+4	3.64E-05	2.65E-05	1.24E-08	1.21E-08	1.44E-05	1.80E-05	2.95E-05	2.47E-05	2.47E-05
Eu+3	3.49E-07	2.53E-07	1.29E-10	1.26E-10	1.50E-07	1.86E-07	3.07E-07	2.56E-07	2.56E-07
Gd+3	1.27E-04	9.22E-05	4.84E-08	4.75E-08	5.64E-05	7.02E-05	1.15E-04	9.64E-05	9.64E-05
Ge+4	6.05E-09	4.40E-09	9.92E-13	9.74E-13	9.68E-10	1.44E-09	2.62E-09	2.12E-09	2.12E-09
In+3	1.01E-06	7.36E-07	2.82E-10	2.77E-10	3.28E-07	4.09E-07	6.72E-07	5.62E-07	5.62E-07
I-	2.73E-06	2.00E-06	2.05E-09	2.01E-09	1.69E-06	2.89E-06	7.61E-07	1.66E-06	1.66E-06
La+3	6.32E-06	4.59E-06	2.13E-09	2.09E-09	2.48E-06	3.09E-06	5.08E-06	4.24E-06	4.24E-06

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+	5.32E-04	3.87E-04	1.02E-08	9.98E-09	7.35E-06	1.47E-05	2.02E-05	1.79E-05	1.79E-05
Mg+2	1.44E-02	1.05E-02	8.48E-07	8.32E-07	6.61E-04	1.23E-03	2.03E-03	1.69E-03	1.69E-03
Mo+6	7.88E-02	5.73E-02	1.71E-05	1.68E-05	1.67E-02	2.48E-02	4.51E-02	3.66E-02	3.66E-02
Nd+3	2.04E-05	1.48E-05	7.13E-09	7.00E-09	8.30E-06	1.03E-05	1.70E-05	1.42E-05	1.42E-05
Np+4	3.21E-06	2.33E-06	1.84E-09	1.81E-09	2.15E-06	2.67E-06	4.40E-06	3.67E-06	3.67E-06
Nb+5	1.43E-03	1.04E-03	3.01E-07	2.96E-07	2.94E-04	4.37E-04	7.94E-04	6.44E-04	6.44E-04
Pd+4	2.34E-03	1.70E-03	6.03E-07	5.92E-07	4.70E-04	8.75E-04	1.44E-03	1.20E-03	1.20E-03
Pu+4	7.51E-06	5.46E-06	4.14E-09	4.06E-09	4.04E-06	6.01E-06	1.09E-05	8.86E-06	8.86E-06
Pr+4	5.75E-06	4.18E-06	1.96E-09	1.93E-09	2.29E-06	2.85E-06	4.68E-06	3.91E-06	3.91E-06
Pm+3	1.40E-09	1.02E-09	4.92E-13	4.83E-13	5.73E-10	7.14E-10	1.17E-09	9.81E-10	9.81E-10
Rh+4	2.48E-06	1.80E-06	6.19E-10	6.07E-10	7.21E-07	8.98E-07	1.48E-06	1.23E-06	1.23E-06
Rb+	3.82E-06	2.77E-06	8.98E-10	8.81E-10	6.49E-07	1.30E-06	1.78E-06	1.58E-06	1.58E-06
Ru+3	1.07E-03	7.78E-04	2.62E-07	2.57E-07	3.06E-04	3.81E-04	6.26E-04	5.23E-04	5.23E-04
Sm+3	3.81E-06	2.77E-06	1.39E-09	1.36E-09	1.62E-06	2.02E-06	3.32E-06	2.77E-06	2.77E-06
Si+4	1.23E-01	8.91E-02	9.56E-06	9.38E-06	1.24E-02	1.39E-02	2.76E-02	2.19E-02	2.19E-02
Sr+2	8.35E-05	6.08E-05	1.77E-08	1.74E-08	1.38E-05	2.57E-05	4.24E-05	3.54E-05	3.54E-05
Tc+7	6.12E-06	4.45E-06	4.30E-09	4.22E-09	6.52E-06	6.24E-06	4.89E-07	2.90E-06	2.90E-06
Te+4	3.28E-06	2.38E-06	9.45E-10	9.28E-10	9.22E-07	1.37E-06	2.49E-06	2.02E-06	2.02E-06
Tb+4	1.45E-09	1.06E-09	5.61E-13	5.50E-13	6.53E-10	8.13E-10	1.34E-09	1.12E-09	1.12E-09
Th+4	1.72E-05	1.25E-05	9.01E-09	8.84E-09	8.79E-06	1.31E-05	2.38E-05	1.93E-05	1.93E-05
Sn+4	2.49E-03	1.81E-03	6.69E-07	6.57E-07	6.53E-04	9.71E-04	1.76E-03	1.43E-03	1.43E-03
Ti+4	1.26E-03	9.15E-04	1.36E-07	1.34E-07	1.33E-04	1.97E-04	3.59E-04	2.91E-04	2.91E-04
Y+3	4.71E-06	3.42E-06	1.02E-09	9.97E-10	1.18E-06	1.47E-06	2.42E-06	2.02E-06	2.02E-06
OH-		5.22E-04	2.55E-06	2.50E-06	1.88E-03	3.70E-03	5.51E-03	4.75E-03	4.75E-03
H2O	4.26E+01	3.32E+01	3.28E-02	3.21E-02	1.09E-03	2.09E-03	3.08E-03	2.67E-03	2.67E-03
SO2		3.88E-07	2.69E-09	2.64E-09					
H2S			1.19E-05	1.16E-05					
CO		8.19E-12	7.79E-04	7.64E-04					
CO2		1.30E-05	7.52E-03	7.38E-03					
H2		3.12E-11	2.10E-04	2.06E-04					
N2		5.46E-07	1.28E-02	1.39E-02					
NO		9.86E-09	4.79E-05	4.70E-05					
NO2		1.25E-07	4.97E-06	4.87E-06					
O2		1.37E-07	4.35E-04	4.27E-04					
S (other)		5.21E-09	1.87E-07	1.84E-07	1.38E-04	2.72E-04	4.06E-04	3.50E-04	3.50E-04
CO3	3.40E-05	2.62E-05	1.57E-04	1.54E-04	1.30E-01	2.28E-01	3.02E-01	2.71E-01	2.71E-01
C (reductant)			2.23E-05	2.18E-05	3.84E-01	3.23E-02		1.35E-02	1.35E-02
O (oxides)	6.36E-01	4.62E-01	4.05E-05	3.97E-05	4.07E-02	5.88E-02	1.11E-01	8.91E-02	8.91E-02
C (organic)	1.71E-01	1.01E+01	9.43E-05	9.25E-05	6.51E-02	1.10E-01	7.94E-03	5.08E-02	5.08E-02
H (organic)	3.14E-01	1.86E+01	1.79E-05	1.75E-05	1.00E-02	1.69E-02	1.22E-03	7.81E-03	7.81E-03
O (organic)	1.57E-01	9.28E+00	9.26E-05	9.09E-05	7.95E-02	1.34E-01	9.69E-03	6.20E-02	6.20E-02
Mass Flow (kg/hr):	4.36E+02	6.00E+02	2.53E+03	2.59E+03	5.03E+01	3.14E+01	4.35E+01	7.50E+01	7.50E+01
Total Canisters Generated								148	
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/Canister
Heat Generation, w/m3	4.01E-01	2.93E-01			2.96E-01	1.96E+00	3.11E+00	2.62E+00	2.09E+00

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/canister
H-3	9.35E-06	6.79E-06	1.19E-06	1.17E-06					
C-14	1.35E-10	9.81E-11	1.67E-11	1.64E-11	1.96E-10	7.75E-11	2.82E-11	4.89E-11	5.21E-08
Co-60	1.45E-05	1.05E-05	5.63E-07	5.52E-07	4.09E-05	5.09E-05	8.38E-05	7.00E-05	7.45E-02
Ni-59	1.59E-06	1.16E-06	6.16E-08	6.05E-08	3.00E-06	5.58E-06	9.20E-06	7.68E-06	8.18E-03
Ni-63	3.70E-05	2.69E-05	1.43E-06	1.41E-06	6.97E-05	1.30E-04	2.14E-04	1.79E-04	1.90E-01
Se-79	4.90E-07	3.56E-07	1.77E-08	1.74E-08	1.08E-06	1.60E-06	2.92E-06	2.37E-06	2.52E-03
Sr-90	2.77E-02	2.02E-02	1.08E-03	1.06E-03	5.23E-02	9.74E-02	1.61E-01	1.34E-01	1.43E+02
Y-90	2.77E-02	2.02E-02	1.08E-03	1.06E-03	7.84E-02	9.76E-02	1.60E-01	1.34E-01	1.43E+02
Zr-93	1.56E-06	1.14E-06	5.66E-08	5.55E-08	3.45E-06	5.13E-06	9.32E-06	7.56E-06	8.05E-03
Nb-93m	1.20E-06	8.76E-07	4.36E-08	4.28E-08	2.65E-06	3.95E-06	7.18E-06	5.82E-06	6.20E-03
Nb-94	1.27E-06	9.24E-07	4.60E-08	4.52E-08	2.80E-06	4.17E-06	7.58E-06	6.15E-06	6.55E-03
Tc-99	1.47E-05	1.07E-05	1.69E-06	1.66E-06	1.60E-04	1.53E-04	1.20E-05	7.12E-05	7.58E-02
Ru-106	1.05E-06	7.62E-07	4.07E-08	4.00E-08	2.96E-06	3.69E-06	6.06E-06	5.07E-06	5.40E-03
Rh-102	6.08E-10	4.42E-10	2.36E-11	2.32E-11	1.72E-09	2.14E-09	3.52E-09	2.94E-09	3.13E-06
Rh-106	1.05E-06	7.62E-07	4.07E-08	4.00E-08	2.96E-06	3.69E-06	6.06E-06	5.07E-06	5.40E-03
Pd-107	1.17E-08	8.48E-09	4.52E-10	4.44E-10	2.20E-08	4.10E-08	6.75E-08	5.64E-08	6.00E-05
Cd-113m	2.34E-06	1.70E-06	9.93E-08	9.75E-08	5.64E-06	9.00E-06	1.30E-05	1.13E-05	1.21E-02
Sn-121m	4.72E-08	3.43E-08	1.71E-09	1.68E-09	1.04E-07	1.55E-07	2.81E-07	2.28E-07	2.43E-04
Sn-126	4.61E-07	3.35E-07	1.67E-08	1.64E-08	1.02E-06	1.51E-06	2.75E-06	2.23E-06	2.37E-03
Sb-125	5.53E-04	4.02E-04	2.15E-05	2.11E-05	1.56E-03	1.94E-03	3.20E-03	2.67E-03	2.84E+00
Sb-126	4.06E-08	2.95E-08	1.58E-09	1.55E-09	1.15E-07	1.43E-07	2.35E-07	1.96E-07	2.09E-04
Te-125m	2.22E-06	1.62E-06	8.05E-08	7.89E-08	4.90E-06	7.29E-06	1.32E-05	1.07E-05	1.14E-02
I-129	5.94E-08	4.35E-08	5.62E-09	5.51E-09	2.90E-07	4.96E-07	1.30E-07	2.83E-07	3.02E-04
Cs-134	5.82E-05	4.48E-05	7.29E-06	7.15E-06	5.95E-04	6.61E-04	3.60E-05	3.22E-04	3.43E-01
Cs-135	9.26E-07	7.13E-07	1.16E-07	1.14E-07	9.48E-06	1.05E-05	5.73E-07	5.12E-06	5.45E-03
Cs-137	3.76E-02	2.89E-02	4.71E-03	4.62E-03	3.84E-01	4.27E-01	2.33E-02	2.08E-01	2.21E+02
Ba-137m	3.55E-02	2.58E-02	1.38E-03	1.35E-03	6.70E-02	1.25E-01	2.06E-01	1.72E-01	1.83E+02
Ce-144	7.08E-07	5.15E-07	2.75E-08	2.70E-08	2.00E-06	2.49E-06	4.10E-06	3.42E-06	3.65E-03
Pr-144	7.08E-07	5.15E-07	2.75E-08	2.70E-08	2.00E-06	2.49E-06	4.10E-06	3.42E-06	3.65E-03
Pm-146	3.59E-08	2.61E-08	1.40E-09	1.37E-09	1.01E-07	1.26E-07	2.08E-07	1.74E-07	1.85E-04
Pm-147	1.91E-04	1.39E-04	7.41E-06	7.27E-06	5.38E-04	6.71E-04	1.10E-03	9.22E-04	9.81E-01
Sm-151	3.77E-04	2.74E-04	1.47E-05	1.44E-05	1.07E-03	1.33E-03	2.18E-03	1.82E-03	1.94E+00
Eu-152	2.27E-06	1.65E-06	8.81E-08	8.64E-08	6.40E-06	7.98E-06	1.31E-05	1.10E-05	1.17E-02
Eu-154	8.52E-05	6.19E-05	3.31E-06	3.25E-06	2.41E-04	3.00E-04	4.93E-04	4.12E-04	4.39E-01
Eu-155	8.97E-05	6.52E-05	3.49E-06	3.42E-06	2.53E-04	3.16E-04	5.19E-04	4.34E-04	4.62E-01
Th-230	8.84E-10	6.43E-10	3.20E-11	3.14E-11	1.95E-09	2.90E-09	5.27E-09	4.27E-09	4.55E-06
Pa-233	2.07E-06	1.50E-06	7.49E-08	7.35E-08	4.56E-06	6.78E-06	1.23E-05	1.00E-05	1.06E-02
U-232	2.03E-09	1.48E-09	7.36E-11	7.22E-11	4.48E-09	6.67E-09	1.21E-08	9.83E-09	1.05E-05
U-233	6.73E-11	4.89E-11	2.44E-12	2.39E-12	1.48E-10	2.21E-10	4.01E-10	3.25E-10	3.46E-07
U-234	1.11E-06	8.08E-07	4.03E-08	3.95E-08	2.45E-06	3.65E-06	6.63E-06	5.38E-06	5.73E-03
U-235	5.79E-08	4.21E-08	2.10E-09	2.06E-09	1.28E-07	1.90E-07	3.45E-07	2.80E-07	2.98E-04
U-236	5.39E-08	3.92E-08	1.95E-09	1.91E-09	1.19E-07	1.77E-07	3.21E-07	2.61E-07	2.78E-04
U-237	4.54E-09	3.30E-09	1.64E-10	1.61E-10	1.00E-08	1.49E-08	2.71E-08	2.20E-08	2.34E-05
U-238	1.96E-08	1.42E-08	7.09E-10	6.95E-10	4.32E-08	6.42E-08	1.17E-07	9.47E-08	1.01E-04
Np-237	5.36E-07	3.89E-07	2.08E-08	2.04E-08	1.51E-06	1.88E-06	3.10E-06	2.59E-06	2.76E-03
Pu-236	3.19E-09	2.32E-09	1.15E-10	1.13E-10	7.02E-09	1.04E-08	1.90E-08	1.54E-08	1.64E-05
Pu-238	9.40E-04	6.83E-04	3.40E-05	3.34E-05	2.07E-03	3.08E-03	5.60E-03	4.54E-03	4.84E+00
Pu-239	1.04E-04	7.59E-05	3.78E-06	3.71E-06	2.30E-04	3.42E-04	6.22E-04	5.05E-04	5.37E-01
Pu-240	1.19E-05	8.67E-06	4.32E-07	4.23E-07	2.63E-05	3.91E-05	7.11E-05	5.76E-05	6.14E-02
Pu-241	7.09E-04	5.16E-04	2.57E-05	2.52E-05	1.56E-03	2.33E-03	4.23E-03	3.43E-03	3.65E+00
Pu-242	9.36E-09	6.80E-09	3.39E-10	3.32E-10	2.06E-08	3.07E-08	5.57E-08	4.52E-08	4.82E-05
Pu-244	5.60E-16	4.07E-16	2.03E-17	1.99E-17	1.23E-15	1.83E-15	3.33E-15	2.71E-15	2.88E-12
Am-241	6.02E-05	4.37E-05	2.34E-06	2.29E-06	1.70E-04	2.12E-04	3.48E-04	2.91E-04	3.10E-01
Am-242m	1.09E-08	7.92E-09	4.23E-10	4.15E-10	3.08E-08	3.83E-08	6.30E-08	5.27E-08	5.61E-05

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/Canister
Am-243	2.07E-08	1.50E-08	8.03E-10	7.88E-10	5.84E-08	7.28E-08	1.20E-07	1.00E-07	1.06E-04
Cm-242	2.14E-08	1.55E-08	7.74E-10	7.60E-10	4.71E-08	7.01E-08	1.27E-07	1.03E-07	1.10E-04
Cm-243	3.10E-08	2.25E-08	1.12E-09	1.10E-09	6.82E-08	1.01E-07	1.84E-07	1.50E-07	1.59E-04
Cm-244	1.38E-06	1.00E-06	4.99E-08	4.90E-08	3.04E-06	4.52E-06	8.22E-06	6.67E-06	7.10E-03
Cm-245	3.26E-10	2.37E-10	1.18E-11	1.16E-11	7.19E-10	1.07E-09	1.94E-09	1.58E-09	1.68E-06
Cm-246	2.14E-11	1.55E-11	7.73E-13	7.59E-13	4.71E-11	7.01E-11	1.27E-10	1.03E-10	1.10E-07
TRU	1.14E-03	8.27E-04	4.14E-05	4.06E-05	2.55E-03	3.75E-03	6.77E-03	5.50E-03	5.86E+00
TRU, nCi/gm	9.47E+02							5.50E+03	
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			69.88%	68.57%					
O2, mol %			0.52%	0.51%					
N2, mol %			17.54%	19.09%					
H2, mol %			4.01%	3.93%					
CO2, mol %			6.57%	6.44%					
CO, ppmv			1.07E+04	1.05E+04					
NO, ppmv			6.13E+02	6.02E+02					
NO2, ppmv			4.15E+01	4.07E+01					
SO2, ppmv			1.61E-02	1.58E-02					
Cl, ppmv			3.41E+01	3.35E+01					
F, ppmv			1.29E+02	1.27E+02					
C (organic), ppmv			3.02E+03	2.96E+03					
H (organic), ppmv			6.81E+03	6.68E+03					
Hg, ug/wscm			1.17E+05	1.15E+05					
PM, mg/wscm			1.08E+04	1.06E+04					
SVM, ug/wscm			2.08E+04	2.04E+04					
LVM, ug/wscm			8.67E+03	8.50E+03					
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			1.73%	1.63%					
N2, mol %, dry basis			58.25%	60.74%					
H2, mol %, dry basis			13.30%	12.51%					
CO2, mol %, dry basis			21.80%	20.50%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			4.97E+03	4.67E+03					
NO, ppmv, dry basis			2.85E+02	2.68E+02					
NO2, ppmv, dry basis			1.93E+01	1.81E+01					
SO2, ppmv, dry basis			7.50E-03	7.06E-03					
Cl, ppmv, dry basis			1.59E+01	1.49E+01					
F, ppmv, dry basis			6.01E+01	5.65E+01					
C (organic), ppmv, dry basis			1.40E+03	1.32E+03					
H (organic), ppmv, dry basis			3.16E+03	2.98E+03					
Hg, ug/dscm			5.43E+04	5.11E+04					
PM, mg/dscm			5.01E+03	4.71E+03					
SVM, ug/dscm			6.90E+04	6.77E+04					
LVM, ug/dscm			2.88E+04	2.82E+04					

Table A-14. Mass balance, Tank WM-187 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-187, Stream #	109	110	111	112	113A	113B	114	115	116
Stream Name	Off-Gas from Filter to Oxidizer	Oxidizer Effluent	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Scrubber Effluent Gas	Demister Effluent Gas	GAC Bed Feed
Rate or Volume	4.37E+05	7.03E+05	3.67E+05	1.01E+04	1.01E+04	0.00E+00	3.76E+05	3.85E+05	4.67E+05
Volume Flow (standard, wet)*	1.03E+05	1.08E+05	1.82E+05				1.82E+05	1.83E+05	1.83E+05
Volume Flow (standard, dry)*	3.29E+04	3.16E+04	3.15E+04				3.15E+04	3.16E+04	3.16E+04
Rate Units	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.93E+03	3.05E+03	5.16E+03	3.82E+04	3.82E+04	0.00	5.15E+03	5.17E+03	5.17E+03
Rate Units	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	527	951	100	82	83	0	82	81	120
Temperature, °F	980	1743	212	179	181	32	179	178	248
Pressure, psia	9.5	9.4	9.3	38.1	9.0	8.4	8.6	8.4	7.7
Specific Gravity	2.09E-04	1.42E-04	4.26E-04	1.01	1.01	1.01	4.15E-04	4.06E-04	3.34E-04
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
H+	8.01E-07	3.09E-08	3.03E-08	1.02E+00	1.02E+00	1.02E+00	2.33E-07	2.32E-07	2.32E-07
Al+3	3.44E-08	3.30E-08	1.95E-08	1.54E-03	1.54E-03	1.54E-03			
Sb+5	1.06E-11	1.02E-11	6.01E-12	1.05E-07	1.05E-07	1.05E-07			
As+3	3.79E-11	3.64E-11	2.15E-11	6.13E-07	6.13E-07	6.13E-07			
Ba+2	2.91E-11	2.80E-11	5.76E-13	3.37E-07	3.37E-07	3.37E-07			
Be+2	4.23E-13	4.07E-13	8.36E-15	7.47E-08	7.46E-08	7.46E-08			
B+3	3.55E-10	3.41E-10	2.01E-10	3.98E-05	3.98E-05	3.98E-05			
Cd+2	6.45E-10	6.20E-10	3.66E-10	2.59E-06	2.60E-06	2.60E-06			
Ca+2	1.55E-08	1.49E-08	3.06E-10	6.15E-04	6.15E-04	6.15E-04			
Cr+3	7.51E-10	7.23E-10	4.27E-10	8.23E-06	8.25E-06	8.25E-06			
Co+2	3.53E-10	3.39E-10	2.00E-10	7.26E-06	7.26E-06	7.26E-06			
Cs+	6.89E-11	6.63E-11	3.91E-11	6.96E-05	6.96E-05	6.96E-05			
Cu+2	8.92E-11	8.58E-11	1.76E-12	2.23E-06	2.23E-06	2.23E-06			
Fe+3	2.86E-09	2.75E-09	1.63E-09	1.02E-04	1.02E-04	1.02E-04			
Pb+2	1.25E-09	1.20E-09	7.09E-10	5.05E-06	5.05E-06	5.05E-06			
Hg+2	7.09E-06	6.82E-06	4.03E-06	1.07E-02	1.07E-02	1.07E-02		2.26E-06	2.26E-06
Mn+4	2.97E-09	2.85E-09	1.68E-09	6.55E-05	6.55E-05	6.55E-05			
Ni+2	2.38E-10	2.29E-10	4.70E-12	6.45E-06	6.44E-06	6.44E-06			
K+	6.91E-08	6.65E-08	3.93E-08	1.66E-03	1.66E-03	1.66E-03			
Se+4	9.39E-11	9.03E-11	5.33E-11	1.46E-06	1.46E-06	1.46E-06			
Ag+	1.07E-09	5.96E-10	3.52E-10	2.09E-06	2.10E-06	2.10E-06			
Na+	6.26E-07	6.02E-07	3.55E-07	6.14E-02	6.14E-02	6.14E-02			
Tl+3	3.53E-12	3.39E-12	2.00E-12	2.09E-08	2.09E-08	2.09E-08			
U+4	1.80E-10	1.73E-10	1.02E-10	9.27E-07	9.27E-07	9.27E-07			
V+3	8.72E-12	8.38E-12	4.95E-12	2.10E-07	2.10E-07	2.10E-07			
Zn+2	1.49E-10	1.43E-10	2.94E-12	3.62E-06	3.61E-06	3.61E-06			
Zr+4	1.55E-08	1.49E-08	8.81E-09	2.09E-04	2.09E-04	2.09E-04			
Cl-	8.56E-08	8.23E-08	4.86E-08	2.16E-03	2.16E-03	2.16E-03	1.03E-08	1.02E-08	1.02E-08
F-	6.21E-07	5.97E-07	3.53E-07	2.10E-02	2.09E-02	2.09E-02	8.81E-07	8.78E-07	8.78E-07
SO4-2	2.11E-11	8.25E-07	4.87E-07	2.22E-02	2.22E-02	2.22E-02			
NO3-	6.42E-06	5.64E-09	3.33E-09	1.04E+00	1.04E+00	1.04E+00	1.14E-05	1.14E-05	1.14E-05
PO4-3	5.39E-08	5.18E-08	3.06E-08	6.75E-04	6.75E-04	6.75E-04			
Am+4	5.02E-14	4.83E-14	2.85E-14	2.50E-10	2.50E-10	2.50E-10			
Br-	2.70E-12	2.59E-12	1.53E-12	3.02E-08	3.02E-08	3.02E-08	3.24E-13	3.23E-13	3.23E-13
Ce+4	1.81E-11	1.74E-11	1.03E-11	1.56E-07	1.56E-07	1.56E-07			
Eu+3	1.88E-13	1.81E-13	1.07E-13	1.50E-09	1.50E-09	1.50E-09			
Gd+3	7.07E-11	6.80E-11	4.01E-11	5.45E-07	5.45E-07	5.45E-07			
Ge+4	1.45E-15	1.39E-15	8.23E-16	2.45E-11	2.45E-11	2.45E-11			
In+3	4.12E-13	3.96E-13	2.34E-13	4.35E-09	4.35E-09	4.35E-09			
I-	5.58E-11	5.36E-11	3.17E-11	3.93E-07	3.93E-07	3.93E-07	6.70E-12	6.68E-12	6.68E-12
La+3	3.11E-12	2.99E-12	1.77E-12	2.71E-08	2.72E-08	2.72E-08			

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
Li+	6.70E-11	3.73E-11	2.20E-11	2.03E-06	2.04E-06	2.04E-06			
Mg+2	1.24E-09	1.19E-09	2.45E-11	8.12E-05	8.11E-05	8.11E-05			
Mo+6	2.50E-08	2.40E-08	1.42E-08	3.20E-04	3.20E-04	3.20E-04			
Nd+3	1.04E-11	1.00E-11	5.91E-12	8.75E-08	8.76E-08	8.76E-08			
Np+4	2.69E-12	2.59E-12	1.53E-12	1.38E-08	1.38E-08	1.38E-08			
Nb+5	4.40E-10	4.23E-10	2.50E-10	5.81E-06	5.82E-06	5.82E-06			
Pd+4	8.81E-10	8.47E-10	1.74E-11	1.32E-05	1.32E-05	1.32E-05			
Pu+4	6.05E-12	5.82E-12	3.44E-12	3.05E-08	3.05E-08	3.05E-08			
Pr+4	2.87E-12	2.76E-12	1.63E-12	2.47E-08	2.47E-08	2.47E-08			
Pm+3	7.19E-16	6.91E-16	4.08E-16	6.01E-12	6.01E-12	6.01E-12			
Rh+4	9.04E-13	8.69E-13	5.13E-13	1.06E-08	1.07E-08	1.07E-08			
Rb+	5.92E-12	3.29E-12	1.94E-12	1.46E-08	1.46E-08	1.46E-08			
Ru+3	3.83E-10	3.69E-10	2.18E-10	4.60E-06	4.60E-06	4.60E-06			
Sm+3	2.03E-12	1.95E-12	1.15E-12	1.64E-08	1.64E-08	1.64E-08			
Si+4	1.40E-08	1.34E-08	7.93E-09	8.21E-04	8.21E-04	8.21E-04			
Sr+2	2.59E-11	2.49E-11	5.12E-13	4.70E-07	4.70E-07	4.70E-07			
Tc+7	6.28E-12	6.04E-12	3.57E-12	5.26E-08	5.27E-08	5.27E-08			
Te+4	1.38E-12	1.33E-12	7.84E-13	1.33E-08	1.33E-08	1.33E-08			
Tb+4	8.19E-16	7.88E-16	4.65E-16	6.25E-12	6.25E-12	6.25E-12			
Th+4	1.32E-11	1.27E-11	7.47E-12	6.96E-08	6.97E-08	6.97E-08			
Sn+4	9.78E-10	9.40E-10	5.55E-10	1.01E-05	1.01E-05	1.01E-05			
Ti+4	1.99E-10	1.91E-10	1.13E-10	5.10E-06	5.10E-06	5.10E-06			
Y+3	1.48E-12	1.43E-12	8.43E-13	2.02E-08	2.02E-08	2.02E-08			
OH-	3.72E-09	1.43E-07	2.88E-07	4.97E-07	4.99E-07	4.99E-07			
H2O	3.19E-02	3.30E-02	3.88E-02	5.23E+01	5.23E+01	5.23E+01	3.88E-02	3.87E-02	3.87E-02
SO2	2.62E-09	2.03E-05	1.20E-05	9.10E-06	9.11E-06	9.11E-06	1.20E-05	1.20E-05	1.20E-05
H2S	1.15E-05	2.53E-21							
CO	7.59E-04	1.52E-09	8.96E-10	1.92E-10	1.94E-10	1.94E-10	8.96E-10	8.93E-10	8.93E-10
CO2	7.32E-03	9.20E-03	5.43E-03	3.05E-04	3.14E-04	3.14E-04	5.44E-03	5.42E-03	5.42E-03
H2	2.05E-04	6.17E-10	3.64E-10	7.32E-10	1.19E-09	1.19E-09	1.81E-08		
N2	1.44E-02	1.38E-02	8.16E-03	1.28E-05	2.47E-05	2.47E-05	8.17E-03	8.14E-03	8.14E-03
NO	4.66E-05	5.07E-05	2.99E-05	2.31E-07	2.93E-07	2.93E-07	2.99E-05	2.98E-05	2.98E-05
NO2	4.84E-06	2.78E-07	1.64E-07	2.94E-06	2.94E-06	2.94E-06	1.64E-07	1.64E-07	1.64E-07
O2	4.23E-04	1.86E-03	1.10E-03	3.20E-06	4.94E-06	4.94E-06	1.10E-03	1.09E-03	1.09E-03
S (other)	2.74E-10	1.79E-25		1.22E-07	1.22E-07	1.22E-07			
CO3	2.30E-07	4.57E-11	8.84E-12	3.48E-05	3.48E-05	3.48E-05			
C (reductant)	3.25E-08	1.32E-18							
O (oxides)	5.92E-08	5.54E-08	3.27E-08	5.02E-03	5.02E-03	5.02E-03			
C (organic)	1.80E-05	1.70E-34							
H (organic)	6.04E-06	5.70E-35							
O (organic)	1.35E-07								
Mass Flow (kg/hr):	2.58E+03	2.83E+03	4.42E+03	3.87E+04	3.87E+04		4.42E+03	4.42E+03	4.42E+03
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				4.12E-02	4.12E-02				

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
H-3	1.16E-06	1.11E-06	6.57E-07	9.73E-07	9.72E-07	9.72E-07	6.57E-07	6.54E-07	6.54E-07
C-14	1.55E-11	1.50E-11	8.85E-12	1.52E-15	1.56E-15	1.56E-15	8.86E-12	8.83E-12	8.83E-12
Co-60	8.22E-10	7.90E-10	4.67E-10	6.22E-08	6.22E-08	6.22E-08			
Ni-59	9.00E-11	8.66E-11	1.78E-12	8.94E-09	8.94E-09	8.94E-09			
Ni-63	2.09E-09	2.01E-09	4.14E-11	2.08E-07	2.08E-07	2.08E-07			
Se-79	2.59E-11	2.49E-11	1.47E-11	1.98E-09	1.98E-09	1.98E-09			
Sr-90	1.57E-06	1.51E-06	3.11E-08	1.56E-04	1.56E-04	1.56E-04			
Y-90	1.57E-06	1.51E-06	8.94E-07	1.19E-04	1.19E-04	1.19E-04			
Zr-93	8.27E-11	7.95E-11	4.70E-11	6.34E-09	6.34E-09	6.34E-09			
Nb-93m	6.37E-11	6.13E-11	3.62E-11	4.88E-09	4.88E-09	4.88E-09			
Nb-94	6.72E-11	6.47E-11	3.82E-11	5.15E-09	5.15E-09	5.15E-09			
Tc-99	2.47E-09	2.38E-09	1.40E-09	1.27E-07	1.27E-07	1.27E-07			
Ru-106	5.95E-11	5.72E-11	3.38E-11	4.50E-09	4.50E-09	4.50E-09			
Rh-102	3.45E-14	3.32E-14	1.96E-14	2.61E-12	2.61E-12	2.61E-12			
Rh-106	5.95E-11	5.72E-11	3.38E-11	4.50E-09	4.50E-09	4.50E-09			
Pd-107	6.61E-13	6.35E-13	1.31E-14	6.56E-11	6.56E-11	6.56E-11			
Cd-113m	1.45E-10	1.40E-10	8.24E-11	4.09E-09	4.10E-09	4.10E-09			
Sn-121m	2.50E-12	2.40E-12	1.42E-12	1.91E-10	1.91E-10	1.91E-10			
Sn-126	2.44E-11	2.34E-11	1.38E-11	1.87E-09	1.87E-09	1.87E-09			
Sb-125	3.14E-08	3.02E-08	1.78E-08	2.37E-06	2.37E-06	2.37E-06			
Sb-126	2.30E-12	2.22E-12	1.31E-12	1.74E-10	1.74E-10	1.74E-10			
Te-125m	1.18E-10	1.13E-10	6.68E-11	9.01E-09	9.01E-09	9.01E-09			
I-129	1.53E-10	1.47E-10	8.68E-11	8.54E-09	8.54E-09	8.54E-09	1.84E-11	1.83E-11	1.83E-11
Cs-134	7.10E-09	6.83E-09	4.03E-09	5.95E-05	5.95E-05	5.95E-05			
Cs-135	1.13E-10	1.09E-10	6.42E-11	9.47E-07	9.47E-07	9.47E-07			
Cs-137	4.59E-06	4.41E-06	2.60E-06	3.84E-02	3.84E-02	3.84E-02			
Ba-137m	2.01E-06	1.94E-06	3.98E-08	2.00E-04	2.00E-04	2.00E-04			
Ce-144	4.02E-11	3.87E-11	2.28E-11	3.04E-09	3.04E-09	3.04E-09			
Pr-144	4.02E-11	3.87E-11	2.28E-11	3.04E-09	3.04E-09	3.04E-09			
Pm-146	2.04E-12	1.96E-12	1.16E-12	1.54E-10	1.54E-10	1.54E-10			
Pm-147	1.08E-08	1.04E-08	6.14E-09	8.19E-07	8.19E-07	8.19E-07			
Sm-151	2.14E-08	2.06E-08	1.22E-08	1.62E-06	1.62E-06	1.62E-06			
Eu-152	1.29E-10	1.24E-10	7.31E-11	9.74E-09	9.74E-09	9.74E-09			
Eu-154	4.84E-09	4.65E-09	2.75E-09	3.66E-07	3.66E-07	3.66E-07			
Eu-155	5.09E-09	4.90E-09	2.89E-09	3.85E-07	3.86E-07	3.86E-07			
Th-230	4.67E-14	4.50E-14	2.65E-14	3.58E-12	3.58E-12	3.58E-12			
Pa-233	1.09E-10	1.05E-10	6.21E-11	8.38E-09	8.39E-09	8.39E-09			
U-232	1.08E-13	1.03E-13	6.11E-14	8.24E-12	8.24E-12	8.24E-12			
U-233	3.56E-15	3.42E-15	2.02E-15	2.73E-13	2.73E-13	2.73E-13			
U-234	5.88E-11	5.66E-11	3.34E-11	4.51E-09	4.51E-09	4.51E-09			
U-235	3.06E-12	2.95E-12	1.74E-12	2.35E-10	2.35E-10	2.35E-10			
U-236	2.85E-12	2.74E-12	1.62E-12	2.19E-10	2.19E-10	2.19E-10			
U-237	2.40E-13	2.31E-13	1.36E-13	1.84E-11	1.84E-11	1.84E-11			
U-238	1.04E-12	9.96E-13	5.88E-13	7.94E-11	7.94E-11	7.94E-11			
Np-237	3.04E-11	2.92E-11	1.73E-11	2.30E-09	2.30E-09	2.30E-09			
Pu-236	1.68E-13	1.62E-13	9.57E-14	1.29E-11	1.29E-11	1.29E-11			
Pu-238	4.97E-08	4.78E-08	2.82E-08	3.81E-06	3.81E-06	3.81E-06			
Pu-239	5.52E-09	5.31E-09	3.13E-09	4.23E-07	4.23E-07	4.23E-07			
Pu-240	6.30E-10	6.06E-10	3.58E-10	4.83E-08	4.83E-08	4.83E-08			
Pu-241	3.75E-08	3.61E-08	2.13E-08	2.87E-06	2.88E-06	2.88E-06			
Pu-242	4.95E-13	4.76E-13	2.81E-13	3.79E-11	3.79E-11	3.79E-11			
Pu-244	2.96E-20	2.85E-20	1.68E-20	2.27E-18	2.27E-18	2.27E-18			
Am-241	3.41E-09	3.28E-09	1.94E-09	2.58E-07	2.58E-07	2.58E-07			
Am-242m	6.18E-13	5.94E-13	3.51E-13	4.68E-11	4.68E-11	4.68E-11			

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	1.17E-12	1.13E-12	6.66E-13	8.88E-11	8.88E-11	8.88E-11			
Cm-242	1.13E-12	1.09E-12	6.42E-13	8.67E-11	8.67E-11	8.67E-11			
Cm-243	1.64E-12	1.57E-12	9.29E-13	1.25E-10	1.25E-10	1.25E-10			
Cm-244	7.29E-11	7.01E-11	4.14E-11	5.59E-09	5.59E-09	5.59E-09			
Cm-245	1.72E-14	1.66E-14	9.79E-15	1.32E-12	1.32E-12	1.32E-12			
Cm-246	1.13E-15	1.09E-15	6.42E-16	8.66E-14	8.66E-14	8.66E-14			
TRU	6.04E-08	5.81E-08	3.43E-08	4.63E-06	4.63E-06	4.63E-06			
TRU, nCi/gm									
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	68.23%	70.61%	82.70%				82.69%	82.69%	82.69%
O2, mol %	0.51%	2.24%	1.32%				1.32%	1.32%	1.32%
N2, mol %	19.75%	19.02%	11.19%				11.20%	11.20%	11.20%
H2, mol %	3.91%	0.00001%	0.00001%				0.0003%		0.00%
CO2, mol %	6.41%	8.06%	4.74%				4.74%	4.74%	4.74%
CO, ppmv	1.04E+04	2.09E-02	1.23E-02				1.23E-02	1.23E-02	1.23E-02
NO, ppmv	5.99E+02	6.51E+02	3.83E+02				3.83E+02	3.83E+02	3.83E+02
NO2, ppmv	4.05E+01	2.33E+00	1.37E+00				1.37E+00	1.37E+00	1.37E+00
SO2, ppmv	1.58E-02	1.22E+02	7.20E+01				7.20E+01	7.20E+01	7.20E+01
Cl, ppmv	9.30E-01	8.95E-01	5.26E-01				1.11E-01	1.11E-01	1.11E-01
F, ppmv	1.26E+01	1.21E+01	7.13E+00				1.78E+01	1.78E+01	1.78E+01
C (organic), ppmv	5.79E+02	5.45E-27							
H (organic), ppmv	2.31E+03	2.18E-26							
Hg, ug/wscm	1.14E+05	1.09E+05	6.46E+04					3.62E+04	3.62E+04
PM, mg/wscm	5.21E+02	1.37E+02	8.92E+01				1.20E+01	4.81E+01	4.81E+01
SVM, ug/wscm	3.03E+01	2.92E+01	1.72E+01						
LVM, ug/wscm	1.27E+01	1.22E+01	7.19E+00						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	1.60%	7.61%	7.61%				7.61%	7.61%	7.61%
N2, mol %, dry basis	62.17%	64.71%	64.70%				64.68%	64.68%	64.68%
H2, mol %, dry basis	12.31%	0.00004%	0.00004%				0.002%		0.00%
CO2, mol %, dry basis	20.18%	27.41%	27.41%				27.40%	27.40%	27.40%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis	4.60E+03	9.94E-03	9.94E-03				9.94E-03	9.94E-03	9.94E-03
NO, ppmv, dry basis	2.64E+02	3.10E+02	3.10E+02				3.10E+02	3.10E+02	3.10E+02
NO2, ppmv, dry basis	1.79E+01	1.11E+00	1.11E+00				1.11E+00	1.11E+00	1.11E+00
SO2, ppmv, dry basis	6.95E-03	5.83E+01	5.83E+01				5.83E+01	5.83E+01	5.83E+01
Cl, ppmv, dry basis	4.10E-01	4.26E-01	4.26E-01				9.01E-02	9.01E-02	9.01E-02
F, ppmv, dry basis	5.55E+00	5.78E+00	5.78E+00				1.44E+01	1.44E+01	1.44E+01
C (organic), ppmv, dry basis	2.55E+02								
H (organic), ppmv, dry basis	1.02E+03								
Hg, ug/dscm	5.01E+04	5.21E+04	5.23E+04					2.93E+04	2.93E+04
PM, mg/dscm	2.30E+02	6.55E+01	7.23E+01				9.68E+00	3.89E+01	3.89E+01
SVM, ug/dscm	1.01E+02	9.69E+01	5.72E+01						
LVM, ug/dscm	4.20E+01	4.04E+01	2.39E+01						

Table A-14. Mass balance, Tank WM-187 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3
WM-187, Stream #	117	118	119	120	201	202	203	204
Stream Name	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-Gas to Blower	Spent GAC	Boiler Feed Water	Fuel Oil to Boiler	Steam To Reformer	Propane to Oxidizer
Rate or Volume	1.32E+04	6.03E+05	6.37E+05	5.20E+00	3.16E+02	4.18E+01	6.32E+04	1.05E+02
Volume Flow (standard, wet)*	1.30E+04	1.83E+05	1.95E+05				5.66E+04	2.97E+02
Volume Flow (standard, dry)*	1.30E+04	3.16E+04	4.46E+04					2.97E+02
Rate Units	ft3/hr	ft3/hr	ft3/hr	lb/hr	gal/hr	gal/hr	ft3/hr	ft3/hr
Rate or Volume, metric	3.68E+02	5.17E+03	5.53E+03	2.36E+00	1.20E+03	1.58E+02	1.60E+03	8.42E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	kg/hr	L/hr	L/hr	wscm/hr	wscm/hr
Temperature, °C	25	120	115	28	15	15	670	25
Temperature, °F	77	248	239	82	59	59	1238	77
Pressure, psia	14.7	6.0	6.0	14.7	42.3	14.7	42.3	42.3
Specific Gravity	1.18E-03	2.59E-04	2.70E-04	5.86E-01	1.00E+00	7.70E-01	6.70E-04	5.19E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
H+		2.32E-07	2.17E-07	9.20E-06		2.40E-01		
Al+3								
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2								
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3								
Pb+2								
Hg+2		2.26E-09	2.12E-09	7.93E-02				
Mn+4								
Ni+2								
K+								
Se+4								
Ag+								
Na+								
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-		1.02E-09	9.58E-10	3.24E-04				
F-		8.78E-07	8.21E-07					
SO4-2								
NO3-		1.14E-05	1.07E-05					
PO4-3								
Am+4								
Br-		3.23E-14	3.02E-14	1.02E-08				
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-		6.68E-13	6.24E-13	2.11E-07				
La+3								

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4								
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-								
H2O	4.68E-06	3.87E-02	3.62E-02		5.56E+01		4.68E-02	
SO2		1.20E-05	1.12E-05					
H2S						1.20E-01		
CO		8.93E-10	8.35E-10					
CO2		5.42E-03	5.07E-03					
H2								
N2	5.75E-02	8.14E-03	1.14E-02					
NO		2.98E-05	2.79E-05					
NO2		1.64E-07	1.53E-07					
O2	1.74E-02	1.09E-03	2.18E-03					
S (other)								
CO3								
C (reductant)				9.20E-01				
O (oxides)								
C (organic)						5.41E+01		9.35E-02
H (organic)						1.15E+02		2.09E-02
O (organic)								
Mass Flow (kg/hr):	4.42E+02	4.42E+03	4.86E+03	2.36E+00	1.20E+03	1.22E+02	1.20E+03	1.54E+01
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				5.89E-11				

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	117	118	119	120	201	202	203
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm
H-3		6.54E-07	6.12E-07				
C-14		8.83E-12	8.25E-12	3.43E-10			
Co-60							
Ni-59							
Ni-63							
Se-79							
Sr-90							
Y-90							
Zr-93							
Nb-93m							
Nb-94							
Tc-99							
Ru-106							
Rh-102							
Rh-106							
Pd-107							
Cd-113m							
Sn-121m							
Sn-126							
Sb-125							
Sb-126							
Te-125m							
I-129		1.83E-12	1.71E-12	3.61E-08			
Cs-134							
Cs-135							
Cs-137							
Ba-137m							
Ce-144							
Pr-144							
Pm-146							
Pm-147							
Sm-151							
Eu-152							
Eu-154							
Eu-155							
Th-230							
Pa-233							
U-232							
U-233							
U-234							
U-235							
U-236							
U-237							
U-238							
Np-237							
Pu-236							
Pu-238							
Pu-239							
Pu-240							
Pu-241							
Pu-242							
Pu-244							
Am-241							
Am-242m							

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	117	118	119	120	201	202	203	204
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
Am-243								
Cm-242								
Cm-243								
Cm-244								
Cm-245								
Cm-246								
TRU								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	0.01%	82.69%	77.18%				100.00%	
O2, mol %	20.99%	1.32%	2.63%					
N2, mol %	79.00%	11.20%	15.71%					
H2, mol %								
CO2, mol %		4.74%	4.43%					
CO, ppmv		1.23E-02	1.15E-02					
NO, ppmv		3.83E+02	3.58E+02					
NO2, ppmv		1.37E+00	1.28E+00					
SO2, ppmv		7.20E+01	6.72E+01					
Cl, ppmv		1.11E-02	1.04E-02					
F, ppmv		1.78E+01	1.66E+01					
C (organic), ppmv								3.00E+06
H (organic), ppmv								8.00E+06
Hg, ug/wscm		3.62E+01	3.39E+01					
PM, mg/wscm	1.57E+01	1.19E+01	1.21E+01				1.16E+01	1.83E+06
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	20.9921%	1.0658%	11.5102%					
N2, mol %, dry basis	79.01%	64.68%	68.86%					
H2, mol %, dry basis								
CO2, mol %, dry basis		27.40%	19.41%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis		9.94E-03	7.04E-03					
NO, ppmv, dry basis		3.10E+02	2.20E+02					
NO2, ppmv, dry basis		1.11E+00	7.87E-01					
SO2, ppmv, dry basis		5.83E+01	4.13E+01					
Cl, ppmv, dry basis		9.01E-03	6.39E-03					
F, ppmv, dry basis		1.44E+01	1.02E+01					
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm		2.93E+01	2.08E+01					
PM, mg/dscm	2.20E+00	9.65E+00	7.45E+00					
SVM, ug/dscm								
LVM, ug/dscm								

Table A-14. Mass balance, Tank WM-187 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-2	PFD-3
WM-187, Stream #	205	206	207	301	302	303	304	305
Stream Name	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 Scrub Makeup	Sugar to Feed	Carbon to Reformer	NOx Catalyst	Bed Media	Grout Mix for Scrub Blowdown
Rate or Volume	4.23E+02	3.52E-08	8.10E-01	3.14E+02	1.38E+02	2.20E-05	1.66E+00	6.61E+00
Volume Flow (standard, wet)*								
Volume Flow (standard, dry)*								
Rate Units	gal/hr	gal/hr	gal/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	1.60E+03	1.33E-07	3.07E+00	1.42E+02	6.26E+01	1.00E-05	7.53E-01	3.00E+00
Rate Units	L/hr	L/hr	L/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	25	25	25	15	15	15	15	25
Temperature, °F	77	77	77	59	59	59	59	77
Pressure, psia	112.3	14.7	42.3	14.7	14.7	14.7	14.7	14.7
Specific Gravity	9.97E-01	1.35E+00	1.28E+00	7.50E-01	5.00E-01	2.58E+00	1.58E+00	2.01E-01
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	1.00E-07	3.09E-08	1.39E+01					
Al+3		2.20E+00			1.53E-03		5.29E-01	
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2					1.85E-02			
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3					8.71E-04	6.99E-01		
Pb+2								
Hg+2					1.92E-06			
Mn+4								
Ni+2								
K+					7.14E-03			
Se+4								
Ag+								
Na+					7.42E-04			
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-								
F-								
SO4-2								
NO3-		6.60E+00	1.39E+01					
PO4-3					2.26E-03			
Am+4								
Br-								
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-								
La+3								

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	205	206	207	301	302	303	304	305
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4					6.26E-03			4.67E-01
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-	1.00E-07	3.09E-08						
H2O	5.54E+01	4.89E+01	2.27E+01					
SO2								
H2S								
CO								
CO2								
H2								
N2								
NO								
NO2								
O2								
S (other)					5.18E-04			
CO3					3.11E-02			
C (reductant)					9.22E-01			
O (oxides)					8.88E-03	3.01E-01	4.71E-01	5.33E-01
C (organic)				4.21E-01				
H (organic)				6.48E-02				
O (organic)				5.14E-01				
Mass Flow (kg/hr):	1.60E+03	1.80E-07	3.94E+00	1.42E+02	6.26E+01	1.00E-05	7.53E-01	3.00E+00

Table A-14. Mass balance, Tank WM-187 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3	PFD-2
WM-187, Stream #	401	402	404	404	503	504	505	506
Stream Name	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Reformer	Oxygen to Oxidizer	Air to Boiler
Rate or Volume	5.62E+00	2.60E-01	8.82E+00	2.29E-01	2.67E+03	6.31E+02	9.81E+02	6.19E+04
Volume Flow (standard, wet)*					1.67E+04	3.90E+03	6.06E+03	6.30E+04
Volume Flow (standard, dry)*					1.67E+04	3.90E+03	6.06E+03	6.30E+04
Rate Units	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.13E+01	9.86E-01	4.00E+00	4.00E+00	4.74E+02	1.10E+02	1.72E+02	1.78E+03
Rate Units	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	79	79	60	60	21	25	25	15
Temperature, °F	174	174	140	140	70	77	77	59
Pressure, psia	12.3	12.3	12.3	12.3	92.3	92.3	92.3	14.7
Specific Gravity	1.01E+00	1.01E+00	2.10E+00	2.10E+00	7.29E-03	8.21E-03	8.21E-03	1.22E-03
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
H+	1.03E+00	1.03E+00	2.57E-04	2.57E-04				
Al+3	1.54E-03	1.54E-03	1.03E-05	1.03E-05				
Sb+5	1.05E-07	1.05E-07	3.16E-09	3.16E-09				
As+3	6.13E-07	6.13E-07	1.13E-08	1.13E-08				
Ba+2	3.37E-07	3.37E-07	1.14E-08	1.14E-08				
Be+2	7.47E-08	7.47E-08	1.66E-10	1.66E-10				
B+3	3.98E-05	3.98E-05	1.06E-07	1.06E-07				
Cd+2	2.59E-06	2.59E-06	7.18E-08	7.18E-08				
Ca+2	6.15E-04	6.15E-04	6.08E-06	6.08E-06				
Cr+3	8.23E-06	8.23E-06	1.06E-07	1.06E-07				
Co+2	7.26E-06	7.26E-06	1.05E-07	1.05E-07				
Cs+	6.96E-05	6.96E-05	2.46E-06	2.46E-06				
Cu+2	2.23E-06	2.23E-06	3.50E-08	3.50E-08				
Fe+3	1.02E-04	1.02E-04	1.40E-06	1.40E-06				
Pb+2	5.05E-06	5.05E-06	2.58E-07	2.58E-07				
Hg+2	1.07E-02	1.07E-02	5.27E-04	5.27E-04				
Mn+4	6.55E-05	6.55E-05	8.86E-07	8.86E-07				
Ni+2	6.45E-06	6.45E-06	9.33E-08	9.33E-08				
K+	1.66E-03	1.66E-03	1.60E-05	1.60E-05				
Se+4	1.46E-06	1.46E-06	2.84E-08	2.84E-08				
Ag+	2.09E-06	2.09E-06	5.55E-08	5.55E-08				
Na+	6.14E-02	6.14E-02	3.48E-04	3.48E-04				
Tl+3	2.09E-08	2.09E-08	1.05E-09	1.05E-09				
U+4	9.27E-07	9.27E-07	5.44E-08	5.44E-08				
V+3	2.10E-07	2.10E-07	2.64E-09	2.64E-09				
Zn+2	3.62E-06	3.62E-06	5.83E-08	5.83E-08				
Zr+4	2.09E-04	2.09E-04	4.69E-06	4.69E-06				
Cl-	2.16E-03	2.16E-03	1.89E-05	1.89E-05				
F-	2.10E-02	2.10E-02	9.82E-05	9.82E-05				
SO4-2	2.22E-02	2.22E-02	5.25E-04	5.25E-04				
NO3-	1.04E+00	1.04E+00	1.58E-02	1.58E-02				
PO4-3	6.75E-04	6.75E-04	1.58E-05	1.58E-05				
Am+4	2.50E-10	2.50E-10	1.50E-11	1.50E-11				
Br-	3.02E-08	3.02E-08	5.94E-10	5.94E-10				
Ce+4	1.56E-07	1.56E-07	5.40E-09	5.40E-09				
Eu+3	1.50E-09	1.50E-09	5.61E-11	5.61E-11				
Gd+3	5.45E-07	5.45E-07	2.11E-08	2.11E-08				
Ge+4	2.45E-11	2.45E-11	4.39E-13	4.39E-13				
In+3	4.35E-09	4.35E-09	1.23E-10	1.23E-10				
I-	3.93E-07	3.93E-07	1.23E-08	1.23E-08				
La+3	2.71E-08	2.71E-08	9.29E-10	9.29E-10				

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
Li+	2.03E-06	2.03E-06	3.47E-09	3.47E-09				
Mg+2	8.12E-05	8.12E-05	4.86E-07	4.86E-07				
Mo+6	3.20E-04	3.20E-04	7.55E-06	7.55E-06				
Nd+3	8.75E-08	8.75E-08	3.11E-09	3.11E-09				
Np+4	1.38E-08	1.38E-08	8.04E-10	8.04E-10				
Nb+5	5.81E-06	5.81E-06	1.33E-07	1.33E-07				
Pd+4	1.32E-05	1.32E-05	3.46E-07	3.46E-07				
Pu+4	3.05E-08	3.05E-08	1.83E-09	1.83E-09				
Pr+4	2.47E-08	2.47E-08	8.57E-10	8.57E-10				
Pm+3	6.01E-12	6.01E-12	2.15E-13	2.15E-13				
Rh+4	1.06E-08	1.06E-08	2.70E-10	2.70E-10				
Rb+	1.46E-08	1.46E-08	3.07E-10	3.07E-10				
Ru+3	4.60E-06	4.60E-06	1.15E-07	1.15E-07				
Sm+3	1.64E-08	1.64E-08	6.07E-10	6.07E-10				
Si+4	8.21E-04	8.21E-04	3.51E-01	3.51E-01				
Sr+2	4.70E-07	4.70E-07	1.02E-08	1.02E-08				
Tc+7	5.26E-08	5.26E-08	1.27E-09	1.27E-09				
Te+4	1.33E-08	1.33E-08	4.18E-10	4.18E-10				
Tb+4	6.25E-12	6.25E-12	2.45E-13	2.45E-13				
Th+4	6.96E-08	6.96E-08	3.98E-09	3.98E-09				
Sn+4	1.01E-05	1.01E-05	2.96E-07	2.96E-07				
Ti+4	5.10E-06	5.10E-06	6.02E-08	6.02E-08				
Y+3	2.02E-08	2.02E-08	4.43E-10	4.43E-10				
OH-	1.22E-02	1.22E-02	5.13E-05	5.13E-05				
H2O	5.23E+01	5.23E+01	2.32E-01	2.32E-01				4.68E-06
SO2	9.10E-06	9.10E-06	1.44E-07	1.44E-07				
H2S								
CO	1.92E-10	1.92E-10	1.32E-12	1.32E-12				
CO2	3.05E-04	3.05E-04	3.31E-06	3.31E-06				
H2	7.32E-10	7.32E-10	3.64E-13	3.64E-13				
N2	1.28E-05	1.28E-05	8.84E-08	8.84E-08	7.27E-02			5.74E-02
NO	2.31E-07	2.31E-07	1.71E-09	1.71E-09				
NO2	2.94E-06	2.94E-06	3.33E-08	3.33E-08				
O2	3.20E-06	3.20E-06	2.52E-08	2.52E-08		8.30E-02	8.30E-02	1.74E-02
S (other)	1.22E-07	1.22E-07	9.65E-10	9.65E-10				
CO3	3.48E-05	3.48E-05	5.15E-07	5.15E-07				
C (reductant)								
O (oxides)	5.02E-03	5.02E-03	3.99E-01	3.99E-01				
C (organic)								
H (organic)								
O (organic)								
Mass Flow (kg/hr):	2.16E+01	1.00E+00	4.00E+00	4.00E+00	5.52E+02	1.47E+02	2.28E+02	2.14E+03
Total Drums Generated				20				
	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3	4.12E-02	4.12E-02	2.30E-02	4.59E-03				

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Radiological Composition	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
H-3								
C-14	1.52E-15	1.52E-15	3.75E-16	1.57E-13				
Co-60	6.22E-08	6.22E-08	1.53E-08	6.44E-06				
Ni-59	8.94E-09	8.94E-09	2.20E-09	9.26E-07				
Ni-63	2.08E-07	2.08E-07	5.13E-08	2.15E-05				
Se-79	1.98E-09	1.98E-09	4.89E-10	2.05E-07				
Sr-90	1.56E-04	1.56E-04	3.85E-05	1.62E-02				
Y-90	1.19E-04	1.19E-04	2.94E-05	1.23E-02				
Zr-93	6.34E-09	6.34E-09	1.56E-09	6.56E-07				
Nb-93m	4.88E-09	4.88E-09	1.20E-09	5.05E-07				
Nb-94	5.15E-09	5.15E-09	1.27E-09	5.33E-07				
Tc-99	1.27E-07	1.27E-07	3.12E-08	1.31E-05				
Ru-106	4.50E-09	4.50E-09	1.11E-09	4.66E-07				
Rh-102	2.61E-12	2.61E-12	6.44E-13	2.71E-10				
Rh-106	4.50E-09	4.50E-09	1.11E-09	4.66E-07				
Pd-107	6.56E-11	6.56E-11	1.62E-11	6.79E-09				
Cd-113m	4.09E-09	4.09E-09	1.01E-09	4.24E-07				
Sn-121m	1.91E-10	1.91E-10	4.71E-11	1.98E-08				
Sn-126	1.87E-09	1.87E-09	4.61E-10	1.93E-07				
Sb-125	2.37E-06	2.37E-06	5.85E-07	2.46E-04				
Sb-126	1.74E-10	1.74E-10	4.30E-11	1.80E-08				
Te-125m	9.01E-09	9.01E-09	2.22E-09	9.32E-07				
I-129	8.54E-09	8.54E-09	2.10E-09	8.84E-07				
Cs-134	5.95E-05	5.95E-05	1.58E-05	6.65E-03				
Cs-135	9.47E-07	9.47E-07	2.52E-07	1.06E-04				
Cs-137	3.84E-02	3.84E-02	1.02E-02	4.30E+00				
Ba-137m	2.00E-04	2.00E-04	4.93E-05	2.07E-02				
Ce-144	3.04E-09	3.04E-09	7.50E-10	3.15E-07				
Pr-144	3.04E-09	3.04E-09	7.50E-10	3.15E-07				
Pm-146	1.54E-10	1.54E-10	3.80E-11	1.60E-08				
Pm-147	8.19E-07	8.19E-07	2.02E-07	8.47E-05				
Sm-151	1.62E-06	1.62E-06	4.00E-07	1.68E-04				
Eu-152	9.74E-09	9.74E-09	2.40E-09	1.01E-06				
Eu-154	3.66E-07	3.66E-07	9.02E-08	3.79E-05				
Eu-155	3.85E-07	3.85E-07	9.50E-08	3.99E-05				
Th-230	3.58E-12	3.58E-12	8.83E-13	3.71E-10				
Pa-233	8.38E-09	8.38E-09	2.07E-09	8.68E-07				
U-232	8.24E-12	8.24E-12	2.03E-12	8.53E-10				
U-233	2.73E-13	2.73E-13	6.72E-14	2.82E-11				
U-234	4.51E-09	4.51E-09	1.11E-09	4.67E-07				
U-235	2.35E-10	2.35E-10	5.79E-11	2.43E-08				
U-236	2.19E-10	2.19E-10	5.38E-11	2.26E-08				
U-237	1.84E-11	1.84E-11	4.54E-12	1.91E-09				
U-238	7.94E-11	7.94E-11	1.96E-11	8.21E-09				
Np-237	2.30E-09	2.30E-09	5.67E-10	2.38E-07				
Pu-236	1.29E-11	1.29E-11	3.18E-12	1.34E-09				
Pu-238	3.81E-06	3.81E-06	9.38E-07	3.94E-04				
Pu-239	4.23E-07	4.23E-07	1.04E-07	4.38E-05				
Pu-240	4.83E-08	4.83E-08	1.19E-08	5.00E-06				
Pu-241	2.87E-06	2.87E-06	7.08E-07	2.98E-04				
Pu-242	3.79E-11	3.79E-11	9.34E-12	3.92E-09				
Pu-244	2.27E-18	2.27E-18	5.59E-19	2.35E-16				
Am-241	2.58E-07	2.58E-07	6.37E-08	2.67E-05				
Am-242m	4.68E-11	4.68E-11	1.15E-11	4.84E-09				

Table A-14. Mass balance, Tank WM-187 waste (continued).

Stream #	401	402	404	404	503	504	505	506
	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	8.88E-11	8.88E-11	2.19E-11	9.19E-09				
Cm-242	8.67E-11	8.67E-11	2.14E-11	8.97E-09				
Cm-243	1.25E-10	1.25E-10	3.09E-11	1.30E-08				
Cm-244	5.59E-09	5.59E-09	1.38E-09	5.78E-07				
Cm-245	1.32E-12	1.32E-12	3.26E-13	1.37E-10				
Cm-246	8.66E-14	8.66E-14	2.13E-14	8.96E-12				
TRU	4.63E-06	4.63E-06	1.14E-06	4.79E-04				
TRU, nCi/gm								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %								0.01%
O2, mol %						100.00%	100.00%	20.99%
N2, mol %					100.00%			79.00%
H2, mol %								
CO2, mol %								
CO, ppmv								
NO, ppmv								
NO2, ppmv								
SO2, ppmv								
Cl, ppmv								
F, ppmv								
C (organic), ppmv								
H (organic), ppmv								
Hg, ug/wscm								
PM, mg/wscm					2.01E+01	1.88E-02		1.60E+01
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis								20.9921%
N2, mol %, dry basis								79.01%
H2, mol %, dry basis								
CO2, mol %, dry basis								
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis								
NO, ppmv, dry basis								
NO2, ppmv, dry basis								
SO2, ppmv, dry basis								
Cl, ppmv, dry basis								
F, ppmv, dry basis								
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm								
PM, mg/dscm								2.25E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-14. Mass balance, Tank WM-187 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-187, Stream #	507	510	511	512	513	514	515	516
Stream Name	Off-Gas from Boiler	Nitrogen to Cool Product	N2 from Product Cooler	Filter Backpulse N2	Solids Transport Nitrogen	Tank Farm Transfer Airlift Air	Ventilation Air	Fresh GAC
Rate or Volume	1.31E+05	2.86E+02	9.08E+02	2.68E+02	6.56E+01	1.40E+01	2.89E+01	4.79E+00
Volume Flow (standard, wet)*	6.70E+04	1.93E+03	1.93E+03	7.84E+02	1.92E+02	4.11E+01	2.94E+01	
Volume Flow (standard, dry)*	5.92E+04	1.93E+03	1.93E+03	7.84E+02	1.92E+02	4.11E+01	2.94E+01	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	1.90E+03	5.47E+01	5.47E+01	2.22E+01	5.44E+00	1.16E+00	8.34E-01	2.17E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	300	0	593	15	15	15	15	25
Temperature, °F	572	32	1099	59	59	59	59	77
Pressure, psia	14.7	92.3	92.3	42.3	42.3	42.3	14.7	14.7
Specific Gravity	6.10E-04	7.85E-03	2.48E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01
Gas Stream Bulk Composition (Wet Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Wt %
H2O	11.52%					0.01%	0.01%	
O2	3.00%					20.99%	20.99%	
N2	74.11%	100.00%	100.00%	100.00%	100.00%	79.00%	79.00%	
H2	0.05%							
CO2	10.64%							
	ppmv							
CO	2.21E+03							
NO	4.30E+03							
NO2	1.97E+00							
SO2	2.40E+02							
C(organic)								
H(organic)								
Gas Stream Bulk Composition (Dry Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	
O2	3.39%					20.99%	20.99%	
N2	83.77%					79.01%	79.01%	
H2	0.05%							
CO2	12.03%							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)								
	ppmv							
CO	3.49E+02							
NO	6.80E+02							
NO2	3.12E-01							
SO2	3.80E+01							
C(organic)								
H(organic)								
PM, mg/dscm	2.62E+00					2.22E+00	2.20E+00	
Hg, ug/dscm								
GAC								100%

Table A-15. Mass balance, Tank WM-188 waste.

PFD #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
WM-188, Stream #	101	102	103	104	105	106	107	108	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Cyclone Drain	Filter Drain	Bed Drain	Cooled Product	Product Shipping Canisters
Rate or Volume	9.66E+01	1.33E+02	4.60E+05	4.14E+05	1.04E+02	6.26E+01	8.47E+01	1.47E+02	1.51E+00
Volume Flow (standard, wet			1.03E+05	1.05E+05					
Volume Flow (standard, dry			3.07E+04	3.25E+04					
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr	lb/hr	can's/day
Rate or Volume, metric	366	504	2.92E+03	2.98E+03	47	28.4	38.4	66.8	66.8
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	19	670	530	670	530	670	55	55
Temperature, °F	59	66	1238	986	1238	986	1238	132	132
Pressure, psia	14.7	44.7	10.6	10.2	10.6	9.5	10.8	9.5	9.5
Specific Gravity	1.22	1.22	1.98E-04	2.25E-04	0.24	1.15	1.46	1.33	1.33
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	2.53E+00	1.88E+00	7.40E-07	7.27E-07	2.56E-06	5.22E-06	7.99E-06	6.81E-06	6.81E-06
Al+3	4.63E-01	3.36E-01	3.14E-05	3.09E-05	3.47E-02	5.17E-02	9.23E-02	7.51E-02	7.51E-02
Sb+5	1.45E-05	1.05E-05	4.05E-09	3.98E-09	4.46E-06	6.66E-06	1.19E-05	9.67E-06	9.67E-06
As+3	8.09E-05	5.88E-05	1.39E-08	1.37E-08	1.53E-05	2.29E-05	4.08E-05	3.32E-05	3.32E-05
Ba+2	6.62E-05	4.81E-05	2.16E-08	2.13E-08	1.84E-05	3.56E-05	6.01E-05	4.97E-05	4.97E-05
Be+2	1.67E-05	1.22E-05	3.59E-10	3.53E-10	3.06E-07	5.91E-07	9.98E-07	8.25E-07	8.25E-07
B+3	1.45E-02	1.05E-02	3.59E-07	3.53E-07	3.96E-04	5.91E-04	1.05E-03	8.58E-04	8.58E-04
Cd+2	2.21E-03	1.61E-03	6.46E-07	6.35E-07	6.42E-04	1.06E-03	1.58E-03	1.36E-03	1.36E-03
Ca+2	4.41E-02	3.21E-02	1.20E-05	1.18E-05	1.02E-02	1.98E-02	3.34E-02	2.76E-02	2.76E-02
Cr+3	4.13E-03	3.00E-03	5.45E-07	5.36E-07	3.83E-04	8.97E-04	1.38E-03	1.18E-03	1.18E-03
Co+2	3.61E-05	2.62E-05	4.88E-09	4.79E-09	5.38E-06	8.03E-06	1.43E-05	1.17E-05	1.17E-05
Cs+	5.27E-05	4.11E-05	5.46E-08	5.37E-08	7.80E-05	8.99E-05	5.02E-06	4.56E-05	4.56E-05
Cu+2	6.19E-04	4.50E-04	9.37E-08	9.21E-08	7.98E-05	1.54E-04	2.60E-04	2.15E-04	2.15E-04
Fe+3	2.28E-02	1.66E-02	2.12E-06	2.08E-06	1.62E-03	3.49E-03	1.10E-02	7.81E-03	7.81E-03
Pb+2	7.26E-04	5.28E-04	1.12E-06	1.10E-06	3.39E-04	1.85E-03	6.32E-05	8.22E-04	8.22E-04
Hg+2	4.64E-03	3.84E-03	8.28E-06	8.14E-06	6.67E-06	1.62E-05		6.91E-06	6.91E-06
Mn+4	1.32E-02	9.61E-03	1.66E-06	1.64E-06	1.84E-03	2.74E-03	4.89E-03	3.98E-03	3.98E-03
Ni+2	1.62E-03	1.18E-03	2.26E-07	2.23E-07	1.93E-04	3.73E-04	6.29E-04	5.20E-04	5.20E-04
K+	1.69E-01	1.23E-01	3.22E-05	3.16E-05	3.87E-02	5.30E-02	3.58E-02	4.31E-02	4.31E-02
Se+4	2.14E-04	1.56E-04	3.76E-08	3.69E-08	4.01E-05	6.19E-05	1.15E-04	9.25E-05	9.25E-05
Ag+	3.33E-04	2.42E-04	9.71E-08	9.55E-08	7.71E-05	1.59E-04	2.25E-04	1.97E-04	1.97E-04
Na+	1.25E+00	9.08E-01	7.78E-05	7.65E-05	6.18E-02	1.28E-01	1.80E-01	1.58E-01	1.58E-01
Tl+3	4.05E-06	2.94E-06	1.90E-09	1.86E-09	2.09E-06	3.12E-06	5.57E-06	4.53E-06	4.53E-06
U+4	3.20E-04	2.33E-04	1.70E-07	1.67E-07	1.81E-04	2.79E-04	5.20E-04	4.17E-04	4.17E-04
V+3	3.24E-05	2.36E-05	3.67E-09	3.61E-09	3.91E-06	6.04E-06	1.13E-05	9.04E-06	9.04E-06
Zn+2	7.17E-04	5.21E-04	1.12E-07	1.10E-07	9.51E-05	1.84E-04	3.10E-04	2.57E-04	2.57E-04
Zr+4	3.34E-02	2.42E-02	6.76E-06	6.65E-06	7.21E-03	1.11E-02	2.07E-02	1.67E-02	1.67E-02
Cl-	2.18E-02	1.59E-02	4.49E-06	4.41E-06	4.05E-03	7.19E-03	1.94E-03	4.17E-03	4.17E-03
F-	3.15E-02	2.37E-02	4.34E-06	4.27E-06	2.36E-03	6.44E-03	6.06E-04	3.08E-03	3.08E-03
SO4-2	3.70E-02	2.78E-02	8.99E-09	8.83E-09	4.50E-06	1.48E-05	1.13E-05	1.28E-05	1.28E-05
NO3-	5.17E+00	3.80E+00	9.35E-06	9.19E-06	1.96E-03	4.49E-03	5.12E-03	4.85E-03	4.85E-03
PO4-3	8.80E-02	6.40E-02	2.40E-05	2.36E-05	4.34E-02	3.96E-02	5.41E-02	4.79E-02	4.79E-02
Am+4	6.13E-08	4.45E-08	3.41E-11	3.35E-11	3.76E-08	5.62E-08	1.00E-07	8.15E-08	8.15E-08
Br-	2.63E-07	1.92E-07	1.22E-10	1.20E-10	1.10E-07	1.96E-07	5.27E-08	1.13E-07	1.13E-07
Ce+4	3.03E-05	2.20E-05	9.73E-09	9.56E-09	1.07E-05	1.60E-05	2.86E-05	2.32E-05	2.32E-05
Eu+3	4.37E-07	3.17E-07	1.52E-10	1.49E-10	1.68E-07	2.50E-07	4.47E-07	3.63E-07	3.63E-07
Gd+3	1.29E-04	9.36E-05	4.64E-08	4.56E-08	5.12E-05	7.64E-05	1.36E-04	1.11E-04	1.11E-04
Ge+4	7.59E-09	5.51E-09	1.22E-12	1.20E-12	1.31E-09	2.02E-09	3.75E-09	3.02E-09	3.02E-09
In+3	1.33E-06	9.70E-07	3.51E-10	3.45E-10	3.87E-07	5.78E-07	1.03E-06	8.39E-07	8.39E-07
I-	2.81E-06	2.06E-06	2.07E-09	2.04E-09	1.87E-06	3.32E-06	8.94E-07	1.93E-06	1.93E-06
La+3	7.93E-06	5.76E-06	2.52E-09	2.48E-09	2.78E-06	4.15E-06	7.41E-06	6.03E-06	6.03E-06

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+	4.14E-04	3.01E-04	7.77E-09	7.63E-09	6.17E-06	1.27E-05	1.80E-05	1.58E-05	1.58E-05
Mg+2	1.63E-02	1.18E-02	9.41E-07	9.25E-07	8.01E-04	1.55E-03	2.62E-03	2.16E-03	2.16E-03
Mo+6	4.78E-02	3.47E-02	1.02E-05	1.00E-05	1.09E-02	1.68E-02	3.12E-02	2.51E-02	2.51E-02
Nd+3	2.56E-05	1.86E-05	8.45E-09	8.30E-09	9.32E-06	1.39E-05	2.48E-05	2.02E-05	2.02E-05
Np+4	2.34E-06	1.70E-06	1.27E-09	1.25E-09	1.40E-06	2.09E-06	3.73E-06	3.03E-06	3.03E-06
Nb+5	9.58E-04	6.96E-04	1.98E-07	1.94E-07	2.11E-04	3.26E-04	6.06E-04	4.87E-04	4.87E-04
Pd+4	1.55E-03	1.13E-03	3.94E-07	3.87E-07	3.35E-04	6.49E-04	1.10E-03	9.05E-04	9.05E-04
Pu+4	6.09E-06	4.42E-06	3.30E-09	3.25E-09	3.52E-06	5.44E-06	1.01E-05	8.13E-06	8.13E-06
Pr+4	7.21E-06	5.24E-06	2.33E-09	2.29E-09	2.57E-06	3.83E-06	6.84E-06	5.56E-06	5.56E-06
Pm+3	1.49E-09	1.08E-09	4.96E-13	4.87E-13	5.46E-10	8.16E-10	1.46E-09	1.18E-09	1.18E-09
Rh+4	3.11E-06	2.26E-06	7.33E-10	7.21E-10	8.08E-07	1.21E-06	2.15E-06	1.75E-06	1.75E-06
Rb+	4.79E-06	3.48E-06	1.11E-09	1.09E-09	8.78E-07	1.81E-06	2.56E-06	2.24E-06	2.24E-06
Ru+3	7.20E-04	5.23E-04	1.67E-07	1.64E-07	1.84E-04	2.74E-04	4.90E-04	3.98E-04	3.98E-04
Sm+3	4.76E-06	3.46E-06	1.64E-09	1.61E-09	1.81E-06	2.70E-06	4.82E-06	3.92E-06	3.92E-06
Si+4	8.17E-02	5.94E-02	6.90E-06	6.78E-06	1.08E-02	1.14E-02	2.40E-02	1.86E-02	1.86E-02
Sr+2	7.11E-05	5.17E-05	1.48E-08	1.46E-08	1.26E-05	2.44E-05	4.12E-05	3.41E-05	3.41E-05
Tc+7	9.28E-06	6.74E-06	6.41E-09	6.30E-09	1.06E-05	1.05E-05	8.46E-07	4.97E-06	4.97E-06
Te+4	3.17E-06	2.30E-06	8.98E-10	8.83E-10	9.57E-07	1.48E-06	2.75E-06	2.21E-06	2.21E-06
Tb+4	1.83E-09	1.33E-09	6.64E-13	6.53E-13	7.33E-10	1.09E-09	1.95E-09	1.59E-09	1.59E-09
Th+4	2.10E-05	1.53E-05	1.08E-08	1.07E-08	1.16E-05	1.78E-05	3.32E-05	2.67E-05	2.67E-05
Sn+4	1.58E-03	1.15E-03	4.17E-07	4.10E-07	4.45E-04	6.87E-04	1.28E-03	1.03E-03	1.03E-03
Ti+4	8.09E-04	5.88E-04	8.61E-08	8.46E-08	9.18E-05	1.42E-04	2.64E-04	2.12E-04	2.12E-04
Y+3	5.91E-06	4.29E-06	1.20E-09	1.18E-09	1.33E-06	1.98E-06	3.54E-06	2.88E-06	2.88E-06
OH-		5.62E-04	2.10E-06	2.06E-06	1.69E-03	3.45E-03	5.27E-03	4.49E-03	4.49E-03
H2O	4.47E+01	3.47E+01	3.29E-02	3.24E-02	1.52E-03	2.93E-03	4.43E-03	3.79E-03	3.79E-03
SO2		3.37E-07	2.43E-09	2.39E-09					
H2S			1.04E-05	1.03E-05					
CO		8.44E-12	7.94E-04	7.80E-04					
CO2		1.29E-05	7.61E-03	7.48E-03					
H2		3.47E-11	2.09E-04	2.06E-04					
N2		5.06E-07	1.24E-02	1.35E-02					
NO		9.58E-09	4.81E-05	4.73E-05					
NO2		1.21E-07	4.99E-06	4.91E-06					
O2		1.29E-07	4.44E-04	4.36E-04					
S (other)		4.50E-09	1.49E-07	1.46E-07	1.20E-04	2.45E-04	3.75E-04	3.20E-04	3.20E-04
CO3	2.63E-05	2.05E-05	1.28E-04	1.26E-04	1.13E-01	2.10E-01	2.94E-01	2.59E-01	2.59E-01
C (reductant)			2.25E-05	2.21E-05	4.24E-01	3.70E-02		1.57E-02	1.57E-02
O (oxides)	4.25E-01	3.09E-01	4.31E-05	4.24E-05	4.58E-02	7.10E-02	1.37E-01	1.09E-01	1.09E-01
C (organic)	6.56E-02	1.03E+01	9.45E-05	9.29E-05	7.13E-02	1.25E-01	9.25E-03	5.85E-02	5.85E-02
H (organic)	1.20E-01	1.89E+01	1.79E-05	1.76E-05	1.10E-02	1.93E-02	1.42E-03	9.01E-03	9.01E-03
O (organic)	6.01E-02	9.45E+00	9.29E-05	9.13E-05	8.71E-02	1.53E-01	1.13E-02	7.15E-02	7.15E-02
Mass Flow (kg/hr):	4.48E+02	6.16E+02	2.58E+03	2.64E+03	4.72E+01	2.84E+01	3.84E+01	6.68E+01	6.68E+01
Total Canisters Generated								213	
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/Canister
Heat Generation, w/m3	3.68E-01	2.68E-01			2.52E-01	1.84E+00	3.41E+00	2.70E+00	2.16E+00

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/canister
H-3	1.06E-05	7.71E-06	1.33E-06	1.30E-06					
C-14	1.44E-10	1.04E-10	1.76E-11	1.73E-11	2.22E-10	8.76E-11	2.92E-11	5.40E-11	5.75E-08
Co-60	8.09E-06	5.88E-06	2.97E-07	2.92E-07	2.04E-05	3.05E-05	5.45E-05	4.43E-05	4.71E-02
Ni-59	1.01E-06	7.33E-07	3.85E-08	3.78E-08	2.05E-06	3.95E-06	6.68E-06	5.52E-06	5.87E-03
Ni-63	3.81E-05	2.77E-05	1.45E-06	1.43E-06	7.73E-05	1.49E-04	2.52E-04	2.09E-04	2.22E-01
Se-79	5.22E-07	3.79E-07	1.86E-08	1.83E-08	1.24E-06	1.91E-06	3.55E-06	2.85E-06	3.03E-03
Sr-90	3.58E-02	2.60E-02	1.37E-03	1.34E-03	7.27E-02	1.41E-01	2.37E-01	1.96E-01	2.09E+02
Y-90	3.58E-02	2.60E-02	1.31E-03	1.29E-03	9.05E-02	1.35E-01	2.41E-01	1.96E-01	2.09E+02
Zr-93	2.06E-06	1.50E-06	7.34E-08	7.22E-08	4.89E-06	7.55E-06	1.41E-05	1.13E-05	1.20E-02
Nb-93m	1.59E-06	1.15E-06	5.66E-08	5.56E-08	3.77E-06	5.82E-06	1.08E-05	8.70E-06	9.25E-03
Nb-94	1.36E-06	9.86E-07	4.83E-08	4.75E-08	3.22E-06	4.97E-06	9.25E-06	7.43E-06	7.90E-03
Tc-99	1.89E-05	1.37E-05	2.13E-06	2.09E-06	2.21E-04	2.19E-04	1.76E-05	1.03E-04	1.10E-01
Ru-106	1.11E-06	8.10E-07	4.09E-08	4.02E-08	2.81E-06	4.20E-06	7.50E-06	6.10E-06	6.48E-03
Rh-102	8.02E-10	5.83E-10	2.94E-11	2.89E-11	2.03E-09	3.03E-09	5.40E-09	4.39E-09	4.67E-06
Rh-106	1.11E-06	8.10E-07	4.09E-08	4.02E-08	2.81E-06	4.20E-06	7.50E-06	6.10E-06	6.48E-03
Pd-107	1.54E-08	1.12E-08	5.87E-10	5.77E-10	3.12E-08	6.03E-08	1.02E-07	8.41E-08	8.95E-05
Cd-113m	3.09E-06	2.25E-06	1.29E-07	1.27E-07	7.99E-06	1.32E-05	1.96E-05	1.69E-05	1.80E-02
Sn-121m	6.22E-08	4.52E-08	2.22E-09	2.18E-09	1.47E-07	2.28E-07	4.24E-07	3.41E-07	3.62E-04
Sn-126	4.91E-07	3.57E-07	1.75E-08	1.72E-08	1.16E-06	1.80E-06	3.35E-06	2.69E-06	2.86E-03
Sb-125	3.37E-04	2.45E-04	1.24E-05	1.22E-05	8.52E-04	1.27E-03	2.27E-03	1.85E-03	1.96E+00
Sb-126	5.35E-08	3.89E-08	1.96E-09	1.93E-09	1.35E-07	2.02E-07	3.60E-07	2.93E-07	3.11E-04
Te-125m	2.93E-06	2.13E-06	1.04E-07	1.03E-07	6.95E-06	1.07E-05	2.00E-05	1.60E-05	1.71E-02
I-129	6.37E-08	4.66E-08	5.92E-09	5.82E-09	3.34E-07	5.93E-07	1.60E-07	3.44E-07	3.65E-04
Cs-134	3.36E-05	2.62E-05	4.20E-06	4.13E-06	3.75E-04	4.32E-04	2.41E-05	2.19E-04	2.33E-01
Cs-135	1.00E-06	7.82E-07	1.25E-07	1.23E-07	1.12E-05	1.29E-05	7.19E-07	6.54E-06	6.95E-03
Cs-137	2.07E-02	1.61E-02	2.59E-03	2.54E-03	2.31E-01	2.66E-01	1.48E-02	1.35E-01	1.43E+02
Ba-137m	1.96E-02	1.42E-02	7.47E-04	7.34E-04	3.97E-02	7.68E-02	1.30E-01	1.07E-01	1.14E+02
Ce-144	7.52E-07	5.46E-07	2.76E-08	2.71E-08	1.90E-06	2.84E-06	5.06E-06	4.12E-06	4.38E-03
Pr-144	7.52E-07	5.46E-07	2.76E-08	2.71E-08	1.90E-06	2.84E-06	5.06E-06	4.12E-06	4.38E-03
Pm-146	4.74E-08	3.44E-08	1.74E-09	1.71E-09	1.20E-07	1.79E-07	3.19E-07	2.59E-07	2.76E-04
Pm-147	2.03E-04	1.48E-04	7.46E-06	7.33E-06	5.13E-04	7.66E-04	1.37E-03	1.11E-03	1.18E+00
Sm-151	4.02E-04	2.92E-04	1.47E-05	1.45E-05	1.01E-03	1.51E-03	2.70E-03	2.20E-03	2.34E+00
Eu-152	2.65E-06	1.93E-06	9.74E-08	9.57E-08	6.70E-06	1.00E-05	1.79E-05	1.45E-05	1.54E-02
Eu-154	4.52E-05	3.28E-05	1.66E-06	1.63E-06	1.14E-04	1.70E-04	3.04E-04	2.47E-04	2.63E-01
Eu-155	3.92E-05	2.85E-05	1.44E-06	1.41E-06	9.89E-05	1.48E-04	2.64E-04	2.14E-04	2.28E-01
Th-230	9.53E-10	6.93E-10	3.39E-11	3.34E-11	2.26E-09	3.49E-09	6.50E-09	5.22E-09	5.55E-06
Pa-233	2.73E-06	1.98E-06	9.72E-08	9.55E-08	6.47E-06	9.99E-06	1.86E-05	1.49E-05	1.59E-02
U-232	2.24E-09	1.63E-09	7.99E-11	7.86E-11	5.32E-09	8.22E-09	1.53E-08	1.23E-08	1.31E-05
U-233	8.12E-11	5.90E-11	2.89E-12	2.84E-12	1.93E-10	2.97E-10	5.53E-10	4.45E-10	4.73E-07
U-234	1.00E-06	7.28E-07	3.57E-08	3.51E-08	2.37E-06	3.66E-06	6.82E-06	5.48E-06	5.83E-03
U-235	7.36E-08	5.35E-08	2.62E-09	2.58E-09	1.74E-07	2.69E-07	5.01E-07	4.03E-07	4.28E-04
U-236	4.33E-08	3.14E-08	1.54E-09	1.51E-09	1.03E-07	1.58E-07	2.95E-07	2.37E-07	2.52E-04
U-237	5.99E-09	4.35E-09	2.13E-10	2.10E-10	1.42E-08	2.19E-08	4.08E-08	3.28E-08	3.49E-05
U-238	1.31E-08	9.52E-09	4.67E-10	4.59E-10	3.11E-08	4.80E-08	8.93E-08	7.17E-08	7.62E-05
Np-237	3.90E-07	2.84E-07	1.43E-08	1.41E-08	9.86E-07	1.47E-06	2.63E-06	2.14E-06	2.27E-03
Pu-236	3.28E-09	2.38E-09	1.17E-10	1.15E-10	7.77E-09	1.20E-08	2.23E-08	1.79E-08	1.91E-05
Pu-238	7.50E-04	5.45E-04	2.67E-05	2.63E-05	1.78E-03	2.74E-03	5.11E-03	4.10E-03	4.36E+00
Pu-239	8.39E-05	6.10E-05	2.99E-06	2.94E-06	1.99E-04	3.07E-04	5.72E-04	4.59E-04	4.88E-01
Pu-240	1.22E-05	8.87E-06	4.35E-07	4.27E-07	2.89E-05	4.47E-05	8.32E-05	6.68E-05	7.10E-02
Pu-241	5.46E-04	3.96E-04	1.94E-05	1.91E-05	1.29E-03	2.00E-03	3.72E-03	2.99E-03	3.17E+00
Pu-242	9.56E-09	6.95E-09	3.41E-10	3.35E-10	2.27E-08	3.50E-08	6.52E-08	5.23E-08	5.56E-05
Pu-244	7.30E-16	5.30E-16	2.60E-17	2.55E-17	1.73E-15	2.67E-15	4.97E-15	3.99E-15	4.25E-12
Am-241	5.26E-05	3.82E-05	1.93E-06	1.90E-06	1.33E-04	1.98E-04	3.54E-04	2.88E-04	3.06E-01
Am-242m	1.45E-08	1.06E-08	5.33E-10	5.24E-10	3.67E-08	5.48E-08	9.77E-08	7.95E-08	8.45E-05

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/Canister
Am-243	2.37E-08	1.72E-08	8.70E-10	8.55E-10	5.99E-08	8.94E-08	1.59E-07	1.30E-07	1.38E-04
Cm-242	3.15E-08	2.29E-08	1.12E-09	1.10E-09	7.45E-08	1.15E-07	2.14E-07	1.72E-07	1.83E-04
Cm-243	3.30E-08	2.40E-08	1.17E-09	1.15E-09	7.82E-08	1.21E-07	2.25E-07	1.80E-07	1.92E-04
Cm-244	1.15E-06	8.38E-07	4.11E-08	4.04E-08	2.73E-06	4.22E-06	7.86E-06	6.31E-06	6.71E-03
Cm-245	3.47E-10	2.52E-10	1.24E-11	1.21E-11	8.22E-10	1.27E-09	2.36E-09	1.90E-09	2.02E-06
Cm-246	2.28E-11	1.66E-11	8.12E-13	7.98E-13	5.40E-11	8.34E-11	1.55E-10	1.25E-10	1.33E-07
TRU	9.16E-04	6.65E-04	3.27E-05	3.21E-05	2.18E-03	3.36E-03	6.24E-03	5.01E-03	5.33E+00
TRU, nCi/gm	7.48E+02							5.01E+03	
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			70.27%	69.08%					
O2, mol %			0.53%	0.52%					
N2, mol %			17.08%	18.49%					
H2, mol %			3.99%	3.92%					
CO2, mol %			6.65%	6.53%					
CO, ppmv			1.09E+04	1.07E+04					
NO, ppmv			6.16E+02	6.06E+02					
NO2, ppmv			4.17E+01	4.10E+01					
SO2, ppmv			1.46E-02	1.43E-02					
Cl, ppmv			4.87E+01	4.78E+01					
F, ppmv			8.78E+01	8.63E+01					
C (organic), ppmv			3.03E+03	2.97E+03					
H (organic), ppmv			6.83E+03	6.72E+03					
Hg, ug/wscm			1.33E+05	1.30E+05					
PM, mg/wscm			9.68E+03	9.51E+03					
SVM, ug/wscm			2.84E+04	2.79E+04					
LVM, ug/wscm			8.97E+03	8.82E+03					
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			1.79%	1.70%					
N2, mol %, dry basis			57.47%	59.81%					
H2, mol %, dry basis			13.42%	12.68%					
CO2, mol %, dry basis			22.36%	21.13%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			5.13E+03	4.85E+03					
NO, ppmv, dry basis			2.90E+02	2.74E+02					
NO2, ppmv, dry basis			1.96E+01	1.86E+01					
SO2, ppmv, dry basis			6.86E-03	6.48E-03					
Cl, ppmv, dry basis			2.29E+01	2.17E+01					
F, ppmv, dry basis			4.14E+01	3.91E+01					
C (organic), ppmv, dry basis			1.43E+03	1.35E+03					
H (organic), ppmv, dry basis			3.22E+03	3.04E+03					
Hg, ug/dscm			6.25E+04	5.91E+04					
PM, mg/dscm			4.56E+03	4.31E+03					
SVM, ug/dscm			9.54E+04	9.38E+04					
LVM, ug/dscm			3.02E+04	2.97E+04					

Table A-15. Mass balance, Tank WM-188 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-188, Stream #	109	110	111	112	113A	113B	114	115	116
Stream Name	Off-Gas from Filter to Oxidizer	Oxidizer Effluent	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Scrubber Effluent Gas	Demister Effluent Gas	GAC Bed Feed
Rate or Volume	4.47E+05	7.20E+05	3.76E+05	1.03E+04	1.03E+04	2.08E-03	3.86E+05	3.95E+05	4.79E+05
Volume Flow (standard, wet)*	1.06E+05	1.10E+05	1.87E+05				1.86E+05	1.87E+05	1.87E+05
Volume Flow (standard, dry)*	3.31E+04	3.18E+04	3.17E+04				3.17E+04	3.18E+04	3.18E+04
Rate Units	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	3.00E+03	3.12E+03	5.28E+03	3.91E+04	3.91E+04	0.01	5.28E+03	5.30E+03	5.30E+03
Rate Units	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	527	952	100	82	83	81	82	81	120
Temperature, °F	980	1746	212	180	181	178	179	178	248
Pressure, psia	9.5	9.4	9.3	38.1	9.0	8.4	8.6	8.4	7.7
Specific Gravity	2.09E-04	1.42E-04	4.25E-04	1.01	1.01	1.01	4.14E-04	4.05E-04	3.34E-04
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
H+	7.19E-07	2.13E-08	2.08E-08	1.02E+00	1.02E+00	1.02E+00	2.30E-07	2.29E-07	2.29E-07
Al+3	4.60E-08	4.42E-08	2.61E-08	1.65E-03	1.65E-03	1.65E-03			
Sb+5	5.92E-12	5.70E-12	3.36E-12	4.71E-08	4.72E-08	4.72E-08			
As+3	2.03E-11	1.96E-11	1.15E-11	2.63E-07	2.63E-07	2.63E-07			
Ba+2	3.17E-11	3.05E-11	7.44E-13	3.18E-07	3.18E-07	3.18E-07			
Be+2	5.25E-13	5.06E-13	1.23E-14	8.04E-08	8.04E-08	8.04E-08			
B+3	5.25E-10	5.05E-10	2.98E-10	4.71E-05	4.71E-05	4.71E-05			
Cd+2	9.46E-10	9.10E-10	5.37E-10	3.03E-06	3.04E-06	3.04E-06			
Ca+2	1.76E-08	1.69E-08	4.14E-10	6.06E-04	6.05E-04	6.05E-04			
Cr+3	7.98E-10	7.68E-10	4.53E-10	8.30E-06	8.31E-06	8.31E-06			
Co+2	7.14E-12	6.87E-12	4.05E-12	1.17E-07	1.17E-07	1.17E-07			
Cs+	5.33E-11	5.13E-11	3.02E-11	6.79E-05	6.78E-05	6.78E-05			
Cu+2	1.37E-10	1.32E-10	3.22E-12	2.98E-06	2.97E-06	2.97E-06			
Fe+3	3.10E-09	2.98E-09	1.76E-09	1.00E-04	1.00E-04	1.00E-04			
Pb+2	1.64E-09	1.58E-09	9.33E-10	5.52E-06	5.52E-06	5.52E-06			
Hg+2	8.07E-06	7.76E-06	4.58E-06	1.12E-02	1.12E-02	1.12E-02		2.55E-06	2.55E-06
Mn+4	2.44E-09	2.34E-09	1.38E-09	4.30E-05	4.30E-05	4.30E-05			
Ni+2	3.31E-10	3.19E-10	7.79E-12	7.79E-06	7.78E-06	7.78E-06			
K+	4.71E-08	4.53E-08	2.67E-08	1.52E-03	1.52E-03	1.52E-03			
Se+4	5.50E-11	5.29E-11	3.12E-11	1.19E-06	1.19E-06	1.19E-06			
Ag+	5.56E-10	4.16E-10	2.46E-10	1.57E-06	1.57E-06	1.57E-06			
Na+	4.45E-07	4.28E-07	2.52E-07	5.84E-02	5.84E-02	5.84E-02			
Tl+3	2.78E-12	2.67E-12	1.58E-12	1.32E-08	1.32E-08	1.32E-08			
U+4	2.48E-10	2.39E-10	1.41E-10	1.78E-06	1.78E-06	1.78E-06			
V+3	5.37E-12	5.17E-12	3.05E-12	1.82E-07	1.82E-07	1.82E-07			
Zn+2	1.63E-10	1.57E-10	3.84E-12	3.45E-06	3.44E-06	3.44E-06			
Zr+4	9.90E-09	9.53E-09	5.62E-09	1.86E-04	1.86E-04	1.86E-04			
Cl-	1.23E-07	1.18E-07	6.98E-08	2.31E-03	2.31E-03	2.31E-03	1.15E-08	1.15E-08	1.15E-08
F-	4.26E-07	4.10E-07	2.42E-07	1.86E-02	1.86E-02	1.86E-02	7.82E-07	7.79E-07	7.79E-07
SO4-2	1.32E-11	4.84E-07	2.85E-07	2.10E-02	2.10E-02	2.10E-02			
NO3-	6.47E-06	5.35E-09	3.16E-09	1.04E+00	1.04E+00	1.04E+00	1.16E-05	1.15E-05	1.15E-05
PO4-3	3.52E-08	3.39E-08	2.00E-08	6.13E-04	6.13E-04	6.13E-04			
Am+4	4.99E-14	4.80E-14	2.83E-14	1.99E-10	1.99E-10	1.99E-10			
Br-	3.35E-12	3.22E-12	1.90E-12	2.78E-08	2.78E-08	2.78E-08	3.13E-13	3.12E-13	3.12E-13
Ce+4	1.42E-11	1.37E-11	8.08E-12	9.84E-08	9.85E-08	9.85E-08			
Eu+3	2.23E-13	2.14E-13	1.26E-13	1.42E-09	1.42E-09	1.42E-09			
Gd+3	6.80E-11	6.54E-11	3.86E-11	4.19E-07	4.19E-07	4.19E-07			
Ge+4	1.79E-15	1.72E-15	1.02E-15	4.22E-11	4.22E-11	4.22E-11			
In+3	5.14E-13	4.94E-13	2.92E-13	4.34E-09	4.34E-09	4.34E-09			
I-	5.68E-11	5.46E-11	3.22E-11	2.97E-07	2.97E-07	2.97E-07	5.31E-12	5.29E-12	5.29E-12
La+3	3.69E-12	3.55E-12	2.09E-12	2.58E-08	2.58E-08	2.58E-08			

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
Li+	4.44E-11	3.33E-11	1.96E-11	1.95E-06	1.95E-06	1.95E-06			
Mg+2	1.38E-09	1.32E-09	3.23E-11	7.81E-05	7.81E-05	7.81E-05			
Mo+6	1.49E-08	1.43E-08	8.46E-09	2.88E-04	2.88E-04	2.88E-04			
Nd+3	1.24E-11	1.19E-11	7.02E-12	8.30E-08	8.31E-08	8.31E-08			
Np+4	1.86E-12	1.79E-12	1.05E-12	7.59E-09	7.60E-09	7.60E-09			
Nb+5	2.90E-10	2.79E-10	1.64E-10	5.38E-06	5.38E-06	5.38E-06			
Pd+4	5.77E-10	5.55E-10	1.35E-11	7.47E-06	7.47E-06	7.47E-06			
Pu+4	4.83E-12	4.65E-12	2.74E-12	3.39E-08	3.39E-08	3.39E-08			
Pr+4	3.41E-12	3.28E-12	1.93E-12	2.34E-08	2.34E-08	2.34E-08			
Pm+3	7.25E-16	6.98E-16	4.12E-16	4.85E-12	4.85E-12	4.85E-12			
Rh+4	1.07E-12	1.03E-12	6.09E-13	1.01E-08	1.01E-08	1.01E-08			
Rb+	6.32E-12	4.74E-12	2.80E-12	2.25E-08	2.26E-08	2.26E-08			
Ru+3	2.44E-10	2.35E-10	1.38E-10	2.34E-06	2.34E-06	2.34E-06			
Sm+3	2.40E-12	2.31E-12	1.36E-12	1.55E-08	1.55E-08	1.55E-08			
Si+4	1.01E-08	9.72E-09	5.73E-09	7.72E-04	7.72E-04	7.72E-04			
Sr+2	2.17E-11	2.09E-11	5.10E-13	3.42E-07	3.42E-07	3.42E-07			
Tc+7	9.38E-12	9.02E-12	5.32E-12	5.78E-08	5.78E-08	5.78E-08			
Te+4	1.31E-12	1.26E-12	7.46E-13	1.76E-08	1.76E-08	1.76E-08			
Tb+4	9.72E-16	9.36E-16	5.52E-16	5.93E-12	5.93E-12	5.93E-12			
Th+4	1.59E-11	1.53E-11	9.00E-12	1.17E-07	1.17E-07	1.17E-07			
Sn+4	6.11E-10	5.87E-10	3.46E-10	8.80E-06	8.80E-06	8.80E-06			
Ti+4	1.26E-10	1.21E-10	7.15E-11	4.50E-06	4.50E-06	4.50E-06			
Y+3	1.76E-12	1.69E-12	1.00E-12	1.92E-08	1.92E-08	1.92E-08			
OH-	3.07E-09	1.17E-07	2.08E-07	5.29E-07	5.30E-07	5.30E-07			
H2O	3.21E-02	3.32E-02	3.90E-02	5.23E+01	5.23E+01	5.23E+01	3.90E-02	3.88E-02	3.88E-02
SO2	2.37E-09	1.81E-05	1.07E-05	8.09E-06	8.10E-06	8.10E-06	1.07E-05	1.07E-05	1.07E-05
H2S	1.02E-05	2.47E-21							
CO	7.74E-04	1.60E-09	9.45E-10	2.02E-10	2.05E-10	2.05E-10	9.45E-10	9.42E-10	9.42E-10
CO2	7.43E-03	9.33E-03	5.50E-03	3.09E-04	3.18E-04	3.18E-04	5.51E-03	5.49E-03	5.49E-03
H2	2.04E-04	6.45E-10	3.80E-10	8.32E-10	1.35E-09	1.35E-09	2.05E-08		
N2	1.39E-02	1.34E-02	7.91E-03	1.21E-05	2.39E-05	2.39E-05	7.91E-03	7.88E-03	7.88E-03
NO	4.69E-05	5.10E-05	3.01E-05	2.30E-07	2.93E-07	2.93E-07	3.01E-05	3.00E-05	3.00E-05
NO2	4.87E-06	2.75E-07	1.62E-07	2.91E-06	2.89E-06	2.89E-06	1.62E-07	1.62E-07	1.62E-07
O2	4.33E-04	1.82E-03	1.07E-03	3.08E-06	4.83E-06	4.83E-06	1.07E-03	1.07E-03	1.07E-03
S (other)	2.18E-10	1.43E-25		1.08E-07	1.08E-07	1.08E-07			
CO3	1.87E-07	2.60E-11	6.82E-12	3.39E-05	3.39E-05	3.39E-05			
C (reductant)	3.29E-08	1.43E-18							
O (oxides)	6.31E-08	5.90E-08	3.48E-08	4.97E-03	4.97E-03	4.97E-03			
C (organic)	1.82E-05	1.99E-34							
H (organic)	6.07E-06	6.67E-35							
O (organic)	1.36E-07								
Mass Flow (kg/hr):	2.64E+03	2.89E+03	4.53E+03	3.97E+04	3.97E+04	8.00E-03	4.53E+03	4.53E+03	4.53E+03
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				2.88E-02	2.87E-02				

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
H-3	1.30E-06	1.25E-06	7.35E-07	1.08E-06	1.08E-06	1.08E-06	7.35E-07	7.32E-07	7.32E-07
C-14	1.63E-11	1.58E-11	9.33E-12	1.60E-15	1.64E-15	1.64E-15	9.33E-12	9.30E-12	9.30E-12
Co-60	4.35E-10	4.18E-10	2.47E-10	2.63E-08	2.63E-08	2.63E-08			
Ni-59	5.63E-11	5.42E-11	1.32E-12	4.85E-09	4.85E-09	4.85E-09			
Ni-63	2.13E-09	2.05E-09	5.00E-11	1.83E-07	1.83E-07	1.83E-07			
Se-79	2.72E-11	2.62E-11	1.54E-11	2.90E-09	2.90E-09	2.90E-09			
Sr-90	2.00E-06	1.93E-06	4.70E-08	1.72E-04	1.72E-04	1.72E-04			
Y-90	1.92E-06	1.85E-06	1.09E-06	1.16E-04	1.16E-04	1.16E-04			
Zr-93	1.07E-10	1.03E-10	6.10E-11	1.15E-08	1.15E-08	1.15E-08			
Nb-93m	8.28E-11	7.97E-11	4.70E-11	8.93E-09	8.93E-09	8.93E-09			
Nb-94	7.07E-11	6.81E-11	4.01E-11	7.63E-09	7.63E-09	7.63E-09			
Tc-99	3.12E-09	3.00E-09	1.77E-09	1.17E-07	1.18E-07	1.18E-07			
Ru-106	5.98E-11	5.76E-11	3.40E-11	3.62E-09	3.62E-09	3.62E-09			
Rh-102	4.31E-14	4.15E-14	2.44E-14	2.61E-12	2.61E-12	2.61E-12			
Rh-106	5.98E-11	5.76E-11	3.40E-11	3.62E-09	3.62E-09	3.62E-09			
Pd-107	8.59E-13	8.26E-13	2.02E-14	7.39E-11	7.39E-11	7.39E-11			
Cd-113m	1.89E-10	1.81E-10	1.07E-10	4.24E-09	4.25E-09	4.25E-09			
Sn-121m	3.24E-12	3.12E-12	1.84E-12	3.46E-10	3.46E-10	3.46E-10			
Sn-126	2.56E-11	2.46E-11	1.45E-11	2.73E-09	2.73E-09	2.73E-09			
Sb-125	1.81E-08	1.74E-08	1.03E-08	1.10E-06	1.10E-06	1.10E-06			
Sb-126	2.87E-12	2.77E-12	1.63E-12	1.74E-10	1.74E-10	1.74E-10			
Te-125m	1.53E-10	1.47E-10	8.67E-11	1.63E-08	1.63E-08	1.63E-08			
I-129	1.62E-10	1.56E-10	9.21E-11	6.73E-09	6.74E-09	6.74E-09	1.52E-11	1.51E-11	1.51E-11
Cs-134	4.10E-09	3.94E-09	2.33E-09	4.33E-05	4.33E-05	4.33E-05			
Cs-135	1.22E-10	1.18E-10	6.93E-11	1.29E-06	1.29E-06	1.29E-06			
Cs-137	2.52E-06	2.43E-06	1.43E-06	2.67E-02	2.67E-02	2.67E-02			
Ba-137m	1.09E-06	1.05E-06	2.57E-08	9.41E-05	9.41E-05	9.41E-05			
Ce-144	4.04E-11	3.89E-11	2.29E-11	2.44E-09	2.44E-09	2.44E-09			
Pr-144	4.04E-11	3.89E-11	2.29E-11	2.44E-09	2.44E-09	2.44E-09			
Pm-146	2.54E-12	2.45E-12	1.44E-12	1.54E-10	1.54E-10	1.54E-10			
Pm-147	1.09E-08	1.05E-08	6.19E-09	6.60E-07	6.60E-07	6.60E-07			
Sm-151	2.16E-08	2.08E-08	1.22E-08	1.30E-06	1.31E-06	1.31E-06			
Eu-152	1.43E-10	1.37E-10	8.09E-11	8.62E-09	8.62E-09	8.62E-09			
Eu-154	2.43E-09	2.33E-09	1.38E-09	1.47E-07	1.47E-07	1.47E-07			
Eu-155	2.10E-09	2.02E-09	1.19E-09	1.27E-07	1.27E-07	1.27E-07			
Th-230	4.97E-14	4.78E-14	2.82E-14	5.31E-12	5.31E-12	5.31E-12			
Pa-233	1.42E-10	1.37E-10	8.07E-11	1.52E-08	1.52E-08	1.52E-08			
U-232	1.17E-13	1.13E-13	6.64E-14	1.25E-11	1.25E-11	1.25E-11			
U-233	4.23E-15	4.07E-15	2.40E-15	4.52E-13	4.52E-13	4.52E-13			
U-234	5.22E-11	5.02E-11	2.96E-11	5.57E-09	5.57E-09	5.57E-09			
U-235	3.83E-12	3.69E-12	2.18E-12	4.10E-10	4.10E-10	4.10E-10			
U-236	2.25E-12	2.17E-12	1.28E-12	2.41E-10	2.41E-10	2.41E-10			
U-237	3.12E-13	3.00E-13	1.77E-13	3.33E-11	3.33E-11	3.33E-11			
U-238	6.83E-13	6.57E-13	3.88E-13	7.29E-11	7.29E-11	7.29E-11			
Np-237	2.10E-11	2.02E-11	1.19E-11	1.27E-09	1.27E-09	1.27E-09			
Pu-236	1.71E-13	1.64E-13	9.69E-14	1.82E-11	1.82E-11	1.82E-11			
Pu-238	3.91E-08	3.76E-08	2.22E-08	4.17E-06	4.17E-06	4.17E-06			
Pu-239	4.37E-09	4.21E-09	2.48E-09	4.67E-07	4.67E-07	4.67E-07			
Pu-240	6.36E-10	6.12E-10	3.61E-10	6.80E-08	6.80E-08	6.80E-08			
Pu-241	2.84E-08	2.74E-08	1.61E-08	3.04E-06	3.04E-06	3.04E-06			
Pu-242	4.98E-13	4.80E-13	2.83E-13	5.32E-11	5.32E-11	5.32E-11			
Pu-244	3.80E-20	3.66E-20	2.16E-20	4.06E-18	4.06E-18	4.06E-18			
Am-241	2.82E-09	2.72E-09	1.60E-09	1.71E-07	1.71E-07	1.71E-07			
Am-242m	7.80E-13	7.50E-13	4.43E-13	4.72E-11	4.72E-11	4.72E-11			

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	1.27E-12	1.22E-12	7.22E-13	7.70E-11	7.70E-11	7.70E-11			
Cm-242	1.64E-12	1.58E-12	9.30E-13	1.75E-10	1.75E-10	1.75E-10			
Cm-243	1.72E-12	1.65E-12	9.75E-13	1.84E-10	1.84E-10	1.84E-10			
Cm-244	6.01E-11	5.78E-11	3.41E-11	6.42E-09	6.42E-09	6.42E-09			
Cm-245	1.81E-14	1.74E-14	1.03E-14	1.93E-12	1.93E-12	1.93E-12			
Cm-246	1.19E-15	1.14E-15	6.74E-16	1.27E-13	1.27E-13	1.27E-13			
TRU	4.78E-08	4.60E-08	2.71E-08	4.98E-06	4.98E-06	4.98E-06			
TRU, nCi/gm									
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	68.72%	71.11%	83.02%				83.01%	83.01%	83.01%
O2, mol %	0.52%	2.19%	1.29%				1.29%	1.29%	1.29%
N2, mol %	19.15%	18.45%	10.84%				10.84%	10.84%	10.84%
H2, mol %	3.90%	0.00001%	0.00001%				0.0004%		0.00%
CO2, mol %	6.50%	8.17%	4.80%				4.80%	4.80%	4.80%
CO, ppmv	1.07E+04	2.20E-02	1.30E-02				1.30E-02	1.30E-02	1.30E-02
NO, ppmv	6.03E+02	6.55E+02	3.85E+02				3.85E+02	3.85E+02	3.85E+02
NO2, ppmv	4.08E+01	2.31E+00	1.36E+00				1.35E+00	1.36E+00	1.36E+00
SO2, ppmv	1.42E-02	1.09E+02	6.40E+01				6.41E+01	6.41E+01	6.41E+01
Cl, ppmv	1.34E+00	1.29E+00	7.56E-01				1.25E-01	1.25E-01	1.25E-01
F, ppmv	8.64E+00	8.31E+00	4.88E+00				1.58E+01	1.58E+01	1.58E+01
C (organic), ppmv	5.83E+02	6.38E-27							
H (organic), ppmv	2.32E+03	2.55E-26							
Hg, ug/wscm	1.29E+05	1.24E+05	7.33E+04					4.09E+04	4.09E+04
PM, mg/wscm	5.36E+02	1.49E+02	9.48E+01				1.20E+01	5.28E+01	5.28E+01
SVM, ug/wscm	4.15E+01	4.00E+01	2.36E+01						
LVM, ug/wscm	1.31E+01	1.26E+01	7.44E+00						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	1.67%	7.57%	7.57%				7.57%	7.57%	7.57%
N2, mol %, dry basis	61.23%	63.86%	63.86%				63.84%	63.84%	63.84%
H2, mol %, dry basis	12.47%	0.00004%	0.00004%				0.00230%		0.00%
CO2, mol %, dry basis	20.78%	28.29%	28.29%				28.28%	28.28%	28.28%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis	4.77E+03	1.07E-02	1.07E-02				1.07E-02	1.07E-02	1.07E-02
NO, ppmv, dry basis	2.70E+02	3.18E+02	3.18E+02				3.18E+02	3.18E+02	3.18E+02
NO2, ppmv, dry basis	1.83E+01	1.12E+00	1.12E+00				1.12E+00	1.12E+00	1.12E+00
SO2, ppmv, dry basis	6.37E-03	5.28E+01	5.28E+01				5.28E+01	5.28E+01	5.28E+01
Cl, ppmv, dry basis	5.99E-01	6.24E-01	6.24E-01				1.03E-01	1.03E-01	1.03E-01
F, ppmv, dry basis	3.87E+00	4.03E+00	4.03E+00				1.30E+01	1.30E+01	1.30E+01
C (organic), ppmv, dry basis	2.61E+02								
H (organic), ppmv, dry basis	1.04E+03								
Hg, ug/dscm	5.79E+04	6.03E+04	6.05E+04					3.37E+04	3.37E+04
PM, mg/dscm	2.40E+02	7.22E+01	7.83E+01				9.89E+00	4.35E+01	4.35E+01
SVM, ug/dscm	1.40E+02	1.34E+02	7.93E+01						
LVM, ug/dscm	4.42E+01	4.25E+01	2.50E+01						

Table A-15. Mass balance, Tank WM-188 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3
WM-188, Stream #	117	118	119	120	201	202	203	204
Stream Name	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-Gas to Blower	Spent GAC	Boiler Feed Water	Fuel Oil to Boiler	Steam To Reformer	Propane to Oxidizer
Rate or Volume	1.35E+04	6.18E+05	6.53E+05	6.01E+00	3.24E+02	4.28E+01	6.48E+04	1.08E+02
Volume Flow (standard, wet)*	1.33E+04	1.87E+05	2.00E+05				5.80E+04	3.07E+02
Volume Flow (standard, dry)*	1.33E+04	3.18E+04	4.50E+04					3.07E+02
Rate Units	ft3/hr	ft3/hr	ft3/hr	lb/hr	gal/hr	gal/hr	ft3/hr	ft3/hr
Rate or Volume, metric	3.77E+02	5.30E+03	5.67E+03	2.73E+00	1.23E+03	1.62E+02	1.64E+03	8.68E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	kg/hr	L/hr	L/hr	wscm/hr	wscm/hr
Temperature, °C	25	120	115	28	15	15	670	25
Temperature, °F	77	248	239	82	59	59	1238	77
Pressure, psia	14.7	6.0	6.0	14.7	42.3	14.7	42.3	42.3
Specific Gravity	1.18E-03	2.58E-04	2.69E-04	5.86E-01	1.00E+00	7.70E-01	6.70E-04	5.19E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
H+		2.28E-07	2.14E-07	9.14E-06		2.40E-01		
Al+3								
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2								
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3								
Pb+2								
Hg+2		2.55E-09	2.38E-09	7.93E-02				
Mn+4								
Ni+2								
K+								
Se+4								
Ag+								
Na+								
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-		1.15E-09	1.07E-09	3.21E-04				
F-		7.79E-07	7.28E-07					
SO4-2								
NO3-		1.15E-05	1.08E-05					
PO4-3								
Am+4								
Br-		3.12E-14	2.92E-14	8.74E-09				
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-		5.29E-13	4.95E-13	1.48E-07				
La+3								

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4								
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-								
H2O	4.68E-06	3.88E-02	3.63E-02		5.56E+01		4.68E-02	
SO2		1.07E-05	9.96E-06					
H2S						1.20E-01		
CO		9.42E-10	8.81E-10					
CO2		5.49E-03	5.13E-03					
H2								
N2	5.75E-02	7.88E-03	1.12E-02					
NO		3.00E-05	2.81E-05					
NO2		1.62E-07	1.51E-07					
O2	1.74E-02	1.07E-03	2.16E-03					
S (other)								
CO3								
C (reductant)				9.20E-01				
O (oxides)								
C (organic)						5.41E+01		9.35E-02
H (organic)						1.15E+02		2.09E-02
O (organic)								
Mass Flow (kg/hr):	4.53E+02	4.53E+03	4.98E+03	2.73E+00	1.23E+03	1.25E+02	1.23E+03	1.59E+01
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				6.13E-11				

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
H-3		7.32E-07	6.85E-07					
C-14		9.30E-12	8.70E-12	3.57E-10				
Co-60								
Ni-59								
Ni-63								
Se-79								
Sr-90								
Y-90								
Zr-93								
Nb-93m								
Nb-94								
Tc-99								
Ru-106								
Rh-102								
Rh-106								
Pd-107								
Cd-113m								
Sn-121m								
Sn-126								
Sb-125								
Sb-126								
Te-125m								
I-129		1.51E-12	1.42E-12	2.65E-08				
Cs-134								
Cs-135								
Cs-137								
Ba-137m								
Ce-144								
Pr-144								
Pm-146								
Pm-147								
Sm-151								
Eu-152								
Eu-154								
Eu-155								
Th-230								
Pa-233								
U-232								
U-233								
U-234								
U-235								
U-236								
U-237								
U-238								
Np-237								
Pu-236								
Pu-238								
Pu-239								
Pu-240								
Pu-241								
Pu-242								
Pu-244								
Am-241								
Am-242m								

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	117	118	119	120	201	202	203	204
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
Am-243								
Cm-242								
Cm-243								
Cm-244								
Cm-245								
Cm-246								
TRU								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	0.01%	83.01%	77.50%				100.00%	
O2, mol %	20.99%	1.29%	2.60%					
N2, mol %	79.00%	10.84%	15.37%					
H2, mol %								
CO2, mol %		4.80%	4.48%					
CO, ppmv		1.30E-02	1.21E-02					
NO, ppmv		3.85E+02	3.60E+02					
NO2, ppmv		1.36E+00	1.26E+00					
SO2, ppmv		6.41E+01	5.98E+01					
Cl, ppmv		1.25E-02	1.16E-02					
F, ppmv		1.58E+01	1.47E+01					
C (organic), ppmv								3.00E+06
H (organic), ppmv								8.00E+06
Hg, ug/wscm		4.09E+01	3.82E+01					
PM, mg/wscm	1.60E+01	1.20E+01	1.21E+01				1.16E+01	1.83E+06
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	20.9921%	1.0604%	11.5328%					
N2, mol %, dry basis	79.01%	63.84%	68.32%					
H2, mol %, dry basis								
CO2, mol %, dry basis		28.28%	19.93%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis		1.07E-02	7.53E-03					
NO, ppmv, dry basis		3.18E+02	2.24E+02					
NO2, ppmv, dry basis		1.12E+00	7.88E-01					
SO2, ppmv, dry basis		5.28E+01	3.73E+01					
Cl, ppmv, dry basis		1.03E-02	7.25E-03					
F, ppmv, dry basis		1.30E+01	9.18E+00					
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm		3.37E+01	2.38E+01					
PM, mg/dscm	2.24E+00	9.88E+00	7.54E+00					
SVM, ug/dscm								
LVM, ug/dscm								

Table A-15. Mass balance, Tank WM-188 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-2	PFD-3
WM-188, Stream #	205	206	207	301	302	303	304	305
Stream Name	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 Scrub Makeup	Sugar to Feed	Carbon to Reformer	NOx Catalyst	Bed Media	Grout Mix for Scrub Blowdown
Rate or Volume	4.34E+02	3.52E-08	8.08E-01	3.25E+02	1.43E+02	2.20E-05	1.47E+00	6.61E+00
Volume Flow (standard, wet)*								
Volume Flow (standard, dry)*								
Rate Units	gal/hr	gal/hr	gal/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	1.64E+03	1.33E-07	3.06E+00	1.47E+02	6.48E+01	1.00E-05	6.68E-01	3.00E+00
Rate Units	L/hr	L/hr	L/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	25	25	25	15	15	15	15	25
Temperature, °F	77	77	77	59	59	59	59	77
Pressure, psia	112.3	14.7	42.3	14.7	14.7	14.7	14.7	14.7
Specific Gravity	9.97E-01	1.35E+00	1.28E+00	7.50E-01	5.00E-01	2.58E+00	1.58E+00	2.01E-01
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	1.00E-07	3.09E-08	1.39E+01					
Al+3		2.20E+00			1.53E-03		5.29E-01	
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2					1.85E-02			
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3					8.71E-04	6.99E-01		
Pb+2								
Hg+2					1.92E-06			
Mn+4								
Ni+2								
K+					7.14E-03			
Se+4								
Ag+								
Na+					7.42E-04			
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-								
F-								
SO4-2								
NO3-		6.60E+00	1.39E+01					
PO4-3					2.26E-03			
Am+4								
Br-								
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-								
La+3								

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	205	206	207	301	302	303	304	305
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4					6.26E-03			4.67E-01
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-	1.00E-07	3.09E-08						
H2O	5.54E+01	4.89E+01	2.27E+01					
SO2								
H2S								
CO								
CO2								
H2								
N2								
NO								
NO2								
O2								
S (other)					5.18E-04			
CO3					3.11E-02			
C (reductant)					9.22E-01			
O (oxides)					8.88E-03	3.01E-01	4.71E-01	5.33E-01
C (organic)				4.21E-01				
H (organic)				6.48E-02				
O (organic)				5.14E-01				
Mass Flow (kg/hr):	1.64E+03	1.80E-07	3.93E+00	1.47E+02	6.48E+01	1.00E-05	6.68E-01	3.00E+00

Table A-15. Mass balance, Tank WM-188 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3	PFD-2
WM-188, Stream #	401	402	404	404	503	504	505	506
Stream Name	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Reformer	Oxygen to Oxidizer	Air to Boiler
Rate or Volume	5.55E+00	2.60E-01	8.82E+00	2.29E-01	2.66E+03	6.54E+02	9.95E+02	6.35E+04
Volume Flow (standard, wet)*					1.67E+04	4.04E+03	6.15E+03	6.46E+04
Volume Flow (standard, dry)*					1.67E+04	4.04E+03	6.15E+03	6.46E+04
Rate Units	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.10E+01	9.86E-01	4.00E+00	4.00E+00	4.72E+02	1.14E+02	1.74E+02	1.83E+03
Rate Units	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	79	79	60	60	21	25	25	15
Temperature, °F	174	174	140	140	70	77	77	59
Pressure, psia	12.3	12.3	12.3	12.3	92.3	92.3	92.3	14.7
Specific Gravity	1.01E+00	1.01E+00	2.10E+00	2.10E+00	7.29E-03	8.21E-03	8.21E-03	1.22E-03
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
H+	1.03E+00	1.03E+00	2.57E-04	2.57E-04				
Al+3	1.65E-03	1.65E-03	1.10E-05	1.10E-05				
Sb+5	4.71E-08	4.71E-08	1.41E-09	1.41E-09				
As+3	2.63E-07	2.63E-07	4.85E-09	4.85E-09				
Ba+2	3.18E-07	3.18E-07	1.08E-08	1.08E-08				
Be+2	8.04E-08	8.04E-08	1.79E-10	1.79E-10				
B+3	4.71E-05	4.71E-05	1.25E-07	1.25E-07				
Cd+2	3.03E-06	3.03E-06	8.39E-08	8.39E-08				
Ca+2	6.06E-04	6.06E-04	5.98E-06	5.98E-06				
Cr+3	8.30E-06	8.30E-06	1.06E-07	1.06E-07				
Co+2	1.17E-07	1.17E-07	1.70E-09	1.70E-09				
Cs+	6.79E-05	6.79E-05	2.47E-06	2.47E-06				
Cu+2	2.98E-06	2.98E-06	4.66E-08	4.66E-08				
Fe+3	1.00E-04	1.00E-04	1.38E-06	1.38E-06				
Pb+2	5.52E-06	5.52E-06	2.82E-07	2.82E-07				
Hg+2	1.12E-02	1.12E-02	5.53E-04	5.53E-04				
Mn+4	4.30E-05	4.30E-05	5.82E-07	5.82E-07				
Ni+2	7.79E-06	7.79E-06	1.13E-07	1.13E-07				
K+	1.52E-03	1.52E-03	1.46E-05	1.46E-05				
Se+4	1.19E-06	1.19E-06	2.32E-08	2.32E-08				
Ag+	1.57E-06	1.57E-06	4.17E-08	4.17E-08				
Na+	5.84E-02	5.84E-02	3.31E-04	3.31E-04				
Tl+3	1.32E-08	1.32E-08	6.63E-10	6.63E-10				
U+4	1.78E-06	1.78E-06	1.05E-07	1.05E-07				
V+3	1.82E-07	1.82E-07	2.29E-09	2.29E-09				
Zn+2	3.45E-06	3.45E-06	5.56E-08	5.56E-08				
Zr+4	1.86E-04	1.86E-04	4.17E-06	4.17E-06				
Cl-	2.31E-03	2.31E-03	2.01E-05	2.01E-05				
F-	1.86E-02	1.86E-02	8.72E-05	8.72E-05				
SO4-2	2.10E-02	2.10E-02	4.96E-04	4.96E-04				
NO3-	1.04E+00	1.04E+00	1.58E-02	1.58E-02				
PO4-3	6.13E-04	6.13E-04	1.44E-05	1.44E-05				
Am+4	1.99E-10	1.99E-10	1.19E-11	1.19E-11				
Br-	2.78E-08	2.78E-08	5.48E-10	5.48E-10				
Ce+4	9.84E-08	9.84E-08	3.40E-09	3.40E-09				
Eu+3	1.42E-09	1.42E-09	5.31E-11	5.31E-11				
Gd+3	4.19E-07	4.19E-07	1.62E-08	1.62E-08				
Ge+4	4.22E-11	4.22E-11	7.56E-13	7.56E-13				
In+3	4.34E-09	4.34E-09	1.23E-10	1.23E-10				
I-	2.97E-07	2.97E-07	9.30E-09	9.30E-09				
La+3	2.58E-08	2.58E-08	8.82E-10	8.82E-10				

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
Li+	1.95E-06	1.95E-06	3.33E-09	3.33E-09				
Mg+2	7.81E-05	7.81E-05	4.68E-07	4.68E-07				
Mo+6	2.88E-04	2.88E-04	6.80E-06	6.80E-06				
Nd+3	8.30E-08	8.30E-08	2.95E-09	2.95E-09				
Np+4	7.59E-09	7.59E-09	4.43E-10	4.43E-10				
Nb+5	5.38E-06	5.38E-06	1.23E-07	1.23E-07				
Pd+4	7.47E-06	7.47E-06	1.96E-07	1.96E-07				
Pu+4	3.39E-08	3.39E-08	2.04E-09	2.04E-09				
Pr+4	2.34E-08	2.34E-08	8.13E-10	8.13E-10				
Pm+3	4.85E-12	4.85E-12	1.73E-13	1.73E-13				
Rh+4	1.01E-08	1.01E-08	2.56E-10	2.56E-10				
Rb+	2.25E-08	2.25E-08	4.74E-10	4.74E-10				
Ru+3	2.34E-06	2.34E-06	5.82E-08	5.82E-08				
Sm+3	1.55E-08	1.55E-08	5.73E-10	5.73E-10				
Si+4	7.72E-04	7.72E-04	3.51E-01	3.51E-01				
Sr+2	3.42E-07	3.42E-07	7.38E-09	7.38E-09				
Tc+7	5.78E-08	5.78E-08	1.39E-09	1.39E-09				
Te+4	1.76E-08	1.76E-08	5.54E-10	5.54E-10				
Tb+4	5.93E-12	5.93E-12	2.32E-13	2.32E-13				
Th+4	1.17E-07	1.17E-07	6.69E-09	6.69E-09				
Sn+4	8.80E-06	8.80E-06	2.57E-07	2.57E-07				
Ti+4	4.50E-06	4.50E-06	5.31E-08	5.31E-08				
Y+3	1.92E-08	1.92E-08	4.21E-10	4.21E-10				
OH-	1.35E-02	1.35E-02	5.65E-05	5.65E-05				
H2O	5.23E+01	5.23E+01	2.32E-01	2.32E-01				4.68E-06
SO2	8.09E-06	8.09E-06	1.28E-07	1.28E-07				
H2S								
CO	2.02E-10	2.02E-10	1.40E-12	1.40E-12				
CO2	3.09E-04	3.09E-04	3.35E-06	3.35E-06				
H2	8.32E-10	8.32E-10	4.13E-13	4.13E-13				
N2	1.21E-05	1.21E-05	8.38E-08	8.38E-08	7.27E-02			5.74E-02
NO	2.30E-07	2.30E-07	1.70E-09	1.70E-09				
NO2	2.91E-06	2.91E-06	3.30E-08	3.30E-08				
O2	3.08E-06	3.08E-06	2.43E-08	2.43E-08		8.30E-02	8.30E-02	1.74E-02
S (other)	1.08E-07	1.08E-07	8.52E-10	8.52E-10				
CO3	3.39E-05	3.39E-05	5.02E-07	5.02E-07				
C (reductant)								
O (oxides)	4.97E-03	4.97E-03	3.99E-01	3.99E-01				
C (organic)								
H (organic)								
O (organic)								
Mass Flow (kg/hr):	2.13E+01	1.00E+00	4.00E+00	4.00E+00	5.50E+02	1.52E+02	2.31E+02	2.19E+03
Total Drums Generated				32				
	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3	2.88E-02	2.88E-02	1.64E-02	3.29E-03				

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Radiological Composition	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
H-3								
C-14	1.60E-15	1.60E-15	3.94E-16	1.65E-13				
Co-60	2.63E-08	2.63E-08	6.48E-09	2.72E-06				
Ni-59	4.85E-09	4.85E-09	1.19E-09	5.02E-07				
Ni-63	1.83E-07	1.83E-07	4.51E-08	1.90E-05				
Se-79	2.90E-09	2.90E-09	7.16E-10	3.01E-07				
Sr-90	1.72E-04	1.72E-04	4.25E-05	1.78E-02				
Y-90	1.16E-04	1.16E-04	2.87E-05	1.20E-02				
Zr-93	1.15E-08	1.15E-08	2.83E-09	1.19E-06				
Nb-93m	8.93E-09	8.93E-09	2.20E-09	9.24E-07				
Nb-94	7.63E-09	7.63E-09	1.88E-09	7.89E-07				
Tc-99	1.17E-07	1.17E-07	2.89E-08	1.22E-05				
Ru-106	3.62E-09	3.62E-09	8.92E-10	3.75E-07				
Rh-102	2.61E-12	2.61E-12	6.42E-13	2.70E-10				
Rh-106	3.62E-09	3.62E-09	8.92E-10	3.75E-07				
Pd-107	7.39E-11	7.39E-11	1.82E-11	7.65E-09				
Cd-113m	4.24E-09	4.24E-09	1.04E-09	4.39E-07				
Sn-121m	3.46E-10	3.46E-10	8.54E-11	3.59E-08				
Sn-126	2.73E-09	2.73E-09	6.74E-10	2.83E-07				
Sb-125	1.10E-06	1.10E-06	2.70E-07	1.13E-04				
Sb-126	1.74E-10	1.74E-10	4.28E-11	1.80E-08				
Te-125m	1.63E-08	1.63E-08	4.02E-09	1.69E-06				
I-129	6.73E-09	6.73E-09	1.66E-09	6.97E-07				
Cs-134	4.33E-05	4.33E-05	1.19E-05	4.98E-03				
Cs-135	1.29E-06	1.29E-06	3.53E-07	1.48E-04				
Cs-137	2.67E-02	2.67E-02	7.30E-03	3.06E+00				
Ba-137m	9.41E-05	9.41E-05	2.32E-05	9.74E-03				
Ce-144	2.44E-09	2.44E-09	6.02E-10	2.53E-07				
Pr-144	2.44E-09	2.44E-09	6.02E-10	2.53E-07				
Pm-146	1.54E-10	1.54E-10	3.79E-11	1.59E-08				
Pm-147	6.60E-07	6.60E-07	1.63E-07	6.83E-05				
Sm-151	1.30E-06	1.30E-06	3.21E-07	1.35E-04				
Eu-152	8.62E-09	8.62E-09	2.12E-09	8.92E-07				
Eu-154	1.47E-07	1.47E-07	3.62E-08	1.52E-05				
Eu-155	1.27E-07	1.27E-07	3.13E-08	1.32E-05				
Th-230	5.31E-12	5.31E-12	1.31E-12	5.49E-10				
Pa-233	1.52E-08	1.52E-08	3.74E-09	1.57E-06				
U-232	1.25E-11	1.25E-11	3.08E-12	1.29E-09				
U-233	4.52E-13	4.52E-13	1.11E-13	4.68E-11				
U-234	5.57E-09	5.57E-09	1.37E-09	5.77E-07				
U-235	4.10E-10	4.10E-10	1.01E-10	4.24E-08				
U-236	2.41E-10	2.41E-10	5.93E-11	2.49E-08				
U-237	3.33E-11	3.33E-11	8.22E-12	3.45E-09				
U-238	7.29E-11	7.29E-11	1.80E-11	7.55E-09				
Np-237	1.27E-09	1.27E-09	3.13E-10	1.31E-07				
Pu-236	1.82E-11	1.82E-11	4.50E-12	1.89E-09				
Pu-238	4.17E-06	4.17E-06	1.03E-06	4.32E-04				
Pu-239	4.67E-07	4.67E-07	1.15E-07	4.83E-05				
Pu-240	6.80E-08	6.80E-08	1.67E-08	7.03E-06				
Pu-241	3.04E-06	3.04E-06	7.48E-07	3.14E-04				
Pu-242	5.32E-11	5.32E-11	1.31E-11	5.51E-09				
Pu-244	4.06E-18	4.06E-18	1.00E-18	4.20E-16				
Am-241	1.71E-07	1.71E-07	4.21E-08	1.77E-05				
Am-242m	4.72E-11	4.72E-11	1.16E-11	4.88E-09				

Table A-15. Mass balance, Tank WM-188 waste (continued).

Stream #	401	402	404	404	503	504	505	506
	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	7.70E-11	7.70E-11	1.90E-11	7.97E-09				
Cm-242	1.75E-10	1.75E-10	4.31E-11	1.81E-08				
Cm-243	1.84E-10	1.84E-10	4.52E-11	1.90E-08				
Cm-244	6.42E-09	6.42E-09	1.58E-09	6.64E-07				
Cm-245	1.93E-12	1.93E-12	4.76E-13	2.00E-10				
Cm-246	1.27E-13	1.27E-13	3.13E-14	1.31E-11				
TRU	4.98E-06	4.98E-06	1.23E-06	5.15E-04				
TRU, nCi/gm								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %								0.01%
O2, mol %						100.00%	100.00%	20.99%
N2, mol %					100.00%			79.00%
H2, mol %								
CO2, mol %								
CO, ppmv								
NO, ppmv								
NO2, ppmv								
SO2, ppmv								
Cl, ppmv								
F, ppmv								
C (organic), ppmv								
H (organic), ppmv								
Hg, ug/wscm								
PM, mg/wscm					1.99E+01	3.46E-01	2.76E-01	1.60E+01
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis								20.99%
N2, mol %, dry basis								79.01%
H2, mol %, dry basis								
CO2, mol %, dry basis								
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis								
NO, ppmv, dry basis								
NO2, ppmv, dry basis								
SO2, ppmv, dry basis								
Cl, ppmv, dry basis								
F, ppmv, dry basis								
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm								
PM, mg/dscm								2.24E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-15. Mass balance, Tank WM-188 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-188, Stream #	507	510	511	512	513	514	515	516
Stream Name	Off-Gas from Boiler	Nitrogen to Cool Product	N2 from Product Cooler	Filter Backpulse N2	Solids Transport Nitrogen	Tank Farm Transfer Airlift Air	Ventilation Air	Fresh GAC
Rate or Volume	1.34E+05	2.65E+02	8.40E+02	2.73E+02	6.78E+01	1.44E+01	2.89E+01	5.53E+00
Volume Flow (standard, wet)*	6.86E+04	1.79E+03	1.79E+03	8.01E+02	1.99E+02	4.22E+01	2.94E+01	
Volume Flow (standard, dry)*	6.07E+04	1.79E+03	1.79E+03	8.01E+02	1.99E+02	4.22E+01	2.94E+01	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	1.94E+03	5.06E+01	5.06E+01	2.27E+01	5.62E+00	1.19E+00	8.34E-01	2.51E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	300	0	591	15	15	15	15	25
Temperature, °F	572	32	1096	59	59	59	59	77
Pressure, psia	14.7	92.3	92.3	42.3	42.3	42.3	14.7	14.7
Specific Gravity	6.10E-04	7.85E-03	2.48E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01
Gas Stream Bulk Composition (Wet Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Wt %
H2O	11.53%					0.01%	0.01%	
O2	3.00%					20.99%	20.99%	
N2	74.11%	100.00%	100.00%	100.00%	100.00%	79.00%	79.00%	
H2	0.05%							
CO2	10.64%							
	ppmv							
CO	2.21E+03							
NO	4.30E+03							
NO2	1.97E+00							
SO2	2.40E+02							
C(organic)	4.39E-14							
H(organic)	1.76E-13							
Gas Stream Bulk Composition (Dry Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	
O2	3.39%					20.99%	20.99%	
N2	83.77%					79.01%	79.01%	
H2	0.05%							
CO2	12.03%							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)								
	ppmv							
CO	3.51E+02							
NO	6.80E+02							
NO2	3.12E-01							
SO2	3.80E+01							
C(organic)	6.96E-15							
H(organic)	2.78E-14							
PM, mg/dscm	2.51E+00					2.18E+00	2.20E+00	
Hg, ug/dscm								
GAC								100%

Table A-16. Mass balance, Tank WM-189 waste.

PFD #	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
WM-189, Stream #	101	102	103	104	105	106	107	108	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Cyclone Drain	Filter Drain	Bed Drain	Cooled Product	Product Shipping Canisters
Rate or Volume	9.74E+01	1.37E+02	4.90E+05	4.42E+05	1.21E+02	7.36E+01	1.01E+02	1.75E+02	1.79E+00
Volume Flow (standard, wet			1.10E+05	1.12E+05					
Volume Flow (standard, dry			3.39E+04	3.60E+04					
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr	lb/hr	can's/day
Rate or Volume, metric	369	520	3.12E+03	3.18E+03	55	33.4	46.0	79.4	79.4
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	19	670	530	670	530	670	57	57
Temperature, °F	59	66	1238	986	1238	986	1238	134	134
Pressure, psia	14.7	44.7	10.6	10.2	10.6	9.5	10.8	9.5	9.5
Specific Gravity	1.28	1.28	2.00E-04	2.28E-04	0.24	1.15	1.46	1.33	1.33
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	2.80E+00	2.03E+00	1.35E-06	1.33E-06	5.60E-06	1.13E-05	1.70E-05	1.46E-05	1.46E-05
Al+3	5.52E-01	3.92E-01	3.54E-05	3.47E-05	3.53E-02	5.28E-02	9.28E-02	7.60E-02	7.60E-02
Sb+5	1.64E-05	1.17E-05	4.32E-09	4.24E-09	4.31E-06	6.45E-06	1.13E-05	9.28E-06	9.28E-06
As+3	8.19E-05	5.81E-05	1.33E-08	1.30E-08	1.32E-05	1.98E-05	3.48E-05	2.85E-05	2.85E-05
Ba+2	6.23E-05	4.42E-05	1.93E-08	1.89E-08	1.50E-05	2.87E-05	4.76E-05	3.97E-05	3.97E-05
Be+2	2.02E-05	1.44E-05	4.11E-10	4.03E-10	3.20E-07	6.13E-07	1.02E-06	8.47E-07	8.47E-07
B+3	1.66E-02	1.18E-02	3.88E-07	3.81E-07	3.88E-04	5.79E-04	1.02E-03	8.33E-04	8.33E-04
Cd+2	2.96E-03	2.10E-03	8.20E-07	8.05E-07	7.46E-04	1.22E-03	1.78E-03	1.55E-03	1.55E-03
Ca+2	5.57E-02	3.95E-02	1.35E-05	1.33E-05	1.05E-02	2.02E-02	3.35E-02	2.79E-02	2.79E-02
Cr+3	4.67E-03	3.31E-03	5.82E-07	5.71E-07	3.75E-04	8.69E-04	1.31E-03	1.13E-03	1.13E-03
Co+2	3.88E-05	2.76E-05	4.95E-09	4.85E-09	4.94E-06	7.38E-06	1.30E-05	1.06E-05	1.06E-05
Cs+	5.54E-05	4.17E-05	5.37E-08	5.27E-08	7.03E-05	8.02E-05	4.39E-06	4.06E-05	4.06E-05
Cu+2	7.99E-04	5.67E-04	1.14E-07	1.12E-07	8.91E-05	1.71E-04	2.83E-04	2.36E-04	2.36E-04
Fe+3	2.70E-02	1.91E-02	2.36E-06	2.32E-06	1.65E-03	3.53E-03	1.09E-02	7.81E-03	7.81E-03
Pb+2	9.05E-04	6.42E-04	1.32E-06	1.30E-06	3.65E-04	1.98E-03	6.63E-05	8.69E-04	8.69E-04
Hg+2	4.94E-03	4.14E-03	8.65E-06	8.49E-06	6.37E-06	1.54E-05		6.47E-06	6.47E-06
Mn+4	1.50E-02	1.06E-02	1.78E-06	1.74E-06	1.77E-03	2.65E-03	4.66E-03	3.81E-03	3.81E-03
Ni+2	1.89E-03	1.34E-03	2.50E-07	2.46E-07	1.95E-04	3.74E-04	6.19E-04	5.16E-04	5.16E-04
K+	1.84E-01	1.30E-01	3.32E-05	3.25E-05	3.66E-02	4.95E-02	3.32E-02	4.01E-02	4.01E-02
Se+4	2.35E-04	1.67E-04	3.90E-08	3.83E-08	3.80E-05	5.82E-05	1.06E-04	8.61E-05	8.61E-05
Ag+	3.68E-04	2.61E-04	9.99E-08	9.80E-08	7.28E-05	1.49E-04	2.10E-04	1.84E-04	1.84E-04
Na+	1.55E+00	1.10E+00	8.99E-05	8.82E-05	6.56E-02	1.34E-01	1.89E-01	1.66E-01	1.66E-01
Tl+3	4.32E-06	3.07E-06	1.91E-09	1.87E-09	1.91E-06	2.85E-06	5.01E-06	4.10E-06	4.10E-06
U+4	5.11E-04	3.63E-04	2.56E-07	2.51E-07	2.49E-04	3.82E-04	6.97E-04	5.65E-04	5.65E-04
V+3	2.87E-05	2.04E-05	3.08E-09	3.02E-09	3.00E-06	4.59E-06	8.38E-06	6.79E-06	6.79E-06
Zn+2	8.56E-04	6.08E-04	1.26E-07	1.24E-07	9.82E-05	1.88E-04	3.12E-04	2.60E-04	2.60E-04
Zr+4	3.53E-02	2.50E-02	6.77E-06	6.64E-06	6.60E-03	1.01E-02	1.85E-02	1.49E-02	1.49E-02
Cl-	1.86E-02	1.33E-02	3.63E-06	3.56E-06	2.99E-03	5.26E-03	1.39E-03	3.02E-03	3.02E-03
F-	3.02E-02	2.18E-02	3.86E-06	3.79E-06	1.92E-03	5.19E-03	4.79E-04	2.46E-03	2.46E-03
SO4-2	8.25E-02	5.93E-02	2.40E-08	2.36E-08	1.10E-05	3.59E-05	2.70E-05	3.07E-05	3.07E-05
NO3-	5.96E+00	4.27E+00	9.43E-06	9.25E-06	2.13E-03	4.77E-03	5.33E-03	5.10E-03	5.10E-03
PO4-3	9.76E-02	6.93E-02	2.53E-05	2.48E-05	4.17E-02	3.77E-02	5.06E-02	4.52E-02	4.52E-02
Am+4	5.93E-08	4.21E-08	3.11E-11	3.05E-11	3.11E-08	4.65E-08	8.17E-08	6.69E-08	6.69E-08
Br-	2.46E-07	1.76E-07	1.08E-10	1.06E-10	8.94E-08	1.57E-07	4.15E-08	9.01E-08	9.01E-08
Ce+4	3.60E-05	2.55E-05	1.09E-08	1.07E-08	1.09E-05	1.62E-05	2.85E-05	2.34E-05	2.34E-05
Eu+3	4.09E-07	2.90E-07	1.34E-10	1.32E-10	1.34E-07	2.01E-07	3.52E-07	2.89E-07	2.89E-07
Gd+3	1.23E-04	8.72E-05	4.17E-08	4.09E-08	4.17E-05	6.23E-05	1.09E-04	8.96E-05	8.96E-05
Ge+4	7.11E-09	5.04E-09	1.08E-12	1.06E-12	1.06E-09	1.62E-09	2.96E-09	2.39E-09	2.39E-09
In+3	1.14E-06	8.09E-07	2.83E-10	2.77E-10	2.82E-07	4.22E-07	7.42E-07	6.07E-07	6.07E-07
I-	2.74E-06	1.96E-06	1.91E-09	1.88E-09	1.58E-06	2.77E-06	7.33E-07	1.59E-06	1.59E-06
La+3	7.42E-06	5.27E-06	2.23E-09	2.19E-09	2.23E-06	3.33E-06	5.84E-06	4.79E-06	4.79E-06

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+	4.92E-04	3.49E-04	8.60E-09	8.44E-09	6.27E-06	1.28E-05	1.81E-05	1.59E-05	1.59E-05
Mg+2	1.76E-02	1.25E-02	9.63E-07	9.45E-07	7.50E-04	1.44E-03	2.38E-03	1.98E-03	1.98E-03
Mo+6	5.31E-02	3.77E-02	1.07E-05	1.05E-05	1.04E-02	1.60E-02	2.92E-02	2.36E-02	2.36E-02
Nd+3	2.39E-05	1.70E-05	7.46E-09	7.32E-09	7.45E-06	1.11E-05	1.96E-05	1.60E-05	1.60E-05
Np+4	2.49E-06	1.76E-06	1.27E-09	1.25E-09	1.27E-06	1.90E-06	3.34E-06	2.73E-06	2.73E-06
Nb+5	1.04E-03	7.36E-04	2.02E-07	1.99E-07	1.97E-04	3.02E-04	5.52E-04	4.47E-04	4.47E-04
Pd+4	1.53E-03	1.09E-03	3.68E-07	3.61E-07	2.87E-04	5.49E-04	9.09E-04	7.58E-04	7.58E-04
Pu+4	6.03E-06	4.28E-06	3.09E-09	3.03E-09	3.02E-06	4.62E-06	8.43E-06	6.83E-06	6.83E-06
Pr+4	6.75E-06	4.79E-06	2.06E-09	2.02E-09	2.05E-06	3.07E-06	5.39E-06	4.41E-06	4.41E-06
Pm+3	1.36E-09	9.62E-10	4.25E-13	4.17E-13	4.24E-10	6.34E-10	1.11E-09	9.12E-10	9.12E-10
Rh+4	2.91E-06	2.07E-06	6.47E-10	6.35E-10	6.47E-07	9.66E-07	1.70E-06	1.39E-06	1.39E-06
Rb+	4.48E-06	3.18E-06	9.65E-10	9.47E-10	7.04E-07	1.44E-06	2.03E-06	1.78E-06	1.78E-06
Ru+3	8.04E-04	5.71E-04	1.76E-07	1.72E-07	1.75E-04	2.62E-04	4.60E-04	3.77E-04	3.77E-04
Sm+3	4.46E-06	3.17E-06	1.45E-09	1.42E-09	1.45E-06	2.16E-06	3.80E-06	3.11E-06	3.11E-06
Si+4	8.94E-02	6.35E-02	7.24E-06	7.10E-06	1.05E-02	1.08E-02	2.25E-02	1.76E-02	1.76E-02
Sr+2	1.08E-04	7.67E-05	2.13E-08	2.09E-08	1.66E-05	3.18E-05	5.27E-05	4.39E-05	4.39E-05
Tc+7	5.33E-06	3.78E-06	3.48E-09	3.41E-09	5.28E-06	5.19E-06	4.09E-07	2.42E-06	2.42E-06
Te+4	5.22E-06	3.70E-06	1.40E-09	1.37E-09	1.36E-06	2.09E-06	3.81E-06	3.09E-06	3.09E-06
Tb+4	1.71E-09	1.21E-09	5.87E-13	5.76E-13	5.86E-10	8.76E-10	1.54E-09	1.26E-09	1.26E-09
Th+4	2.59E-05	1.84E-05	1.26E-08	1.24E-08	1.23E-05	1.88E-05	3.44E-05	2.79E-05	2.79E-05
Sn+4	1.75E-03	1.24E-03	4.36E-07	4.28E-07	4.25E-04	6.50E-04	1.19E-03	9.62E-04	9.62E-04
Ti+4	9.02E-04	6.40E-04	9.08E-08	8.91E-08	8.85E-05	1.35E-04	2.47E-04	2.00E-04	2.00E-04
Y+3	5.53E-06	3.93E-06	1.06E-09	1.04E-09	1.06E-06	1.59E-06	2.79E-06	2.28E-06	2.28E-06
OH-		8.50E-04	2.47E-06	2.42E-06	1.83E-03	3.69E-03	5.52E-03	4.75E-03	4.75E-03
H2O	4.43E+01	3.37E+01	3.24E-02	3.18E-02	1.66E-03	3.12E-03	4.61E-03	3.99E-03	3.99E-03
SO2		7.08E-07	4.74E-09	4.65E-09					
H2S			2.09E-05	2.05E-05					
CO		8.99E-12	8.65E-04	8.49E-04					
CO2		1.43E-05	8.25E-03	8.09E-03					
H2		3.77E-11	2.09E-04	2.05E-04					
N2		5.49E-07	1.27E-02	1.38E-02					
NO		9.53E-09	4.53E-05	4.44E-05					
NO2		1.20E-07	4.70E-06	4.61E-06					
O2		1.36E-07	4.83E-04	4.73E-04					
S (other)		9.40E-09	2.94E-07	2.88E-07	2.17E-04	4.38E-04	6.58E-04	5.66E-04	5.66E-04
CO3	2.77E-05	2.08E-05	1.47E-04	1.44E-04	1.18E-01	2.19E-01	3.04E-01	2.68E-01	2.68E-01
C (reductant)			2.45E-05	2.40E-05	4.22E-01	3.65E-02		1.54E-02	1.54E-02
O (oxides)	4.70E-01	3.33E-01	4.75E-05	4.66E-05	4.60E-02	7.09E-02	1.35E-01	1.08E-01	1.08E-01
C (organic)	4.39E-02	1.16E+01	1.03E-04	1.01E-04	7.08E-02	1.23E-01	8.93E-03	5.70E-02	5.70E-02
H (organic)	8.05E-02	2.12E+01	1.95E-05	1.91E-05	1.09E-02	1.90E-02	1.37E-03	8.77E-03	8.77E-03
O (organic)	4.02E-02	1.06E+01	1.01E-04	9.89E-05	8.65E-02	1.51E-01	1.09E-02	6.96E-02	6.96E-02
Mass Flow (kg/hr):	4.73E+02	6.67E+02	2.78E+03	2.85E+03	5.49E+01	3.34E+01	4.60E+01	7.94E+01	7.94E+01
Total Canisters Generated								242	
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/Canister
Heat Generation, w/m3	4.64E-01	3.31E-01			3.04E-01	2.18E+00	3.46E+00	2.92E+00	2.34E+00

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/canister
H-3	8.12E-06	5.76E-06	9.60E-07	9.42E-07					
C-14	1.31E-10	9.27E-11	1.51E-11	1.48E-11	1.75E-10	6.91E-11	2.37E-11	4.28E-11	4.55E-08
Co-60	2.65E-05	1.88E-05	9.18E-07	9.00E-07	5.72E-05	8.55E-05	1.50E-04	1.23E-04	1.31E-01
Ni-59	1.11E-06	7.90E-07	4.02E-08	3.94E-08	1.95E-06	3.74E-06	6.20E-06	5.16E-06	5.50E-03
Ni-63	3.47E-05	2.46E-05	1.25E-06	1.23E-06	6.08E-05	1.17E-04	1.93E-04	1.61E-04	1.71E-01
Se-79	4.74E-07	3.37E-07	1.60E-08	1.57E-08	9.72E-07	1.49E-06	2.72E-06	2.20E-06	2.34E-03
Sr-90	3.15E-02	2.23E-02	1.13E-03	1.11E-03	5.52E-02	1.06E-01	1.75E-01	1.46E-01	1.55E+02
Y-90	3.15E-02	2.23E-02	1.09E-03	1.07E-03	6.79E-02	1.01E-01	1.78E-01	1.46E-01	1.55E+02
Zr-93	1.76E-06	1.25E-06	5.93E-08	5.82E-08	3.61E-06	5.53E-06	1.01E-05	8.17E-06	8.70E-03
Nb-93m	1.36E-06	9.63E-07	4.57E-08	4.48E-08	2.78E-06	4.26E-06	7.78E-06	6.30E-06	6.70E-03
Nb-94	1.23E-06	8.75E-07	4.15E-08	4.07E-08	2.53E-06	3.87E-06	7.07E-06	5.72E-06	6.09E-03
Tc-99	1.25E-05	8.88E-06	1.34E-06	1.31E-06	1.27E-04	1.24E-04	9.80E-06	5.80E-05	6.17E-02
Ru-106	1.01E-06	7.19E-07	3.51E-08	3.44E-08	2.19E-06	3.27E-06	5.75E-06	4.70E-06	5.01E-03
Rh-102	6.85E-10	4.86E-10	2.37E-11	2.33E-11	1.48E-09	2.21E-09	3.88E-09	3.18E-09	3.38E-06
Rh-106	1.01E-06	7.19E-07	3.51E-08	3.44E-08	2.19E-06	3.27E-06	5.75E-06	4.70E-06	5.01E-03
Pd-107	1.31E-08	9.32E-09	4.74E-10	4.65E-10	2.30E-08	4.42E-08	7.31E-08	6.09E-08	6.49E-05
Cd-113m	2.64E-06	1.87E-06	1.04E-07	1.02E-07	5.91E-06	9.70E-06	1.41E-05	1.22E-05	1.30E-02
Sn-121m	5.32E-08	3.77E-08	1.79E-09	1.76E-09	1.09E-07	1.67E-07	3.05E-07	2.47E-07	2.63E-04
Sn-126	4.47E-07	3.17E-07	1.50E-08	1.48E-08	9.15E-07	1.40E-06	2.56E-06	2.07E-06	2.21E-03
Sb-125	3.72E-04	2.64E-04	1.29E-05	1.26E-05	8.04E-04	1.20E-03	2.11E-03	1.73E-03	1.84E+00
Sb-126	4.57E-08	3.24E-08	1.58E-09	1.55E-09	9.87E-08	1.47E-07	2.59E-07	2.12E-07	2.26E-04
Te-125m	2.50E-06	1.78E-06	8.43E-08	8.27E-08	5.13E-06	7.86E-06	1.44E-05	1.16E-05	1.24E-02
I-129	5.79E-08	4.15E-08	5.11E-09	5.01E-09	2.63E-07	4.62E-07	1.22E-07	2.65E-07	2.82E-04
Cs-134	5.75E-05	4.32E-05	6.71E-06	6.59E-06	5.49E-04	6.26E-04	3.43E-05	3.17E-04	3.37E-01
Cs-135	9.07E-07	6.82E-07	1.06E-07	1.04E-07	8.65E-06	9.87E-06	5.41E-07	5.00E-06	5.32E-03
Cs-137	4.70E-02	3.53E-02	5.48E-03	5.38E-03	4.48E-01	5.11E-01	2.80E-02	2.59E-01	2.76E+02
Ba-137m	4.45E-02	3.16E-02	1.60E-03	1.57E-03	7.80E-02	1.49E-01	2.47E-01	2.06E-01	2.20E+02
Ce-144	6.85E-07	4.86E-07	2.37E-08	2.32E-08	1.48E-06	2.21E-06	3.88E-06	3.18E-06	3.38E-03
Pr-144	6.85E-07	4.86E-07	2.37E-08	2.32E-08	1.48E-06	2.21E-06	3.88E-06	3.18E-06	3.38E-03
Pm-146	4.05E-08	2.87E-08	1.40E-09	1.37E-09	8.73E-08	1.30E-07	2.29E-07	1.88E-07	2.00E-04
Pm-147	1.85E-04	1.31E-04	6.39E-06	6.27E-06	3.99E-04	5.96E-04	1.05E-03	8.57E-04	9.12E-01
Sm-151	3.65E-04	2.59E-04	1.26E-05	1.24E-05	7.88E-04	1.18E-03	2.07E-03	1.69E-03	1.80E+00
Eu-152	2.34E-06	1.66E-06	8.11E-08	7.96E-08	5.06E-06	7.56E-06	1.33E-05	1.09E-05	1.16E-02
Eu-154	1.40E-04	9.93E-05	4.84E-06	4.75E-06	3.02E-04	4.51E-04	7.93E-04	6.49E-04	6.91E-01
Eu-155	1.32E-04	9.35E-05	4.56E-06	4.47E-06	2.84E-04	4.25E-04	7.46E-04	6.11E-04	6.50E-01
Th-230	8.62E-10	6.12E-10	2.90E-11	2.85E-11	1.77E-09	2.70E-09	4.94E-09	4.00E-09	4.26E-06
Pa-233	2.33E-06	1.65E-06	7.85E-08	7.70E-08	4.78E-06	7.31E-06	1.34E-05	1.08E-05	1.15E-02
U-232	2.02E-09	1.43E-09	6.79E-11	6.66E-11	4.13E-09	6.33E-09	1.16E-08	9.36E-09	9.96E-06
U-233	7.11E-11	5.05E-11	2.39E-12	2.35E-12	1.46E-10	2.23E-10	4.07E-10	3.30E-10	3.51E-07
U-234	1.40E-06	9.90E-07	4.70E-08	4.61E-08	2.86E-06	4.38E-06	8.00E-06	6.47E-06	6.89E-03
U-235	5.63E-08	3.99E-08	1.89E-09	1.86E-09	1.15E-07	1.77E-07	3.22E-07	2.61E-07	2.78E-04
U-236	6.53E-08	4.63E-08	2.20E-09	2.16E-09	1.34E-07	2.05E-07	3.74E-07	3.03E-07	3.22E-04
U-237	5.12E-09	3.63E-09	1.72E-10	1.69E-10	1.05E-08	1.61E-08	2.93E-08	2.37E-08	2.53E-05
U-238	3.10E-08	2.20E-08	1.04E-09	1.02E-09	6.35E-08	9.71E-08	1.77E-07	1.44E-07	1.53E-04
Np-237	4.15E-07	2.95E-07	1.44E-08	1.41E-08	8.96E-07	1.34E-06	2.35E-06	1.93E-06	2.05E-03
Pu-236	3.29E-09	2.33E-09	1.11E-10	1.09E-10	6.74E-09	1.03E-08	1.88E-08	1.53E-08	1.62E-05
Pu-238	7.59E-04	5.39E-04	2.56E-05	2.51E-05	1.56E-03	2.38E-03	4.35E-03	3.52E-03	3.75E+00
Pu-239	8.29E-05	5.88E-05	2.79E-06	2.74E-06	1.70E-04	2.60E-04	4.75E-04	3.85E-04	4.10E-01
Pu-240	1.23E-05	8.70E-06	4.13E-07	4.05E-07	2.51E-05	3.85E-05	7.03E-05	5.69E-05	6.06E-02
Pu-241	6.64E-04	4.71E-04	2.24E-05	2.19E-05	1.36E-03	2.08E-03	3.81E-03	3.08E-03	3.28E+00
Pu-242	9.60E-09	6.81E-09	3.23E-10	3.17E-10	1.97E-08	3.01E-08	5.50E-08	4.45E-08	4.74E-05
Pu-244	2.86E-16	2.03E-16	9.64E-18	9.46E-18	5.87E-16	8.98E-16	1.64E-15	1.33E-15	1.41E-12
Am-241	6.48E-05	4.60E-05	2.24E-06	2.20E-06	1.40E-04	2.09E-04	3.67E-04	3.00E-04	3.20E-01
Am-242m	1.21E-08	8.62E-09	4.20E-10	4.12E-10	2.62E-08	3.92E-08	6.88E-08	5.64E-08	6.00E-05

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	105	106	107	108	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg	Ci/kg	Ci/Canister
Am-243	2.07E-08	1.47E-08	7.17E-10	7.03E-10	4.47E-08	6.68E-08	1.17E-07	9.61E-08	1.02E-04
Cm-242	2.43E-08	1.72E-08	8.17E-10	8.02E-10	4.97E-08	7.61E-08	1.39E-07	1.13E-07	1.20E-04
Cm-243	2.99E-08	2.12E-08	1.01E-09	9.86E-10	6.12E-08	9.37E-08	1.71E-07	1.39E-07	1.47E-04
Cm-244	1.26E-06	8.97E-07	4.26E-08	4.18E-08	2.59E-06	3.97E-06	7.25E-06	5.87E-06	6.25E-03
Cm-245	3.14E-10	2.23E-10	1.06E-11	1.04E-11	6.44E-10	9.86E-10	1.80E-09	1.46E-09	1.55E-06
Cm-246	2.06E-11	1.46E-11	6.95E-13	6.82E-13	4.23E-11	6.47E-11	1.18E-10	9.57E-11	1.02E-07
TRU	9.40E-04	6.67E-04	3.17E-05	3.11E-05	1.93E-03	2.96E-03	5.38E-03	4.36E-03	4.64E+00
TRU, nCi/gm	7.33E+02							4.36E+03	
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			69.24%	67.93%					
O2, mol %			0.58%	0.57%					
N2, mol %			17.38%	18.95%					
H2, mol %			3.99%	3.91%					
CO2, mol %			7.20%	7.07%					
CO, ppmv			1.19E+04	1.17E+04					
NO, ppmv			5.80E+02	5.69E+02					
NO2, ppmv			3.92E+01	3.85E+01					
SO2, ppmv			2.84E-02	2.79E-02					
Cl, ppmv			3.93E+01	3.86E+01					
F, ppmv			7.81E+01	7.66E+01					
C (organic), ppmv			3.29E+03	3.22E+03					
H (organic), ppmv			7.42E+03	7.28E+03					
Hg, ug/wscm			1.39E+05	1.36E+05					
PM, mg/wscm			1.07E+04	1.05E+04					
SVM, ug/wscm			3.44E+04	3.37E+04					
LVM, ug/wscm			9.56E+03	9.38E+03					
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			1.88%	1.77%					
N2, mol %, dry basis			56.51%	59.08%					
H2, mol %, dry basis			12.96%	12.20%					
CO2, mol %, dry basis			23.42%	22.04%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			5.41E+03	5.09E+03					
NO, ppmv, dry basis			2.64E+02	2.48E+02					
NO2, ppmv, dry basis			1.79E+01	1.68E+01					
SO2, ppmv, dry basis			1.29E-02	1.22E-02					
Cl, ppmv, dry basis			1.79E+01	1.69E+01					
F, ppmv, dry basis			3.55E+01	3.34E+01					
C (organic), ppmv, dry basis			1.50E+03	1.41E+03					
H (organic), ppmv, dry basis			3.38E+03	3.18E+03					
Hg, ug/dscm			6.31E+04	5.94E+04					
PM, mg/dscm			4.87E+03	4.58E+03					
SVM, ug/dscm			1.12E+05	1.10E+05					
LVM, ug/dscm			3.11E+04	3.05E+04					

Table A-16. Mass balance, Tank WM-189 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-189, Stream #	109	110	111	112	113A	113B	114	115	116
Stream Name	Off-Gas from Filter to Oxidizer	Oxidizer Effluent	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Scrubber Effluent Gas	Demister Effluent Gas	GAC Bed Feed
Rate or Volume	4.77E+05	7.66E+05	4.01E+05	1.10E+04	1.10E+04	1.33E-02	4.09E+05	4.18E+05	5.08E+05
Volume Flow (standard, wet)*	1.13E+05	1.17E+05	1.99E+05				1.98E+05	1.98E+05	1.98E+05
Volume Flow (standard, dry)*	3.66E+04	3.51E+04	3.50E+04				3.50E+04	3.51E+04	3.51E+04
Rate Units	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	3.20E+03	3.32E+03	5.63E+03	4.16E+04	4.17E+04	0.05	5.60E+03	5.62E+03	5.62E+03
Rate Units	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	527	950	100	81	83	81	82	81	120
Temperature, °F	980	1742	212	179	181	177	179	177	248
Pressure, psia	9.5	9.4	9.3	38.1	9.0	8.4	8.6	8.4	7.7
Specific Gravity	2.11E-04	1.43E-04	4.28E-04	1.02	1.01	1.01	4.17E-04	4.08E-04	3.36E-04
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
H+	1.31E-06	1.89E-08	2.01E-08	1.02E+00	1.02E+00	1.02E+00	2.07E-07	2.06E-07	2.06E-07
Al+3	5.17E-08	4.98E-08	2.94E-08	1.90E-03	1.90E-03	1.90E-03			
Sb+5	6.31E-12	6.08E-12	3.59E-12	5.15E-08	5.15E-08	5.15E-08			
As+3	1.94E-11	1.87E-11	1.10E-11	2.57E-07	2.57E-07	2.57E-07			
Ba+2	2.81E-11	2.71E-11	3.12E-13	2.05E-07	2.05E-07	2.05E-07			
Be+2	6.00E-13	5.78E-13	6.66E-15	6.68E-08	6.67E-08	6.67E-08			
B+3	5.67E-10	5.46E-10	3.22E-10	5.21E-05	5.21E-05	5.21E-05			
Cd+2	1.20E-09	1.15E-09	6.81E-10	5.74E-06	5.74E-06	5.74E-06			
Ca+2	1.98E-08	1.90E-08	2.19E-10	4.94E-04	4.94E-04	4.94E-04			
Cr+3	8.51E-10	8.20E-10	4.84E-10	1.18E-05	1.18E-05	1.18E-05			
Co+2	7.22E-12	6.96E-12	4.11E-12	1.22E-07	1.22E-07	1.22E-07			
Cs+	5.23E-11	5.04E-11	2.97E-11	5.45E-05	5.45E-05	5.45E-05			
Cu+2	1.67E-10	1.61E-10	1.85E-12	2.64E-06	2.63E-06	2.63E-06			
Fe+3	3.45E-09	3.33E-09	1.96E-09	9.96E-05	9.96E-05	9.96E-05			
Pb+2	1.93E-09	1.86E-09	1.10E-09	7.19E-06	7.19E-06	7.19E-06			
Hg+2	8.41E-06	8.11E-06	4.79E-06	1.48E-02	1.48E-02	1.48E-02		2.58E-06	2.58E-06
Mn+4	2.59E-09	2.50E-09	1.48E-09	4.69E-05	4.69E-05	4.69E-05			
Ni+2	3.66E-10	3.53E-10	4.06E-12	6.25E-06	6.24E-06	6.24E-06			
K+	4.84E-08	4.67E-08	2.76E-08	1.59E-03	1.59E-03	1.59E-03			
Se+4	5.70E-11	5.49E-11	3.24E-11	1.19E-06	1.19E-06	1.19E-06			
Ag+	4.73E-10	2.89E-10	1.71E-10	2.04E-06	2.04E-06	2.04E-06			
Na+	4.26E-07	4.10E-07	2.42E-07	5.28E-02	5.28E-02	5.28E-02			
Tl+3	2.79E-12	2.69E-12	1.59E-12	1.36E-08	1.36E-08	1.36E-08			
U+4	3.74E-10	3.60E-10	2.12E-10	2.59E-06	2.58E-06	2.58E-06			
V+3	4.49E-12	4.33E-12	2.55E-12	1.48E-07	1.48E-07	1.48E-07			
Zn+2	1.84E-10	1.78E-10	2.04E-12	2.82E-06	2.82E-06	2.82E-06			
Zr+4	9.89E-09	9.53E-09	5.62E-09	1.79E-04	1.78E-04	1.78E-04			
Cl-	1.05E-07	1.01E-07	5.98E-08	2.58E-03	2.58E-03	2.58E-03	1.26E-08	1.25E-08	1.25E-08
F-	3.75E-07	3.62E-07	2.13E-07	8.06E-03	8.03E-03	8.03E-03	3.34E-07	3.33E-07	3.33E-07
SO4-2	3.51E-11	5.71E-07	3.37E-07	1.89E-02	1.89E-02	1.89E-02			
NO3-	6.08E-06	5.68E-09	3.35E-09	1.06E+00	1.05E+00	1.05E+00	1.16E-05	1.16E-05	1.16E-05
PO4-3	3.69E-08	3.56E-08	2.10E-08	6.11E-04	6.10E-04	6.10E-04			
Am+4	4.55E-14	4.38E-14	2.59E-14	1.86E-10	1.86E-10	1.86E-10			
Br-	3.14E-12	3.03E-12	1.79E-12	3.42E-08	3.42E-08	3.42E-08	3.76E-13	3.75E-13	3.75E-13
Ce+4	1.59E-11	1.53E-11	9.04E-12	1.13E-07	1.13E-07	1.13E-07			
Eu+3	1.96E-13	1.89E-13	1.12E-13	1.28E-09	1.28E-09	1.28E-09			
Gd+3	6.10E-11	5.88E-11	3.47E-11	3.85E-07	3.85E-07	3.85E-07			
Ge+4	1.58E-15	1.53E-15	9.01E-16	3.60E-11	3.59E-11	3.59E-11			
In+3	4.13E-13	3.98E-13	2.35E-13	3.57E-09	3.57E-09	3.57E-09			
I-	5.55E-11	5.34E-11	3.15E-11	3.81E-07	3.80E-07	3.80E-07	6.64E-12	6.61E-12	6.61E-12
La+3	3.25E-12	3.14E-12	1.85E-12	2.33E-08	2.33E-08	2.33E-08			

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf	lb/wscf	lb/wscf
Li+	4.07E-11	2.49E-11	1.47E-11	2.73E-06	2.73E-06	2.73E-06			
Mg+2	1.41E-09	1.36E-09	1.56E-11	5.80E-05	5.79E-05	5.79E-05			
Mo+6	1.56E-08	1.51E-08	8.89E-09	2.81E-04	2.81E-04	2.81E-04			
Nd+3	1.09E-11	1.05E-11	6.20E-12	7.51E-08	7.50E-08	7.50E-08			
Np+4	1.86E-12	1.79E-12	1.06E-12	7.79E-09	7.79E-09	7.79E-09			
Nb+5	2.96E-10	2.85E-10	1.68E-10	5.34E-06	5.34E-06	5.34E-06			
Pd+4	5.37E-10	5.18E-10	5.96E-12	5.06E-06	5.06E-06	5.06E-06			
Pu+4	4.52E-12	4.35E-12	2.57E-12	3.05E-08	3.05E-08	3.05E-08			
Pr+4	3.00E-12	2.89E-12	1.71E-12	2.12E-08	2.12E-08	2.12E-08			
Pm+3	6.21E-16	5.98E-16	3.53E-16	4.25E-12	4.25E-12	4.25E-12			
Rh+4	9.46E-13	9.11E-13	5.38E-13	9.13E-09	9.13E-09	9.13E-09			
Rb+	4.57E-12	2.79E-12	1.65E-12	2.49E-08	2.49E-08	2.49E-08			
Ru+3	2.56E-10	2.47E-10	1.46E-10	2.52E-06	2.52E-06	2.52E-06			
Sm+3	2.12E-12	2.04E-12	1.20E-12	1.40E-08	1.40E-08	1.40E-08			
Si+4	1.06E-08	1.02E-08	6.01E-09	7.40E-04	7.39E-04	7.39E-04			
Sr+2	3.12E-11	3.00E-11	3.46E-13	3.57E-07	3.56E-07	3.56E-07			
Tc+7	5.08E-12	4.90E-12	2.89E-12	6.22E-08	6.21E-08	6.21E-08			
Te+4	2.04E-12	1.97E-12	1.16E-12	2.64E-08	2.64E-08	2.64E-08			
Tb+4	8.57E-16	8.26E-16	4.87E-16	5.36E-12	5.36E-12	5.36E-12			
Th+4	1.84E-11	1.78E-11	1.05E-11	1.31E-07	1.31E-07	1.31E-07			
Sn+4	6.37E-10	6.14E-10	3.62E-10	8.84E-06	8.83E-06	8.83E-06			
Ti+4	1.33E-10	1.28E-10	7.54E-11	4.56E-06	4.56E-06	4.56E-06			
Y+3	1.55E-12	1.50E-12	8.83E-13	1.73E-08	1.73E-08	1.73E-08			
OH-	3.61E-09	8.69E-08	2.02E-07	7.39E-07	7.46E-07	7.46E-07			
H2O	3.16E-02	3.28E-02	3.87E-02	5.23E+01	5.23E+01	5.23E+01	3.86E-02	3.85E-02	3.85E-02
SO2	4.61E-09	3.65E-05	2.15E-05	1.65E-05	1.65E-05	1.65E-05	2.17E-05	2.16E-05	2.16E-05
H2S	2.04E-05	4.53E-21							
CO	8.43E-04	1.64E-09	9.68E-10	2.09E-10	2.12E-10	2.12E-10	9.73E-10	9.70E-10	9.70E-10
CO2	8.03E-03	9.97E-03	5.88E-03	3.33E-04	3.43E-04	3.43E-04	5.92E-03	5.89E-03	5.89E-03
H2	2.04E-04	6.12E-10	3.61E-10	8.76E-10	1.42E-09	1.42E-09	2.15E-08		
N2	1.43E-02	1.38E-02	8.12E-03	1.28E-05	2.47E-05	2.47E-05	8.17E-03	8.13E-03	8.13E-03
NO	4.41E-05	4.80E-05	2.83E-05	2.22E-07	2.81E-07	2.81E-07	2.85E-05	2.84E-05	2.84E-05
NO2	4.57E-06	2.62E-07	1.55E-07	2.79E-06	2.79E-06	2.79E-06	1.55E-07	1.55E-07	1.55E-07
O2	4.70E-04	1.83E-03	1.08E-03	3.16E-06	4.89E-06	4.89E-06	1.08E-03	1.08E-03	1.08E-03
S (other)	4.29E-10	1.96E-25		2.19E-07	2.19E-07	2.19E-07			
CO3	2.15E-07	2.08E-11	6.71E-12	2.73E-05	2.72E-05	2.72E-05			
C (reductant)	3.57E-08	1.44E-18							
O (oxides)	6.93E-08	6.49E-08	3.83E-08	5.26E-03	5.26E-03	5.26E-03			
C (organic)	1.97E-05	1.82E-34							
H (organic)	6.59E-06	6.11E-35							
O (organic)	1.47E-07								
Mass Flow (kg/hr):	2.85E+03	3.11E+03	4.85E+03	4.23E+04	4.23E+04	5.11E-02	4.83E+03	4.83E+03	4.83E+03
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				4.87E-02	4.86E-02				

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
H-3	9.35E-07	9.01E-07	5.32E-07	7.89E-07	7.88E-07	7.88E-07	5.31E-07	5.29E-07	5.29E-07
C-14	1.40E-11	1.36E-11	8.00E-12	1.35E-15	1.38E-15	1.38E-15	8.05E-12	8.02E-12	8.02E-12
Co-60	1.34E-09	1.29E-09	7.62E-10	8.31E-08	8.31E-08	8.31E-08			
Ni-59	5.87E-11	5.65E-11	6.51E-13	3.67E-09	3.67E-09	3.67E-09			
Ni-63	1.83E-09	1.76E-09	2.03E-11	1.14E-07	1.14E-07	1.14E-07			
Se-79	2.33E-11	2.25E-11	1.33E-11	2.40E-09	2.40E-09	2.40E-09			
Sr-90	1.66E-06	1.60E-06	1.84E-08	1.04E-04	1.04E-04	1.04E-04			
Y-90	1.59E-06	1.53E-06	9.04E-07	9.86E-05	9.86E-05	9.86E-05			
Zr-93	8.66E-11	8.35E-11	4.93E-11	8.91E-09	8.91E-09	8.91E-09			
Nb-93m	6.68E-11	6.43E-11	3.80E-11	6.99E-09	6.99E-09	6.99E-09			
Nb-94	6.07E-11	5.85E-11	3.45E-11	6.35E-09	6.35E-09	6.35E-09			
Tc-99	1.95E-09	1.88E-09	1.11E-09	1.46E-07	1.46E-07	1.46E-07			
Ru-106	5.13E-11	4.94E-11	2.91E-11	3.18E-09	3.18E-09	3.18E-09			
Rh-102	3.46E-14	3.34E-14	1.97E-14	2.15E-12	2.15E-12	2.15E-12			
Rh-106	5.13E-11	4.94E-11	2.91E-11	3.18E-09	3.18E-09	3.18E-09			
Pd-107	6.92E-13	6.67E-13	7.68E-15	4.33E-11	4.33E-11	4.33E-11			
Cd-113m	1.52E-10	1.47E-10	8.65E-11	5.11E-09	5.12E-09	5.12E-09			
Sn-121m	2.61E-12	2.52E-12	1.49E-12	2.69E-10	2.69E-10	2.69E-10			
Sn-126	2.20E-11	2.12E-11	1.25E-11	2.26E-09	2.26E-09	2.26E-09			
Sb-125	1.88E-08	1.81E-08	1.07E-08	1.17E-06	1.17E-06	1.17E-06			
Sb-126	2.31E-12	2.23E-12	1.31E-12	1.43E-10	1.43E-10	1.43E-10			
Te-125m	1.23E-10	1.19E-10	7.01E-11	1.27E-08	1.27E-08	1.27E-08			
I-129	1.48E-10	1.43E-10	8.42E-11	8.05E-09	8.05E-09	8.05E-09	1.77E-11	1.77E-11	1.77E-11
Cs-134	6.54E-09	6.30E-09	3.72E-09	5.66E-05	5.65E-05	5.65E-05			
Cs-135	1.03E-10	9.94E-11	5.86E-11	8.92E-07	8.91E-07	8.91E-07			
Cs-137	5.34E-06	5.15E-06	3.04E-06	4.62E-02	4.62E-02	4.62E-02			
Ba-137m	2.34E-06	2.26E-06	2.60E-08	1.47E-04	1.46E-04	1.46E-04			
Ce-144	3.46E-11	3.34E-11	1.97E-11	2.15E-09	2.15E-09	2.15E-09			
Pr-144	3.46E-11	3.34E-11	1.97E-11	2.15E-09	2.15E-09	2.15E-09			
Pm-146	2.05E-12	1.97E-12	1.16E-12	1.27E-10	1.27E-10	1.27E-10			
Pm-147	9.34E-09	9.00E-09	5.31E-09	5.79E-07	5.79E-07	5.79E-07			
Sm-151	1.85E-08	1.78E-08	1.05E-08	1.15E-06	1.14E-06	1.14E-06			
Eu-152	1.19E-10	1.14E-10	6.74E-11	7.35E-09	7.35E-09	7.35E-09			
Eu-154	7.07E-09	6.82E-09	4.02E-09	4.39E-07	4.38E-07	4.38E-07			
Eu-155	6.66E-09	6.42E-09	3.79E-09	4.13E-07	4.13E-07	4.13E-07			
Th-230	4.24E-14	4.09E-14	2.41E-14	4.36E-12	4.36E-12	4.36E-12			
Pa-233	1.15E-10	1.10E-10	6.52E-11	1.18E-08	1.18E-08	1.18E-08			
U-232	9.92E-14	9.56E-14	5.64E-14	1.02E-11	1.02E-11	1.02E-11			
U-233	3.50E-15	3.37E-15	1.99E-15	3.60E-13	3.59E-13	3.59E-13			
U-234	6.86E-11	6.61E-11	3.90E-11	7.06E-09	7.05E-09	7.05E-09			
U-235	2.77E-12	2.67E-12	1.57E-12	2.85E-10	2.85E-10	2.85E-10			
U-236	3.21E-12	3.09E-12	1.83E-12	3.30E-10	3.30E-10	3.30E-10			
U-237	2.52E-13	2.43E-13	1.43E-13	2.59E-11	2.59E-11	2.59E-11			
U-238	1.52E-12	1.47E-12	8.66E-13	1.57E-10	1.57E-10	1.57E-10			
Np-237	2.10E-11	2.02E-11	1.19E-11	1.30E-09	1.30E-09	1.30E-09			
Pu-236	1.62E-13	1.56E-13	9.20E-14	1.66E-11	1.66E-11	1.66E-11			
Pu-238	3.73E-08	3.60E-08	2.12E-08	3.84E-06	3.84E-06	3.84E-06			
Pu-239	4.08E-09	3.93E-09	2.32E-09	4.20E-07	4.19E-07	4.19E-07			
Pu-240	6.03E-10	5.81E-10	3.43E-10	6.20E-08	6.20E-08	6.20E-08			
Pu-241	3.27E-08	3.15E-08	1.86E-08	3.36E-06	3.36E-06	3.36E-06			
Pu-242	4.72E-13	4.55E-13	2.69E-13	4.86E-11	4.85E-11	4.85E-11			
Pu-244	1.41E-20	1.36E-20	8.01E-21	1.45E-18	1.45E-18	1.45E-18			
Am-241	3.27E-09	3.16E-09	1.86E-09	2.03E-07	2.03E-07	2.03E-07			
Am-242m	6.14E-13	5.92E-13	3.49E-13	3.81E-11	3.81E-11	3.81E-11			

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	109	110	111	112	113A	113B	114	115	116
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	1.05E-12	1.01E-12	5.95E-13	6.49E-11	6.49E-11	6.49E-11			
Cm-242	1.19E-12	1.15E-12	6.79E-13	1.23E-10	1.23E-10	1.23E-10			
Cm-243	1.47E-12	1.42E-12	8.35E-13	1.51E-10	1.51E-10	1.51E-10			
Cm-244	6.22E-11	6.00E-11	3.54E-11	6.40E-09	6.39E-09	6.39E-09			
Cm-245	1.55E-14	1.49E-14	8.79E-15	1.59E-12	1.59E-12	1.59E-12			
Cm-246	1.01E-15	9.78E-16	5.77E-16	1.04E-13	1.04E-13	1.04E-13			
TRU	4.63E-08	4.46E-08	2.63E-08	4.63E-06	4.63E-06	4.63E-06			
TRU, nCi/gm									
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	67.58%	70.06%	82.39%				82.29%	82.29%	82.29%
O2, mol %	0.57%	2.20%	1.29%				1.30%	1.30%	1.30%
N2, mol %	19.62%	18.93%	11.13%				11.19%	11.19%	11.19%
H2, mol %	3.89%	0.00001%	0.00001%				0.0004%		0.00%
CO2, mol %	7.03%	8.73%	5.13%				5.16%	5.16%	5.16%
CO, ppmv	1.16E+04	2.26E-02	1.33E-02				1.33E-02	1.33E-02	1.33E-02
NO, ppmv	5.66E+02	6.17E+02	3.63E+02				3.65E+02	3.65E+02	3.65E+02
NO2, ppmv	3.83E+01	2.19E+00	1.29E+00				1.30E+00	1.30E+00	1.30E+00
SO2, ppmv	2.77E-02	2.19E+02	1.29E+02				1.30E+02	1.30E+02	1.30E+02
Cl, ppmv	1.14E+00	1.10E+00	6.48E-01				1.36E-01	1.36E-01	1.36E-01
F, ppmv	7.61E+00	7.34E+00	4.31E+00				6.75E+00	6.75E+00	6.75E+00
C (organic), ppmv	6.32E+02	5.84E-27							
H (organic), ppmv	2.52E+03	2.34E-26							
Hg, ug/wscm	1.35E+05	1.30E+05	7.67E+04					4.14E+04	4.14E+04
PM, mg/wscm	5.66E+02	1.54E+02	9.78E+01				1.18E+01	5.31E+01	5.31E+01
SVM, ug/wscm	5.02E+01	4.84E+01	2.86E+01						
LVM, ug/wscm	1.40E+01	1.35E+01	7.93E+00						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	1.75%	7.35%	7.35%				7.34%	7.34%	7.34%
N2, mol %, dry basis	60.51%	63.21%	63.21%				63.19%	63.19%	63.19%
H2, mol %, dry basis	12.01%	0.00004%	0.00004%				0.002%		0.00%
CO2, mol %, dry basis	21.69%	29.15%	29.15%				29.14%	29.14%	29.14%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis	5.01E+03	1.06E-02	1.06E-02				1.06E-02	1.06E-02	1.06E-02
NO, ppmv, dry basis	2.44E+02	2.89E+02	2.89E+02				2.88E+02	2.88E+02	2.88E+02
NO2, ppmv, dry basis	1.65E+01	1.03E+00	1.03E+00				1.03E+00	1.03E+00	1.03E+00
SO2, ppmv, dry basis	1.20E-02	1.03E+02	1.03E+02				1.03E+02	1.03E+02	1.03E+02
Cl, ppmv, dry basis	4.94E-01	5.16E-01	5.16E-01				1.08E-01	1.08E-01	1.08E-01
F, ppmv, dry basis	3.29E+00	3.43E+00	3.43E+00				5.34E+00	5.34E+00	5.34E+00
C (organic), ppmv, dry basis	2.73E+02								
H (organic), ppmv, dry basis	1.09E+03								
Hg, ug/dscm	5.82E+04	6.08E+04	6.10E+04					3.27E+04	3.27E+04
PM, mg/dscm	2.44E+02	7.20E+01	7.79E+01				9.31E+00	4.20E+01	4.20E+01
SVM, ug/dscm	1.63E+02	1.57E+02	9.28E+01						
LVM, ug/dscm	4.54E+01	4.37E+01	2.58E+01						

Table A-16. Mass balance, Tank WM-189 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3
WM-189, Stream #	117	118	119	120	201	202	203	204
Stream Name	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-Gas to Blower	Spent GAC	Boiler Feed Water	Fuel Oil to Boiler	Steam To Reformer	Propane to Oxidizer
Rate or Volume	1.45E+04	6.55E+05	6.92E+05	6.46E+00	3.43E+02	4.53E+01	6.85E+04	1.07E+02
Volume Flow (standard, wet)*	1.42E+04	1.98E+05	2.12E+05				6.13E+04	3.02E+02
Volume Flow (standard, dry)*	1.42E+04	3.51E+04	4.93E+04					3.02E+02
Rate Units	ft3/hr	ft3/hr	ft3/hr	lb/hr	gal/hr	gal/hr	ft3/hr	ft3/hr
Rate or Volume, metric	4.02E+02	5.62E+03	6.01E+03	2.93E+00	1.30E+03	1.71E+02	1.74E+03	8.54E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	kg/hr	L/hr	L/hr	wscm/hr	wscm/hr
Temperature, °C	25	120	115	28	15	15	670	25
Temperature, °F	77	248	239	82	59	59	1238	77
Pressure, psia	14.7	6.0	6.0	14.7	42.3	14.7	42.3	42.3
Specific Gravity	1.18E-03	2.60E-04	2.71E-04	5.86E-01	1.00E+00	7.70E-01	6.70E-04	5.19E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
H+		2.06E-07	1.92E-07	9.87E-06		2.40E-01		
Al+3								
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2								
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3								
Pb+2								
Hg+2		2.58E-09	2.42E-09	7.93E-02				
Mn+4								
Ni+2								
K+								
Se+4								
Ag+								
Na+								
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-		1.25E-09	1.17E-09	3.47E-04				
F-		3.33E-07	3.11E-07					
SO4-2								
NO3-		1.16E-05	1.08E-05					
PO4-3								
Am+4								
Br-		3.75E-14	3.50E-14	1.04E-08				
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-		6.61E-13	6.18E-13	1.83E-07				
La+3								

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	Wt frac	Mol/liter	Mol/liter	lb/wscf	lb/wscf
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4								
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-								
H2O	4.68E-06	3.85E-02	3.60E-02		5.56E+01		4.68E-02	
SO2		2.16E-05	2.02E-05					
H2S						1.20E-01		
CO		9.70E-10	9.07E-10					
CO2		5.89E-03	5.51E-03					
H2								
N2	5.75E-02	8.13E-03	1.15E-02					
NO		2.84E-05	2.65E-05					
NO2		1.55E-07	1.45E-07					
O2	1.74E-02	1.08E-03	2.18E-03					
S (other)								
CO3								
C (reductant)				9.20E-01				
O (oxides)								
C (organic)						5.41E+01		9.35E-02
H (organic)						1.15E+02		2.09E-02
O (organic)								
Mass Flow (kg/hr):	4.83E+02	4.83E+03	5.31E+03	2.93E+00	1.30E+03	1.32E+02	1.30E+03	1.57E+01
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3				4.92E-11				

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	117	118	119	120	201	202	203	204
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
H-3		5.29E-07	4.95E-07					
C-14		8.02E-12	7.50E-12	2.86E-10				
Co-60								
Ni-59								
Ni-63								
Se-79								
Sr-90								
Y-90								
Zr-93								
Nb-93m								
Nb-94								
Tc-99								
Ru-106								
Rh-102								
Rh-106								
Pd-107								
Cd-113m								
Sn-121m								
Sn-126								
Sb-125								
Sb-126								
Te-125m								
I-129		1.77E-12	1.65E-12	3.05E-08				
Cs-134								
Cs-135								
Cs-137								
Ba-137m								
Ce-144								
Pr-144								
Pm-146								
Pm-147								
Sm-151								
Eu-152								
Eu-154								
Eu-155								
Th-230								
Pa-233								
U-232								
U-233								
U-234								
U-235								
U-236								
U-237								
U-238								
Np-237								
Pu-236								
Pu-238								
Pu-239								
Pu-240								
Pu-241								
Pu-242								
Pu-244								
Am-241								
Am-242m								

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	117	118	119	120	201	202	203	204
	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg	Ci/L	Ci/L	Ci/wscm	Ci/wscm
Am-243								
Cm-242								
Cm-243								
Cm-244								
Cm-245								
Cm-246								
TRU								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	0.01%	82.29%	76.79%				100.00%	
O2, mol %	20.99%	1.30%	2.62%					
N2, mol %	79.00%	11.19%	15.72%					
H2, mol %								
CO2, mol %		5.16%	4.81%					
CO, ppmv		1.33E-02	1.24E-02					
NO, ppmv		3.65E+02	3.40E+02					
NO2, ppmv		1.30E+00	1.21E+00					
SO2, ppmv		1.30E+02	1.21E+02					
Cl, ppmv		1.36E-02	1.27E-02					
F, ppmv		6.75E+00	6.30E+00					
C (organic), ppmv								3.00E+06
H (organic), ppmv								8.00E+06
Hg, ug/wscm		4.14E+01	3.87E+01					
PM, mg/wscm	1.58E+01	1.18E+01	1.22E+01				1.17E+01	1.83E+06
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	20.99%	1.03%	11.27%					
N2, mol %, dry basis	79.01%	63.19%	67.75%					
H2, mol %, dry basis								
CO2, mol %, dry basis		29.14%	20.75%					
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis		1.06E-02	7.52E-03					
NO, ppmv, dry basis		2.88E+02	2.05E+02					
NO2, ppmv, dry basis		1.03E+00	7.30E-01					
SO2, ppmv, dry basis		1.03E+02	7.31E+01					
Cl, ppmv, dry basis		1.08E-02	7.68E-03					
F, ppmv, dry basis		5.34E+00	3.80E+00					
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm		3.28E+01	2.34E+01					
PM, mg/dscm	2.21E+00	9.37E+00	7.36E+00					
SVM, ug/dscm								
LVM, ug/dscm								

Table A-16. Mass balance, Tank WM-189 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-2	PFD-3
WM-189, Stream #	205	206	207	301	302	303	304	305
Stream Name	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 Scrub Makeup	Sugar to Feed	Carbon to Reformer	NOx Catalyst	Bed Media	Grout Mix for Scrub Blowdown
Rate or Volume	4.62E+02	3.52E-08	9.20E-01	3.77E+02	1.66E+02	2.20E-05	1.79E+00	6.61E+00
Volume Flow (standard, wet)*								
Volume Flow (standard, dry)*								
Rate Units	gal/hr	gal/hr	gal/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	1.75E+03	1.33E-07	3.48E+00	1.71E+02	7.52E+01	1.00E-05	8.14E-01	3.00E+00
Rate Units	L/hr	L/hr	L/hr	kg/hr	kg/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	25	25	25	15	15	15	15	25
Temperature, °F	77	77	77	59	59	59	59	77
Pressure, psia	112.3	14.7	42.3	14.7	14.7	14.7	14.7	14.7
Specific Gravity	9.97E-01	1.35E+00	1.28E+00	7.50E-01	5.00E-01	2.58E+00	1.58E+00	2.01E-01
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
H+	1.00E-07	3.09E-08	1.39E+01					
Al+3		2.20E+00			1.53E-03		5.29E-01	
Sb+5								
As+3								
Ba+2								
Be+2								
B+3								
Cd+2								
Ca+2					1.85E-02			
Cr+3								
Co+2								
Cs+								
Cu+2								
Fe+3					8.71E-04	6.99E-01		
Pb+2								
Hg+2					1.92E-06			
Mn+4								
Ni+2								
K+					7.14E-03			
Se+4								
Ag+								
Na+					7.42E-04			
Tl+3								
U+4								
V+3								
Zn+2								
Zr+4								
Cl-								
F-								
SO4-2								
NO3-		6.60E+00	1.39E+01					
PO4-3					2.26E-03			
Am+4								
Br-								
Ce+4								
Eu+3								
Gd+3								
Ge+4								
In+3								
I-								
La+3								

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	205	206	207	301	302	303	304	305
Chemical Composition	Mol/liter	Mol/liter	Mol/liter	Wt frac	Wt frac	Wt frac	Wt frac	Wt frac
Li+								
Mg+2								
Mo+6								
Nd+3								
Np+4								
Nb+5								
Pd+4								
Pu+4								
Pr+4								
Pm+3								
Rh+4								
Rb+								
Ru+3								
Sm+3								
Si+4					6.26E-03			4.67E-01
Sr+2								
Tc+7								
Te+4								
Tb+4								
Th+4								
Sn+4								
Ti+4								
Y+3								
OH-	1.00E-07	3.09E-08						
H2O	5.54E+01	4.89E+01	2.27E+01					
SO2								
H2S								
CO								
CO2								
H2								
N2								
NO								
NO2								
O2								
S (other)					5.18E-04			
CO3					3.11E-02			
C (reductant)					9.22E-01			
O (oxides)					8.88E-03	3.01E-01	4.71E-01	5.33E-01
C (organic)				4.21E-01				
H (organic)				6.48E-02				
O (organic)				5.14E-01				
Mass Flow (kg/hr):	1.74E+03	1.80E-07	4.47E+00	1.71E+02	7.52E+01	1.00E-05	8.14E-01	3.00E+00

Table A-16. Mass balance, Tank WM-189 waste (continued).

PFD #	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-2	PFD-3	PFD-2
WM-189, Stream #	401	402	404	404	503	504	505	506
Stream Name	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Reformer	Oxygen to Oxidizer	Air to Boiler
Rate or Volume	5.90E+00	2.60E-01	8.82E+00	2.29E-01	2.88E+03	7.84E+02	1.05E+03	6.71E+04
Volume Flow (standard, wet)*					1.80E+04	4.84E+03	6.47E+03	6.82E+04
Volume Flow (standard, dry)*					1.80E+04	4.84E+03	6.47E+03	6.82E+04
Rate Units	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr	ft3/hr	ft3/hr
Rate or Volume, metric	2.23E+01	9.84E-01	4.00E+00	4.00E+00	5.10E+02	1.37E+02	1.83E+02	1.93E+03
Rate Units	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr
Temperature, °C	79	79	60	60	21	25	25	15
Temperature, °F	174	174	140	140	70	77	77	59
Pressure, psia	12.3	12.3	12.3	12.3	92.3	92.3	92.3	14.7
Specific Gravity	1.02E+00	1.02E+00	2.10E+00	2.10E+00	7.29E-03	8.21E-03	8.21E-03	1.22E-03
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
H+	1.04E+00	1.04E+00	2.58E-04	2.58E-04				
Al+3	1.90E-03	1.90E-03	1.26E-05	1.26E-05				
Sb+5	5.15E-08	5.15E-08	1.54E-09	1.54E-09				
As+3	2.57E-07	2.57E-07	4.73E-09	4.73E-09				
Ba+2	2.05E-07	2.05E-07	6.94E-09	6.94E-09				
Be+2	6.68E-08	6.68E-08	1.48E-10	1.48E-10				
B+3	5.21E-05	5.21E-05	1.39E-07	1.39E-07				
Cd+2	5.74E-06	5.74E-06	1.59E-07	1.59E-07				
Ca+2	4.94E-04	4.94E-04	4.88E-06	4.88E-06				
Cr+3	1.18E-05	1.18E-05	1.51E-07	1.51E-07				
Co+2	1.22E-07	1.22E-07	1.77E-09	1.77E-09				
Cs+	5.45E-05	5.45E-05	2.00E-06	2.00E-06				
Cu+2	2.64E-06	2.64E-06	4.12E-08	4.12E-08				
Fe+3	9.96E-05	9.96E-05	1.37E-06	1.37E-06				
Pb+2	7.19E-06	7.19E-06	3.67E-07	3.67E-07				
Hg+2	1.48E-02	1.48E-02	7.32E-04	7.32E-04				
Mn+4	4.69E-05	4.69E-05	6.34E-07	6.34E-07				
Ni+2	6.25E-06	6.25E-06	9.03E-08	9.03E-08				
K+	1.59E-03	1.59E-03	1.53E-05	1.53E-05				
Se+4	1.19E-06	1.19E-06	2.31E-08	2.31E-08				
Ag+	2.04E-06	2.04E-06	5.42E-08	5.42E-08				
Na+	5.28E-02	5.28E-02	2.99E-04	2.99E-04				
Tl+3	1.36E-08	1.36E-08	6.82E-10	6.82E-10				
U+4	2.59E-06	2.59E-06	1.52E-07	1.52E-07				
V+3	1.48E-07	1.48E-07	1.85E-09	1.85E-09				
Zn+2	2.82E-06	2.82E-06	4.55E-08	4.55E-08				
Zr+4	1.79E-04	1.79E-04	4.01E-06	4.01E-06				
Cl-	2.58E-03	2.58E-03	2.25E-05	2.25E-05				
F-	8.06E-03	8.06E-03	3.77E-05	3.77E-05				
SO4-2	1.89E-02	1.89E-02	4.48E-04	4.48E-04				
NO3-	1.06E+00	1.06E+00	1.60E-02	1.60E-02				
PO4-3	6.11E-04	6.11E-04	1.43E-05	1.43E-05				
Am+4	1.86E-10	1.86E-10	1.11E-11	1.11E-11				
Br-	3.42E-08	3.42E-08	6.73E-10	6.73E-10				
Ce+4	1.13E-07	1.13E-07	3.89E-09	3.89E-09				
Eu+3	1.28E-09	1.28E-09	4.80E-11	4.80E-11				
Gd+3	3.85E-07	3.85E-07	1.49E-08	1.49E-08				
Ge+4	3.60E-11	3.60E-11	6.43E-13	6.43E-13				
In+3	3.57E-09	3.57E-09	1.01E-10	1.01E-10				
I-	3.81E-07	3.81E-07	1.19E-08	1.19E-08				
La+3	2.33E-08	2.33E-08	7.96E-10	7.96E-10				

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Chemical Composition	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf	lb/wscf	lb/wscf
Li+	2.73E-06	2.73E-06	4.67E-09	4.67E-09				
Mg+2	5.80E-05	5.80E-05	3.47E-07	3.47E-07				
Mo+6	2.81E-04	2.81E-04	6.64E-06	6.64E-06				
Nd+3	7.51E-08	7.51E-08	2.66E-09	2.66E-09				
Np+4	7.79E-09	7.79E-09	4.55E-10	4.55E-10				
Nb+5	5.34E-06	5.34E-06	1.22E-07	1.22E-07				
Pd+4	5.06E-06	5.06E-06	1.33E-07	1.33E-07				
Pu+4	3.05E-08	3.05E-08	1.83E-09	1.83E-09				
Pr+4	2.12E-08	2.12E-08	7.34E-10	7.34E-10				
Pm+3	4.25E-12	4.25E-12	1.52E-13	1.52E-13				
Rh+4	9.13E-09	9.13E-09	2.31E-10	2.31E-10				
Rb+	2.49E-08	2.49E-08	5.24E-10	5.24E-10				
Ru+3	2.52E-06	2.52E-06	6.27E-08	6.27E-08				
Sm+3	1.40E-08	1.40E-08	5.18E-10	5.18E-10				
Si+4	7.40E-04	7.40E-04	3.51E-01	3.51E-01				
Sr+2	3.57E-07	3.57E-07	7.69E-09	7.69E-09				
Tc+7	6.22E-08	6.22E-08	1.50E-09	1.50E-09				
Te+4	2.64E-08	2.64E-08	8.29E-10	8.29E-10				
Tb+4	5.36E-12	5.36E-12	2.10E-13	2.10E-13				
Th+4	1.31E-07	1.31E-07	7.48E-09	7.48E-09				
Sn+4	8.84E-06	8.84E-06	2.58E-07	2.58E-07				
Ti+4	4.56E-06	4.56E-06	5.38E-08	5.38E-08				
Y+3	1.73E-08	1.73E-08	3.80E-10	3.80E-10				
OH-	1.98E-02	1.98E-02	8.27E-05	8.27E-05				
H2O	5.23E+01	5.23E+01	2.32E-01	2.32E-01				4.68E-06
SO2	1.65E-05	1.65E-05	2.60E-07	2.60E-07				
H2S								
CO	2.09E-10	2.09E-10	1.44E-12	1.44E-12				
CO2	3.33E-04	3.33E-04	3.60E-06	3.60E-06				
H2	8.76E-10	8.76E-10	4.34E-13	4.34E-13				
N2	1.28E-05	1.28E-05	8.80E-08	8.80E-08	7.27E-02			5.74E-02
NO	2.22E-07	2.22E-07	1.64E-09	1.64E-09				
NO2	2.79E-06	2.79E-06	3.16E-08	3.16E-08				
O2	3.16E-06	3.16E-06	2.49E-08	2.49E-08		8.30E-02	8.30E-02	1.74E-02
S (other)	2.19E-07	2.19E-07	1.73E-09	1.73E-09				
CO3	2.73E-05	2.73E-05	4.03E-07	4.03E-07				
C (reductant)								
O (oxides)	5.26E-03	5.26E-03	3.99E-01	3.99E-01				
C (organic)								
H (organic)								
O (organic)								
Mass Flow (kg/hr):	2.27E+01	1.00E+00	4.00E+00	4.00E+00	5.94E+02	1.82E+02	2.44E+02	2.32E+03
Total Drums Generated				31				
	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3	w/m3	w/m3
Heat Generation, w/m3	4.87E-02	4.87E-02	2.81E-02	5.62E-03				

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	401	402	404	404	503	504	505	506
Radiological Composition	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
H-3								
C-14	1.35E-15	1.35E-15	3.31E-16	1.39E-13				
Co-60	8.31E-08	8.31E-08	2.05E-08	8.59E-06				
Ni-59	3.67E-09	3.67E-09	9.04E-10	3.80E-07				
Ni-63	1.14E-07	1.14E-07	2.82E-08	1.18E-05				
Se-79	2.40E-09	2.40E-09	5.91E-10	2.48E-07				
Sr-90	1.04E-04	1.04E-04	2.55E-05	1.07E-02				
Y-90	9.86E-05	9.86E-05	2.43E-05	1.02E-02				
Zr-93	8.91E-09	8.91E-09	2.19E-09	9.21E-07				
Nb-93m	6.99E-09	6.99E-09	1.72E-09	7.23E-07				
Nb-94	6.35E-09	6.35E-09	1.56E-09	6.57E-07				
Tc-99	1.46E-07	1.46E-07	3.59E-08	1.51E-05				
Ru-106	3.18E-09	3.18E-09	7.82E-10	3.29E-07				
Rh-102	2.15E-12	2.15E-12	5.29E-13	2.22E-10				
Rh-106	3.18E-09	3.18E-09	7.82E-10	3.29E-07				
Pd-107	4.33E-11	4.33E-11	1.07E-11	4.48E-09				
Cd-113m	5.11E-09	5.11E-09	1.26E-09	5.28E-07				
Sn-121m	2.69E-10	2.69E-10	6.62E-11	2.78E-08				
Sn-126	2.26E-09	2.26E-09	5.56E-10	2.34E-07				
Sb-125	1.17E-06	1.17E-06	2.87E-07	1.21E-04				
Sb-126	1.43E-10	1.43E-10	3.53E-11	1.48E-08				
Te-125m	1.27E-08	1.27E-08	3.12E-09	1.31E-06				
I-129	8.05E-09	8.05E-09	1.98E-09	8.32E-07				
Cs-134	5.66E-05	5.66E-05	1.56E-05	6.55E-03				
Cs-135	8.92E-07	8.92E-07	2.46E-07	1.03E-04				
Cs-137	4.62E-02	4.62E-02	1.27E-02	5.35E+00				
Ba-137m	1.47E-04	1.47E-04	3.61E-05	1.52E-02				
Ce-144	2.15E-09	2.15E-09	5.28E-10	2.22E-07				
Pr-144	2.15E-09	2.15E-09	5.28E-10	2.22E-07				
Pm-146	1.27E-10	1.27E-10	3.12E-11	1.31E-08				
Pm-147	5.79E-07	5.79E-07	1.43E-07	5.99E-05				
Sm-151	1.15E-06	1.15E-06	2.82E-07	1.18E-04				
Eu-152	7.35E-09	7.35E-09	1.81E-09	7.60E-07				
Eu-154	4.39E-07	4.39E-07	1.08E-07	4.53E-05				
Eu-155	4.13E-07	4.13E-07	1.02E-07	4.27E-05				
Th-230	4.36E-12	4.36E-12	1.07E-12	4.51E-10				
Pa-233	1.18E-08	1.18E-08	2.90E-09	1.22E-06				
U-232	1.02E-11	1.02E-11	2.51E-12	1.05E-09				
U-233	3.60E-13	3.60E-13	8.85E-14	3.72E-11				
U-234	7.06E-09	7.06E-09	1.74E-09	7.30E-07				
U-235	2.85E-10	2.85E-10	7.01E-11	2.94E-08				
U-236	3.30E-10	3.30E-10	8.13E-11	3.41E-08				
U-237	2.59E-11	2.59E-11	6.37E-12	2.68E-09				
U-238	1.57E-10	1.57E-10	3.85E-11	1.62E-08				
Np-237	1.30E-09	1.30E-09	3.20E-10	1.35E-07				
Pu-236	1.66E-11	1.66E-11	4.09E-12	1.72E-09				
Pu-238	3.84E-06	3.84E-06	9.46E-07	3.97E-04				
Pu-239	4.20E-07	4.20E-07	1.03E-07	4.34E-05				
Pu-240	6.20E-08	6.20E-08	1.53E-08	6.41E-06				
Pu-241	3.36E-06	3.36E-06	8.27E-07	3.47E-04				
Pu-242	4.86E-11	4.86E-11	1.20E-11	5.02E-09				
Pu-244	1.45E-18	1.45E-18	3.56E-19	1.50E-16				
Am-241	2.03E-07	2.03E-07	5.00E-08	2.10E-05				
Am-242m	3.81E-11	3.81E-11	9.37E-12	3.94E-09				

Table A-16. Mass balance, Tank WM-189 waste (continued).

Stream #	401	402	404	404	503	504	505	506
	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm
Am-243	6.49E-11	6.49E-11	1.60E-11	6.71E-09				
Cm-242	1.23E-10	1.23E-10	3.02E-11	1.27E-08				
Cm-243	1.51E-10	1.51E-10	3.72E-11	1.56E-08				
Cm-244	6.40E-09	6.40E-09	1.57E-09	6.61E-07				
Cm-245	1.59E-12	1.59E-12	3.91E-13	1.64E-10				
Cm-246	1.04E-13	1.04E-13	2.57E-14	1.08E-11				
TRU	4.63E-06	4.63E-06	1.14E-06	4.79E-04				
TRU, nCi/gm								
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %								0.01%
O2, mol %						100.00%	100.00%	20.99%
N2, mol %					100.00%			79.00%
H2, mol %								
CO2, mol %								
CO, ppmv								
NO, ppmv								
NO2, ppmv								
SO2, ppmv								
Cl, ppmv								
F, ppmv								
C (organic), ppmv								
H (organic), ppmv								
Hg, ug/wscm								
PM, mg/wscm					1.98E+01	2.60E-01		1.57E+01
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis								20.99%
N2, mol %, dry basis								79.01%
H2, mol %, dry basis								
CO2, mol %, dry basis								
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
CO, ppmv, dry basis								
NO, ppmv, dry basis								
NO2, ppmv, dry basis								
SO2, ppmv, dry basis								
Cl, ppmv, dry basis								
F, ppmv, dry basis								
C (organic), ppmv, dry basis								
H (organic), ppmv, dry basis								
Hg, ug/dscm								
PM, mg/dscm								2.20E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-16. Mass balance, Tank WM-189 waste (continued).

PFD #	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
WM-189, Stream #	507	510	511	512	513	514	515	516
Stream Name	Off-Gas from Boiler	Nitrogen to Cool Product	N2 from Product Cooler	Filter Backpulse N2	Solids Transport Nitrogen	Tank Farm Transfer Airlift Air	Ventilation Air	Fresh GAC
Rate or Volume	1.42E+05	3.16E+02	1.00E+03	2.95E+02	7.87E+01	1.52E+01	2.89E+01	5.94E+00
Volume Flow (standard, wet)*	7.25E+04	2.13E+03	2.13E+03	8.63E+02	2.30E+02	4.46E+01	2.94E+01	
Volume Flow (standard, dry)*	6.42E+04	2.13E+03	2.13E+03	8.63E+02	2.30E+02	4.46E+01	2.94E+01	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	2.05E+03	6.03E+01	6.03E+01	2.44E+01	6.52E+00	1.26E+00	8.34E-01	2.70E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	300	0	592	15	15	15	15	25
Temperature, °F	572	32	1098	59	59	59	59	77
Pressure, psia	14.7	92.3	92.3	42.3	42.3	42.3	14.7	14.7
Specific Gravity	6.10E-04	7.85E-03	2.48E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01
Gas Stream Bulk Composition (Wet Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Wt %
H2O	11.53%					0.01%	0.01%	
O2	3.00%					20.99%	20.99%	
N2	74.11%	100.00%	100.00%	100.00%	100.00%	79.00%	79.00%	
H2	0.05%							
CO2	10.64%							
	ppmv							
CO	2.21E+03							
NO	4.30E+03							
NO2	1.97E+00							
SO2	2.40E+02							
C(organic)	4.36E-14							
H(organic)	1.74E-13							
Gas Stream Bulk Composition (Dry Basis)								
	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	
O2	3.39%					20.99%	20.99%	
N2	83.77%					79.01%	79.01%	
H2	0.05%							
CO2	12.03%							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)								
	ppmv							
CO	3.50E+02							
NO	6.80E+02							
NO2	3.12E-01							
SO2	3.80E+01							
C(organic)	6.90E-15							
H(organic)	2.76E-14							
PM, mg/dscm	2.53E+00					2.17E+00	2.20E+00	
Hg, ug/dscm								
GAC								100%

Table A-17 lists the major chemicals consumed for reforming SBW with the TWR process. Entries in the body of the table are consumption rates for processing individual tank wastes, while the final column shows the total accumulated material used for complete processing. Alumina is used as starting bed material and a total of 4 bed change-outs would require about 10,500 pounds.

Table A-17. Consumable chemicals estimate for TWR processing of SBW.

Stream	WM-180	WM-187	WM-188	WM-189	Totals	
SBW (gal/hr)	9.59E+01	9.54E+01	9.65E+01	9.73E+01	1.16E+06	gal
Gases:						
CO_2 (lb/hr)	2.98E+03	2.95E+03	2.86E+03	2.92E+03	3.51E+07	lb
N_2 (lb/hr)	1.01E+02	1.01E+02	8.91E+01	1.08E+02	1.19E+06	lb
O_2 (lb/hr)	2.79E+03	2.77E+03	2.78E+03	2.80E+03	3.34E+07	lb
Propane (lb/hr)	2.93E+02	2.93E+02	2.93E+02	2.93E+02	3.52E+06	lb
Isopropyl Alcohol (lb/hr)	6.69E+02	6.69E+02	9.86E+02	7.06E+02	9.22E+06	lb
Quench water (lb/hr)	3.84E+03	3.79E+03	3.81E+03	3.87E+03	4.60E+07	lb
Nitric acid (lb/hr)	6.13E+00	6.13E+00	6.13E+00	6.13E+00	7.35E+04	lb
Processing time (hrs)	3.28E+03	2.10E+03	3.38E+03	3.24E+03	1.20E+04	hr

Table A-18 summarizes the production rate of reformer product and the associated packaging rate for TWR. The values in the table assume a densification operation is used to increase the product's bulk density from about 0.15 to 1.42 g/ml (89 lb/ft3). The table also summarizes the estimated decay heat and TRU activity of the final waste.

Table A-18. Summary of estimated waste product quantities and properties for TWR processing of SBW.

	WM-180	WM-187	WM-188	WM-189	Total
Product mass rate (lb/hr)	115	134	115	138	
Processing time (hr)	3,280	2,100	3,380	3,240	12,000
Canister filling rate (can/day)[a]	1.11	1.29	1.11	1.32	
Number of canisters[a,b]	152	113	156	178	599
Heat generation (W/m^3)	2.64	3.38	3.65	3.88	
Heat per canister (W/can)	2.12	2.71	2.92	3.10	
TRU specific activity (nCi/g)	7,600	6,770	6,410	5,540	

[a]Waste specific gravity assumed as 1.42.
[b]A canister contains 0.8 m^3 waste.

The estimated spent scrub quantities and treatment process are the same for the TWR and TTT processes.

Mass balances for Tanks WM-180, WM-187, WM-188 and WM-189 are shown below in Tables A-19, A-20, A-21, and A-22, respectively.

Table A-19. Mass balance, Tank WM-180 waste.

Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Filter Drain	Bed Drain	Cooled Product
Rate or Volume	9.59E+01	1.67E+02	2.20E+05	1.81E+05	7.19E+00	1.08E+02	1.15E+02
Volume Flow (standard, wet)*			5.35E+04	5.49E+04			
Volume Flow (standard, dry)*			3.70E+04	3.84E+04			
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	3.63E+02	6.33E+02	1.51E+03	1.55E+03	3.26E+00	4.90E+01	5.23E+01
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	17	600	400	400	600	56
Temperature, °F	59	63	1112	752	752	1112	133
Pressure, psia	14.70	44.70	10.62	10.22	9.50	10.80	9.50
Specific Gravity	1.20	1.20	3.31E-04	4.12E-04	0.79	1.46	1.42
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt Frac	Wt Frac	Wt frac
H+	1.03E+00	6.19E-01	1.31E-06	1.28E-06	2.22E-05	7.75E-05	7.41E-05
Al+3	5.38E-01	3.09E-01	1.32E-05	1.28E-05	9.81E-02	1.07E-01	1.06E-01
Sb+5	1.28E-06	7.37E-07	1.35E-10	1.31E-10	1.00E-06	1.09E-06	1.09E-06
As+3	4.12E-04	2.37E-04	2.67E-08	2.60E-08	1.98E-04	2.16E-04	2.15E-04
Ba+2	4.61E-05	2.64E-05	4.96E-09	4.83E-09	3.69E-05	4.45E-05	4.40E-05
Be+2	7.21E-06	4.14E-06	5.09E-11	4.96E-11	3.78E-07	4.56E-07	4.51E-07
B+3	9.59E-03	5.51E-03	8.95E-08	8.73E-08	6.66E-04	7.25E-04	7.21E-04
Cd+2	6.60E-04	3.79E-04	2.60E-07	2.53E-07	1.93E-03	4.21E-04	5.16E-04
Ca+2	3.41E-02	1.95E-02	1.07E-06	1.04E-06	7.95E-03	9.59E-03	9.49E-03
Cr+3	3.10E-03	1.78E-03	1.93E-07	1.88E-07	1.43E-03	1.10E-03	1.12E-03
Co+2	1.69E-05	9.69E-06	8.59E-10	8.37E-10	6.39E-06	6.95E-06	6.91E-06
Cs+	2.37E-05	1.36E-05	1.84E-08	1.79E-08	1.37E-04	1.43E-05	2.19E-05
Cu+2	5.83E-04	3.34E-04	2.90E-08	2.83E-08	2.16E-04	2.60E-04	2.57E-04
Fe+3	1.77E-02	1.02E-02	1.26E-06	1.22E-06	9.31E-03	6.72E-03	6.88E-03
Pb+2	1.16E-03	6.68E-04	8.44E-07	8.23E-07	6.28E-03	1.37E-03	1.68E-03
Hg+2	1.35E-03	1.83E-03	9.55E-06	9.31E-06	7.10E-05	4.73E-06	8.87E-06
Mn+4	1.17E-02	6.74E-03	5.57E-07	5.43E-07	4.14E-03	4.51E-03	4.49E-03
Ni+2	1.28E-03	7.34E-04	5.88E-08	5.73E-08	4.37E-04	5.28E-04	5.22E-04
K+	1.62E-01	9.31E-02	8.08E-06	7.88E-06	6.01E-02	4.30E-02	4.41E-02
Se+4	7.08E-05	4.06E-05	4.82E-09	4.70E-09	3.59E-05	3.90E-05	3.88E-05
Ag+	5.61E-06	3.22E-06	4.98E-10	4.86E-10	3.71E-06	4.23E-06	4.20E-06
Na+	1.74E+00	9.99E-01	3.30E-05	3.22E-05	2.45E-01	2.80E-01	2.78E-01
Tl+3	2.53E-05	1.45E-05	4.47E-09	4.36E-09	3.33E-05	3.62E-05	3.60E-05
U+4	3.33E-04	1.91E-04	6.84E-08	6.67E-08	5.09E-04	5.54E-04	5.51E-04
V+3	8.08E-04	4.63E-04	3.55E-08	3.46E-08	2.64E-04	2.87E-04	2.86E-04
Zn+2	8.77E-04	5.03E-04	4.49E-08	4.38E-08	3.34E-04	4.03E-04	3.98E-04
Zr+4	1.22E-03	7.00E-04	9.60E-08	9.36E-08	7.14E-04	7.77E-04	7.73E-04
Cl-	2.64E-02	1.51E-02	8.47E-07	8.26E-07	5.92E-03	6.51E-03	6.48E-03
F-	3.71E-02	2.15E-02	1.22E-06	1.19E-06	4.08E-03	4.66E-03	4.63E-03
SO4-2	4.58E-02	2.63E-02	1.55E-12	1.51E-12	1.15E-08	1.32E-08	1.31E-08
NO3-	4.51E+00	2.61E+00	1.28E-06	1.25E-06	9.55E-03	3.49E-03	3.86E-03
PO4-3	1.80E-02	1.03E-02	1.48E-06	1.44E-06	1.10E-02	1.19E-02	1.19E-02
Am+4	2.91E-08	1.67E-08	6.12E-12	5.96E-12	4.55E-08	4.95E-08	4.93E-08
Br-	1.43E-07	8.23E-08	1.04E-11	1.01E-11	7.26E-08	7.98E-08	7.94E-08
Ce+4	4.02E-05	2.31E-05	4.86E-09	4.74E-09	3.62E-05	3.94E-05	3.92E-05
Eu+3	2.38E-07	1.37E-07	3.12E-11	3.04E-11	2.32E-07	2.53E-07	2.51E-07
Gd+3	1.48E-04	8.51E-05	2.01E-08	1.96E-08	1.50E-04	1.63E-04	1.62E-04
Ge+4	4.13E-09	2.37E-09	2.59E-13	2.52E-13	1.93E-09	2.10E-09	2.09E-09
In+3	6.51E-07	3.74E-07	6.45E-11	6.29E-11	4.80E-07	5.22E-07	5.20E-07
I-	1.24E-06	7.14E-07	1.43E-10	1.39E-10	1.00E-06	1.10E-06	1.09E-06
La+3	4.32E-06	2.48E-06	5.18E-10	5.05E-10	3.85E-06	4.19E-06	4.17E-06

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	106	107	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac
Li+	4.10E-04	2.35E-04	2.34E-09	2.28E-09	1.74E-05	1.99E-05	1.98E-05
Mg+2	1.01E-02	5.82E-03	1.93E-07	1.88E-07	1.43E-03	1.73E-03	1.71E-03
Mo+6	1.52E-03	8.69E-04	1.25E-07	1.22E-07	9.33E-04	1.02E-03	1.01E-03
Nd+3	1.39E-05	8.00E-06	1.73E-09	1.69E-09	1.29E-05	1.40E-05	1.40E-05
Np+4	8.05E-06	4.62E-06	1.65E-09	1.61E-09	1.23E-05	1.33E-05	1.33E-05
Nb+5	4.12E-04	2.36E-04	3.30E-08	3.22E-08	2.45E-04	2.67E-04	2.66E-04
Pd+4	2.89E-05	1.66E-05	2.40E-09	2.34E-09	1.79E-05	2.16E-05	2.13E-05
Pu+4	9.29E-06	5.33E-06	1.96E-09	1.91E-09	1.45E-05	1.58E-05	1.58E-05
Pr+4	3.93E-06	2.25E-06	4.78E-10	4.66E-10	3.55E-06	3.87E-06	3.85E-06
Pm+3	5.95E-10	3.42E-10	7.45E-14	7.26E-14	5.54E-10	6.03E-10	6.00E-10
Rh+4	1.69E-06	9.73E-07	1.51E-10	1.47E-10	1.12E-06	1.22E-06	1.21E-06
Rb+	2.61E-06	1.50E-06	1.84E-10	1.79E-10	1.37E-06	1.56E-06	1.55E-06
Ru+3	1.16E-04	6.68E-05	1.02E-08	9.90E-09	7.56E-05	8.22E-05	8.18E-05
Sm+3	2.58E-06	1.48E-06	3.35E-10	3.27E-10	2.50E-06	2.72E-06	2.70E-06
Si+4	2.84E-03	1.63E-03	6.88E-08	6.70E-08	5.11E-04	5.57E-04	5.54E-04
Sr+2	9.93E-05	5.70E-05	6.81E-09	6.64E-09	5.06E-05	6.11E-05	6.04E-05
Tc+7	4.89E-06	2.81E-06	3.77E-09	3.67E-09	2.80E-05	1.69E-06	3.33E-06
Te+4	1.36E-06	7.78E-07	1.49E-10	1.46E-10	1.11E-06	1.21E-06	1.20E-06
Tb+4	9.94E-10	5.71E-10	1.36E-13	1.33E-13	1.01E-09	1.10E-09	1.10E-09
Th+4	9.69E-11	5.56E-11	1.94E-14	1.89E-14	1.44E-10	1.57E-10	1.56E-10
Sn+4	6.81E-05	3.91E-05	6.97E-09	6.80E-09	5.19E-05	5.65E-05	5.62E-05
Ti+4	1.24E-04	7.11E-05	5.12E-09	4.99E-09	3.81E-05	4.15E-05	4.12E-05
Y+3	3.22E-06	1.85E-06	2.47E-10	2.41E-10	1.84E-06	2.00E-06	1.99E-06
OH-		3.86E-08	3.01E-10	2.94E-10	2.24E-06	1.61E-06	1.65E-06
H2O	4.68E+01	2.85E+01	1.44E-02	1.40E-02	5.02E-03	3.25E-03	3.36E-03
SO2		2.44E-08	1.62E-12	1.58E-12			
H2S			2.15E-05	2.10E-05			
CO		8.72E-11	3.53E-04	3.44E-04			
CO2		6.64E-06	6.21E-02	6.06E-02			
H2		5.59E-10	5.60E-04	5.46E-04			
N2		2.04E-10	9.44E-04	2.76E-03			
NO		2.82E-09	1.41E-04	1.38E-04			
NO2		4.27E-07	2.06E-06	2.01E-06			
O2		7.02E-10					
S (other)		3.46E-10	9.36E-08	9.12E-08	6.96E-04	7.95E-04	7.89E-04
CO3	1.19E-05	6.81E-06	4.98E-05	4.86E-05	3.71E-01	4.05E-01	4.03E-01
C (reductant)							
O (oxides)	5.00E-02	2.87E-02	1.32E-05	1.28E-05	9.78%	10.41%	10.37%
C (organic)	4.11E-03	2.39E+01	5.44E-03	5.30E-03	5.52E-02	8.48E-04	4.24E-03
H (organic)	1.10E-02	6.38E+01	1.02E-03	9.94E-04	9.84E-03	1.51E-04	7.56E-04
O (organic)	1.37E-03	7.97E+00					
Mass Flow (kg/hr):	4.36E+02	7.60E+02	2.07E+03	2.11E+03	3.26E+00	4.90E+01	5.23E+01
Canister Rate, canisters/day							1.11
Total Canisters Generated							151
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	2.68E-01	1.54E-01			2.02E+00	2.66E+00	2.64E+00

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
H-3	1.59E-05	9.12E-06	3.81E-06	3.71E-06			
C-14	5.71E-11	3.28E-11	1.36E-11	1.33E-11	4.87E-12	3.08E-12	3.19E-12
Co-60	3.66E-06	2.10E-06	5.06E-08	4.93E-08	2.35E-05	2.56E-05	2.55E-05
Ni-59	8.43E-08	4.83E-08	1.06E-09	1.03E-09	4.91E-07	5.92E-07	5.85E-07
Ni-63	2.22E-05	1.27E-05	2.79E-07	2.72E-07	1.29E-04	1.56E-04	1.54E-04
Se-79	2.08E-07	1.19E-07	2.87E-09	2.80E-09	1.33E-06	1.45E-06	1.44E-06
Sr-90	1.80E-02	1.03E-02	2.25E-04	2.19E-04	1.05E-01	1.26E-01	1.25E-01
Y-90	1.80E-02	1.03E-02	2.48E-04	2.42E-04	1.15E-01	1.26E-01	1.25E-01
Zr-93	1.01E-06	5.77E-07	1.39E-08	1.35E-08	6.45E-06	7.02E-06	6.98E-06
Nb-93m	7.75E-07	4.44E-07	1.07E-08	1.04E-08	4.97E-06	5.41E-06	5.38E-06
Nb-94	5.42E-07	3.11E-07	7.49E-09	7.30E-09	3.48E-06	3.78E-06	3.76E-06
Tc-99	8.31E-06	4.77E-06	1.05E-06	1.02E-06	4.85E-04	2.92E-05	5.77E-05
Ru-106	4.43E-07	2.54E-07	6.12E-09	5.97E-09	2.84E-06	3.09E-06	3.08E-06
Rh-102	3.91E-10	2.25E-10	5.41E-12	5.27E-12	2.51E-09	2.73E-09	2.72E-09
Rh-106	4.43E-07	2.54E-07	6.12E-09	5.97E-09	2.84E-06	3.09E-06	3.08E-06
Pd-107	7.50E-09	4.30E-09	9.40E-11	9.16E-11	4.36E-08	5.26E-08	5.21E-08
Cd-113m	1.51E-06	8.64E-07	8.45E-08	8.23E-08	3.92E-05	8.56E-06	1.05E-05
Sn-121m	3.03E-08	1.74E-08	4.19E-10	4.09E-10	1.95E-07	2.12E-07	2.11E-07
Sn-126	1.95E-07	1.12E-07	2.70E-09	2.63E-09	1.25E-06	1.36E-06	1.36E-06
Sb-125	7.28E-06	4.18E-06	1.01E-07	9.82E-08	4.68E-05	5.09E-05	5.06E-05
Sb-126	2.61E-08	1.50E-08	3.61E-10	3.52E-10	1.68E-07	1.82E-07	1.81E-07
Te-125m	1.43E-06	8.20E-07	1.97E-08	1.92E-08	9.17E-06	9.98E-06	9.93E-06
I-129	2.21E-08	1.27E-08	3.21E-10	3.13E-10	1.40E-07	1.54E-07	1.53E-07
Cs-134	4.73E-06	2.71E-06	4.41E-07	4.30E-07	2.05E-04	2.14E-05	3.28E-05
Cs-135	4.07E-07	2.33E-07	3.80E-08	3.70E-08	1.76E-05	1.84E-06	2.83E-06
Cs-137	2.38E-02	1.37E-02	2.22E-03	2.17E-03	1.03E+00	1.08E-01	1.66E-01
Ba-137m	2.26E-02	1.29E-02	2.83E-04	2.76E-04	1.31E-01	1.58E-01	1.57E-01
Ce-144	2.98E-07	1.71E-07	4.13E-09	4.02E-09	1.92E-06	2.09E-06	2.08E-06
Pr-144	2.98E-07	1.71E-07	4.13E-09	4.02E-09	1.92E-06	2.09E-06	2.08E-06
Pm-146	2.31E-08	1.33E-08	3.19E-10	3.11E-10	1.48E-07	1.61E-07	1.61E-07
Pm-147	8.10E-05	4.65E-05	1.12E-06	1.09E-06	5.20E-04	5.66E-04	5.63E-04
Sm-151	1.60E-04	9.17E-05	2.21E-06	2.15E-06	1.03E-03	1.12E-03	1.11E-03
Eu-152	1.16E-06	6.64E-07	1.60E-08	1.56E-08	7.43E-06	8.08E-06	8.04E-06
Eu-154	4.15E-05	2.38E-05	5.74E-07	5.59E-07	2.66E-04	2.90E-04	2.89E-04
Eu-155	7.55E-05	4.33E-05	1.04E-06	1.02E-06	4.85E-04	5.28E-04	5.25E-04
Th-230	3.96E-10	2.27E-10	5.47E-12	5.33E-12	2.54E-09	2.76E-09	2.75E-09
Pa-233	1.33E-06	7.63E-07	1.84E-08	1.79E-08	8.53E-06	9.29E-06	9.24E-06
U-232	9.54E-10	5.47E-10	1.32E-11	1.28E-11	6.12E-09	6.66E-09	6.63E-09
U-233	3.72E-11	2.13E-11	5.14E-13	5.01E-13	2.39E-10	2.60E-10	2.58E-10
U-234	9.56E-07	5.48E-07	1.32E-08	1.29E-08	6.13E-06	6.67E-06	6.64E-06
U-235	3.49E-08	2.00E-08	4.82E-10	4.70E-10	2.24E-07	2.44E-07	2.43E-07
U-236	5.18E-08	2.97E-08	7.16E-10	6.98E-10	3.32E-07	3.62E-07	3.60E-07
U-237	2.92E-09	1.68E-09	4.04E-11	3.93E-11	1.87E-08	2.04E-08	2.03E-08
U-238	2.06E-08	1.18E-08	2.85E-10	2.78E-10	1.32E-07	1.44E-07	1.43E-07
Np-237	1.34E-06	7.72E-07	1.86E-08	1.81E-08	8.64E-06	9.40E-06	9.35E-06
Pu-236	1.91E-09	1.10E-09	2.65E-11	2.58E-11	1.23E-08	1.34E-08	1.33E-08
Pu-238	8.73E-04	5.01E-04	1.21E-05	1.18E-05	5.60E-03	6.10E-03	6.07E-03
Pu-239	1.33E-04	7.60E-05	1.83E-06	1.78E-06	8.50E-04	9.25E-04	9.21E-04
Pu-240	7.19E-06	4.12E-06	9.94E-08	9.68E-08	4.61E-05	5.02E-05	5.00E-05
Pu-241	5.26E-04	3.02E-04	7.27E-06	7.09E-06	3.38E-03	3.67E-03	3.65E-03
Pu-242	5.54E-09	3.18E-09	7.66E-11	7.47E-11	3.56E-08	3.87E-08	3.85E-08
Pu-244	4.75E-16	2.72E-16	6.56E-18	6.40E-18	3.05E-15	3.32E-15	3.30E-15
Am-241	6.32E-05	3.63E-05	8.75E-07	8.53E-07	4.06E-04	4.42E-04	4.40E-04
Am-242m	6.90E-09	3.96E-09	9.55E-11	9.31E-11	4.43E-08	4.82E-08	4.80E-08

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
Am-243	1.00E-08	5.75E-09	1.39E-10	1.35E-10	6.43E-08	7.00E-08	6.97E-08
Cm-242	5.69E-09	3.27E-09	7.87E-11	7.67E-11	3.65E-08	3.98E-08	3.96E-08
Cm-243	1.64E-08	9.39E-09	2.26E-10	2.21E-10	1.05E-07	1.14E-07	1.14E-07
Cm-244	1.02E-06	5.84E-07	1.41E-08	1.37E-08	6.53E-06	7.10E-06	7.07E-06
Cm-245	1.72E-10	9.88E-11	2.38E-12	2.32E-12	1.11E-09	1.20E-09	1.20E-09
Cm-246	1.13E-11	6.49E-12	1.56E-13	1.52E-13	7.26E-11	7.90E-11	7.86E-11
TRU	1.09E-03	6.27E-04	1.51E-05	1.47E-05	7.02E-03	7.64E-03	7.60E-03
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			30.81%	30.03%			
O2, mol %							
N2, mol %			1.30%	3.80%			
H2, mol %			10.70%	10.43%			
CO2, mol %			54.40%	53.02%			
COgas, ppmv			4.85E+03	4.73E+03			
NO, ppmv			1.81E+03	1.77E+03			
NO2, ppmv			1.73E+01	1.68E+01			
SO2, ppmv			9.76E-06	9.52E-06			
Cl, ppmv			9.21E+00	8.97E+00			
F, ppmv			2.47E+01	2.41E+01			
C (organic), ppmv			1.74E+05	1.70E+05			
H (organic), ppmv			3.90E+05	3.80E+05			
Hg, ug/wscm			1.53E+05	1.49E+05			
PM, mg/wscm			1.06E+05	1.03E+05			
SVM, ug/wscm			1.77E+04	1.72E+04			
LVM, ug/wscm			3.52E+03	3.43E+03			
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis			1.88%	5.43%			
H2, mol %, dry basis			15.46%	14.90%			
CO2, mol %, dry basis			78.62%	75.77%			
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			9.82E+02	9.46E+02			
NO, ppmv, dry basis			3.67E+02	3.54E+02			
NO2, ppmv, dry basis			3.50E+00	3.37E+00			
SO2, ppmv, dry basis			1.98E-06	1.90E-06			
Cl, ppmv, dry basis			1.86E+00	1.80E+00			
F, ppmv, dry basis			5.00E+00	4.82E+00			
C (organic), ppmv, dry basis			3.53E+04	3.40E+04			
H (organic), ppmv, dry basis			7.89E+04	7.60E+04			
Hg, ug/dscm			3.10E+04	2.98E+04			
PM, mg/dscm			2.14E+04	2.06E+04			
SVM, ug/dscm			2.56E+04	2.49E+04			
LVM, ug/dscm			5.08E+03	4.96E+03			

Table A-19. Mass balance, Tank WM-180 waste (continued).

PFD Number	PFD-2	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	108	109	110	111	112	113A	113B	114
Stream Name	Product Shipping Canisters	Off-Gas from Filter to Oxidizer	Outlet of Oxidizer	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Off-Gas to Demister
Rate or Volume	1.11E+00	1.96E+05	6.48E+05	3.58E+05	9.82E+03	9.84E+03	0	3.60E+05
Volume Flow (standard, wet)*		5.55E+04	9.54E+04	1.78E+05				1.76E+05
Volume Flow (standard, dry)*		3.90E+04	5.25E+04	5.25E+04				5.23E+04
Rate Units	cont/day	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr
Rate or Volume, metric	5.23E+01	1.57E+03	2.70E+03	5.03E+03	3.72E+04	3.72E+04	0	4.98E+03
Rate Units	kg/hr	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr
Temperature, °C	56	397	1000	100	77	79	338	78
Temperature, °F	133	747	1832	212	171	174	170	172
Pressure, psia	9.50	9.50	9.39	9.28	37.52	8.96	8.42	8.60
Specific Gravity	1.42	3.83E-04	1.92E-04	5.20E-04	1.02	1.02	1.02	5.16E-04
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
H+	7.41E-05	1.26E-06	2.08E-08	1.12E-08	9.72E-01	9.70E-01		1.23E-07
Al+3	1.06E-01				1.08E-02	1.08E-02		
Sb+5	1.09E-06				2.46E-08	2.45E-08		
As+3	2.15E-04				7.90E-06	7.89E-06		
Ba+2	4.40E-05							
Be+2	4.51E-07							
B+3	7.21E-04				1.84E-04	1.83E-04		
Cd+2	5.16E-04							
Ca+2	9.49E-03							
Cr+3	1.12E-03							
Co+2	6.91E-06				3.23E-07	3.23E-07		
Cs+	2.19E-05							
Cu+2	2.57E-04							
Fe+3	6.88E-03	3.79E-09	2.21E-09	1.19E-09	7.26E-05	7.26E-05		
Pb+2	1.68E-03							
Hg+2	8.87E-06	9.19E-06	5.35E-06	2.87E-06	3.30E-02	3.30E-02		1.14E-06
Mn+4	4.49E-03				2.25E-04	2.24E-04		
Ni+2	5.22E-04							
K+	4.41E-02							
Se+4	3.88E-05							
Ag+	4.20E-06							
Na+	2.78E-01							
Tl+3	3.60E-05				4.85E-07	4.84E-07		
U+4	5.51E-04							
V+3	2.86E-04							
Zn+2	3.98E-04							
Zr+4	7.73E-04							
Cl-	6.48E-03	4.92E-08	2.87E-08	1.54E-08	5.43E-04	5.43E-04		9.46E-09
F-	4.63E-03	6.46E-07	3.76E-07	2.02E-07	5.99E-03	5.98E-03		1.75E-07
SO4-2	1.31E-08		1.48E-10	7.96E-11				
NO3-	3.86E-03	9.65E-12	5.66E-12	3.04E-12	8.77E-01	8.75E-01		6.99E-06
PO4-3	1.19E-02							
Am+4	4.93E-08				5.58E-10	5.57E-10		
Br-	7.94E-08	6.04E-13	3.51E-13	1.89E-13	2.95E-09	2.95E-09		1.16E-13
Ce+4	3.92E-05				7.70E-07	7.68E-07		
Eu+3	2.51E-07				4.55E-09	4.55E-09		
Gd+3	1.62E-04				2.84E-06	2.83E-06		
Ge+4	2.09E-09							
In+3	5.20E-07				1.25E-08	1.24E-08		
I-	1.09E-06	8.31E-12	4.84E-12	2.60E-12	2.56E-08	2.56E-08		1.60E-12
La+3	4.17E-06				8.27E-08	8.26E-08		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
Li+	1.98E-05							
Mg+2	1.71E-03							
Mo+6	1.01E-03							
Nd+3	1.40E-05				2.67E-07	2.66E-07		
Np+4	1.33E-05				1.54E-07	1.54E-07		
Nb+5	2.66E-04							
Pd+4	2.13E-05							
Pu+4	1.58E-05							
Pr+4	3.85E-06				7.52E-08	7.51E-08		
Pm+3	6.00E-10				1.14E-11	1.14E-11		
Rh+4	1.21E-06				3.24E-08	3.24E-08		
Rb+	1.55E-06							
Ru+3	8.18E-05				2.23E-06	2.23E-06		
Sm+3	2.70E-06				4.95E-08	4.94E-08		
Si+4	5.54E-04							
Sr+2	6.04E-05							
Tc+7	3.33E-06	7.62E-12	4.44E-12	2.38E-12	8.21E-08	8.20E-08		
Te+4	1.20E-06							
Tb+4	1.10E-09				1.90E-11	1.90E-11		
Th+4	1.56E-10							
Sn+4	5.62E-05							
Ti+4	4.12E-05							
Y+3	1.99E-06				6.17E-08	6.16E-08		
OH-	1.65E-06		6.56E-21	3.69E-11	1.21E-06	1.21E-06		
H2O	3.36E-03	1.39E-02	2.10E-02	3.29E-02	5.31E+01	5.31E+01		3.30E-02
SO2		1.56E-12	2.27E-05	1.22E-05	7.64E-07	8.04E-07		1.23E-05
H2S		2.08E-05	6.72E-21	3.61E-21				
CO		3.40E-04	2.14E-08	1.15E-08	2.73E-09	2.82E-09		1.16E-08
CO2		5.99E-02	5.55E-02	2.98E-02	2.08E-04	3.11E-04		3.01E-02
H2		5.39E-04	8.14E-10	4.37E-10	1.75E-08	1.48E-08		1.32E-08
N2		3.57E-03	2.13E-03	1.14E-03	6.38E-09	2.47E-07		1.15E-03
NO		1.36E-04	1.95E-05	1.05E-05	8.82E-08	1.39E-07		1.05E-05
NO2		1.99E-06	1.16E-06	6.22E-07	1.34E-05	1.34E-05		6.27E-07
O2			2.89E-03	1.55E-03	2.20E-08	5.05E-07		1.57E-03
S (other)	7.89E-04				1.08E-08	1.12E-08		
CO3	4.03E-01				1.19E-10	1.77E-10		
C (reductant)			2.23E-17	1.20E-17				
O (oxides)	10.37%	1.63E-09	9.51E-10	5.11E-10	1.09E-04	1.09E-04		
C (organic)		5.23E-03						
H (organic)		9.81E-04						
O (organic)								
Mass Flow (kg/hr):	5.23E+01	2.13E+03	3.53E+03	5.27E+03	3.79E+04	3.79E+04		5.25E+03
Canister Rate, canisters/day								
Total Canisters Generated								
	w/Canister	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	2.12E+00				1.95E-03	1.94E-03		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
H-3		3.67E-06	2.14E-06	1.15E-06	2.02E-06	2.01E-06		1.15E-06
C-14	3.62E-09	1.31E-11	7.63E-12	4.10E-12	7.84E-17	1.17E-16		4.13E-12
Co-60	2.89E-02				7.01E-08	7.00E-08		
Ni-59	6.64E-04							
Ni-63	1.75E-01							
Se-79	1.64E-03							
Sr-90	1.42E+02							
Y-90	1.42E+02				3.44E-04	3.43E-04		
Zr-93	7.92E-03							
Nb-93m	6.11E-03							
Nb-94	4.27E-03							
Tc-99	6.55E-02	2.12E-09	1.23E-09	6.62E-10	1.40E-07	1.39E-07		
Ru-106	3.49E-03				8.48E-09	8.47E-09		
Rh-102	3.09E-06				7.49E-12	7.48E-12		
Rh-106	3.49E-03				8.48E-09	8.47E-09		
Pd-107	5.91E-05							
Cd-113m	1.19E-02							
Sn-121m	2.39E-04							
Sn-126	1.54E-03							
Sb-125	5.75E-02				1.39E-07	1.39E-07		
Sb-126	2.06E-04				5.00E-10	4.99E-10		
Te-125m	1.13E-02							
I-129	1.74E-04	1.87E-11	1.09E-11	5.83E-12	4.56E-10	4.55E-10		3.58E-12
Cs-134	3.73E-02							
Cs-135	3.21E-03							
Cs-137	1.88E+02							
Ba-137m	1.78E+02							
Ce-144	2.36E-03				5.72E-09	5.71E-09		
Pr-144	2.36E-03				5.72E-09	5.71E-09		
Pm-146	1.82E-04				4.42E-10	4.42E-10		
Pm-147	6.39E-01				1.55E-06	1.55E-06		
Sm-151	1.26E+00				3.06E-06	3.05E-06		
Eu-152	9.12E-03				2.21E-08	2.21E-08		
Eu-154	3.27E-01				7.95E-07	7.93E-07		
Eu-155	5.96E-01				1.45E-06	1.44E-06		
Th-230	3.12E-06							
Pa-233	1.05E-02							
U-232	7.52E-06							
U-233	2.93E-07							
U-234	7.53E-03							
U-235	2.75E-04							
U-236	4.08E-04							
U-237	2.30E-05							
U-238	1.63E-04							
Np-237	1.06E-02				2.58E-08	2.57E-08		
Pu-236	1.51E-05							
Pu-238	6.88E+00							
Pu-239	1.04E+00							
Pu-240	5.67E-02							
Pu-241	4.15E+00							
Pu-242	4.37E-05							
Pu-244	3.74E-12							
Am-241	4.99E-01				1.21E-06	1.21E-06		
Am-242m	5.45E-05				1.32E-10	1.32E-10		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
Am-243	7.91E-05				1.92E-10	1.92E-10		
Cm-242	4.49E-05							
Cm-243	1.29E-04							
Cm-244	8.02E-03							
Cm-245	1.36E-06							
Cm-246	8.92E-08							
TRU	8.62E+00				1.24E-06	1.24E-06		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %		29.69%	44.95%	70.43%				70.26%
O2, mol %			3.4827%	1.8707%				1.8811%
N2, mol %		4.92%	2.92%	1.57%				1.58%
H2, mol %		10.31%	0.00002%	0.00001%				0.0003%
CO2, mol %		52.43%	48.60%	26.10%				26.25%
COgas, ppmv		4.68E+03	2.95E-01	1.58E-01				1.59E-01
NO, ppmv		1.75E+03	2.50E+02	1.34E+02				1.35E+02
NO2, ppmv		1.67E+01	9.70E+00	5.21E+00				5.23E+00
SO2, ppmv		9.41E-06	1.37E+02	7.34E+01				7.38E+01
Cl, ppmv		5.35E-01	3.11E-01	1.67E-01				1.02E-01
F, ppmv		1.31E+01	7.63E+00	4.10E+00				3.54E+00
C (organic), ppmv		1.68E+05						
H (organic), ppmv		3.75E+05						
Hg, ug/wscm		1.47E+05	8.57E+04	4.60E+04				
PM, mg/wscm		9.97E+04	9.19E+01	5.45E+01				8.63E+00
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			6.3267%	6.3267%				6.3262%
N2, mol %, dry basis		6.99%	5.31%	5.31%				5.31%
H2, mol %, dry basis		14.66%	0.00003%	0.00003%				0.001%
CO2, mol %, dry basis		74.57%	88.29%	88.29%				88.27%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis		9.31E+02	7.50E-02	7.50E-02				7.50E-02
NO, ppmv, dry basis		3.48E+02	6.36E+01	6.36E+01				6.36E+01
NO2, ppmv, dry basis		3.32E+00	2.47E+00	2.47E+00				2.47E+00
SO2, ppmv, dry basis		1.87E-06	3.48E+01	3.48E+01				3.48E+01
Cl, ppmv, dry basis		1.07E-01	7.93E-02	7.93E-02				4.83E-02
F, ppmv, dry basis		2.61E+00	1.94E+00	1.94E+00				1.67E+00
C (organic), ppmv, dry basis		3.34E+04						
H (organic), ppmv, dry basis		7.47E+04						
Hg, ug/dscm		2.93E+04	2.18E+04	2.18E+04				
PM, mg/dscm		1.98E+04	2.34E+01	2.58E+01				4.07E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-19. Mass balance, Tank WM-180 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	115	116	117	118	119	120
Stream Name	Scrubbed Off-Gas to Preheater	Preheated Off-gas to GAC	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-gas to Exhaust Blower	Spent GAC
Rate or Volume	3.93E+05	4.86E+05	1.57E+04	5.91E+05	6.32E+05	3.38E+00
Volume Flow (standard, wet)*	1.77E+05	1.77E+05	1.55E+04	1.77E+05	1.92E+05	
Volume Flow (standard, dry)*	5.25E+04	5.25E+04	1.55E+04	5.25E+04	6.79E+04	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	5.00E+03	5.00E+03	4.38E+02	5.00E+03	5.43E+03	1.53E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	77	120	25	120	114	28
Temperature, °F	170	248	77	248	237	82
Pressure, psia	7.88	7.16	14.70	5.89	5.89	14.70
Specific Gravity	4.72E-04	3.81E-04	1.18E-03	3.14E-04	3.23E-04	5.86E-01
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
H+	1.23E-07	1.23E-07		1.22E-07	1.13E-07	1.03E-05
Al+3						
Sb+5						
As+3						
Ba+2						
Be+2						
B+3						
Cd+2						
Ca+2						
Cr+3						
Co+2						
Cs+						
Cu+2						
Fe+3						
Pb+2						
Hg+2	1.14E-06	1.14E-06		1.52E-09	1.40E-09	5.93E-02
Mn+4						
Ni+2						
K+						
Se+4						
Ag+						
Na+						
Tl+3						
U+4						
V+3						
Zn+2						
Zr+4						
Cl-	9.42E-09	9.42E-09		2.46E-09	2.27E-09	3.64E-04
F-	1.75E-07	1.75E-07		1.75E-07	1.61E-07	
SO4-2						
NO3-	6.96E-06	6.96E-06		6.96E-06	6.41E-06	
PO4-3						
Am+4						
Br-	1.16E-13	1.16E-13		3.01E-14	2.78E-14	4.46E-09
Ce+4						
Eu+3						
Gd+3						
Ge+4						
In+3						
I-	1.59E-12	1.59E-12		4.15E-13	3.82E-13	6.14E-08
La+3						

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	115	116	117	118	119	120
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
Li+						
Mg+2						
Mo+6						
Nd+3						
Np+4						
Nb+5						
Pd+4						
Pu+4						
Pr+4						
Pm+3						
Rh+4						
Rb+						
Ru+3						
Sm+3						
Si+4						
Sr+2						
Tc+7						
Te+4						
Tb+4						
Th+4						
Sn+4						
Ti+4						
Y+3						
OH-						
H2O	3.29E-02	3.29E-02	4.68E-06	3.29E-02	3.03E-02	
SO2	1.23E-05	1.23E-05		1.23E-05	1.13E-05	
H2S						
CO	1.16E-08	1.16E-08		1.16E-08	1.07E-08	
CO2	3.00E-02	3.00E-02		3.00E-02	2.76E-02	
H2						
N2	1.15E-03	1.15E-03	5.75E-02	1.15E-03	5.69E-03	
NO	1.05E-05	1.05E-05		1.05E-05	9.68E-06	
NO2	6.25E-07	6.25E-07		6.25E-07	5.76E-07	
O2	1.56E-03	1.56E-03	1.74E-02	1.56E-03	2.84E-03	
S (other)						
CO3						
C (reductant)						9.40E-01
O (oxides)						
C (organic)						
H (organic)						
O (organic)						
Mass Flow (kg/hr):	5.25E+03	5.25E+03	5.25E+02	5.25E+03	5.78E+03	1.53E+00
Canister Rate, canisters/day						
Total Canisters Generated						
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation						1.30E-14

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
H-3	1.15E-06	1.15E-06		1.15E-06	1.05E-06	
C-14	4.12E-12	4.12E-12		4.12E-12	3.79E-12	2.89E-11
Co-60						
Ni-59						
Ni-63						
Se-79						
Sr-90						
Y-90						
Zr-93						
Nb-93m						
Nb-94						
Tc-99						
Ru-106						
Rh-102						
Rh-106						
Pd-107						
Cd-113m						
Sn-121m						
Sn-126						
Sb-125						
Sb-126						
Te-125m						
I-129	3.57E-12	3.57E-12		9.32E-13	8.59E-13	8.61E-09
Cs-134						
Cs-135						
Cs-137						
Ba-137m						
Ce-144						
Pr-144						
Pm-146						
Pm-147						
Sm-151						
Eu-152						
Eu-154						
Eu-155						
Th-230						
Pa-233						
U-232						
U-233						
U-234						
U-235						
U-236						
U-237						
U-238						
Np-237						
Pu-236						
Pu-238						
Pu-239						
Pu-240						
Pu-241						
Pu-242						
Pu-244						
Am-241						
Am-242m						

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
Am-243						
Cm-242						
Cm-243						
Cm-244						
Cm-245						
Cm-246						
TRU						
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	70.27%	70.27%	0.01%	70.27%	64.61%	
O2, mol %	1.88%	1.88%	20.99%	1.88%	3.42%	
N2, mol %	1.58%	1.58%	79.00%	1.58%	7.81%	
H2, mol %						
CO2, mol %	26.25%	26.25%		26.25%	24.13%	
COgas, ppmv	1.59E-01	1.59E-01		1.59E-01	1.46E-01	
NO, ppmv	1.35E+02	1.35E+02		1.35E+02	1.24E+02	
NO2, ppmv	5.23E+00	5.23E+00		5.23E+00	4.81E+00	
SO2, ppmv	7.38E+01	7.38E+01		7.38E+01	6.78E+01	
Cl, ppmv	1.02E-01	1.02E-01		2.67E-02	2.46E-02	
F, ppmv	3.54E+00	3.54E+00		3.54E+00	3.26E+00	
C (organic), ppmv						
H (organic), ppmv						
Hg, ug/wscm	2.43E+04	2.43E+04		2.43E+01	2.24E+01	
PM, mg/wscm	3.29E+01	3.29E+01	1.58E+01	8.64E+00	9.31E+00	
SVM, ug/wscm						
LVM, ug/wscm						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	6.33%	6.33%	20.99%	0.89%	9.66%	
N2, mol %, dry basis	5.31%	5.31%	79.01%	5.31%	22.08%	
H2, mol %, dry basis						
CO2, mol %, dry basis	88.27%	88.27%		88.28%	68.19%	
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis	7.50E-02	7.50E-02		7.50E-02	5.79E-02	
NO, ppmv, dry basis	6.36E+01	6.36E+01		6.36E+01	4.91E+01	
NO2, ppmv, dry basis	2.47E+00	2.47E+00		2.47E+00	1.91E+00	
SO2, ppmv, dry basis	3.48E+01	3.48E+01		3.48E+01	2.69E+01	
Cl, ppmv, dry basis	4.83E-02	4.83E-02		1.26E-02	9.73E-03	
F, ppmv, dry basis	1.67E+00	1.67E+00		1.67E+00	1.29E+00	
C (organic), ppmv, dry basis						
H (organic), ppmv, dry basis						
Hg, ug/dscm	1.15E+04	1.15E+04		1.15E+01	8.88E+00	
PM, mg/dscm	1.55E+01	1.55E+01	2.21E+00	4.07E+00	3.69E+00	
SVM, ug/dscm						
LVM, ug/dscm						

Table A-19. Mass balance, Tank WM-180 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2
Stream Number	203	204	205	206	207	301	303
Stream Name	Fluidizing Gas to Reformer	Propane to Oxidizer	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 to Scrub for H+ Adjust	Isopropanol	Bed Media
Rate or Volume	1.11E+04	9.05E+02	4.64E+02	3.66E-02	-6.17E-03	7.77E+01	1.15E+00
Volume Flow (standard, wet)*	1.09E+04	2.56E+03					
Volume Flow (standard, dry)*	1.09E+04	2.56E+03					
Rate Units	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	gal/hr	lb/hr
Rate or Volume, metric	3.10E+02	7.26E+01	1.76E+03	1.39E-01	-2.34E-02	2.94E+02	5.22E-01
Rate Units	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	L/hr	kg/hr
Temperature, °C	580	25	25	25	25	15	15
Temperature, °F	1076	77	77	77	77	59	59
Pressure, psia	42.30	42.30	112.30	14.70	42.30	14.70	14.70
Specific Gravity	1.81E-03	5.19E-03	9.93E-01	1.80E+00	1.23E+00	1.03E+00	1.58E+00
Chemical Composition	Mol %	lb/wscf	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt frac
H+			9.95E-08		1.33E+01		
Al+3				2.20E+00			0.529
Sb+5							
As+3							
Ba+2							
Be+2							
B+3							
Cd+2							
Ca+2							
Cr+3							
Co+2							
Cs+							
Cu+2							
Fe+3							
Pb+2							
Hg+2							
Mn+4							
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3							
U+4							
V+3							
Zn+2							
Zr+4							
Cl-							
F-							
SO4-2							
NO3-				6.60E+00	1.33E+01		
CO2	100						
OH-			9.95E-08	7.31E-08			
H2O			5.51E+01	7.41E+01	2.17E+01		
O (oxides)							0.471
C (organic)		9.35E-02				5.15E+01	
H (organic)		2.09E-02				1.37E+02	
O (organic)						1.72E+01	
Mass Flow (kg/hr):	5.66E+02	1.33E+02	1.74E+03	2.50E-01		3.03E+02	5.22E-01

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream Number	305	401	402	404	404	503	505
Stream Name	Grout Mix for Scrub Blowdown	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout from Scrub	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Oxidizer
Rate or Volume	6.61E+00	5.34E+00	2.59E-01	8.82E+00	2.29E-01	5.30E+03	5.44E+03
Volume Flow (standard, wet)*						1.52E+04	3.36E+04
Volume Flow (standard, dry)*						1.52E+04	3.36E+04
Rate Units	lb/hr	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr
Rate or Volume, metric	3.00E+00	2.02E+01	9.81E-01	4.00E+00	4.00E+00	4.30E+02	9.52E+02
Rate Units	kg/hr	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr
Temperature, °C	25	70	70	54	54	21	25
Temperature, °F	77	158	158	129	129	70	77
Pressure, psia	14.70	29.98	29.98	14.70	14.70	42.30	92.30
Specific Gravity	2.01E-01	1.02E+00	1.02E+00	2.10E+00	2.10E+00	5.25E-03	8.21E-03
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
H+		9.72E-01	9.72E-01	2.40E-04	2.40E-04		
Al+3		1.08E-02	1.08E-02	0.01%	0.01%		
Sb+5		2.46E-08	2.46E-08	7.34E-10	7.34E-10		
As+3		7.90E-06	7.90E-06	1.45E-07	1.45E-07		
Ba+2							
Be+2							
B+3		1.84E-04	1.84E-04	4.87E-07	4.87E-07		
Cd+2							
Ca+2							
Cr+3							
Co+2		3.23E-07	3.23E-07	4.67E-09	4.67E-09		
Cs+							
Cu+2							
Fe+3		7.26E-05	7.26E-05	9.95E-07	9.95E-07		
Pb+2							
Hg+2		3.30E-02	3.30E-02	1.62E-03	1.62E-03		
Mn+4		2.25E-04	2.25E-04	3.03E-06	3.03E-06		
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3		4.85E-07	4.85E-07	2.43E-08	2.43E-08		
U+4							
V+3							
Zn+2							
Zr+4							
Cl-		5.43E-04	5.43E-04	4.72E-06	4.72E-06		
F-		5.99E-03	5.99E-03	2.79E-05	2.79E-05		
SO4-2							
NO3-		8.77E-01	8.77E-01	1.33E-02	1.33E-02		
PO4-3							
Am+4		5.58E-10	5.58E-10	3.33E-11	3.33E-11		
Br-		2.95E-09	2.95E-09	5.79E-11	5.79E-11		
Ce+4		7.70E-07	7.70E-07	2.64E-08	2.64E-08		
Eu+3		4.55E-09	4.55E-09	1.70E-10	1.70E-10		
Gd+3		2.84E-06	2.84E-06	1.09E-07	1.09E-07		
Ge+4							
In+3		1.25E-08	1.25E-08	3.51E-10	3.51E-10		
I-		2.56E-08	2.56E-08	7.97E-10	7.97E-10		
La+3		8.27E-08	8.27E-08	2.82E-09	2.82E-09		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	305	401	402	404	404	503	505
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
Li+							
Mg+2							
Mo+6							
Nd+3		2.67E-07	2.67E-07	9.43E-09	9.43E-09		
Np+4		1.54E-07	1.54E-07	8.96E-09	8.96E-09		
Nb+5							
Pd+4							
Pu+4							
Pr+4		7.52E-08	7.52E-08	2.60E-09	2.60E-09		
Pm+3		1.14E-11	1.14E-11	4.05E-13	4.05E-13		
Rh+4		3.24E-08	3.24E-08	8.19E-10	8.19E-10		
Rb+							
Ru+3		2.23E-06	2.23E-06	5.52E-08	5.52E-08		
Sm+3		4.95E-08	4.95E-08	1.82E-09	1.82E-09		
Si+4	4.67E-01			3.51E-01	3.51E-01		
Sr+2							
Tc+7		8.21E-08	8.21E-08	1.97E-09	1.97E-09		
Te+4							
Tb+4		1.90E-11	1.90E-11	7.42E-13	7.42E-13		
Th+4							
Sn+4							
Ti+4							
Y+3		6.17E-08	6.17E-08	1.34E-09	1.34E-09		
OH-		1.21E-06	1.21E-06	5.04E-09	5.04E-09		
H2O		5.31E+01	5.31E+01	2.35E-01	2.35E-01		
SO2		7.64E-07	7.64E-07	1.20E-08	1.20E-08		
H2S							
CO		2.73E-09	2.73E-09	1.87E-11	1.87E-11		
CO2		2.08E-04	2.08E-04	2.24E-06	2.24E-06	1.14E-01	
H2		1.75E-08	1.75E-08	8.65E-12	8.65E-12		
N2		6.38E-09	6.38E-09	4.38E-11	4.38E-11		
NO		8.82E-08	8.82E-08	6.49E-10	6.49E-10		
NO2		1.34E-05	1.34E-05	1.51E-07	1.51E-07		
O2		2.20E-08	2.20E-08	1.72E-10	1.72E-10		8.30E-02
S (other)		1.08E-08	1.08E-08	8.52E-11	8.52E-11		
CO3							
C (reductant)							
O (oxides)	53.26%	1.09E-04	1.09E-04	39.94%	39.94%		
C (organic)							
H (organic)							
O (organic)							
Mass Flow (kg/hr):	3.00E+00	2.06E+01	1.00E+00	4.00E+00	4.00E+00	7.87E+02	1.27E+03
Waste Rate, drums/day					0.23		
Total drums Generated					31		
Heat Generation	w/m3	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3
Heat Generation		1.95E-03	1.95E-03	1.00E-03	2.01E-04		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
H-3							
C-14		7.84E-17	7.84E-17	1.92E-17	8.08E-15		
Co-60		7.01E-08	7.01E-08	1.72E-08	7.22E-06		
Ni-59							
Ni-63							
Se-79							
Sr-90							
Y-90		3.44E-04	3.44E-04	8.43E-05	3.54E-02		
Zr-93							
Nb-93m							
Nb-94							
Tc-99		1.40E-07	1.40E-07	3.42E-08	1.44E-05		
Ru-106		8.48E-09	8.48E-09	2.08E-09	8.73E-07		
Rh-102		7.49E-12	7.49E-12	1.84E-12	7.71E-10		
Rh-106		8.48E-09	8.48E-09	2.08E-09	8.73E-07		
Pd-107							
Cd-113m							
Sn-121m							
Sn-126							
Sb-125		1.39E-07	1.39E-07	3.42E-08	1.44E-05		
Sb-126		5.00E-10	5.00E-10	1.23E-10	5.15E-08		
Te-125m							
I-129		4.56E-10	4.56E-10	1.12E-10	4.69E-08		
Cs-134							
Cs-135							
Cs-137							
Ba-137m							
Ce-144		5.72E-09	5.72E-09	1.40E-09	5.89E-07		
Pr-144		5.72E-09	5.72E-09	1.40E-09	5.89E-07		
Pm-146		4.42E-10	4.42E-10	1.08E-10	4.55E-08		
Pm-147		1.55E-06	1.55E-06	3.80E-07	1.60E-04		
Sm-151		3.06E-06	3.06E-06	7.50E-07	3.15E-04		
Eu-152		2.21E-08	2.21E-08	5.43E-09	2.28E-06		
Eu-154		7.95E-07	7.95E-07	1.95E-07	8.18E-05		
Eu-155		1.45E-06	1.45E-06	3.54E-07	1.49E-04		
Th-230							
Pa-233							
U-232							
U-233							
U-234							
U-235							
U-236							
U-237							
U-238							
Np-237		2.58E-08	2.58E-08	6.32E-09	2.65E-06		
Pu-236							
Pu-238							
Pu-239							
Pu-240							
Pu-241							
Pu-242							
Pu-244							
Am-241		1.21E-06	1.21E-06	2.97E-07	1.25E-04		
Am-242m		1.32E-10	1.32E-10	3.24E-11	1.36E-08		

Table A-19. Mass balance, Tank WM-180 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
Am-243		1.92E-10	1.92E-10	4.70E-11	1.98E-08		
Cm-242							
Cm-243							
Cm-244							
Cm-245							
Cm-246							
TRU		1.24E-06	1.24E-06	3.03E-07	1.27E-04		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %							
O2, mol %							100%
N2, mol %							
H2, mol %							
CO2, mol %						100%	
COgas, ppmv							
NO, ppmv							
NO2, ppmv							
SO2, ppmv							
Cl, ppmv							
F, ppmv							
C (organic), ppmv							
H (organic), ppmv							
Hg, ug/wscm							
PM, mg/wscm							1.67E-01
SVM, ug/wscm							
LVM, ug/wscm							
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis							
H2, mol %, dry basis							
CO2, mol %, dry basis							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis							
NO, ppmv, dry basis							
NO2, ppmv, dry basis							
SO2, ppmv, dry basis							
Cl, ppmv, dry basis							
F, ppmv, dry basis							
C (organic), ppmv, dry basis							
H (organic), ppmv, dry basis							
Hg, ug/dscm							
PM, mg/dscm							
SVM, ug/dscm							
LVM, ug/dscm							

Table A-19. Mass balance, Tank WM-180 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	510	511	512	513	514	515	516	517
Stream Name	Gas to Cool Product	Hot Gas after Product Cooling	Backpulse Gas for Candle Filters	Bed/ Solid Reductant Transport Gas	TF Transfer & Tank Sparge Air	Ventilation Air	New GAC	Off-gas Preheater Steam
Rate or Volume	2.06E+02	6.45E+02	2.21E+02	5.41E-01	1.40E+01	2.89E+01	3.11E+00	1.31E+03
Volume Flow (standard, wet)*	1.39E+03	1.39E+03	6.46E+02	1.58E+00	4.11E+01	2.94E+01		6.51E+03
Volume Flow (standard, dry)*	1.39E+03	1.39E+03	6.46E+02	1.58E+00	4.11E+01	2.94E+01		0.00E+00
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr	ft3/hr
Rate or Volume, metric	3.93E+01	3.93E+01	1.83E+01	4.49E-02	1.16E+00	8.34E-01	1.41E+00	1.84E+02
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr	wscm/hr
Temperature, °C	0	581	15	15	15	15	25	177
Temperature, °F	32	1078	59	59	59	59	77	350
Pressure, psia	92.30	92.30	42.30	42.30	42.30	14.70	14.70	112.30
Specific Gravity	7.85E-03	2.51E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01	3.73E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	Wt. %	lb/wscf
C (reductant)							100%	
Gas Composition, wet basis	mol %	mol %	mol %	mol %	mol %	mol %	mol %	mol %
H2O, mol %					0.01%	0.01%		100%
O2, mol %					21%	21%		
N2, mol %	100%	100%	100%	100%	79%	79%		
PM, mg/wscm	1.99E+01	1.99E+01	2.00E+01	2.10E+01	1.57E+01	1.57E+01		1.19E+01
kg/hr	4.58E+01	4.58E+01	2.13E+01	5.22E-02	1.39E+00	1.00E+00	1.41E+00	1.38E+02

Table A-20. Mass balance, Tank WM-187 waste.

PFD Number	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
Stream Number	101	102	103	104	106	107	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Filter Drain	Bed Drain	Cooled Product
Rate or Volume	9.54E+01	1.67E+02	2.16E+05	1.77E+05	8.56E+00	1.26E+02	1.34E+02
Volume Flow (standard, wet)*			5.23E+04	5.37E+04			
Volume Flow (standard, dry)*			3.65E+04	3.79E+04			
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	3.61E+02	6.30E+02	1.48E+03	1.52E+03	3.88E+00	5.71E+01	6.09E+01
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	17	600	400	400	600	56
Temperature, °F	59	63	1112	752	752	1112	132
Pressure, psia	14.70	44.70	10.62	10.22	9.50	10.80	9.50
Specific Gravity	1.20	1.20	3.35E-04	4.16E-04	0.79	1.46	1.42
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt Frac	Wt Frac	Wt frac
H+	2.72E+00	1.59E+00	1.25E-06	1.22E-06	1.54E-05	4.74E-05	4.54E-05
Al+3	3.10E-01	1.78E-01	8.14E-06	7.93E-06	4.97E-02	5.53E-02	5.50E-02
Sb+5	2.46E-05	1.41E-05	2.64E-09	2.57E-09	1.61E-05	1.79E-05	1.78E-05
As+3	1.43E-04	8.23E-05	9.44E-09	9.20E-09	5.77E-05	6.42E-05	6.38E-05
Ba+2	6.02E-05	3.45E-05	6.58E-09	6.41E-09	4.02E-05	4.96E-05	4.90E-05
Be+2	1.33E-05	7.63E-06	9.56E-11	9.31E-11	5.84E-07	7.20E-07	7.11E-07
B+3	9.30E-03	5.34E-03	8.83E-08	8.61E-08	5.40E-04	6.01E-04	5.97E-04
Cd+2	1.49E-03	8.54E-04	5.96E-07	5.81E-07	3.64E-03	8.12E-04	9.93E-04
Ca+2	2.97E-02	1.70E-02	9.47E-07	9.23E-07	5.79E-03	7.14E-03	7.05E-03
Cr+3	3.85E-03	2.21E-03	2.43E-07	2.37E-07	1.49E-03	1.17E-03	1.19E-03
Co+2	1.70E-03	9.74E-04	8.79E-08	8.56E-08	5.37E-04	5.97E-04	5.94E-04
Cs+	6.83E-05	3.91E-05	5.38E-08	5.24E-08	3.29E-04	3.51E-05	5.38E-05
Cu+2	3.98E-04	2.28E-04	2.02E-08	1.96E-08	1.23E-04	1.52E-04	1.50E-04
Fe+3	2.06E-02	1.18E-02	1.49E-06	1.45E-06	9.05E-03	6.68E-03	6.83E-03
Pb+2	5.45E-04	3.12E-04	4.02E-07	3.92E-07	2.46E-03	5.48E-04	6.70E-04
Hg+2	3.97E-03	4.30E-03	2.29E-05	2.23E-05	1.40E-04	9.52E-06	1.78E-05
Mn+4	1.53E-02	8.78E-03	7.39E-07	7.20E-07	4.52E-03	5.02E-03	4.99E-03
Ni+2	1.15E-03	6.59E-04	5.38E-08	5.24E-08	3.28E-04	4.05E-04	4.00E-04
K+	2.63E-01	1.51E-01	1.33E-05	1.30E-05	8.15E-02	5.96E-02	6.10E-02
Se+4	3.62E-04	2.07E-04	2.51E-08	2.44E-08	1.53E-04	1.70E-04	1.69E-04
Ag+	5.50E-04	3.15E-04	4.97E-08	4.84E-08	3.04E-04	3.55E-04	3.52E-04
Na+	1.50E+00	8.60E-01	2.89E-05	2.82E-05	1.77E-01	2.06E-01	2.05E-01
Tl+3	4.89E-06	2.81E-06	8.79E-10	8.56E-10	5.37E-06	5.98E-06	5.94E-06
U+4	2.30E-04	1.32E-04	4.80E-08	4.67E-08	2.93E-04	3.26E-04	3.24E-04
V+3	5.21E-05	2.98E-05	2.33E-09	2.27E-09	1.42E-05	1.58E-05	1.57E-05
Zn+2	6.45E-04	3.69E-04	3.36E-08	3.27E-08	2.05E-04	2.53E-04	2.50E-04
Zr+4	5.17E-02	2.96E-02	4.14E-06	4.03E-06	2.53E-02	2.82E-02	2.80E-02
Cl-	1.51E-02	8.64E-03	4.99E-07	4.86E-07	2.87E-03	3.18E-03	3.16E-03
F-	4.62E-02	2.67E-02	1.55E-06	1.51E-06	4.25E-03	4.96E-03	4.92E-03
SO4-2	4.22E-02	2.42E-02	1.15E-12	1.12E-12	7.04E-09	8.23E-09	8.16E-09
NO3-	5.07E+00	2.94E+00	1.67E-06	1.63E-06	1.02E-02	3.76E-03	4.17E-03
PO4-3	1.36E-01	7.77E-02	1.13E-05	1.10E-05	6.92E-02	7.68E-02	7.63E-02
Am+4	5.85E-08	3.36E-08	1.25E-11	1.22E-11	7.64E-08	8.50E-08	8.44E-08
Br-	2.11E-07	1.21E-07	1.57E-11	1.53E-11	9.04E-08	1.00E-07	9.95E-08
Ce+4	3.66E-05	2.10E-05	4.50E-09	4.39E-09	2.75E-05	3.06E-05	3.04E-05
Eu+3	3.50E-07	2.01E-07	4.68E-11	4.56E-11	2.86E-07	3.18E-07	3.16E-07
Gd+3	1.27E-04	7.31E-05	1.76E-08	1.72E-08	1.08E-04	1.20E-04	1.19E-04
Ge+4	6.07E-09	3.48E-09	3.87E-13	3.77E-13	2.36E-09	2.63E-09	2.61E-09
In+3	1.02E-06	5.83E-07	1.03E-10	9.99E-11	6.27E-07	6.97E-07	6.93E-07
I-	2.74E-06	1.57E-06	3.25E-10	3.17E-10	1.87E-06	2.07E-06	2.06E-06
La+3	6.35E-06	3.64E-06	7.75E-10	7.55E-10	4.74E-06	5.27E-06	5.23E-06

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	106	107	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac
Li+	5.34E-04	3.06E-04	3.11E-09	3.03E-09	1.90E-05	2.22E-05	2.20E-05
Mg+2	1.45E-02	8.29E-03	2.80E-07	2.73E-07	1.71E-03	2.11E-03	2.09E-03
Mo+6	7.92E-02	4.53E-02	6.66E-06	6.49E-06	4.07E-02	4.53E-02	4.50E-02
Nd+3	2.05E-05	1.17E-05	2.59E-09	2.53E-09	1.59E-05	1.76E-05	1.75E-05
Np+4	3.22E-06	1.85E-06	6.71E-10	6.53E-10	4.10E-06	4.56E-06	4.53E-06
Nb+5	1.44E-03	8.25E-04	1.17E-07	1.14E-07	7.18E-04	7.98E-04	7.93E-04
Pd+4	2.35E-03	1.35E-03	1.99E-07	1.94E-07	1.22E-03	1.50E-03	1.48E-03
Pu+4	7.55E-06	4.32E-06	1.62E-09	1.57E-09	9.87E-06	1.10E-05	1.09E-05
Pr+4	5.77E-06	3.31E-06	7.15E-10	6.96E-10	4.37E-06	4.86E-06	4.83E-06
Pm+3	1.41E-09	8.07E-10	1.79E-13	1.74E-13	1.09E-09	1.22E-09	1.21E-09
Rh+4	2.49E-06	1.43E-06	2.25E-10	2.19E-10	1.38E-06	1.53E-06	1.52E-06
Rb+	3.83E-06	2.20E-06	2.75E-10	2.68E-10	1.68E-06	1.96E-06	1.94E-06
Ru+3	1.07E-03	6.17E-04	9.55E-08	9.30E-08	5.84E-04	6.49E-04	6.45E-04
Sm+3	3.83E-06	2.20E-06	5.06E-10	4.93E-10	3.09E-06	3.44E-06	3.42E-06
Si+4	1.23E-01	7.05E-02	3.03E-06	2.95E-06	1.85E-02	2.06E-02	2.05E-02
Sr+2	8.39E-05	4.80E-05	5.85E-09	5.70E-09	3.58E-05	4.41E-05	4.36E-05
Tc+7	6.15E-06	3.52E-06	4.82E-09	4.70E-09	2.94E-05	1.81E-06	3.57E-06
Te+4	3.29E-06	1.89E-06	3.69E-10	3.59E-10	2.25E-06	2.51E-06	2.49E-06
Tb+4	1.46E-09	8.38E-10	2.04E-13	1.99E-13	1.25E-09	1.39E-09	1.38E-09
Th+4	1.73E-05	9.88E-06	3.51E-09	3.42E-09	2.15E-05	2.39E-05	2.37E-05
Sn+4	2.51E-03	1.43E-03	2.61E-07	2.54E-07	1.59E-03	1.77E-03	1.76E-03
Ti+4	1.26E-03	7.24E-04	5.31E-08	5.17E-08	3.24E-04	3.61E-04	3.59E-04
Y+3	4.73E-06	2.72E-06	3.70E-10	3.60E-10	2.26E-06	2.51E-06	2.50E-06
OH-		4.01E-08	3.84E-10	3.75E-10	2.35E-06	1.72E-06	1.76E-06
H2O	4.28E+01	2.62E+01	1.41E-02	1.37E-02	7.57E-03	3.52E-03	3.77E-03
SO2		2.24E-08	1.55E-12	1.51E-12			
H2S			2.04E-05	1.99E-05			
CO		8.62E-11	3.59E-04	3.49E-04			
CO2		6.73E-06	6.31E-02	6.15E-02			
H2		8.91E-10	5.40E-04	5.26E-04			
N2		2.07E-10	1.08E-03	2.93E-03			
NO		2.76E-09	1.41E-04	1.37E-04			
NO2		4.14E-07	2.06E-06	2.01E-06			
O2		6.82E-10					
S (other)		3.28E-10	7.90E-08	7.69E-08	4.83E-04	5.64E-04	5.58E-04
CO3	3.42E-05	1.96E-05	4.88E-05	4.75E-05	2.98E-01	3.22E-01	3.20E-01
C (reductant)							
O (oxides)	6.38E-01	3.66E-01	1.47E-05	1.43E-05	8.98%	9.76%	9.71%
C (organic)		2.40E+01	5.54E-03	5.40E-03	5.52E-02	8.56E-04	4.32E-03
H (organic)		6.40E+01	1.04E-03	1.01E-03	9.84E-03	1.53E-04	7.70E-04
O (organic)		8.00E+00					
Mass Flow (kg/hr):	4.34E+02	7.58E+02	2.04E+03	2.09E+03	3.88E+00	5.71E+01	6.09E+01
Canister Rate, canisters/day							1.29
Total Canisters Generated							113
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	4.03E-01	2.31E-01			2.59E+00	3.40E+00	3.38E+00

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
H-3	9.39E-06	5.38E-06	2.29E-06	2.23E-06			
C-14	1.36E-10	7.77E-11	3.28E-11	3.20E-11	1.03E-11	5.84E-12	6.12E-12
Co-60	1.45E-05	8.35E-06	2.05E-07	1.99E-07	7.81E-05	8.69E-05	8.63E-05
Ni-59	1.60E-06	9.14E-07	2.03E-08	1.98E-08	7.76E-06	9.57E-06	9.46E-06
Ni-63	3.71E-05	2.13E-05	4.73E-07	4.61E-07	1.81E-04	2.23E-04	2.20E-04
Se-79	4.92E-07	2.82E-07	6.91E-09	6.73E-09	2.64E-06	2.93E-06	2.91E-06
Sr-90	2.78E-02	1.60E-02	3.55E-04	3.46E-04	1.35E-01	1.67E-01	1.65E-01
Y-90	2.78E-02	1.60E-02	3.92E-04	3.82E-04	1.50E-01	1.66E-01	1.65E-01
Zr-93	1.57E-06	8.99E-07	2.21E-08	2.15E-08	8.42E-06	9.37E-06	9.31E-06
Nb-93m	1.21E-06	6.93E-07	1.70E-08	1.66E-08	6.49E-06	7.22E-06	7.17E-06
Nb-94	1.28E-06	7.31E-07	1.79E-08	1.75E-08	6.84E-06	7.62E-06	7.57E-06
Tc-99	1.48E-05	8.48E-06	1.90E-06	1.85E-06	7.22E-04	4.45E-05	8.77E-05
Ru-106	1.05E-06	6.04E-07	1.48E-08	1.44E-08	5.65E-06	6.29E-06	6.25E-06
Rh-102	6.11E-10	3.51E-10	8.60E-12	8.38E-12	3.28E-09	3.65E-09	3.63E-09
Rh-106	1.05E-06	6.04E-07	1.48E-08	1.44E-08	5.65E-06	6.29E-06	6.25E-06
Pd-107	1.17E-08	6.71E-09	1.49E-10	1.45E-10	5.70E-08	7.02E-08	6.94E-08
Cd-113m	2.35E-06	1.35E-06	1.34E-07	1.31E-07	5.12E-05	1.14E-05	1.39E-05
Sn-121m	4.74E-08	2.71E-08	6.66E-10	6.49E-10	2.54E-07	2.83E-07	2.81E-07
Sn-126	4.63E-07	2.65E-07	6.51E-09	6.34E-09	2.48E-06	2.76E-06	2.74E-06
Sb-125	5.55E-04	3.19E-04	7.81E-06	7.61E-06	2.98E-03	3.32E-03	3.30E-03
Sb-126	4.08E-08	2.34E-08	5.74E-10	5.59E-10	2.19E-07	2.44E-07	2.42E-07
Te-125m	2.23E-06	1.28E-06	3.14E-08	3.06E-08	1.20E-05	1.33E-05	1.32E-05
I-129	5.96E-08	3.42E-08	8.92E-10	8.69E-10	3.20E-07	3.55E-07	3.52E-07
Cs-134	5.84E-05	3.35E-05	5.54E-06	5.40E-06	2.11E-03	2.26E-04	3.46E-04
Cs-135	9.30E-07	5.33E-07	8.82E-08	8.59E-08	3.37E-05	3.60E-06	5.51E-06
Cs-137	3.77E-02	2.16E-02	3.58E-03	3.49E-03	1.37E+00	1.46E-01	2.24E-01
Ba-137m	3.57E-02	2.04E-02	4.55E-04	4.43E-04	1.74E-01	2.14E-01	2.11E-01
Ce-144	7.11E-07	4.08E-07	1.00E-08	9.76E-09	3.82E-06	4.25E-06	4.22E-06
Pr-144	7.11E-07	4.08E-07	1.00E-08	9.76E-09	3.82E-06	4.25E-06	4.22E-06
Pm-146	3.61E-08	2.07E-08	5.08E-10	4.95E-10	1.94E-07	2.16E-07	2.14E-07
Pm-147	1.91E-04	1.10E-04	2.70E-06	2.63E-06	1.03E-03	1.14E-03	1.14E-03
Sm-151	3.79E-04	2.18E-04	5.34E-06	5.20E-06	2.04E-03	2.26E-03	2.25E-03
Eu-152	2.28E-06	1.31E-06	3.21E-08	3.12E-08	1.22E-05	1.36E-05	1.35E-05
Eu-154	8.56E-05	4.91E-05	1.20E-06	1.17E-06	4.60E-04	5.11E-04	5.08E-04
Eu-155	9.01E-05	5.17E-05	1.27E-06	1.24E-06	4.84E-04	5.39E-04	5.35E-04
Th-230	8.88E-10	5.08E-10	1.25E-11	1.22E-11	4.76E-09	5.30E-09	5.26E-09
Pa-233	2.08E-06	1.19E-06	2.92E-08	2.84E-08	1.11E-05	1.24E-05	1.23E-05
U-232	2.04E-09	1.17E-09	2.87E-11	2.80E-11	1.09E-08	1.22E-08	1.21E-08
U-233	6.76E-11	3.87E-11	9.50E-13	9.25E-13	3.62E-10	4.03E-10	4.01E-10
U-234	1.12E-06	6.40E-07	1.57E-08	1.53E-08	5.99E-06	6.66E-06	6.62E-06
U-235	5.82E-08	3.33E-08	8.18E-10	7.97E-10	3.12E-07	3.47E-07	3.45E-07
U-236	5.41E-08	3.10E-08	7.61E-10	7.41E-10	2.90E-07	3.23E-07	3.21E-07
U-237	4.56E-09	2.61E-09	6.41E-11	6.24E-11	2.45E-08	2.72E-08	2.70E-08
U-238	1.97E-08	1.13E-08	2.76E-10	2.69E-10	1.05E-07	1.17E-07	1.17E-07
Np-237	5.38E-07	3.09E-07	7.57E-09	7.38E-09	2.89E-06	3.21E-06	3.19E-06
Pu-236	3.20E-09	1.83E-09	4.50E-11	4.38E-11	1.71E-08	1.91E-08	1.90E-08
Pu-238	9.43E-04	5.40E-04	1.33E-05	1.29E-05	5.06E-03	5.63E-03	5.59E-03
Pu-239	1.05E-04	6.00E-05	1.47E-06	1.44E-06	5.62E-04	6.25E-04	6.21E-04
Pu-240	1.20E-05	6.86E-06	1.68E-07	1.64E-07	6.42E-05	7.14E-05	7.09E-05
Pu-241	7.12E-04	4.08E-04	1.00E-05	9.75E-06	3.82E-03	4.25E-03	4.22E-03
Pu-242	9.39E-09	5.38E-09	1.32E-10	1.29E-10	5.04E-08	5.60E-08	5.57E-08
Pu-244	5.62E-16	3.22E-16	7.90E-18	7.69E-18	3.01E-15	3.35E-15	3.33E-15
Am-241	6.04E-05	3.47E-05	8.51E-07	8.29E-07	3.24E-04	3.61E-04	3.59E-04
Am-242m	1.09E-08	6.28E-09	1.54E-10	1.50E-10	5.87E-08	6.54E-08	6.49E-08

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
Am-243	2.08E-08	1.19E-08	2.92E-10	2.85E-10	1.12E-07	1.24E-07	1.23E-07
Cm-242	2.15E-08	1.23E-08	3.02E-10	2.94E-10	1.15E-07	1.28E-07	1.27E-07
Cm-243	3.11E-08	1.78E-08	4.37E-10	4.25E-10	1.67E-07	1.85E-07	1.84E-07
Cm-244	1.38E-06	7.93E-07	1.95E-08	1.90E-08	7.42E-06	8.26E-06	8.20E-06
Cm-245	3.27E-10	1.88E-10	4.60E-12	4.48E-12	1.76E-09	1.95E-09	1.94E-09
Cm-246	2.15E-11	1.23E-11	3.02E-13	2.94E-13	1.15E-10	1.28E-10	1.27E-10
TRU	1.14E-03	6.55E-04	1.61E-05	1.56E-05	6.13E-03	6.82E-03	6.77E-03
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			30.16%	29.38%			
O2, mol %							
N2, mol %			1.49%	4.03%			
H2, mol %			10.31%	10.05%			
CO2, mol %			55.21%	53.78%			
COgas, ppmv			4.93E+03	4.80E+03			
NO, ppmv			1.81E+03	1.76E+03			
NO2, ppmv			1.73E+01	1.68E+01			
SO2, ppmv			9.30E-06	9.06E-06			
Cl, ppmv			5.42E+00	5.28E+00			
F, ppmv			3.13E+01	3.05E+01			
C (organic), ppmv			1.78E+05	1.73E+05			
H (organic), ppmv			3.97E+05	3.87E+05			
Hg, ug/wscm			3.67E+05	3.57E+05			
PM, mg/wscm			1.08E+05	1.05E+05			
SVM, ug/wscm			1.60E+04	1.56E+04			
LVM, ug/wscm			4.05E+03	3.95E+03			
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis			2.13%	5.71%			
H2, mol %, dry basis			14.77%	14.23%			
CO2, mol %, dry basis			79.04%	76.15%			
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			9.89E+02	9.53E+02			
NO, ppmv, dry basis			3.63E+02	3.50E+02			
NO2, ppmv, dry basis			3.46E+00	3.33E+00			
SO2, ppmv, dry basis			1.87E-06	1.80E-06			
Cl, ppmv, dry basis			1.09E+00	1.05E+00			
F, ppmv, dry basis			6.28E+00	6.05E+00			
C (organic), ppmv, dry basis			3.56E+04	3.43E+04			
H (organic), ppmv, dry basis			7.96E+04	7.67E+04			
Hg, ug/dscm			7.35E+04	7.08E+04			
PM, mg/dscm			2.16E+04	2.09E+04			
SVM, ug/dscm			2.29E+04	2.23E+04			
LVM, ug/dscm			5.80E+03	5.65E+03			

Table A-20. Mass balance, Tank WM-187 waste (continued).

PFD Number	PFD-2	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	108	109	110	111	112	113A	113B	114
Stream Name	Product Shipping Canisters	Off-Gas from Filter to Oxidizer	Outlet of Oxidizer	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Off-Gas to Demister
Rate or Volume	1.29E+00	1.92E+05	6.40E+05	3.53E+05	9.69E+03	9.71E+03	0	3.55E+05
Volume Flow (standard, wet)*		5.43E+04	9.41E+04	1.75E+05				1.74E+05
Volume Flow (standard, dry)*		3.85E+04	5.23E+04	5.23E+04				5.21E+04
Rate Units	cont/day	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr
Rate or Volume, metric	6.09E+01	1.54E+03	2.66E+03	4.96E+03	3.67E+04	3.67E+04	1	4.92E+03
Rate Units	kg/hr	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr
Temperature, °C	56	397	1000	100	77	79	339	78
Temperature, °F	132	747	1832	212	171	173	170	172
Pressure, psia	9.50	9.50	9.39	9.28	37.52	8.96	8.42	8.60
Specific Gravity	1.42	3.87E-04	1.93E-04	5.22E-04	1.03	1.03	1.03	5.17E-04
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
H+	4.54E-05	1.21E-06	2.55E-08	1.37E-08	9.55E-01	9.54E-01		1.25E-07
Al+3	5.50E-02				1.27E-02	1.26E-02		
Sb+5	1.78E-05				9.09E-07	9.08E-07		
As+3	6.38E-05				5.29E-06	5.28E-06		
Ba+2	4.90E-05							
Be+2	7.11E-07							
B+3	5.97E-04				3.43E-04	3.43E-04		
Cd+2	9.93E-04							
Ca+2	7.05E-03							
Cr+3	1.19E-03							
Co+2	5.94E-04				6.26E-05	6.25E-05		
Cs+	5.38E-05							
Cu+2	1.50E-04							
Fe+3	6.83E-03	4.48E-09	2.59E-09	1.39E-09	8.43E-05	8.42E-05		
Pb+2	6.70E-04							
Hg+2	1.78E-05	2.20E-05	1.27E-05	6.82E-06	6.43E-02	6.42E-02		3.47E-06
Mn+4	4.99E-03				5.65E-04	5.64E-04		
Ni+2	4.00E-04							
K+	6.10E-02							
Se+4	1.69E-04							
Ag+	3.52E-04							
Na+	2.05E-01							
Tl+3	5.94E-06				1.81E-07	1.80E-07		
U+4	3.24E-04							
V+3	1.57E-05							
Zn+2	2.50E-04							
Zr+4	2.80E-02							
Cl-	3.16E-03	2.86E-08	1.65E-08	8.87E-09	3.15E-04	3.14E-04		5.43E-09
F-	4.92E-03	8.18E-07	4.72E-07	2.54E-07	7.38E-03	7.37E-03		2.21E-07
SO4-2	8.16E-09		1.37E-10	7.36E-11				
NO3-	4.17E-03	1.23E-11	7.17E-12	3.85E-12	9.09E-01	9.08E-01		6.97E-06
PO4-3	7.63E-02							
Am+4	8.44E-08				2.16E-09	2.16E-09		
Br-	9.95E-08	9.02E-13	5.21E-13	2.80E-13	4.40E-09	4.40E-09		1.71E-13
Ce+4	3.04E-05				1.35E-06	1.35E-06		
Eu+3	3.16E-07				1.29E-08	1.29E-08		
Gd+3	1.19E-04				4.70E-06	4.69E-06		
Ge+4	2.61E-09							
In+3	6.93E-07				3.75E-08	3.74E-08		
I-	2.06E-06	1.86E-11	1.08E-11	5.78E-12	5.73E-08	5.72E-08		3.53E-12
La+3	5.23E-06				2.34E-07	2.34E-07		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
Li+	2.20E-05							
Mg+2	2.09E-03							
Mo+6	4.50E-02							
Nd+3	1.75E-05				7.55E-07	7.54E-07		
Np+4	4.53E-06				1.19E-07	1.19E-07		
Nb+5	7.93E-04							
Pd+4	1.48E-03							
Pu+4	1.09E-05							
Pr+4	4.83E-06				2.13E-07	2.13E-07		
Pm+3	1.21E-09				5.19E-11	5.18E-11		
Rh+4	1.52E-06				9.19E-08	9.17E-08		
Rb+	1.94E-06							
Ru+3	6.45E-04				3.97E-05	3.96E-05		
Sm+3	3.42E-06				1.41E-07	1.41E-07		
Si+4	2.05E-02							
Sr+2	4.36E-05							
Tc+7	3.57E-06	9.75E-12	5.63E-12	3.02E-12	1.02E-07	1.02E-07		
Te+4	2.49E-06							
Tb+4	1.38E-09				5.39E-11	5.38E-11		
Th+4	2.37E-05							
Sn+4	1.76E-03							
Ti+4	3.59E-04							
Y+3	2.50E-06				1.75E-07	1.74E-07		
OH-	1.76E-06		1.53E-20	3.69E-11	1.28E-06	1.27E-06		
H2O	3.77E-03	1.36E-02	2.08E-02	3.28E-02	5.30E+01	5.30E+01		3.29E-02
SO2		1.49E-12	2.13E-05	1.14E-05	7.13E-07	7.49E-07		1.15E-05
H2S		1.96E-05	6.28E-21	3.37E-21				
CO		3.45E-04	2.17E-08	1.16E-08	2.74E-09	2.83E-09		1.17E-08
CO2		6.07E-02	5.60E-02	3.01E-02	2.14E-04	3.18E-04		3.03E-02
H2		5.20E-04	8.07E-10	4.33E-10	2.83E-08	3.42E-08		3.06E-08
N2		3.75E-03	2.21E-03	1.19E-03	6.59E-09	2.54E-07		1.20E-03
NO		1.36E-04	1.94E-05	1.04E-05	8.78E-08	1.38E-07		1.05E-05
NO2		1.98E-06	1.15E-06	6.15E-07	1.32E-05	1.31E-05		6.20E-07
O2			2.88E-03	1.54E-03	2.17E-08	4.98E-07		1.56E-03
S (other)	5.58E-04				1.04E-08	1.07E-08		
CO3	3.20E-01				1.24E-10	1.83E-10		
C (reductant)	0.00%		2.26E-17	1.22E-17				
O (oxides)	9.71%	1.93E-09	1.12E-09	5.99E-10	1.27E-04	1.27E-04		
C (organic)		5.33E-03	3.63E-33	1.95E-33				
H (organic)		9.99E-04	1.22E-33	6.54E-34				
O (organic)								
Mass Flow (kg/hr):	6.09E+01	2.11E+03	3.50E+03	5.22E+03	3.77E+04	3.77E+04		5.20E+03
Canister Rate, canisters/day								
Total Canisters Generated								
	w/Canister	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	2.71E+00				5.78E-03	5.77E-03		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
H-3		2.20E-06	1.27E-06	6.83E-07	1.19E-06	1.19E-06		6.85E-07
C-14	6.94E-09	3.16E-11	1.83E-11	9.81E-12	1.92E-16	2.85E-16		9.88E-12
Co-60	9.79E-02				5.37E-07	5.36E-07		
Ni-59	1.07E-02							
Ni-63	2.49E-01							
Se-79	3.30E-03							
Sr-90	1.87E+02							
Y-90	1.88E+02				1.03E-03	1.03E-03		
Zr-93	1.06E-02							
Nb-93m	8.13E-03							
Nb-94	8.58E-03							
Tc-99	9.94E-02	3.84E-09	2.21E-09	1.19E-09	2.47E-07	2.46E-07		
Ru-106	7.09E-03				3.88E-08	3.88E-08		
Rh-102	4.11E-06				2.25E-11	2.25E-11		
Rh-106	7.09E-03				3.88E-08	3.88E-08		
Pd-107	7.87E-05							
Cd-113m	1.58E-02							
Sn-121m	3.18E-04							
Sn-126	3.11E-03							
Sb-125	3.74E+00				2.05E-05	2.05E-05		
Sb-126	2.74E-04				1.50E-09	1.50E-09		
Te-125m	1.50E-02							
I-129	4.00E-04	5.11E-11	2.95E-11	1.59E-11	1.24E-09	1.24E-09		9.69E-12
Cs-134	3.93E-01							
Cs-135	6.25E-03							
Cs-137	2.53E+02							
Ba-137m	2.40E+02							
Ce-144	4.79E-03				2.63E-08	2.62E-08		
Pr-144	4.79E-03				2.63E-08	2.62E-08		
Pm-146	2.43E-04				1.33E-09	1.33E-09		
Pm-147	1.29E+00				7.06E-06	7.05E-06		
Sm-151	2.55E+00				1.40E-05	1.40E-05		
Eu-152	1.53E-02				8.40E-08	8.39E-08		
Eu-154	5.76E-01				3.16E-06	3.15E-06		
Eu-155	6.07E-01				3.33E-06	3.32E-06		
Th-230	5.97E-06							
Pa-233	1.40E-02							
U-232	1.37E-05							
U-233	4.54E-07							
U-234	7.51E-03							
U-235	3.91E-04							
U-236	3.64E-04							
U-237	3.07E-05							
U-238	1.32E-04							
Np-237	3.62E-03				1.99E-08	1.98E-08		
Pu-236	2.15E-05							
Pu-238	6.34E+00							
Pu-239	7.04E-01							
Pu-240	8.05E-02							
Pu-241	4.79E+00							
Pu-242	6.31E-05							
Pu-244	3.78E-12							
Am-241	4.07E-01				2.23E-06	2.23E-06		
Am-242m	7.36E-05				4.04E-10	4.03E-10		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
Am-243	1.40E-04				7.66E-10	7.65E-10		
Cm-242	1.44E-04							
Cm-243	2.09E-04							
Cm-244	9.30E-03							
Cm-245	2.20E-06							
Cm-246	1.44E-07							
TRU	7.68E+00				2.25E-06	2.25E-06		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %		29.05%	44.44%	70.17%				70.04%
O2, mol %			3.46%	1.86%				1.87%
N2, mol %		5.16%	3.04%	1.63%				1.64%
H2, mol %		9.93%	0.00002%	0.00001%				0.001%
CO2, mol %		53.18%	49.02%	26.32%				26.43%
COgas, ppmv		4.75E+03	2.98E-01	1.60E-01				1.61E-01
NO, ppmv		1.74E+03	2.49E+02	1.34E+02				1.34E+02
NO2, ppmv		1.66E+01	9.60E+00	5.15E+00				5.18E+00
SO2, ppmv		8.96E-06	1.28E+02	6.88E+01				6.91E+01
Cl, ppmv		3.11E-01	1.80E-01	9.64E-02				5.87E-02
F, ppmv		1.66E+01	9.58E+00	5.14E+00				4.47E+00
C (organic), ppmv		1.71E+05						
H (organic), ppmv		3.82E+05						
Hg, ug/wscm		3.53E+05	2.04E+05	1.09E+05				
PM, mg/wscm		1.02E+05	2.09E+02	1.18E+02				8.51E+00
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			6.23%	6.23%				6.23%
N2, mol %, dry basis		7.27%	5.48%	5.48%				5.48%
H2, mol %, dry basis		14.00%	0.00003%	0.00003%				0.002%
CO2, mol %, dry basis		74.95%	88.22%	88.22%				88.20%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis		9.37E+02	7.51E-02	7.51E-02				7.51E-02
NO, ppmv, dry basis		3.44E+02	6.28E+01	6.28E+01				6.28E+01
NO2, ppmv, dry basis		3.28E+00	2.42E+00	2.42E+00				2.42E+00
SO2, ppmv, dry basis		1.77E-06	3.23E+01	3.23E+01				3.23E+01
Cl, ppmv, dry basis		6.14E-02	4.53E-02	4.53E-02				2.75E-02
F, ppmv, dry basis		3.27E+00	2.42E+00	2.42E+00				2.09E+00
C (organic), ppmv, dry basis		3.37E+04	2.93E-26	2.93E-26				
H (organic), ppmv, dry basis		7.53E+04	1.17E-25	1.17E-25				
Hg, ug/dscm		6.96E+04	5.13E+04	5.13E+04				
PM, mg/dscm		2.01E+04	5.28E+01	5.53E+01				3.98E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-20. Mass balance, Tank WM-187 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	115	116	117	118	119	120
Stream Name	Scrubbed Off-Gas to Preheater	Preheated Off-gas to GAC	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-gas to Exhaust Blower	Spent GAC
Rate or Volume	3.88E+05	4.80E+05	1.56E+04	5.83E+05	6.24E+05	4.66E+00
Volume Flow (standard, wet)*	1.74E+05	1.74E+05	1.53E+04	1.74E+05	1.89E+05	
Volume Flow (standard, dry)*	5.23E+04	5.23E+04	1.53E+04	5.23E+04	6.75E+04	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	4.94E+03	4.94E+03	4.33E+02	4.94E+03	5.36E+03	2.11E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	77	120	25	120	114	27
Temperature, °F	170	248	77	248	237	81
Pressure, psia	7.88	7.16	14.70	5.89	5.89	14.70
Specific Gravity	4.73E-04	3.82E-04	1.18E-03	3.15E-04	3.24E-04	5.86E-01
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
H+	1.25E-07	1.25E-07		1.25E-07	1.15E-07	4.27E-06
Al+3						
Sb+5						
As+3						
Ba+2						
Be+2						
B+3						
Cd+2						
Ca+2						
Cr+3						
Co+2						
Cs+						
Cu+2						
Fe+3						
Pb+2						
Hg+2	3.46E-06	3.46E-06		2.12E-09	1.95E-09	1.30E-01
Mn+4						
Ni+2						
K+						
Se+4						
Ag+						
Na+						
Tl+3						
U+4						
V+3						
Zn+2						
Zr+4						
Cl-	5.41E-09	5.41E-09		1.40E-09	1.29E-09	1.50E-04
F-	2.20E-07	2.20E-07		2.20E-07	2.03E-07	
SO4-2						
NO3-	6.94E-06	6.94E-06		6.94E-06	6.39E-06	
PO4-3						
Am+4						
Br-	1.70E-13	1.70E-13		4.40E-14	4.05E-14	4.73E-09
Ce+4						
Eu+3						
Gd+3						
Ge+4						
In+3						
I-	3.52E-12	3.52E-12		9.10E-13	8.38E-13	9.79E-08
La+3						

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	115	116	117	118	119	120
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
Li+						
Mg+2						
Mo+6						
Nd+3						
Np+4						
Nb+5						
Pd+4						
Pu+4						
Pr+4						
Pm+3						
Rh+4						
Rb+						
Ru+3						
Sm+3						
Si+4						
Sr+2						
Tc+7						
Te+4						
Tb+4						
Th+4						
Sn+4						
Ti+4						
Y+3						
OH-						
H2O	3.27E-02	3.27E-02	4.68E-06	3.27E-02	3.02E-02	
SO2	1.15E-05	1.15E-05		1.15E-05	1.06E-05	
H2S						
CO	1.17E-08	1.17E-08		1.17E-08	1.08E-08	
CO2	3.02E-02	3.02E-02		3.02E-02	2.78E-02	
H2						
N2	1.19E-03	1.19E-03	5.75E-02	1.19E-03	5.74E-03	
NO	1.05E-05	1.05E-05		1.05E-05	9.64E-06	
NO2	6.18E-07	6.18E-07		6.18E-07	5.69E-07	
O2	1.55E-03	1.55E-03	1.74E-02	1.55E-03	2.84E-03	
S (other)						
CO3						
C (reductant)						8.70E-01
O (oxides)						
C (organic)						
H (organic)						
O (organic)						
Mass Flow (kg/hr):	5.20E+03	5.20E+03	5.20E+02	5.20E+03	5.72E+03	2.11E+00
Canister Rate, canisters/day						
Total Canisters Generated						
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation						4.25E-14

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
H-3	6.82E-07	6.82E-07		6.82E-07	6.28E-07	
C-14	9.85E-12	9.85E-12		9.85E-12	9.07E-12	6.87E-11
Co-60						
Ni-59						
Ni-63						
Se-79						
Sr-90						
Y-90						
Zr-93						
Nb-93m						
Nb-94						
Tc-99						
Ru-106						
Rh-102						
Rh-106						
Pd-107						
Cd-113m						
Sn-121m						
Sn-126						
Sb-125						
Sb-126						
Te-125m						
I-129	9.66E-12	9.66E-12		2.50E-12	2.30E-12	1.68E-08
Cs-134						
Cs-135						
Cs-137						
Ba-137m						
Ce-144						
Pr-144						
Pm-146						
Pm-147						
Sm-151						
Eu-152						
Eu-154						
Eu-155						
Th-230						
Pa-233						
U-232						
U-233						
U-234						
U-235						
U-236						
U-237						
U-238						
Np-237						
Pu-236						
Pu-238						
Pu-239						
Pu-240						
Pu-241						
Pu-242						
Pu-244						
Am-241						
Am-242m						

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
Am-243						
Cm-242						
Cm-243						
Cm-244						
Cm-245						
Cm-246						
TRU						
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	70.03%	70.03%	0.01%	70.03%	64.38%	
O2, mol %	1.87%	1.87%	20.99%	1.87%	3.41%	
N2, mol %	1.64%	1.64%	79.00%	1.64%	7.88%	
H2, mol %						
CO2, mol %	26.43%	26.43%		26.43%	24.30%	
COgas, ppmv	1.61E-01	1.61E-01		1.61E-01	1.48E-01	
NO, ppmv	1.34E+02	1.34E+02		1.34E+02	1.24E+02	
NO2, ppmv	5.18E+00	5.18E+00		5.18E+00	4.76E+00	
SO2, ppmv	6.91E+01	6.91E+01		6.91E+01	6.35E+01	
Cl, ppmv	5.88E-02	5.88E-02		1.52E-02	1.40E-02	
F, ppmv	4.47E+00	4.47E+00		4.47E+00	4.11E+00	
C (organic), ppmv						
H (organic), ppmv						
Hg, ug/wscm	3.40E+04	3.40E+04		3.40E+01	3.13E+01	
PM, mg/wscm	4.26E+01	4.26E+01	1.58E+01	8.61E+00	9.27E+00	
SVM, ug/wscm						
LVM, ug/wscm						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	6.23%	6.23%	20.99%	0.87%	9.57%	
N2, mol %, dry basis	5.48%	5.48%	79.01%	5.48%	22.13%	
H2, mol %, dry basis						
CO2, mol %, dry basis	88.21%	88.21%		88.21%	68.23%	
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis	7.51E-02	7.51E-02		7.51E-02	5.81E-02	
NO, ppmv, dry basis	6.28E+01	6.28E+01		6.28E+01	4.86E+01	
NO2, ppmv, dry basis	2.42E+00	2.42E+00		2.42E+00	1.87E+00	
SO2, ppmv, dry basis	3.23E+01	3.23E+01		3.23E+01	2.50E+01	
Cl, ppmv, dry basis	2.75E-02	2.75E-02		7.10E-03	5.49E-03	
F, ppmv, dry basis	2.09E+00	2.09E+00		2.09E+00	1.62E+00	
C (organic), ppmv, dry basis						
H (organic), ppmv, dry basis						
Hg, ug/dscm	1.59E+04	1.59E+04		1.59E+01	1.23E+01	
PM, mg/dscm	1.99E+01	1.99E+01	2.21E+00	4.02E+00	3.65E+00	
SVM, ug/dscm						
LVM, ug/dscm						

Table A-20. Mass balance, Tank WM-187 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2
Stream Number	203	204	205	206	207	301	303
Stream Name	Fluidizing Gas to Reformer	Propane to Oxidizer	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 to Scrub for H+ Adjust	Isopropanol	Bed Media
Rate or Volume	1.11E+04	9.05E+02	4.58E+02	4.48E-02	1.22E+00	7.77E+01	1.34E+00
Volume Flow (standard, wet)*	1.09E+04	2.56E+03					
Volume Flow (standard, dry)*	1.09E+04	2.56E+03					
Rate Units	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	gal/hr	lb/hr
Rate or Volume, metric	3.10E+02	7.26E+01	1.73E+03	1.70E-01	4.60E+00	2.94E+02	6.09E-01
Rate Units	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	L/hr	kg/hr
Temperature, °C	580	25	25	25	25	15	15
Temperature, °F	1076	77	77	77	77	59	59
Pressure, psia	42.30	42.30	112.30	14.70	42.30	14.70	14.70
Specific Gravity	1.81E-03	5.19E-03	9.93E-01	1.80E+00	1.23E+00	1.03E+00	1.58E+00
Chemical Composition	Mol %	lb/wscf	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt frac
H+			9.95E-08		1.33E+01		
Al+3				2.20E+00			0.529
Sb+5							
As+3							
Ba+2							
Be+2							
B+3							
Cd+2							
Ca+2							
Cr+3							
Co+2							
Cs+							
Cu+2							
Fe+3							
Pb+2							
Hg+2							
Mn+4							
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3							
U+4							
V+3							
Zn+2							
Zr+4							
Cl-							
F-							
SO4-2							
NO3-				6.60E+00	1.33E+01		
CO2	100						
OH-			9.95E-08	7.31E-08			
H2O			5.51E+01	7.41E+01	2.17E+01		
O (oxides)							0.471
C (organic)		9.35E-02				5.15E+01	
H (organic)		2.09E-02				1.37E+02	
O (organic)						1.72E+01	
Mass Flow (kg/hr):	5.66E+02	1.33E+02	1.72E+03	3.06E-01	5.66E+00	3.03E+02	6.09E-01

Table A-20. Mass balance, Tank WM-187 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-3
Stream Number	305	401	402	404	404	503	505
Stream Name	Grout Mix for Scrub Blowdown	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout from Scrub	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Oxidizer
Rate or Volume	6.61E+00	5.24E+00	2.57E-01	8.82E+00	2.29E-01	5.20E+03	5.40E+03
Volume Flow (standard, wet)*						1.49E+04	3.33E+04
Volume Flow (standard, dry)*						1.49E+04	3.33E+04
Rate Units	lb/hr	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr
Rate or Volume, metric	3.00E+00	1.98E+01	9.74E-01	4.00E+00	4.00E+00	4.23E+02	9.44E+02
Rate Units	kg/hr	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr
Temperature, °C	25	70	70	54	54	21	25
Temperature, °F	77	158	158	129	129	70	77
Pressure, psia	14.70	29.98	29.98	14.70	14.70	42.30	92.30
Specific Gravity	2.01E-01	1.03E+00	1.03E+00	2.10E+00	2.10E+00	5.25E-03	8.21E-03
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
H+		9.55E-01	9.55E-01	2.35E-04	2.35E-04		
Al+3		1.27E-02	1.27E-02	0.01%	0.01%		
Sb+5		9.09E-07	9.09E-07	2.70E-08	2.70E-08		
As+3		5.29E-06	5.29E-06	9.66E-08	9.66E-08		
Ba+2							
Be+2							
B+3		3.43E-04	3.43E-04	9.04E-07	9.04E-07		
Cd+2							
Ca+2							
Cr+3							
Co+2		6.26E-05	6.26E-05	8.99E-07	8.99E-07		
Cs+							
Cu+2							
Fe+3		8.43E-05	8.43E-05	1.15E-06	1.15E-06		
Pb+2							
Hg+2		6.43E-02	6.43E-02	3.14E-03	3.14E-03		
Mn+4		5.65E-04	5.65E-04	7.56E-06	7.56E-06		
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3		1.81E-07	1.81E-07	8.99E-09	8.99E-09		
U+4							
V+3							
Zn+2							
Zr+4							
Cl-		3.15E-04	3.15E-04	2.72E-06	2.72E-06		
F-		7.38E-03	7.38E-03	3.41E-05	3.41E-05		
SO4-2							
NO3-		9.09E-01	9.09E-01	1.37E-02	1.37E-02		
PO4-3							
Am+4		2.16E-09	2.16E-09	1.28E-10	1.28E-10		
Br-		4.40E-09	4.40E-09	8.56E-11	8.56E-11		
Ce+4		1.35E-06	1.35E-06	4.61E-08	4.61E-08		
Eu+3		1.29E-08	1.29E-08	4.78E-10	4.78E-10		
Gd+3		4.70E-06	4.70E-06	1.80E-07	1.80E-07		
Ge+4							
In+3		3.75E-08	3.75E-08	1.05E-09	1.05E-09		
I-		5.73E-08	5.73E-08	1.77E-09	1.77E-09		
La+3		2.34E-07	2.34E-07	7.93E-09	7.93E-09		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	305	401	402	404	404	503	505
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
Li+							
Mg+2							
Mo+6							
Nd+3		7.55E-07	7.55E-07	2.65E-08	2.65E-08		
Np+4		1.19E-07	1.19E-07	6.86E-09	6.86E-09		
Nb+5							
Pd+4							
Pu+4							
Pr+4		2.13E-07	2.13E-07	7.31E-09	7.31E-09		
Pm+3		5.19E-11	5.19E-11	1.83E-12	1.83E-12		
Rh+4		9.19E-08	9.19E-08	2.30E-09	2.30E-09		
Rb+							
Ru+3		3.97E-05	3.97E-05	9.77E-07	9.77E-07		
Sm+3		1.41E-07	1.41E-07	5.18E-09	5.18E-09		
Si+4	4.67E-01			3.51E-01	3.51E-01		
Sr+2							
Tc+7		1.02E-07	1.02E-07	2.44E-09	2.44E-09		
Te+4							
Tb+4		5.39E-11	5.39E-11	2.09E-12	2.09E-12		
Th+4							
Sn+4							
Ti+4							
Y+3		1.75E-07	1.75E-07	3.78E-09	3.78E-09		
OH-		1.28E-06	1.28E-06	5.28E-09	5.28E-09		
H2O		5.30E+01	5.30E+01	2.33E-01	2.33E-01		
SO2		7.13E-07	7.13E-07	1.11E-08	1.11E-08		
H2S							
CO		2.74E-09	2.74E-09	1.87E-11	1.87E-11		
CO2		2.14E-04	2.14E-04	2.29E-06	2.29E-06	1.14E-01	
H2		2.83E-08	2.83E-08	1.39E-11	1.39E-11		
N2		6.59E-09	6.59E-09	4.50E-11	4.50E-11		
NO		8.78E-08	8.78E-08	6.42E-10	6.42E-10		
NO2		1.32E-05	1.32E-05	1.48E-07	1.48E-07		
O2		2.17E-08	2.17E-08	1.69E-10	1.69E-10		8.30E-02
S (other)		1.04E-08	1.04E-08	8.16E-11	8.16E-11		
CO3							
C (reductant)							
O (oxides)	53.26%	1.27E-04	1.27E-04	39.94%	39.94%		
C (organic)							
H (organic)							
O (organic)							
Mass Flow (kg/hr):	3.00E+00	2.03E+01	1.00E+00	4.00E+00	4.00E+00	7.73E+02	1.26E+03
Canister Rate, canisters/day					0.23		
Total Canisters Generated					20		
Heat Generation	w/m3	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3
Heat Generation		5.78E-03	5.78E-03	2.96E-03	5.91E-04		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
H-3							
C-14		1.92E-16	1.92E-16	4.67E-17	1.96E-14		
Co-60		5.37E-07	5.37E-07	1.31E-07	5.49E-05		
Ni-59							
Ni-63							
Se-79							
Sr-90							
Y-90		1.03E-03	1.03E-03	2.50E-04	1.05E-01		
Zr-93							
Nb-93m							
Nb-94							
Tc-99		2.47E-07	2.47E-07	6.00E-08	2.52E-05		
Ru-106		3.88E-08	3.88E-08	9.46E-09	3.97E-06		
Rh-102		2.25E-11	2.25E-11	5.49E-12	2.31E-09		
Rh-106		3.88E-08	3.88E-08	9.46E-09	3.97E-06		
Pd-107							
Cd-113m							
Sn-121m							
Sn-126							
Sb-125		2.05E-05	2.05E-05	4.99E-06	2.10E-03		
Sb-126		1.50E-09	1.50E-09	3.66E-10	1.54E-07		
Te-125m							
I-129		1.24E-09	1.24E-09	3.03E-10	1.27E-07		
Cs-134							
Cs-135							
Cs-137							
Ba-137m							
Ce-144		2.63E-08	2.63E-08	6.39E-09	2.69E-06		
Pr-144		2.63E-08	2.63E-08	6.39E-09	2.69E-06		
Pm-146		1.33E-09	1.33E-09	3.24E-10	1.36E-07		
Pm-147		7.06E-06	7.06E-06	1.72E-06	7.23E-04		
Sm-151		1.40E-05	1.40E-05	3.41E-06	1.43E-03		
Eu-152		8.40E-08	8.40E-08	2.05E-08	8.60E-06		
Eu-154		3.16E-06	3.16E-06	7.69E-07	3.23E-04		
Eu-155		3.33E-06	3.33E-06	8.10E-07	3.40E-04		
Th-230							
Pa-233							
U-232							
U-233							
U-234							
U-235							
U-236							
U-237							
U-238							
Np-237		1.99E-08	1.99E-08	4.84E-09	2.03E-06		
Pu-236							
Pu-238							
Pu-239							
Pu-240							
Pu-241							
Pu-242							
Pu-244							
Am-241		2.23E-06	2.23E-06	5.43E-07	2.28E-04		
Am-242m		4.04E-10	4.04E-10	9.83E-11	4.13E-08		

Table A-20. Mass balance, Tank WM-187 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
Am-243		7.66E-10	7.66E-10	1.87E-10	7.84E-08		
Cm-242							
Cm-243							
Cm-244							
Cm-245							
Cm-246							
TRU		2.25E-06	2.25E-06	5.48E-07	2.30E-04		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %							
O2, mol %							100%
N2, mol %							
H2, mol %							
CO2, mol %						100%	
COgas, ppmv							
NO, ppmv							
NO2, ppmv							
SO2, ppmv							
Cl, ppmv							
F, ppmv							
C (organic), ppmv							
H (organic), ppmv							
Hg, ug/wscm							
PM, mg/wscm							
SVM, ug/wscm							
LVM, ug/wscm							
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis							
H2, mol %, dry basis							
CO2, mol %, dry basis							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis							
NO, ppmv, dry basis							
NO2, ppmv, dry basis							
SO2, ppmv, dry basis							
Cl, ppmv, dry basis							
F, ppmv, dry basis							
C (organic), ppmv, dry basis							
H (organic), ppmv, dry basis							
Hg, ug/dscm							
PM, mg/dscm							
SVM, ug/dscm							
LVM, ug/dscm							

Table A-20. Mass balance, Tank WM-187 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	510	511	512	513	514	515	516	517
Stream Name	Gas to Cool Product	Hot Gas after Product Cooling	Backpulse Gas for Candle Filters	Bed/ Solid Reductant Transport Gas	TF Transfer & Tank Sparge Air	Ventilation Air	New GAC	Off-gas Preheater Steam
Rate or Volume	2.06E+02	6.42E+02	2.18E+02	6.31E-01	1.40E+01	2.89E+01	4.29E+00	1.29E+03
Volume Flow (standard, wet)*	1.39E+03	1.39E+03	6.38E+02	1.85E+00	4.09E+01	2.94E+01		6.42E+03
Volume Flow (standard, dry)*	1.39E+03	1.39E+03	6.38E+02	1.85E+00	4.09E+01	2.94E+01		0.00E+00
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr	ft3/hr
Rate or Volume, metric	3.93E+01	3.93E+01	1.81E+01	5.23E-02	1.16E+00	8.34E-01	1.94E+00	1.82E+02
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr	wscm/hr
Temperature, °C	0	580	15	15	15	15	25	177
Temperature, °F	32	1076	59	59	59	59	77	350
Pressure, psia	92.30	92.30	42.30	42.30	42.30	14.70	14.70	112.30
Specific Gravity	7.85E-03	2.51E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01	3.73E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	Wt. %	lb/wscf
C (reductant)							100%	
Gas Composition, wet basis	mol %	mol %	mol %	mol %	mol %	mol %	mol %	mol %
H2O, mol %					0.01%	0.01%		100%
O2, mol %					21%	21%		
N2, mol %	100%	100%	100%	100%	79%	79%		
PM, mg/wscm	2.01E+01	2.01E+01	1.97E+01	1.99E+01	1.54E+01	1.57E+01		1.16E+01
kg/hr	4.57E+01	4.57E+01	2.11E+01	6.09E-02	1.39E+00	1.00E+00	1.94E+00	1.36E+02

Table A-21. Mass balance, Tank WM-188 waste.

PFD Number	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
Stream Number	101	102	103	104	106	107	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Filter Drain	Bed Drain	Cooled Product
Rate or Volume	9.65E+01	1.68E+02	2.18E+05	1.78E+05	7.29E+00	1.08E+02	1.15E+02
Volume Flow (standard, wet)*			5.28E+04	5.40E+04			
Volume Flow (standard, dry)*			3.64E+04	3.76E+04			
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	3.65E+02	6.37E+02	1.50E+03	1.53E+03	3.30E+00	4.90E+01	5.23E+01
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	17	600	400	400	600	55
Temperature, °F	59	63	1112	752	752	1112	132
Pressure, psia	14.70	44.70	10.62	10.22	9.50	10.80	9.50
Specific Gravity	1.22	1.22	3.30E-04	4.10E-04	0.79	1.46	1.42
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt Frac	Wt Frac	Wt frac
H+	2.53E+00	1.48E+00	1.11E-06	1.08E-06	1.35E-05	4.23E-05	4.05E-05
Al+3	4.63E-01	2.66E-01	1.17E-05	1.14E-05	8.45E-02	9.33E-02	9.27E-02
Sb+5	1.45E-05	8.34E-06	1.56E-09	1.52E-09	1.13E-05	1.24E-05	1.24E-05
As+3	8.10E-05	4.65E-05	5.34E-09	5.22E-09	3.87E-05	4.27E-05	4.25E-05
Ba+2	6.63E-05	3.80E-05	7.26E-09	7.09E-09	5.26E-05	6.43E-05	6.36E-05
Be+2	1.67E-05	9.61E-06	1.20E-10	1.18E-10	8.73E-07	1.07E-06	1.05E-06
B+3	1.45E-02	8.33E-03	1.38E-07	1.35E-07	1.00E-03	1.10E-03	1.10E-03
Cd+2	2.21E-03	1.27E-03	8.87E-07	8.67E-07	6.43E-03	1.42E-03	1.74E-03
Ca+2	4.42E-02	2.53E-02	1.41E-06	1.38E-06	1.02E-02	1.25E-02	1.24E-02
Cr+3	4.14E-03	2.37E-03	2.62E-07	2.56E-07	1.90E-03	1.48E-03	1.50E-03
Co+2	3.62E-05	2.08E-05	1.88E-09	1.83E-09	1.36E-05	1.50E-05	1.49E-05
Cs+	5.27E-05	3.03E-05	4.16E-08	4.07E-08	3.01E-04	3.19E-05	4.90E-05
Cu+2	6.20E-04	3.56E-04	3.14E-08	3.07E-08	2.28E-04	2.79E-04	2.75E-04
Fe+3	2.28E-02	1.31E-02	1.65E-06	1.61E-06	1.19E-02	8.70E-03	8.91E-03
Pb+2	7.27E-04	4.17E-04	5.37E-07	5.25E-07	3.89E-03	8.61E-04	1.05E-03
Hg+2	4.65E-03	4.90E-03	2.61E-05	2.55E-05	1.89E-04	1.28E-05	2.39E-05
Mn+4	1.32E-02	7.60E-03	6.40E-07	6.26E-07	4.64E-03	5.12E-03	5.09E-03
Ni+2	1.62E-03	9.30E-04	7.59E-08	7.42E-08	5.50E-04	6.73E-04	6.65E-04
K+	1.69E-01	9.72E-02	8.59E-06	8.40E-06	6.23E-02	4.52E-02	4.63E-02
Se+4	2.14E-04	1.23E-04	1.49E-08	1.45E-08	1.08E-04	1.19E-04	1.18E-04
Ag+	3.34E-04	1.91E-04	3.02E-08	2.96E-08	2.19E-04	2.54E-04	2.52E-04
Na+	1.25E+00	7.17E-01	2.41E-05	2.36E-05	1.75E-01	2.02E-01	2.01E-01
Tl+3	4.06E-06	2.33E-06	7.30E-10	7.13E-10	5.29E-06	5.83E-06	5.80E-06
U+4	3.21E-04	1.84E-04	6.71E-08	6.56E-08	4.86E-04	5.37E-04	5.33E-04
V+3	3.25E-05	1.86E-05	1.45E-09	1.42E-09	1.05E-05	1.16E-05	1.16E-05
Zn+2	7.18E-04	4.12E-04	3.75E-08	3.66E-08	2.71E-04	3.32E-04	3.28E-04
Zr+4	3.34E-02	1.92E-02	2.68E-06	2.62E-06	1.94E-02	2.14E-02	2.13E-02
Cl-	2.18E-02	1.25E-02	7.24E-07	7.08E-07	4.94E-03	5.43E-03	5.40E-03
F-	3.16E-02	1.83E-02	1.06E-06	1.03E-06	3.45E-03	3.99E-03	3.96E-03
SO4-2	3.71E-02	2.13E-02	6.40E-13	6.26E-13	4.64E-09	5.39E-09	5.34E-09
NO3-	5.19E+00	3.00E+00	2.27E-06	2.22E-06	1.64E-02	5.51E-03	6.20E-03
PO4-3	8.81E-02	5.05E-02	7.37E-06	7.20E-06	5.34E-02	5.88E-02	5.85E-02
Am+4	6.14E-08	3.52E-08	1.31E-11	1.28E-11	9.51E-08	1.05E-07	1.04E-07
Br-	2.64E-07	1.51E-07	1.97E-11	1.92E-11	1.34E-07	1.48E-07	1.47E-07
Ce+4	3.03E-05	1.74E-05	3.74E-09	3.66E-09	2.71E-05	2.99E-05	2.97E-05
Eu+3	4.37E-07	2.51E-07	5.85E-11	5.72E-11	4.24E-07	4.68E-07	4.65E-07
Gd+3	1.29E-04	7.41E-05	1.79E-08	1.75E-08	1.29E-04	1.43E-04	1.42E-04
Ge+4	7.60E-09	4.36E-09	4.85E-13	4.74E-13	3.51E-09	3.88E-09	3.85E-09
In+3	1.34E-06	7.67E-07	1.35E-10	1.32E-10	9.78E-07	1.08E-06	1.07E-06
I-	2.82E-06	1.62E-06	3.34E-10	3.27E-10	2.28E-06	2.51E-06	2.49E-06
La+3	7.94E-06	4.56E-06	9.70E-10	9.48E-10	7.03E-06	7.76E-06	7.71E-06

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	106	107	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac
Li+	4.15E-04	2.38E-04	2.42E-09	2.36E-09	1.75E-05	2.03E-05	2.01E-05
Mg+2	1.63E-02	9.33E-03	3.16E-07	3.08E-07	2.29E-03	2.80E-03	2.76E-03
Mo+6	4.78E-02	2.74E-02	4.03E-06	3.94E-06	2.92E-02	3.22E-02	3.21E-02
Nd+3	2.56E-05	1.47E-05	3.25E-09	3.18E-09	2.35E-05	2.60E-05	2.58E-05
Np+4	2.34E-06	1.34E-06	4.88E-10	4.77E-10	3.54E-06	3.90E-06	3.88E-06
Nb+5	9.59E-04	5.50E-04	7.83E-08	7.66E-08	5.68E-04	6.26E-04	6.23E-04
Pd+4	1.56E-03	8.93E-04	1.32E-07	1.29E-07	9.57E-04	1.17E-03	1.16E-03
Pu+4	6.09E-06	3.50E-06	1.31E-09	1.28E-09	9.47E-06	1.05E-05	1.04E-05
Pr+4	7.22E-06	4.14E-06	8.95E-10	8.75E-10	6.49E-06	7.16E-06	7.11E-06
Pm+3	1.49E-09	8.58E-10	1.91E-13	1.86E-13	1.38E-09	1.52E-09	1.52E-09
Rh+4	3.11E-06	1.79E-06	2.82E-10	2.76E-10	2.04E-06	2.25E-06	2.24E-06
Rb+	4.80E-06	2.75E-06	3.44E-10	3.36E-10	2.49E-06	2.89E-06	2.86E-06
Ru+3	7.21E-04	4.14E-04	6.41E-08	6.26E-08	4.64E-04	5.12E-04	5.09E-04
Sm+3	4.77E-06	2.74E-06	6.31E-10	6.17E-10	4.57E-06	5.04E-06	5.01E-06
Si+4	8.18E-02	4.69E-02	2.02E-06	1.97E-06	1.46E-02	1.62E-02	1.61E-02
Sr+2	7.12E-05	4.08E-05	4.98E-09	4.86E-09	3.61E-05	4.41E-05	4.36E-05
Tc+7	9.29E-06	5.33E-06	7.30E-09	7.13E-09	5.28E-05	3.23E-06	6.36E-06
Te+4	3.17E-06	1.82E-06	3.56E-10	3.47E-10	2.58E-06	2.84E-06	2.83E-06
Tb+4	1.83E-09	1.05E-09	2.56E-13	2.50E-13	1.85E-09	2.04E-09	2.03E-09
Th+4	2.10E-05	1.21E-05	4.29E-09	4.19E-09	3.11E-05	3.43E-05	3.41E-05
Sn+4	1.58E-03	9.08E-04	1.65E-07	1.61E-07	1.20E-03	1.32E-03	1.31E-03
Ti+4	8.10E-04	4.64E-04	3.41E-08	3.33E-08	2.47E-04	2.73E-04	2.71E-04
Y+3	5.92E-06	3.40E-06	4.63E-10	4.52E-10	3.35E-06	3.70E-06	3.68E-06
OH-		3.90E-08	3.17E-10	3.10E-10	2.30E-06	1.67E-06	1.71E-06
H2O	4.48E+01	2.73E+01	1.45E-02	1.42E-02	1.22E-02	4.83E-03	5.30E-03
SO2		1.90E-08	1.26E-12	1.23E-12			
H2S			1.81E-05	1.77E-05			
CO		8.65E-11	3.55E-04	3.47E-04			
CO2		6.29E-06	6.13E-02	5.99E-02			
H2		9.21E-10	5.71E-04	5.58E-04			
N2		1.73E-10	1.11E-03	2.73E-03			
NO		2.51E-09	1.41E-04	1.38E-04			
NO2		3.94E-07	2.06E-06	2.01E-06			
O2		5.22E-10					
S (other)		2.78E-10	5.84E-08	5.70E-08	4.23E-04	4.90E-04	4.86E-04
CO3	2.64E-05	1.51E-05	3.98E-05	3.89E-05	2.88E-01	3.15E-01	3.13E-01
C (reductant)							
O (oxides)	4.26E-01	2.44E-01	1.60E-05	1.56E-05	11.59%	12.46%	12.40%
C (organic)	1.64E-02	2.45E+01	5.63E-03	5.50E-03	5.52E-02	8.49E-04	4.28E-03
H (organic)	4.38E-02	6.54E+01	1.06E-03	1.03E-03	9.84E-03	1.51E-04	7.64E-04
O (organic)	5.47E-03	8.18E+00					
Mass Flow (kg/hr):	4.47E+02	7.80E+02	2.03E+03	2.07E+03	3.30E+00	4.90E+01	5.23E+01
Canister Rate, canisters/day							1.11
Total Canisters Generated							156
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	3.68E-01	2.11E-01			2.42E+00	3.71E+00	3.65E+00

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
H-3	1.06E-05	6.10E-06	2.60E-06	2.54E-06			
C-14	1.44E-10	8.25E-11	3.49E-11	3.42E-11	1.09E-11	6.19E-12	6.49E-12
Co-60	8.10E-06	4.65E-06	1.14E-07	1.12E-07	5.17E-05	5.70E-05	5.67E-05
Ni-59	1.01E-06	5.79E-07	1.29E-08	1.26E-08	5.84E-06	7.14E-06	7.06E-06
Ni-63	3.82E-05	2.19E-05	4.88E-07	4.76E-07	2.21E-04	2.70E-04	2.67E-04
Se-79	5.22E-07	3.00E-07	7.35E-09	7.19E-09	3.33E-06	3.67E-06	3.65E-06
Sr-90	3.59E-02	2.06E-02	4.59E-04	4.48E-04	2.07E-01	2.54E-01	2.51E-01
Y-90	3.59E-02	2.06E-02	5.06E-04	4.94E-04	2.29E-01	2.52E-01	2.51E-01
Zr-93	2.06E-06	1.18E-06	2.91E-08	2.84E-08	1.32E-05	1.45E-05	1.44E-05
Nb-93m	1.59E-06	9.12E-07	2.24E-08	2.19E-08	1.01E-05	1.12E-05	1.11E-05
Nb-94	1.36E-06	7.79E-07	1.91E-08	1.87E-08	8.66E-06	9.55E-06	9.50E-06
Tc-99	1.89E-05	1.08E-05	2.43E-06	2.37E-06	1.10E-03	6.69E-05	1.32E-04
Ru-106	1.12E-06	6.41E-07	1.57E-08	1.54E-08	7.11E-06	7.85E-06	7.80E-06
Rh-102	8.03E-10	4.61E-10	1.13E-11	1.11E-11	5.12E-09	5.65E-09	5.62E-09
Rh-106	1.12E-06	6.41E-07	1.57E-08	1.54E-08	7.11E-06	7.85E-06	7.80E-06
Pd-107	1.54E-08	8.83E-09	1.97E-10	1.92E-10	8.90E-08	1.09E-07	1.08E-07
Cd-113m	3.10E-06	1.78E-06	1.77E-07	1.73E-07	8.00E-05	1.77E-05	2.16E-05
Sn-121m	6.23E-08	3.57E-08	8.78E-10	8.58E-10	3.97E-07	4.38E-07	4.35E-07
Sn-126	4.92E-07	2.82E-07	6.92E-09	6.77E-09	3.13E-06	3.46E-06	3.44E-06
Sb-125	3.38E-04	1.94E-04	4.76E-06	4.65E-06	2.15E-03	2.38E-03	2.36E-03
Sb-126	5.36E-08	3.08E-08	7.56E-10	7.38E-10	3.42E-07	3.77E-07	3.75E-07
Te-125m	2.94E-06	1.68E-06	4.13E-08	4.04E-08	1.87E-05	2.06E-05	2.05E-05
I-129	6.38E-08	3.66E-08	9.56E-10	9.34E-10	4.07E-07	4.47E-07	4.45E-07
Cs-134	3.37E-05	1.93E-05	3.20E-06	3.13E-06	1.45E-03	1.54E-04	2.35E-04
Cs-135	1.00E-06	5.76E-07	9.55E-08	9.33E-08	4.32E-05	4.58E-06	7.02E-06
Cs-137	2.07E-02	1.19E-02	1.97E-03	1.93E-03	8.91E-01	9.45E-02	1.45E-01
Ba-137m	1.96E-02	1.12E-02	2.51E-04	2.45E-04	1.13E-01	1.39E-01	1.37E-01
Ce-144	7.53E-07	4.32E-07	1.06E-08	1.04E-08	4.80E-06	5.30E-06	5.27E-06
Pr-144	7.53E-07	4.32E-07	1.06E-08	1.04E-08	4.80E-06	5.30E-06	5.27E-06
Pm-146	4.74E-08	2.72E-08	6.69E-10	6.53E-10	3.02E-07	3.34E-07	3.32E-07
Pm-147	2.03E-04	1.17E-04	2.87E-06	2.80E-06	1.30E-03	1.43E-03	1.42E-03
Sm-151	4.02E-04	2.31E-04	5.67E-06	5.54E-06	2.56E-03	2.83E-03	2.81E-03
Eu-152	2.66E-06	1.53E-06	3.75E-08	3.66E-08	1.69E-05	1.87E-05	1.86E-05
Eu-154	4.52E-05	2.60E-05	6.38E-07	6.23E-07	2.88E-04	3.18E-04	3.16E-04
Eu-155	3.92E-05	2.25E-05	5.53E-07	5.40E-07	2.50E-04	2.76E-04	2.74E-04
Th-230	9.55E-10	5.47E-10	1.34E-11	1.31E-11	6.08E-09	6.71E-09	6.67E-09
Pa-233	2.73E-06	1.57E-06	3.85E-08	3.76E-08	1.74E-05	1.92E-05	1.91E-05
U-232	2.25E-09	1.29E-09	3.17E-11	3.09E-11	1.43E-08	1.58E-08	1.57E-08
U-233	8.13E-11	4.66E-11	1.15E-12	1.12E-12	5.18E-10	5.72E-10	5.68E-10
U-234	1.00E-06	5.75E-07	1.41E-08	1.38E-08	6.39E-06	7.05E-06	7.01E-06
U-235	7.37E-08	4.23E-08	1.04E-09	1.01E-09	4.69E-07	5.18E-07	5.15E-07
U-236	4.33E-08	2.48E-08	6.10E-10	5.96E-10	2.76E-07	3.04E-07	3.03E-07
U-237	6.00E-09	3.44E-09	8.45E-11	8.26E-11	3.82E-08	4.22E-08	4.19E-08
U-238	1.31E-08	7.52E-09	1.85E-10	1.81E-10	8.36E-08	9.22E-08	9.17E-08
Np-237	3.91E-07	2.24E-07	5.51E-09	5.39E-09	2.49E-06	2.75E-06	2.73E-06
Pu-236	3.28E-09	1.88E-09	4.62E-11	4.52E-11	2.09E-08	2.31E-08	2.29E-08
Pu-238	7.51E-04	4.31E-04	1.06E-05	1.03E-05	4.78E-03	5.28E-03	5.25E-03
Pu-239	8.40E-05	4.82E-05	1.18E-06	1.16E-06	5.35E-04	5.91E-04	5.87E-04
Pu-240	1.22E-05	7.01E-06	1.72E-07	1.68E-07	7.79E-05	8.59E-05	8.54E-05
Pu-241	5.46E-04	3.13E-04	7.69E-06	7.52E-06	3.48E-03	3.84E-03	3.82E-03
Pu-242	9.57E-09	5.49E-09	1.35E-10	1.32E-10	6.10E-08	6.73E-08	6.69E-08
Pu-244	7.31E-16	4.19E-16	1.03E-17	1.01E-17	4.65E-15	5.14E-15	5.11E-15
Am-241	5.26E-05	3.02E-05	7.42E-07	7.25E-07	3.36E-04	3.70E-04	3.68E-04
Am-242m	1.45E-08	8.35E-09	2.05E-10	2.00E-10	9.27E-08	1.02E-07	1.02E-07

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
Am-243	2.37E-08	1.36E-08	3.34E-10	3.27E-10	1.51E-07	1.67E-07	1.66E-07
Cm-242	3.15E-08	1.81E-08	4.43E-10	4.33E-10	2.01E-07	2.21E-07	2.20E-07
Cm-243	3.30E-08	1.89E-08	4.65E-10	4.55E-10	2.10E-07	2.32E-07	2.31E-07
Cm-244	1.15E-06	6.62E-07	1.63E-08	1.59E-08	7.36E-06	8.12E-06	8.07E-06
Cm-245	3.48E-10	1.99E-10	4.89E-12	4.78E-12	2.21E-09	2.44E-09	2.43E-09
Cm-246	2.28E-11	1.31E-11	3.21E-13	3.14E-13	1.45E-10	1.60E-10	1.59E-10
TRU	9.17E-04	5.26E-04	1.29E-05	1.26E-05	5.84E-03	6.45E-03	6.41E-03
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			31.07%	30.36%			
O2, mol %							
N2, mol %			1.53%	3.76%			
H2, mol %			10.92%	10.67%			
CO2, mol %			53.61%	52.40%			
COgas, ppmv			4.88E+03	4.77E+03			
NO, ppmv			1.81E+03	1.77E+03			
NO2, ppmv			1.72E+01	1.69E+01			
SO2, ppmv			7.55E-06	7.38E-06			
Cl, ppmv			7.87E+00	7.69E+00			
F, ppmv			2.15E+01	2.10E+01			
C (organic), ppmv			1.80E+05	1.76E+05			
H (organic), ppmv			4.04E+05	3.94E+05			
Hg, ug/wscm			4.18E+05	4.09E+05			
PM, mg/wscm			1.09E+05	1.07E+05			
SVM, ug/wscm			2.28E+04	2.23E+04			
LVM, ug/wscm			4.29E+03	4.19E+03			
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis			2.22%	5.40%			
H2, mol %, dry basis			15.84%	15.32%			
CO2, mol %, dry basis			77.77%	75.24%			
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			9.92E+02	9.60E+02			
NO, ppmv, dry basis			3.67E+02	3.55E+02			
NO2, ppmv, dry basis			3.50E+00	3.39E+00			
SO2, ppmv, dry basis			1.53E-06	1.48E-06			
Cl, ppmv, dry basis			1.60E+00	1.55E+00			
F, ppmv, dry basis			4.36E+00	4.22E+00			
C (organic), ppmv, dry basis			3.66E+04	3.55E+04			
H (organic), ppmv, dry basis			8.20E+04	7.93E+04			
Hg, ug/dscm			8.50E+04	8.22E+04			
PM, mg/dscm			2.22E+04	2.15E+04			
SVM, ug/dscm			3.31E+04	3.24E+04			
LVM, ug/dscm			6.22E+03	6.08E+03			

Table A-21. Mass balance, Tank WM-188 waste (continued).

PFD Number	PFD-2	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	108	109	110	111	112	113A	113B	114
Stream Name	Product Shipping Canisters	Off-Gas from Filter to Oxidizer	Outlet of Oxidizer	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Off-Gas to Demister
Rate or Volume	1.11E+00	1.93E+05	6.42E+05	3.54E+05	9.73E+03	9.74E+03	0	3.57E+05
Volume Flow (standard, wet)*		5.46E+04	9.45E+04	1.76E+05				1.74E+05
Volume Flow (standard, dry)*		3.82E+04	5.14E+04	5.14E+04				5.12E+04
Rate Units	cont/day	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr
Rate or Volume, metric	5.23E+01	1.55E+03	2.67E+03	4.98E+03	3.68E+04	3.69E+04	1	4.94E+03
Rate Units	kg/hr	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr
Temperature, °C	55	397	1000	100	77	79	339	78
Temperature, °F	132	747	1832	212	171	174	171	172
Pressure, psia	9.50	9.50	9.39	9.28	37.52	8.96	8.42	8.60
Specific Gravity	1.42	3.82E-04	1.92E-04	5.19E-04	1.03	1.03	1.03	5.14E-04
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
H+	4.05E-05	1.07E-06	1.80E-08	9.65E-09	9.56E-01	9.55E-01		1.26E-07
Al+3	9.27E-02				9.25E-03	9.24E-03		
Sb+5	1.24E-05				2.74E-07	2.73E-07		
As+3	4.25E-05				1.53E-06	1.52E-06		
Ba+2	6.36E-05							
Be+2	1.05E-06							
B+3	1.10E-03				2.73E-04	2.73E-04		
Cd+2	1.74E-03							
Ca+2	1.24E-02							
Cr+3	1.50E-03							
Co+2	1.49E-05				6.81E-07	6.80E-07		
Cs+	4.90E-05							
Cu+2	2.75E-04							
Fe+3	8.91E-03	4.98E-09	2.88E-09	1.55E-09	9.46E-05	9.46E-05		
Pb+2	1.05E-03							
Hg+2	2.39E-05	2.52E-05	1.46E-05	7.83E-06	7.43E-02	7.42E-02		4.10E-06
Mn+4	5.09E-03				2.49E-04	2.49E-04		
Ni+2	6.65E-04							
K+	4.63E-02							
Se+4	1.18E-04							
Ag+	2.52E-04							
Na+	2.01E-01							
Tl+3	5.80E-06				7.64E-08	7.63E-08		
U+4	5.33E-04							
V+3	1.16E-05							
Zn+2	3.28E-04							
Zr+4	2.13E-02							
Cl-	5.40E-03	4.17E-08	2.41E-08	1.30E-08	4.71E-04	4.70E-04		7.98E-09
F-	3.96E-03	5.63E-07	3.26E-07	1.75E-07	5.09E-03	5.09E-03		1.55E-07
SO4-2	5.34E-09		1.17E-10	6.30E-11				
NO3-	6.20E-03	1.87E-11	1.09E-11	5.84E-12	9.16E-01	9.15E-01		7.20E-06
PO4-3	5.85E-02							
Am+4	1.04E-07				1.16E-09	1.15E-09		
Br-	1.47E-07	1.13E-12	6.56E-13	3.52E-13	5.68E-09	5.67E-09		2.17E-13
Ce+4	2.97E-05				5.71E-07	5.71E-07		
Eu+3	4.65E-07				8.24E-09	8.23E-09		
Gd+3	1.42E-04				2.43E-06	2.43E-06		
Ge+4	3.85E-09							
In+3	1.07E-06				2.52E-08	2.51E-08		
I-	2.49E-06	1.93E-11	1.11E-11	5.98E-12	6.07E-08	6.07E-08		3.68E-12
La+3	7.71E-06				1.50E-07	1.49E-07		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
Li+	2.01E-05							
Mg+2	2.76E-03							
Mo+6	3.21E-02							
Nd+3	2.58E-05				4.82E-07	4.81E-07		
Np+4	3.88E-06				4.41E-08	4.40E-08		
Nb+5	6.23E-04							
Pd+4	1.16E-03							
Pu+4	1.04E-05							
Pr+4	7.11E-06				1.36E-07	1.36E-07		
Pm+3	1.52E-09				2.81E-11	2.81E-11		
Rh+4	2.24E-06				5.86E-08	5.85E-08		
Rb+	2.86E-06							
Ru+3	5.09E-04				1.36E-05	1.35E-05		
Sm+3	5.01E-06				8.98E-08	8.97E-08		
Si+4	1.61E-02							
Sr+2	4.36E-05							
Tc+7	6.36E-06	1.48E-11	8.57E-12	4.60E-12	1.55E-07	1.55E-07		
Te+4	2.83E-06							
Tb+4	2.03E-09				3.44E-11	3.44E-11		
Th+4	3.41E-05							
Sn+4	1.31E-03							
Ti+4	2.71E-04							
Y+3	3.68E-06				1.11E-07	1.11E-07		
OH-	1.71E-06		1.69E-20	3.69E-11	1.30E-06	1.30E-06		
H2O	5.30E-03	1.40E-02	2.13E-02	3.31E-02	5.29E+01	5.29E+01		3.32E-02
SO2		1.21E-12	1.91E-05	1.02E-05	6.31E-07	6.66E-07		1.03E-05
H2S		1.75E-05	7.12E-21	3.82E-21				
CO		3.43E-04	2.30E-08	1.23E-08	2.88E-09	2.98E-09		1.24E-08
CO2		5.92E-02	5.53E-02	2.97E-02	2.09E-04	3.19E-04		3.00E-02
H2		5.52E-04	8.88E-10	4.77E-10	3.07E-08	3.88E-08		3.51E-08
N2		3.55E-03	2.10E-03	1.13E-03	5.76E-09	2.41E-07		1.14E-03
NO		1.36E-04	1.94E-05	1.04E-05	8.34E-08	1.36E-07		1.05E-05
NO2		1.99E-06	1.15E-06	6.18E-07	1.31E-05	1.31E-05		6.24E-07
O2			2.50E-03	1.34E-03	1.74E-08	4.32E-07		1.35E-03
S (other)	4.86E-04				9.26E-09	9.57E-09		
CO3	3.13E-01				1.19E-10	1.81E-10		
C (reductant)			2.57E-17	1.38E-17				
O (oxides)	1.24E-01	2.15E-09	1.24E-09	6.68E-10	1.42E-04	1.42E-04		
C (organic)		5.43E-03	5.00E-33	2.68E-33				
H (organic)		1.02E-03	1.68E-33	9.01E-34				
O (organic)								
Mass Flow (kg/hr):	5.23E+01	2.09E+03	3.48E+03	5.21E+03	3.78E+04	3.78E+04		5.19E+03
Canister Rate, canisters/day								
Total Canisters Generated								
	w/Canister	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	2.92E+00				3.78E-03	3.77E-03		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
H-3		2.51E-06	1.45E-06	7.80E-07	1.34E-06	1.34E-06		7.81E-07
C-14	7.37E-09	3.37E-11	1.95E-11	1.05E-11	2.03E-16	3.09E-16		1.06E-11
Co-60	6.43E-02				1.53E-07	1.52E-07		
Ni-59	8.00E-03							
Ni-63	3.02E-01							
Se-79	4.14E-03							
Sr-90	2.84E+02							
Y-90	2.85E+02				6.76E-04	6.75E-04		
Zr-93	1.64E-02							
Nb-93m	1.26E-02							
Nb-94	1.08E-02							
Tc-99	1.50E-01	4.92E-09	2.85E-09	1.53E-09	3.15E-07	3.15E-07		
Ru-106	8.85E-03				2.10E-08	2.10E-08		
Rh-102	6.37E-06				1.51E-11	1.51E-11		
Rh-106	8.85E-03				2.10E-08	2.10E-08		
Pd-107	1.22E-04							
Cd-113m	2.45E-02							
Sn-121m	4.94E-04							
Sn-126	3.90E-03							
Sb-125	2.68E+00				6.36E-06	6.35E-06		
Sb-126	4.25E-04				1.01E-09	1.01E-09		
Te-125m	2.33E-02							
I-129	5.04E-04	5.50E-11	3.18E-11	1.71E-11	1.38E-09	1.37E-09		1.05E-11
Cs-134	2.67E-01							
Cs-135	7.96E-03							
Cs-137	1.64E+02							
Ba-137m	1.55E+02							
Ce-144	5.97E-03				1.42E-08	1.42E-08		
Pr-144	5.97E-03				1.42E-08	1.42E-08		
Pm-146	3.76E-04				8.93E-10	8.92E-10		
Pm-147	1.61E+00				3.83E-06	3.83E-06		
Sm-151	3.19E+00				7.57E-06	7.56E-06		
Eu-152	2.11E-02				5.00E-08	5.00E-08		
Eu-154	3.59E-01				8.52E-07	8.51E-07		
Eu-155	3.11E-01				7.39E-07	7.37E-07		
Th-230	7.57E-06							
Pa-233	2.17E-02							
U-232	1.78E-05							
U-233	6.45E-07							
U-234	7.95E-03							
U-235	5.84E-04							
U-236	3.43E-04							
U-237	4.75E-05							
U-238	1.04E-04							
Np-237	3.10E-03				7.36E-09	7.35E-09		
Pu-236	2.60E-05							
Pu-238	5.95E+00							
Pu-239	6.66E-01							
Pu-240	9.69E-02							
Pu-241	4.33E+00							
Pu-242	7.59E-05							
Pu-244	5.79E-12							
Am-241	4.18E-01				9.91E-07	9.90E-07		
Am-242m	1.15E-04				2.74E-10	2.73E-10		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
Am-243	1.88E-04				4.47E-10	4.46E-10		
Cm-242	2.50E-04							
Cm-243	2.62E-04							
Cm-244	9.15E-03							
Cm-245	2.75E-06							
Cm-246	1.81E-07							
TRU	7.27E+00				1.00E-06	9.98E-07		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %		30.02%	45.60%	70.79%				70.65%
O2, mol %			3.01%	1.62%				1.62%
N2, mol %		4.88%	2.88%	1.55%				1.56%
H2, mol %		10.55%	0.00002%	0.00001%				0.0007%
CO2, mol %		51.81%	48.46%	26.02%				26.15%
COgas, ppmv		4.72E+03	3.16E-01	1.70E-01				1.71E-01
NO, ppmv		1.75E+03	2.49E+02	1.34E+02				1.35E+02
NO2, ppmv		1.67E+01	9.64E+00	5.18E+00				5.21E+00
SO2, ppmv		7.29E-06	1.15E+02	6.16E+01				6.19E+01
Cl, ppmv		4.53E-01	2.62E-01	1.41E-01				8.64E-02
F, ppmv		1.14E+01	6.61E+00	3.55E+00				3.13E+00
C (organic), ppmv		1.74E+05						
H (organic), ppmv		3.90E+05						
Hg, ug/wscm		4.04E+05	2.34E+05	1.25E+05				
PM, mg/wscm		1.04E+05	2.40E+02	1.34E+02				8.72E+00
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			5.54%	5.54%				5.54%
N2, mol %, dry basis		6.97%	5.30%	5.30%				5.30%
H2, mol %, dry basis		15.08%	0.00003%	0.00003%				0.002%
CO2, mol %, dry basis		74.04%	89.09%	89.09%				89.08%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis		9.44E+02	8.14E-02	8.14E-02				8.14E-02
NO, ppmv, dry basis		3.50E+02	6.42E+01	6.42E+01				6.42E+01
NO2, ppmv, dry basis		3.34E+00	2.48E+00	2.48E+00				2.49E+00
SO2, ppmv, dry basis		1.46E-06	2.95E+01	2.95E+01				2.95E+01
Cl, ppmv, dry basis		9.07E-02	6.75E-02	6.75E-02				4.12E-02
F, ppmv, dry basis		2.28E+00	1.70E+00	1.70E+00				1.49E+00
C (organic), ppmv, dry basis		3.48E+04	4.13E-26	4.13E-26				
H (organic), ppmv, dry basis		7.79E+04	1.65E-25	1.65E-25				
Hg, ug/dscm		8.08E+04	6.02E+04	6.01E+04				
PM, mg/dscm		2.07E+04	6.18E+01	6.43E+01				4.16E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-21. Mass balance, Tank WM-188 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	115	116	117	118	119	120
Stream Name	Scrubbed Off-Gas to Preheater	Preheated Off-gas to GAC	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-gas to Exhaust Blower	Spent GAC
Rate or Volume	3.90E+05	4.82E+05	1.55E+04	5.85E+05	6.26E+05	5.01E+00
Volume Flow (standard, wet)*	1.75E+05	1.75E+05	1.53E+04	1.75E+05	1.90E+05	
Volume Flow (standard, dry)*	5.14E+04	5.14E+04	1.53E+04	5.14E+04	6.66E+04	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	4.96E+03	4.96E+03	4.33E+02	4.96E+03	5.38E+03	2.27E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	77	120	25	120	114	27
Temperature, °F	171	248	77	248	237	81
Pressure, psia	7.88	7.16	14.70	5.89	5.89	14.70
Specific Gravity	4.70E-04	3.81E-04	1.18E-03	3.13E-04	3.22E-04	5.86E-01
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
H+	1.25E-07	1.25E-07		1.25E-07	1.15E-07	5.82E-06
Al+3						
Sb+5						
As+3						
Ba+2						
Be+2						
B+3						
Cd+2						
Ca+2						
Cr+3						
Co+2						
Cs+						
Cu+2						
Fe+3						
Pb+2						
Hg+2	4.09E-06	4.09E-06		2.27E-09	2.09E-09	1.43E-01
Mn+4						
Ni+2						
K+						
Se+4						
Ag+						
Na+						
Tl+3						
U+4						
V+3						
Zn+2						
Zr+4						
Cl-	7.95E-09	7.95E-09		2.09E-09	1.93E-09	2.05E-04
F-	1.54E-07	1.54E-07		1.54E-07	1.42E-07	
SO4-2						
NO3-	7.17E-06	7.17E-06		7.18E-06	6.61E-06	
PO4-3						
Am+4						
Br-	2.16E-13	2.16E-13		5.69E-14	5.25E-14	5.57E-09
Ce+4						
Eu+3						
Gd+3						
Ge+4						
In+3						
I-	3.67E-12	3.67E-12		9.67E-13	8.91E-13	9.46E-08
La+3						

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	115	116	117	118	119	120
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
Li+						
Mg+2						
Mo+6						
Nd+3						
Np+4						
Nb+5						
Pd+4						
Pu+4						
Pr+4						
Pm+3						
Rh+4						
Rb+						
Ru+3						
Sm+3						
Si+4						
Sr+2						
Tc+7						
Te+4						
Tb+4						
Th+4						
Sn+4						
Ti+4						
Y+3						
OH-						
H2O	3.30E-02	3.30E-02	4.68E-06	3.30E-02	3.04E-02	
SO2	1.03E-05	1.03E-05		1.03E-05	9.48E-06	
H2S						
CO	1.24E-08	1.24E-08		1.24E-08	1.14E-08	
CO2	2.99E-02	2.99E-02		2.99E-02	2.75E-02	
H2						
N2	1.13E-03	1.13E-03	5.75E-02	1.13E-03	5.66E-03	
NO	1.05E-05	1.05E-05		1.05E-05	9.66E-06	
NO2	6.22E-07	6.22E-07		6.22E-07	5.73E-07	
O2	1.35E-03	1.35E-03	1.74E-02	1.35E-03	2.65E-03	
S (other)						
CO3						
C (reductant)						8.57E-01
O (oxides)						
C (organic)						
H (organic)						
O (organic)						
Mass Flow (kg/hr):	5.19E+03	5.19E+03	5.19E+02	5.19E+03	5.71E+03	2.27E+00
Canister Rate, canisters/day						
Total Canisters Generated						
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation						4.95E-14

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
H-3	7.78E-07	7.78E-07		7.78E-07	7.16E-07	
C-14	1.05E-11	1.05E-11		1.05E-11	9.71E-12	7.43E-11
Co-60						
Ni-59						
Ni-63						
Se-79						
Sr-90						
Y-90						
Zr-93						
Nb-93m						
Nb-94						
Tc-99						
Ru-106						
Rh-102						
Rh-106						
Pd-107						
Cd-113m						
Sn-121m						
Sn-126						
Sb-125						
Sb-126						
Te-125m						
I-129	1.05E-11	1.05E-11		2.76E-12	2.55E-12	1.69E-08
Cs-134						
Cs-135						
Cs-137						
Ba-137m						
Ce-144						
Pr-144						
Pm-146						
Pm-147						
Sm-151						
Eu-152						
Eu-154						
Eu-155						
Th-230						
Pa-233						
U-232						
U-233						
U-234						
U-235						
U-236						
U-237						
U-238						
Np-237						
Pu-236						
Pu-238						
Pu-239						
Pu-240						
Pu-241						
Pu-242						
Pu-244						
Am-241						
Am-242m						

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
Am-243						
Cm-242						
Cm-243						
Cm-244						
Cm-245						
Cm-246						
TRU						
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	70.64%	70.64%	0.01%	70.64%	64.97%	
O2, mol %	1.6245%	1.6245%	20.99%	1.6245%	3.1804%	
N2, mol %	1.56%	1.56%	79.00%	1.56%	7.78%	
H2, mol %						
CO2, mol %	26.15%	26.15%		26.15%	24.05%	
COgas, ppmv	1.71E-01	1.71E-01		1.71E-01	1.57E-01	
NO, ppmv	1.35E+02	1.35E+02		1.35E+02	1.24E+02	
NO2, ppmv	5.21E+00	5.21E+00		5.21E+00	4.79E+00	
SO2, ppmv	6.19E+01	6.19E+01		6.19E+01	5.69E+01	
Cl, ppmv	8.64E-02	8.64E-02		2.28E-02	2.09E-02	
F, ppmv	3.13E+00	3.13E+00		3.13E+00	2.88E+00	
C (organic), ppmv						
H (organic), ppmv						
Hg, ug/wscm	3.64E+04	3.64E+04		3.64E+01	3.35E+01	
PM, mg/wscm	4.52E+01	4.52E+01	1.57E+01	8.75E+00	9.14E+00	
SVM, ug/wscm						
LVM, ug/wscm						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	5.53%	5.53%	20.99%	0.78%	9.08%	
N2, mol %, dry basis	5.30%	5.30%	79.01%	5.30%	22.20%	
H2, mol %, dry basis						
CO2, mol %, dry basis	89.08%	89.08%		89.08%	68.65%	
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis	8.14E-02	8.14E-02		8.14E-02	6.27E-02	
NO, ppmv, dry basis	6.42E+01	6.42E+01		6.42E+01	4.95E+01	
NO2, ppmv, dry basis	2.49E+00	2.49E+00		2.49E+00	1.92E+00	
SO2, ppmv, dry basis	2.95E+01	2.95E+01		2.95E+01	2.28E+01	
Cl, ppmv, dry basis	4.12E-02	4.12E-02		1.09E-02	8.37E-03	
F, ppmv, dry basis	1.49E+00	1.49E+00		1.49E+00	1.15E+00	
C (organic), ppmv, dry basis						
H (organic), ppmv, dry basis						
Hg, ug/dscm	1.74E+04	1.74E+04		1.74E+01	1.34E+01	
PM, mg/dscm	2.16E+01	2.16E+01	2.21E+00	4.18E+00	3.66E+00	
SVM, ug/dscm						
LVM, ug/dscm						

Table A-21. Mass balance, Tank WM-188 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2
Stream Number	203	204	205	206	207	301	303
Stream Name	Fluidizing Gas to Reformer	Propane to Oxidizer	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 to Scrub for H+ Adjust	Isopropanol	Bed Media
Rate or Volume	1.11E+04	9.05E+02	4.59E+02	3.12E-02	1.21E+00	8.02E+01	1.15E+00
Volume Flow (standard, wet)*	1.09E+04	2.56E+03					
Volume Flow (standard, dry)*	1.09E+04	2.56E+03					
Rate Units	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	gal/hr	lb/hr
Rate or Volume, metric	3.10E+02	7.26E+01	1.74E+03	1.18E-01	4.57E+00	3.04E+02	5.23E-01
Rate Units	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	L/hr	kg/hr
Temperature, °C	580	25	25	25	25	15	15
Temperature, °F	1076	77	77	77	77	59	59
Pressure, psia	42.30	42.30	112.30	14.70	42.30	14.70	14.70
Specific Gravity	1.81E-03	5.19E-03	9.93E-01	1.80E+00	1.23E+00	1.03E+00	1.58E+00
Chemical Composition	Mol %	lb/wscf	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt frac
H+			9.95E-08		1.33E+01		
Al+3				2.20E+00			0.529
Sb+5							
As+3							
Ba+2							
Be+2							
B+3							
Cd+2							
Ca+2							
Cr+3							
Co+2							
Cs+							
Cu+2							
Fe+3							
Pb+2							
Hg+2							
Mn+4							
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3							
U+4							
V+3							
Zn+2							
Zr+4							
Cl-							
F-							
SO4-2							
NO3-				6.60E+00	1.33E+01		
CO2	100						
OH-			9.95E-08	7.31E-08			
H2O			5.51E+01	7.41E+01	2.17E+01		
O (oxides)							0.471
C (organic)		9.35E-02				5.15E+01	
H (organic)		2.09E-02				1.37E+02	
O (organic)						1.72E+01	
Mass Flow (kg/hr):	5.66E+02	1.33E+02	1.73E+03	2.13E-01	5.62E+00	3.13E+02	5.23E-01

Table A-21. Mass balance, Tank WM-188 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-3
Stream Number	305	401	402	404	404	503	505
Stream Name	Grout Mix for Scrub Blowdown	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout from Scrub	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Oxidizer
Rate or Volume	6.61E+00	5.06E+00	2.57E-01	8.82E+00	2.29E-01	4.93E+03	5.42E+03
Volume Flow (standard, wet)*						1.41E+04	3.35E+04
Volume Flow (standard, dry)*						1.41E+04	3.35E+04
Rate Units	lb/hr	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr
Rate or Volume, metric	3.00E+00	1.91E+01	9.74E-01	4.00E+00	4.00E+00	4.00E+02	9.48E+02
Rate Units	kg/hr	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr
Temperature, °C	25	70	70	54	54	21	25
Temperature, °F	77	158	158	129	129	70	77
Pressure, psia	14.70	29.98	29.98	14.70	14.70	42.30	92.30
Specific Gravity	2.01E-01	1.03E+00	1.03E+00	2.10E+00	2.10E+00	5.25E-03	8.21E-03
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
H+		9.56E-01	9.56E-01	2.35E-04	2.35E-04		
Al+3		9.25E-03	9.25E-03	0.01%	0.01%		
Sb+5		2.74E-07	2.74E-07	8.11E-09	8.11E-09		
As+3		1.53E-06	1.53E-06	2.78E-08	2.78E-08		
Ba+2							
Be+2							
B+3		2.73E-04	2.73E-04	7.20E-07	7.20E-07		
Cd+2							
Ca+2							
Cr+3							
Co+2		6.81E-07	6.81E-07	9.78E-09	9.78E-09		
Cs+							
Cu+2							
Fe+3		9.46E-05	9.46E-05	1.29E-06	1.29E-06		
Pb+2							
Hg+2		7.43E-02	7.43E-02	3.63E-03	3.63E-03		
Mn+4		2.49E-04	2.49E-04	3.34E-06	3.34E-06		
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3		7.64E-08	7.64E-08	3.80E-09	3.80E-09		
U+4							
V+3							
Zn+2							
Zr+4							
Cl-		4.71E-04	4.71E-04	4.06E-06	4.06E-06		
F-		5.09E-03	5.09E-03	2.36E-05	2.36E-05		
SO4-2							
NO3-		9.16E-01	9.16E-01	1.38E-02	1.38E-02		
PO4-3							
Am+4		1.16E-09	1.16E-09	6.84E-11	6.84E-11		
Br-		5.68E-09	5.68E-09	1.11E-10	1.11E-10		
Ce+4		5.71E-07	5.71E-07	1.95E-08	1.95E-08		
Eu+3		8.24E-09	8.24E-09	3.05E-10	3.05E-10		
Gd+3		2.43E-06	2.43E-06	9.31E-08	9.31E-08		
Ge+4							
In+3		2.52E-08	2.52E-08	7.04E-10	7.04E-10		
I-		6.07E-08	6.07E-08	1.88E-09	1.88E-09		
La+3		1.50E-07	1.50E-07	5.06E-09	5.06E-09		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	305	401	402	404	404	503	505
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
Li+							
Mg+2							
Mo+6							
Nd+3		4.82E-07	4.82E-07	1.69E-08	1.69E-08		
Np+4		4.41E-08	4.41E-08	2.54E-09	2.54E-09		
Nb+5							
Pd+4							
Pu+4							
Pr+4		1.36E-07	1.36E-07	4.66E-09	4.66E-09		
Pm+3		2.81E-11	2.81E-11	9.93E-13	9.93E-13		
Rh+4		5.86E-08	5.86E-08	1.47E-09	1.47E-09		
Rb+							
Ru+3		1.36E-05	1.36E-05	3.34E-07	3.34E-07		
Sm+3		8.98E-08	8.98E-08	3.29E-09	3.29E-09		
Si+4	4.67E-01			3.51E-01	3.51E-01		
Sr+2							
Tc+7		1.55E-07	1.55E-07	3.70E-09	3.70E-09		
Te+4							
Tb+4		3.44E-11	3.44E-11	1.33E-12	1.33E-12		
Th+4							
Sn+4							
Ti+4							
Y+3		1.11E-07	1.11E-07	2.41E-09	2.41E-09		
OH-		1.30E-06	1.30E-06	5.37E-09	5.37E-09		
H2O		5.29E+01	5.29E+01	2.32E-01	2.32E-01		
SO2		6.31E-07	6.31E-07	9.84E-09	9.84E-09		
H2S							
CO		2.88E-09	2.88E-09	1.96E-11	1.96E-11		
CO2		2.09E-04	2.09E-04	2.24E-06	2.24E-06	1.14E-01	
H2		3.07E-08	3.07E-08	1.50E-11	1.50E-11		
N2		5.76E-09	5.76E-09	3.93E-11	3.93E-11		
NO		8.34E-08	8.34E-08	6.09E-10	6.09E-10		
NO2		1.31E-05	1.31E-05	1.47E-07	1.47E-07		
O2		1.74E-08	1.74E-08	1.35E-10	1.35E-10		8.30E-02
S (other)		9.26E-09	9.26E-09	7.23E-11	7.23E-11		
CO3							
C (reductant)							
O (oxides)	53.26%	1.42E-04	1.42E-04	39.94%	39.94%		
C (organic)							
H (organic)							
O (organic)							
Mass Flow (kg/hr):	3.00E+00	1.97E+01	1.00E+00	4.00E+00	4.00E+00	7.32E+02	1.26E+03
Canister Rate, canisters/day					0.23		
Total Canisters Generated					32		
Heat Generation	w/m3	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3
Heat Generation		3.78E-03	3.78E-03	1.93E-03	3.87E-04		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
H-3							
C-14		2.03E-16	2.03E-16	4.94E-17	2.07E-14		
Co-60		1.53E-07	1.53E-07	3.72E-08	1.56E-05		
Ni-59							
Ni-63							
Se-79							
Sr-90							
Y-90		6.76E-04	6.76E-04	1.65E-04	6.91E-02		
Zr-93							
Nb-93m							
Nb-94							
Tc-99		3.15E-07	3.15E-07	7.67E-08	3.22E-05		
Ru-106		2.10E-08	2.10E-08	5.12E-09	2.15E-06		
Rh-102		1.51E-11	1.51E-11	3.68E-12	1.55E-09		
Rh-106		2.10E-08	2.10E-08	5.12E-09	2.15E-06		
Pd-107							
Cd-113m							
Sn-121m							
Sn-126							
Sb-125		6.36E-06	6.36E-06	1.55E-06	6.51E-04		
Sb-126		1.01E-09	1.01E-09	2.46E-10	1.03E-07		
Te-125m							
I-129		1.38E-09	1.38E-09	3.35E-10	1.41E-07		
Cs-134							
Cs-135							
Cs-137							
Ba-137m							
Ce-144		1.42E-08	1.42E-08	3.45E-09	1.45E-06		
Pr-144		1.42E-08	1.42E-08	3.45E-09	1.45E-06		
Pm-146		8.93E-10	8.93E-10	2.17E-10	9.13E-08		
Pm-147		3.83E-06	3.83E-06	9.33E-07	3.92E-04		
Sm-151		7.57E-06	7.57E-06	1.84E-06	7.74E-04		
Eu-152		5.00E-08	5.00E-08	1.22E-08	5.12E-06		
Eu-154		8.52E-07	8.52E-07	2.07E-07	8.71E-05		
Eu-155		7.39E-07	7.39E-07	1.80E-07	7.55E-05		
Th-230							
Pa-233							
U-232							
U-233							
U-234							
U-235							
U-236							
U-237							
U-238							
Np-237		7.36E-09	7.36E-09	1.79E-09	7.53E-07		
Pu-236							
Pu-238							
Pu-239							
Pu-240							
Pu-241							
Pu-242							
Pu-244							
Am-241		9.91E-07	9.91E-07	2.41E-07	1.01E-04		
Am-242m		2.74E-10	2.74E-10	6.67E-11	2.80E-08		

Table A-21. Mass balance, Tank WM-188 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
Am-243		4.47E-10	4.47E-10	1.09E-10	4.57E-08		
Cm-242							
Cm-243							
Cm-244							
Cm-245							
Cm-246							
TRU		1.00E-06	1.00E-06	2.43E-07	1.02E-04		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %							
O2, mol %							100%
N2, mol %							
H2, mol %							
CO2, mol %						100%	
COgas, ppmv							
NO, ppmv							
NO2, ppmv							
SO2, ppmv							
Cl, ppmv							
F, ppmv							
C (organic), ppmv							
H (organic), ppmv							
Hg, ug/wscm							
PM, mg/wscm						1.89E-01	3.05E-02
SVM, ug/wscm							
LVM, ug/wscm							
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis							
H2, mol %, dry basis							
CO2, mol %, dry basis							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis							
NO, ppmv, dry basis							
NO2, ppmv, dry basis							
SO2, ppmv, dry basis							
Cl, ppmv, dry basis							
F, ppmv, dry basis							
C (organic), ppmv, dry basis							
H (organic), ppmv, dry basis							
Hg, ug/dscm							
PM, mg/dscm							
SVM, ug/dscm							
LVM, ug/dscm							

Table A-21. Mass balance, Tank WM-188 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	510	511	512	513	514	515	516	517
Stream Name	Gas to Cool Product	Hot Gas after Product Cooling	Backpulse Gas for Candle Filters	Bed/ Solid Reductant Transport Gas	TF Transfer & Tank Sparge Air	Ventilation Air	New GAC	Off-gas Preheater Steam
Rate or Volume	1.82E+02	5.68E+02	2.16E+02	5.41E-01	1.44E+01	2.89E+01	4.61E+00	1.29E+03
Volume Flow (standard, wet)*	1.22E+03	1.22E+03	6.34E+02	1.59E+00	4.21E+01	2.94E+01		6.40E+03
Volume Flow (standard, dry)*	1.22E+03	1.22E+03	6.34E+02	1.59E+00	4.21E+01	2.94E+01		0.00E+00
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr	ft3/hr
Rate or Volume, metric	3.47E+01	3.47E+01	1.79E+01	4.49E-02	1.19E+00	8.34E-01	2.09E+00	1.81E+02
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr	wscm/hr
Temperature, °C	0	580	15	15	15	15	25	177
Temperature, °F	32	1077	59	59	59	59	77	350
Pressure, psia	92.30	92.30	42.30	42.30	42.30	14.70	14.70	112.30
Specific Gravity	7.85E-03	2.51E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01	3.73E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	Wt. %	lb/wscf
C (reductant)							100%	
Gas Composition, wet basis	mol %	mol %	mol %	mol %	mol %	mol %	mol %	mol %
H2O, mol %					0.01%	0.01%		100%
O2, mol %					21%	21%		
N2, mol %	100%	100%	100%	100%	79%	79%		
PM, mg/wscm	1.98E+01	1.98E+01	2.02E+01	1.94E+01	1.62E+01	1.57E+01		1.17E+01
kg/hr	4.04E+01	4.04E+01	2.09E+01	5.23E-02	1.43E+00	1.00E+00	2.09E+00	1.36E+02

Table A-22. Mass balance, Tank WM-189 waste.

PFD Number	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2	PFD-2
Stream Number	101	102	103	104	106	107	108
Stream Name	SBW	Reformer Feed	Reformer Off-gas	Reformer Off-gas Cooled	Filter Drain	Bed Drain	Cooled Product
Rate or Volume	9.73E+01	1.67E+02	2.23E+05	1.83E+05	8.69E+00	1.29E+02	1.38E+02
Volume Flow (standard, wet)*			5.40E+04	5.55E+04			
Volume Flow (standard, dry)*			3.73E+04	3.88E+04			
Rate Units	gal/hr	gal/hr	ft3/hr	ft3/hr	lb/hr	lb/hr	lb/hr
Rate or Volume, metric	3.68E+02	6.34E+02	1.53E+03	1.57E+03	3.94E+00	5.86E+01	6.26E+01
Rate Units	L/hr	L/hr	wscm/hr	wscm/hr	kg/hr	kg/hr	kg/hr
Temperature, °C	15	17	600	400	400	600	56
Temperature, °F	59	63	1112	752	752	1112	133
Pressure, psia	14.70	44.70	10.62	10.22	9.50	10.80	9.50
Specific Gravity	1.28	1.28	3.30E-04	4.10E-04	0.79	1.46	1.42
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt Frac	Wt Frac	Wt frac
H+	2.80E+00	1.65E+00	2.36E-06	2.30E-06	3.04E-05	5.74E-05	5.57E-05
Al+3	5.52E-01	3.21E-01	1.37E-05	1.33E-05	8.52E-02	9.36E-02	9.31E-02
Sb+5	1.64E-05	9.56E-06	1.74E-09	1.69E-09	1.08E-05	1.19E-05	1.18E-05
As+3	8.20E-05	4.77E-05	5.33E-09	5.18E-09	3.31E-05	3.64E-05	3.62E-05
Ba+2	6.23E-05	3.62E-05	6.73E-09	6.55E-09	4.18E-05	5.09E-05	5.04E-05
Be+2	2.03E-05	1.18E-05	1.44E-10	1.40E-10	8.92E-07	1.09E-06	1.08E-06
B+3	1.66E-02	9.67E-03	1.56E-07	1.52E-07	9.69E-04	1.07E-03	1.06E-03
Cd+2	2.97E-03	1.72E-03	1.17E-06	1.14E-06	7.29E-03	1.61E-03	1.96E-03
Ca+2	5.57E-02	3.24E-02	1.76E-06	1.71E-06	1.09E-02	1.33E-02	1.32E-02
Cr+3	4.67E-03	2.71E-03	2.92E-07	2.84E-07	1.81E-03	1.40E-03	1.43E-03
Co+2	3.89E-05	2.26E-05	1.99E-09	1.93E-09	1.23E-05	1.36E-05	1.35E-05
Cs+	5.55E-05	3.22E-05	4.31E-08	4.20E-08	2.68E-04	2.83E-05	4.34E-05
Cu+2	8.00E-04	4.65E-04	4.00E-08	3.89E-08	2.48E-04	3.03E-04	2.99E-04
Fe+3	2.70E-02	1.57E-02	1.92E-06	1.87E-06	1.19E-02	8.67E-03	8.87E-03
Pb+2	9.06E-04	5.26E-04	6.60E-07	6.42E-07	4.10E-03	9.03E-04	1.10E-03
Hg+2	4.95E-03	5.35E-03	2.77E-05	2.70E-05	1.72E-04	1.16E-05	2.17E-05
Mn+4	1.50E-02	8.71E-03	7.14E-07	6.95E-07	4.44E-03	4.88E-03	4.85E-03
Ni+2	1.90E-03	1.10E-03	8.75E-08	8.52E-08	5.44E-04	6.63E-04	6.55E-04
K+	1.84E-01	1.07E-01	9.19E-06	8.94E-06	5.71E-02	4.13E-02	4.23E-02
Se+4	2.35E-04	1.37E-04	1.61E-08	1.57E-08	1.00E-04	1.10E-04	1.09E-04
Ag+	3.68E-04	2.14E-04	3.29E-08	3.20E-08	2.04E-04	2.36E-04	2.34E-04
Na+	1.55E+00	9.00E-01	2.95E-05	2.87E-05	1.83E-01	2.11E-01	2.10E-01
Tl+3	4.33E-06	2.52E-06	7.67E-10	7.47E-10	4.77E-06	5.24E-06	5.21E-06
U+4	5.12E-04	2.97E-04	1.06E-07	1.03E-07	6.56E-04	7.21E-04	7.17E-04
V+3	2.87E-05	1.67E-05	1.27E-09	1.23E-09	7.88E-06	8.67E-06	8.62E-06
Zn+2	8.57E-04	4.98E-04	4.41E-08	4.29E-08	2.74E-04	3.34E-04	3.30E-04
Zr+4	3.53E-02	2.05E-02	2.79E-06	2.72E-06	1.74E-02	1.91E-02	1.90E-02
Cl-	1.86E-02	1.08E-02	6.05E-07	5.89E-07	3.53E-03	3.90E-03	3.88E-03
F-	3.02E-02	1.77E-02	9.97E-07	9.71E-07	2.79E-03	3.22E-03	3.19E-03
SO4-2	8.26E-02	4.80E-02	2.15E-12	2.09E-12	1.34E-08	1.55E-08	1.53E-08
NO3-	5.96E+00	3.49E+00	2.86E-06	2.79E-06	1.78E-02	5.71E-03	6.47E-03
PO4-3	9.77E-02	5.68E-02	8.05E-06	7.84E-06	5.01E-02	5.49E-02	5.46E-02
Am+4	5.94E-08	3.45E-08	1.25E-11	1.22E-11	7.77E-08	8.55E-08	8.50E-08
Br-	2.47E-07	1.43E-07	1.81E-11	1.76E-11	1.06E-07	1.16E-07	1.16E-07
Ce+4	3.60E-05	2.09E-05	4.37E-09	4.26E-09	2.72E-05	2.99E-05	2.97E-05
Eu+3	4.10E-07	2.38E-07	5.40E-11	5.25E-11	3.35E-07	3.69E-07	3.67E-07
Gd+3	1.23E-04	7.15E-05	1.68E-08	1.63E-08	1.04E-04	1.15E-04	1.14E-04
Ge+4	7.11E-09	4.13E-09	4.47E-13	4.36E-13	2.78E-09	3.06E-09	3.04E-09
In+3	1.14E-06	6.63E-07	1.14E-10	1.11E-10	7.06E-07	7.76E-07	7.72E-07
I-	2.74E-06	1.59E-06	3.19E-10	3.10E-10	1.86E-06	2.06E-06	2.04E-06
La+3	7.43E-06	4.32E-06	8.95E-10	8.71E-10	5.56E-06	6.12E-06	6.08E-06

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	106	107	108
Chemical Composition	Mol/liter	Mol/liter	lb/wscf	lb/wscf	Wt frac	Wt frac	Wt frac
Li+	4.93E-04	2.86E-04	2.83E-09	2.76E-09	1.76E-05	2.03E-05	2.01E-05
Mg+2	1.76E-02	1.02E-02	3.36E-07	3.28E-07	2.09E-03	2.55E-03	2.52E-03
Mo+6	5.31E-02	3.09E-02	4.42E-06	4.30E-06	2.75E-02	3.02E-02	3.00E-02
Nd+3	2.40E-05	1.39E-05	3.00E-09	2.92E-09	1.86E-05	2.05E-05	2.04E-05
Np+4	2.49E-06	1.45E-06	5.12E-10	4.98E-10	3.18E-06	3.50E-06	3.48E-06
Nb+5	1.04E-03	6.03E-04	8.35E-08	8.13E-08	5.19E-04	5.71E-04	5.67E-04
Pd+4	1.54E-03	8.93E-04	1.29E-07	1.25E-07	7.99E-04	9.73E-04	9.62E-04
Pu+4	6.03E-06	3.51E-06	1.28E-09	1.24E-09	7.93E-06	8.72E-06	8.67E-06
Pr+4	6.76E-06	3.93E-06	8.26E-10	8.04E-10	5.13E-06	5.64E-06	5.61E-06
Pm+3	1.36E-09	7.89E-10	1.71E-13	1.66E-13	1.06E-09	1.17E-09	1.16E-09
Rh+4	2.91E-06	1.69E-06	2.60E-10	2.53E-10	1.62E-06	1.78E-06	1.77E-06
Rb+	4.49E-06	2.61E-06	3.18E-10	3.09E-10	1.97E-06	2.28E-06	2.26E-06
Ru+3	8.05E-04	4.68E-04	7.05E-08	6.87E-08	4.38E-04	4.82E-04	4.79E-04
Sm+3	4.47E-06	2.60E-06	5.82E-10	5.67E-10	3.62E-06	3.98E-06	3.96E-06
Si+4	8.95E-02	5.20E-02	2.18E-06	2.12E-06	1.35E-02	1.49E-02	1.48E-02
Sr+2	1.08E-04	6.29E-05	7.45E-09	7.26E-09	4.63E-05	5.64E-05	5.58E-05
Tc+7	5.33E-06	3.10E-06	4.13E-09	4.02E-09	2.56E-05	1.56E-06	3.08E-06
Te+4	5.22E-06	3.03E-06	5.77E-10	5.62E-10	3.59E-06	3.94E-06	3.92E-06
Tb+4	1.71E-09	9.95E-10	2.36E-13	2.29E-13	1.47E-09	1.61E-09	1.60E-09
Th+4	2.59E-05	1.51E-05	5.21E-09	5.07E-09	3.24E-05	3.56E-05	3.54E-05
Sn+4	1.75E-03	1.02E-03	1.80E-07	1.75E-07	1.12E-03	1.23E-03	1.22E-03
Ti+4	9.03E-04	5.24E-04	3.74E-08	3.65E-08	2.33E-04	2.56E-04	2.54E-04
Y+3	5.54E-06	3.22E-06	4.27E-10	4.16E-10	2.65E-06	2.92E-06	2.90E-06
OH-		4.11E-08	3.26E-10	3.18E-10	2.03E-06	1.47E-06	1.50E-06
H2O	4.43E+01	2.74E+01	1.45E-02	1.41E-02	1.33E-02	4.91E-03	5.44E-03
SO2		4.33E-08	2.82E-12	2.74E-12			
H2S			3.93E-05	3.83E-05			
CO		9.04E-11	3.53E-04	3.43E-04			
CO2		6.51E-06	6.13E-02	5.97E-02			
H2		1.16E-09	5.66E-04	5.51E-04			
N2		2.13E-10	1.26E-03	3.16E-03			
NO		2.67E-09	1.41E-04	1.37E-04			
NO2		4.14E-07	2.06E-06	2.01E-06			
O2		5.69E-10					
S (other)		6.48E-10	1.54E-07	1.50E-07	9.59E-04	1.11E-03	1.10E-03
CO3	2.77E-05	1.61E-05	4.79E-05	4.66E-05	2.98E-01	3.26E-01	3.24E-01
C (reductant)							
O (oxides)	4.70E-01	2.73E-01	1.84E-05	1.79E-05	11.43%	12.23%	12.18%
C (organic)	1.10E-02	2.52E+01	5.53E-03	5.38E-03	5.52E-02	8.56E-04	4.28E-03
H (organic)	2.93E-02	6.73E+01	1.04E-03	1.01E-03	9.84E-03	1.53E-04	7.63E-04
O (organic)	3.66E-03	8.41E+00					
Mass Flow (kg/hr):	4.72E+02	8.13E+02	2.08E+03	2.13E+03	3.94E+00	5.86E+01	6.26E+01
Canister Rate, canisters/day							1.32
Total Canisters Generated							179
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	4.65E-01	2.70E-01			3.08E+00	3.88E+00	3.88E+00

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
H-3	8.12E-06	4.72E-06	1.96E-06	1.90E-06			
C-14	1.31E-10	7.60E-11	3.13E-11	3.04E-11	9.99E-12	5.76E-12	6.02E-12
Co-60	2.65E-05	1.54E-05	3.69E-07	3.59E-07	1.43E-04	1.57E-04	1.56E-04
Ni-59	1.11E-06	6.47E-07	1.40E-08	1.37E-08	5.44E-06	6.63E-06	6.56E-06
Ni-63	3.47E-05	2.02E-05	4.37E-07	4.26E-07	1.70E-04	2.07E-04	2.04E-04
Se-79	4.75E-07	2.76E-07	6.59E-09	6.41E-09	2.56E-06	2.81E-06	2.79E-06
Sr-90	3.15E-02	1.83E-02	3.96E-04	3.86E-04	1.54E-01	1.87E-01	1.85E-01
Y-90	3.15E-02	1.83E-02	4.37E-04	4.26E-04	1.70E-01	1.87E-01	1.85E-01
Zr-93	1.76E-06	1.02E-06	2.45E-08	2.38E-08	9.49E-06	1.04E-05	1.04E-05
Nb-93m	1.36E-06	7.89E-07	1.89E-08	1.84E-08	7.32E-06	8.04E-06	8.00E-06
Nb-94	1.23E-06	7.17E-07	1.71E-08	1.67E-08	6.65E-06	7.31E-06	7.27E-06
Tc-99	1.25E-05	7.28E-06	1.59E-06	1.54E-06	6.14E-04	3.74E-05	7.37E-05
Ru-106	1.01E-06	5.90E-07	1.41E-08	1.37E-08	5.47E-06	6.01E-06	5.98E-06
Rh-102	6.86E-10	3.99E-10	9.53E-12	9.28E-12	3.70E-09	4.06E-09	4.04E-09
Rh-106	1.01E-06	5.90E-07	1.41E-08	1.37E-08	5.47E-06	6.01E-06	5.98E-06
Pd-107	1.31E-08	7.64E-09	1.66E-10	1.61E-10	6.42E-08	7.83E-08	7.74E-08
Cd-113m	2.64E-06	1.54E-06	1.49E-07	1.45E-07	5.77E-05	1.27E-05	1.56E-05
Sn-121m	5.32E-08	3.09E-08	7.39E-10	7.19E-10	2.87E-07	3.15E-07	3.13E-07
Sn-126	4.47E-07	2.60E-07	6.20E-09	6.04E-09	2.41E-06	2.65E-06	2.63E-06
Sb-125	3.73E-04	2.17E-04	5.18E-06	5.04E-06	2.01E-03	2.21E-03	2.20E-03
Sb-126	4.58E-08	2.66E-08	6.36E-10	6.19E-10	2.47E-07	2.71E-07	2.70E-07
Te-125m	2.51E-06	1.46E-06	3.48E-08	3.39E-08	1.35E-05	1.48E-05	1.48E-05
I-129	5.80E-08	3.37E-08	8.51E-10	8.28E-10	3.10E-07	3.43E-07	3.41E-07
Cs-134	5.76E-05	3.35E-05	5.39E-06	5.25E-06	2.09E-03	2.21E-04	3.39E-04
Cs-135	9.08E-07	5.28E-07	8.51E-08	8.28E-08	3.30E-05	3.49E-06	5.35E-06
Cs-137	4.70E-02	2.73E-02	4.41E-03	4.29E-03	1.71E+00	1.81E-01	2.77E-01
Ba-137m	4.45E-02	2.58E-02	5.60E-04	5.45E-04	2.17E-01	2.65E-01	2.62E-01
Ce-144	6.85E-07	3.98E-07	9.52E-09	9.26E-09	3.69E-06	4.06E-06	4.04E-06
Pr-144	6.85E-07	3.98E-07	9.52E-09	9.26E-09	3.69E-06	4.06E-06	4.04E-06
Pm-146	4.05E-08	2.35E-08	5.63E-10	5.48E-10	2.18E-07	2.40E-07	2.39E-07
Pm-147	1.85E-04	1.08E-04	2.57E-06	2.50E-06	9.96E-04	1.10E-03	1.09E-03
Sm-151	3.66E-04	2.13E-04	5.08E-06	4.94E-06	1.97E-03	2.17E-03	2.15E-03
Eu-152	2.35E-06	1.36E-06	3.26E-08	3.17E-08	1.26E-05	1.39E-05	1.38E-05
Eu-154	1.40E-04	8.14E-05	1.95E-06	1.89E-06	7.55E-04	8.30E-04	8.25E-04
Eu-155	1.32E-04	7.67E-05	1.83E-06	1.78E-06	7.10E-04	7.81E-04	7.77E-04
Th-230	8.63E-10	5.01E-10	1.20E-11	1.17E-11	4.65E-09	5.11E-09	5.08E-09
Pa-233	2.33E-06	1.36E-06	3.24E-08	3.15E-08	1.26E-05	1.38E-05	1.37E-05
U-232	2.02E-09	1.17E-09	2.80E-11	2.73E-11	1.09E-08	1.20E-08	1.19E-08
U-233	7.12E-11	4.13E-11	9.88E-13	9.61E-13	3.83E-10	4.21E-10	4.19E-10
U-234	1.40E-06	8.11E-07	1.94E-08	1.89E-08	7.52E-06	8.27E-06	8.22E-06
U-235	5.63E-08	3.27E-08	7.82E-10	7.61E-10	3.03E-07	3.33E-07	3.32E-07
U-236	6.53E-08	3.79E-08	9.07E-10	8.82E-10	3.52E-07	3.87E-07	3.84E-07
U-237	5.12E-09	2.98E-09	7.11E-11	6.92E-11	2.76E-08	3.03E-08	3.01E-08
U-238	3.10E-08	1.80E-08	4.30E-10	4.19E-10	1.67E-07	1.83E-07	1.82E-07
Np-237	4.16E-07	2.42E-07	5.77E-09	5.62E-09	2.24E-06	2.46E-06	2.45E-06
Pu-236	3.29E-09	1.91E-09	4.57E-11	4.45E-11	1.77E-08	1.95E-08	1.94E-08
Pu-238	7.60E-04	4.42E-04	1.05E-05	1.03E-05	4.09E-03	4.50E-03	4.47E-03
Pu-239	8.30E-05	4.82E-05	1.15E-06	1.12E-06	4.47E-04	4.91E-04	4.89E-04
Pu-240	1.23E-05	7.13E-06	1.70E-07	1.66E-07	6.61E-05	7.27E-05	7.22E-05
Pu-241	6.65E-04	3.86E-04	9.23E-06	8.98E-06	3.58E-03	3.94E-03	3.91E-03
Pu-242	9.61E-09	5.58E-09	1.33E-10	1.30E-10	5.17E-08	5.69E-08	5.66E-08
Pu-244	2.86E-16	1.66E-16	3.98E-18	3.87E-18	1.54E-15	1.70E-15	1.69E-15
Am-241	6.48E-05	3.77E-05	9.00E-07	8.76E-07	3.49E-04	3.84E-04	3.82E-04
Am-242m	1.22E-08	7.07E-09	1.69E-10	1.64E-10	6.55E-08	7.21E-08	7.16E-08

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	101	102	103	104	106	107	108
Radiological Composition	Ci/L	Ci/L	Ci/wscm	Ci/wscm	Ci/kg	Ci/kg	Ci/kg
Am-243	2.07E-08	1.21E-08	2.88E-10	2.80E-10	1.12E-07	1.23E-07	1.22E-07
Cm-242	2.43E-08	1.41E-08	3.37E-10	3.28E-10	1.31E-07	1.44E-07	1.43E-07
Cm-243	2.99E-08	1.74E-08	4.15E-10	4.04E-10	1.61E-07	1.77E-07	1.76E-07
Cm-244	1.27E-06	7.35E-07	1.76E-08	1.71E-08	6.82E-06	7.49E-06	7.45E-06
Cm-245	3.15E-10	1.83E-10	4.37E-12	4.25E-12	1.69E-09	1.86E-09	1.85E-09
Cm-246	2.06E-11	1.20E-11	2.87E-13	2.79E-13	1.11E-10	1.22E-10	1.22E-10
TRU	9.41E-04	5.47E-04	1.31E-05	1.27E-05	5.07E-03	5.57E-03	5.54E-03
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %			30.94%	30.12%			
O2, mol %							
N2, mol %			1.74%	4.35%			
H2, mol %			10.82%	10.54%			
CO2, mol %			53.64%	52.21%			
COgas, ppmv			4.85E+03	4.72E+03			
NO, ppmv			1.81E+03	1.76E+03			
NO2, ppmv			1.73E+01	1.68E+01			
SO2, ppmv			1.69E-05	1.65E-05			
Cl, ppmv			6.57E+00	6.40E+00			
F, ppmv			2.02E+01	1.97E+01			
C (organic), ppmv			1.77E+05	1.73E+05			
H (organic), ppmv			3.97E+05	3.86E+05			
Hg, ug/wscm			4.44E+05	4.33E+05			
PM, mg/wscm			1.08E+05	1.05E+05			
SVM, ug/wscm			2.94E+04	2.86E+04			
LVM, ug/wscm			4.76E+03	4.64E+03			
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis			2.51%	6.23%			
H2, mol %, dry basis			15.67%	15.08%			
CO2, mol %, dry basis			77.67%	74.71%			
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis			9.83E+02	9.46E+02			
NO, ppmv, dry basis			3.67E+02	3.53E+02			
NO2, ppmv, dry basis			3.50E+00	3.37E+00			
SO2, ppmv, dry basis			3.43E-06	3.30E-06			
Cl, ppmv, dry basis			1.33E+00	1.28E+00			
F, ppmv, dry basis			4.10E+00	3.94E+00			
C (organic), ppmv, dry basis			3.59E+04	3.46E+04			
H (organic), ppmv, dry basis			8.04E+04	7.73E+04			
Hg, ug/dscm			9.01E+04	8.66E+04			
PM, mg/dscm			2.19E+04	2.10E+04			
SVM, ug/dscm			4.25E+04	4.14E+04			
LVM, ug/dscm			6.90E+03	6.71E+03			

Table A-22. Mass balance, Tank WM-189 waste (continued).

PFD Number	PFD-2	PFD-2	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	108	109	110	111	112	113A	113B	114
Stream Name	Product Shipping Canisters	Off-Gas from Filter to Oxidizer	Outlet of Oxidizer	Quenched Oxidizer Off-gas	Scrub	Packed Scrubber Drain	Demister Drain	Off-Gas to Demister
Rate or Volume	1.32E+00	1.99E+05	6.53E+05	3.61E+05	9.89E+03	9.91E+03	0	3.63E+05
Volume Flow (standard, wet)*		5.61E+04	9.61E+04	1.79E+05				1.77E+05
Volume Flow (standard, dry)*		3.94E+04	5.26E+04	5.26E+04				5.24E+04
Rate Units	cont/day	ft3/hr	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	ft3/hr
Rate or Volume, metric	6.26E+01	1.59E+03	2.72E+03	5.06E+03	3.75E+04	3.75E+04	1	5.02E+03
Rate Units	kg/hr	wscm/hr	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	wscm/hr
Temperature, °C	56	397	1000	100	77	79	339	78
Temperature, °F	133	747	1832	212	171	174	171	172
Pressure, psia	9.50	9.50	9.39	9.28	37.52	8.96	8.42	8.60
Specific Gravity	1.42	3.81E-04	1.92E-04	5.19E-04	1.03	1.03	1.03	5.15E-04
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
H+	5.57E-05	2.27E-06	1.69E-08	9.10E-09	9.36E-01	9.34E-01		1.20E-07
Al+3	9.31E-02				9.19E-03	9.17E-03		
Sb+5	1.18E-05				2.58E-07	2.57E-07		
As+3	3.62E-05				1.29E-06	1.28E-06		
Ba+2	5.04E-05							
Be+2	1.08E-06							
B+3	1.06E-03				2.61E-04	2.60E-04		
Cd+2	1.96E-03							
Ca+2	1.32E-02							
Cr+3	1.43E-03							
Co+2	1.35E-05				6.10E-07	6.09E-07		
Cs+	4.34E-05							
Cu+2	2.99E-04							
Fe+3	8.87E-03	5.79E-09	3.38E-09	1.82E-09	1.10E-04	1.10E-04		
Pb+2	1.10E-03							
Hg+2	2.17E-05	2.67E-05	1.56E-05	8.37E-06	7.92E-02	7.91E-02		4.33E-06
Mn+4	4.85E-03				2.35E-04	2.35E-04		
Ni+2	6.55E-04							
K+	4.23E-02							
Se+4	1.09E-04							
Ag+	2.34E-04							
Na+	2.10E-01							
Tl+3	5.21E-06				6.79E-08	6.78E-08		
U+4	7.17E-04							
V+3	8.62E-06							
Zn+2	3.30E-04							
Zr+4	1.90E-02							
Cl-	3.88E-03	3.49E-08	2.04E-08	1.10E-08	4.00E-04	4.00E-04		6.72E-09
F-	3.19E-03	5.28E-07	3.08E-07	1.66E-07	4.86E-03	4.86E-03		1.46E-07
SO4-2	1.53E-08		2.54E-10	1.37E-10	4.51E-06	4.50E-06		
NO3-	6.47E-03	1.06E-11	6.21E-12	3.34E-12	8.98E-01	8.96E-01		6.87E-06
PO4-3	5.46E-02							
Am+4	8.50E-08				9.31E-10	9.30E-10		
Br-	1.16E-07	1.04E-12	6.09E-13	3.27E-13	5.30E-09	5.30E-09		2.01E-13
Ce+4	2.97E-05				5.65E-07	5.64E-07		
Eu+3	3.67E-07				6.43E-09	6.42E-09		
Gd+3	1.14E-04				1.93E-06	1.93E-06		
Ge+4	3.04E-09							
In+3	7.72E-07				1.79E-08	1.79E-08		
I-	2.04E-06	1.84E-11	1.07E-11	5.77E-12	5.89E-08	5.89E-08		3.54E-12
La+3	6.08E-06				1.17E-07	1.16E-07		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Chemical Composition	Wt frac	lb/wscf	lb/wscf	lb/wscf	Mol/liter	Mol/liter	Mol/liter	lb/wscf
Li+	2.01E-05							
Mg+2	2.52E-03							
Mo+6	3.00E-02							
Nd+3	2.04E-05				3.76E-07	3.75E-07		
Np+4	3.48E-06				3.90E-08	3.90E-08		
Nb+5	5.67E-04							
Pd+4	9.62E-04							
Pu+4	8.67E-06							
Pr+4	5.61E-06				1.06E-07	1.06E-07		
Pm+3	1.16E-09				2.13E-11	2.13E-11		
Rh+4	1.77E-06				4.57E-08	4.57E-08		
Rb+	2.26E-06							
Ru+3	4.79E-04				1.26E-05	1.26E-05		
Sm+3	3.96E-06				7.01E-08	7.00E-08		
Si+4	1.48E-02							
Sr+2	5.58E-05							
Tc+7	3.08E-06	8.35E-12	4.87E-12	2.62E-12	9.15E-08	9.14E-08		
Te+4	3.92E-06							
Tb+4	1.60E-09				2.68E-11	2.68E-11		
Th+4	3.54E-05							
Sn+4	1.22E-03							
Ti+4	2.54E-04							
Y+3	2.90E-06				8.69E-08	8.68E-08		
OH-	1.50E-06		1.79E-20	3.69E-11	1.32E-06	1.31E-06		
H2O	5.44E-03	1.39E-02	2.12E-02	3.30E-02	5.30E+01	5.29E+01		3.31E-02
SO2		2.71E-12	4.15E-05	2.23E-05	1.39E-06	1.46E-06		2.25E-05
H2S		3.78E-05	1.54E-20	8.28E-21				
CO		3.39E-04	2.29E-08	1.23E-08	2.90E-09	2.99E-09		1.24E-08
CO2		5.90E-02	5.53E-02	2.97E-02	2.08E-04	3.14E-04		2.99E-02
H2		5.45E-04	8.82E-10	4.74E-10	3.71E-08	4.17E-08		3.75E-08
N2		3.97E-03	2.36E-03	1.27E-03	6.83E-09	2.72E-07		1.28E-03
NO		1.36E-04	1.94E-05	1.04E-05	8.55E-08	1.37E-07		1.05E-05
NO2		1.98E-06	1.16E-06	6.23E-07	1.33E-05	1.33E-05		6.28E-07
O2			2.50E-03	1.34E-03	1.82E-08	4.34E-07		1.35E-03
S (other)	1.10E-03				2.08E-08	2.14E-08		
CO3	3.24E-01				1.23E-10	1.85E-10		
C (reductant)			2.57E-17	1.38E-17				
O (oxides)	12.18%	2.49E-09	1.46E-09	7.82E-10	1.65E-04	1.65E-04		
C (organic)		5.31E-03	4.92E-33	2.64E-33				
H (organic)		9.97E-04	1.65E-33	8.88E-34				
O (organic)								
Mass Flow (kg/hr):	6.26E+01	2.15E+03	3.55E+03	5.30E+03	3.85E+04	3.85E+04		5.29E+03
Canister Rate, canisters/day								
Total Canisters Generated								
	w/Canister	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation	3.10E+00				2.78E-03	2.77E-03		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
H-3		1.88E-06	1.10E-06	5.91E-07	1.02E-06	1.02E-06		5.92E-07
C-14	6.83E-09	3.01E-11	1.76E-11	9.45E-12	1.82E-16	2.75E-16		9.52E-12
Co-60	1.77E-01				4.16E-07	4.16E-07		
Ni-59	7.44E-03							
Ni-63	2.32E-01							
Se-79	3.17E-03							
Sr-90	2.10E+02							
Y-90	2.10E+02				4.94E-04	4.93E-04		
Zr-93	1.18E-02							
Nb-93m	9.07E-03							
Nb-94	8.24E-03							
Tc-99	8.36E-02	3.20E-09	1.87E-09	1.01E-09	2.15E-07	2.15E-07		
Ru-106	6.78E-03				1.59E-08	1.59E-08		
Rh-102	4.58E-06				1.08E-11	1.07E-11		
Rh-106	6.78E-03				1.59E-08	1.59E-08		
Pd-107	8.78E-05							
Cd-113m	1.76E-02							
Sn-121m	3.55E-04							
Sn-126	2.98E-03							
Sb-125	2.49E+00				5.85E-06	5.84E-06		
Sb-126	3.06E-04				7.18E-10	7.17E-10		
Te-125m	1.67E-02							
I-129	3.86E-04	4.91E-11	2.87E-11	1.54E-11	1.25E-09	1.24E-09		9.45E-12
Cs-134	3.85E-01							
Cs-135	6.06E-03							
Cs-137	3.14E+02							
Ba-137m	2.97E+02							
Ce-144	4.58E-03				1.08E-08	1.07E-08		
Pr-144	4.58E-03				1.08E-08	1.07E-08		
Pm-146	2.71E-04				6.35E-10	6.34E-10		
Pm-147	1.24E+00				2.90E-06	2.90E-06		
Sm-151	2.44E+00				5.74E-06	5.73E-06		
Eu-152	1.57E-02				3.68E-08	3.68E-08		
Eu-154	9.36E-01				2.20E-06	2.19E-06		
Eu-155	8.81E-01				2.07E-06	2.07E-06		
Th-230	5.76E-06							
Pa-233	1.56E-02							
U-232	1.35E-05							
U-233	4.75E-07							
U-234	9.32E-03							
U-235	3.76E-04							
U-236	4.36E-04							
U-237	3.42E-05							
U-238	2.07E-04							
Np-237	2.78E-03				6.52E-09	6.51E-09		
Pu-236	2.20E-05							
Pu-238	5.07E+00							
Pu-239	5.54E-01							
Pu-240	8.19E-02							
Pu-241	4.44E+00							
Pu-242	6.42E-05							
Pu-244	1.91E-12							
Am-241	4.33E-01				1.02E-06	1.02E-06		
Am-242m	8.13E-05				1.91E-10	1.90E-10		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	108	109	110	111	112	113A	113B	114
Radiological Composition	Ci/Canister	Ci/wscm	Ci/wscm	Ci/wscm	Ci/L	Ci/L	Ci/L	Ci/wscm
Am-243	1.39E-04				3.25E-10	3.25E-10		
Cm-242	1.62E-04							
Cm-243	2.00E-04							
Cm-244	8.45E-03							
Cm-245	2.10E-06							
Cm-246	1.38E-07							
TRU	6.28E+00				1.02E-06	1.02E-06		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %		29.78%	45.30%	70.61%				70.49%
O2, mol %			3.0108%	1.6176%				1.6244%
N2, mol %		5.46%	3.25%	1.75%				1.75%
H2, mol %		10.42%	0.00002%	0.00001%				0.0007%
CO2, mol %		51.63%	48.38%	25.99%				26.10%
COgas, ppmv		4.67E+03	3.16E-01	1.70E-01				1.70E-01
NO, ppmv		1.74E+03	2.49E+02	1.34E+02				1.35E+02
NO2, ppmv		1.66E+01	9.71E+00	5.22E+00				5.24E+00
SO2, ppmv		1.63E-05	2.50E+02	1.34E+02				1.35E+02
Cl, ppmv		3.79E-01	2.22E-01	1.19E-01				7.27E-02
F, ppmv		1.07E+01	6.25E+00	3.36E+00				2.94E+00
C (organic), ppmv		1.70E+05						
H (organic), ppmv		3.81E+05						
Hg, ug/wscm		4.27E+05	2.50E+05	1.34E+05				
PM, mg/wscm		1.01E+05	2.55E+02	1.43E+02				8.43E+00
SVM, ug/wscm								
LVM, ug/wscm								
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis			5.50%	5.50%				5.50%
N2, mol %, dry basis		7.78%	5.95%	5.95%				5.95%
H2, mol %, dry basis		14.84%	0.00003%	0.00003%				0.002%
CO2, mol %, dry basis		73.53%	88.45%	88.45%				88.44%
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis		9.31E+02	8.08E-02	8.08E-02				8.08E-02
NO, ppmv, dry basis		3.48E+02	6.39E+01	6.39E+01				6.39E+01
NO2, ppmv, dry basis		3.31E+00	2.49E+00	2.49E+00				2.49E+00
SO2, ppmv, dry basis		3.25E-06	6.40E+01	6.40E+01				6.40E+01
Cl, ppmv, dry basis		7.56E-02	5.67E-02	5.67E-02				3.45E-02
F, ppmv, dry basis		2.13E+00	1.60E+00	1.60E+00				1.40E+00
C (organic), ppmv, dry basis		3.40E+04	4.04E-26	4.04E-26				
H (organic), ppmv, dry basis		7.60E+04	1.62E-25	1.62E-25				
Hg, ug/dscm		8.52E+04	6.39E+04	6.39E+04				
PM, mg/dscm		2.02E+04	6.54E+01	6.80E+01				4.00E+00
SVM, ug/dscm								
LVM, ug/dscm								

Table A-22. Mass balance, Tank WM-189 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	115	116	117	118	119	120
Stream Name	Scrubbed Off-Gas to Preheater	Preheated Off-gas to GAC	Pressure Control Bleed Air	Final HEPA Off-Gas Outlet	Off-gas to Exhaust Blower	Spent GAC
Rate or Volume	3.97E+05	4.90E+05	1.58E+04	5.96E+05	6.37E+05	5.14E+00
Volume Flow (standard, wet)*	1.78E+05	1.78E+05	1.56E+04	1.78E+05	1.93E+05	
Volume Flow (standard, dry)*	5.26E+04	5.26E+04	1.56E+04	5.26E+04	6.80E+04	
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr
Rate or Volume, metric	5.04E+03	5.04E+03	4.41E+02	5.04E+03	5.47E+03	2.33E+00
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr
Temperature, °C	77	120	25	120	114	27
Temperature, °F	171	248	77	248	237	81
Pressure, psia	7.88	7.16	14.70	5.89	5.89	14.70
Specific Gravity	4.70E-04	3.81E-04	1.18E-03	3.13E-04	3.22E-04	5.86E-01
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
H+	1.19E-07	1.19E-07		1.19E-07	1.10E-07	4.88E-06
Al+3						
Sb+5						
As+3						
Ba+2						
Be+2						
B+3						
Cd+2						
Ca+2						
Cr+3						
Co+2						
Cs+						
Cu+2						
Fe+3						
Pb+2						
Hg+2	4.31E-06	4.31E-06		2.29E-09	2.11E-09	1.49E-01
Mn+4						
Ni+2						
K+						
Se+4						
Ag+						
Na+						
Tl+3						
U+4						
V+3						
Zn+2						
Zr+4						
Cl-	6.69E-09	6.69E-09		1.74E-09	1.61E-09	1.71E-04
F-	1.45E-07	1.45E-07		1.45E-07	1.34E-07	
SO4-2						
NO3-	6.84E-06	6.84E-06		6.84E-06	6.30E-06	
PO4-3						
Am+4						
Br-	2.00E-13	2.00E-13		5.21E-14	4.80E-14	5.12E-09
Ce+4						
Eu+3						
Gd+3						
Ge+4						
In+3						
I-	3.53E-12	3.53E-12		9.19E-13	8.47E-13	9.04E-08
La+3						

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	115	116	117	118	119	120
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	wt frac
Li+						
Mg+2						
Mo+6						
Nd+3						
Np+4						
Nb+5						
Pd+4						
Pu+4						
Pr+4						
Pm+3						
Rh+4						
Rb+						
Ru+3						
Sm+3						
Si+4						
Sr+2						
Tc+7						
Te+4						
Tb+4						
Th+4						
Sn+4						
Ti+4						
Y+3						
OH-						
H2O	3.30E-02	3.30E-02	4.68E-06	3.30E-02	3.04E-02	
SO2	2.24E-05	2.24E-05		2.24E-05	2.07E-05	
H2S						
CO	1.24E-08	1.24E-08		1.24E-08	1.14E-08	
CO2	2.98E-02	2.98E-02		2.98E-02	2.75E-02	
H2						
N2	1.28E-03	1.28E-03	5.75E-02	1.28E-03	5.80E-03	
NO	1.05E-05	1.05E-05		1.05E-05	9.66E-06	
NO2	6.26E-07	6.26E-07		6.26E-07	5.77E-07	
O2	1.35E-03	1.35E-03	1.74E-02	1.35E-03	2.65E-03	
S (other)						
CO3						
C (reductant)						8.50E-01
O (oxides)						
C (organic)						
H (organic)						
O (organic)						
Mass Flow (kg/hr):	5.29E+03	5.29E+03	5.29E+02	5.29E+03	5.81E+03	2.33E+00
Canister Rate, canisters/day						
Total Canisters Generated						
	w/m3	w/m3	w/m3	w/m3	w/m3	w/m3
Heat Generation						4.58E-14

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
H-3	5.89E-07	5.89E-07		5.89E-07	5.43E-07	
C-14	9.49E-12	9.49E-12		9.49E-12	8.74E-12	6.70E-11
Co-60						
Ni-59						
Ni-63						
Se-79						
Sr-90						
Y-90						
Zr-93						
Nb-93m						
Nb-94						
Tc-99						
Ru-106						
Rh-102						
Rh-106						
Pd-107						
Cd-113m						
Sn-121m						
Sn-126						
Sb-125						
Sb-126						
Te-125m						
I-129	9.42E-12	9.42E-12		2.45E-12	2.26E-12	1.51E-08
Cs-134						
Cs-135						
Cs-137						
Ba-137m						
Ce-144						
Pr-144						
Pm-146						
Pm-147						
Sm-151						
Eu-152						
Eu-154						
Eu-155						
Th-230						
Pa-233						
U-232						
U-233						
U-234						
U-235						
U-236						
U-237						
U-238						
Np-237						
Pu-236						
Pu-238						
Pu-239						
Pu-240						
Pu-241						
Pu-242						
Pu-244						
Am-241						
Am-242m						

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	115	116	117	118	119	120
Radiological Composition	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/wscm	Ci/kg
Am-243						
Cm-242						
Cm-243						
Cm-244						
Cm-245						
Cm-246						
TRU						
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %	70.48%	70.48%	0.01%	70.48%	64.82%	
O2, mol %	1.62%	1.62%	20.99%	1.62%	3.18%	
N2, mol %	1.76%	1.76%	79.00%	1.76%	7.96%	
H2, mol %						
CO2, mol %	26.11%	26.11%		26.11%	24.01%	
COgas, ppmv	1.70E-01	1.70E-01		1.70E-01	1.57E-01	
NO, ppmv	1.35E+02	1.35E+02		1.35E+02	1.24E+02	
NO2, ppmv	5.24E+00	5.24E+00		5.24E+00	4.82E+00	
SO2, ppmv	1.35E+02	1.35E+02		1.35E+02	1.24E+02	
Cl, ppmv	7.27E-02	7.27E-02		1.90E-02	1.74E-02	
F, ppmv	2.94E+00	2.94E+00		2.94E+00	2.71E+00	
C (organic), ppmv						
H (organic), ppmv						
Hg, ug/wscm	3.67E+04	3.67E+04		3.67E+01	3.38E+01	
PM, mg/wscm	4.53E+01	4.53E+01	1.58E+01	8.69E+00	9.29E+00	
SVM, ug/wscm						
LVM, ug/wscm						
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis	5.50%	5.50%	20.99%	0.77%	9.04%	
N2, mol %, dry basis	5.95%	5.95%	79.01%	5.95%	22.64%	
H2, mol %, dry basis						
CO2, mol %, dry basis	88.44%	88.44%		88.44%	68.24%	
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis	8.08E-02	8.08E-02		8.08E-02	6.24E-02	
NO, ppmv, dry basis	6.39E+01	6.39E+01		6.39E+01	4.93E+01	
NO2, ppmv, dry basis	2.49E+00	2.49E+00		2.49E+00	1.92E+00	
SO2, ppmv, dry basis	6.40E+01	6.40E+01		6.40E+01	4.94E+01	
Cl, ppmv, dry basis	3.45E-02	3.45E-02		9.00E-03	6.94E-03	
F, ppmv, dry basis	1.40E+00	1.40E+00		1.40E+00	1.08E+00	
C (organic), ppmv, dry basis						
H (organic), ppmv, dry basis						
Hg, ug/dscm	1.74E+04	1.74E+04		1.74E+01	1.35E+01	
PM, mg/dscm	2.15E+01	2.15E+01	2.22E+00	4.12E+00	3.70E+00	
SVM, ug/dscm						
LVM, ug/dscm						

Table A-22. Mass balance, Tank WM-189 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2
Stream Number	203	204	205	206	207	301	303
Stream Name	Fluidizing Gas to Reformer	Propane to Oxidizer	Water to Spray Quench	ANN to Scrub for F Adjust	HNO3 to Scrub for H+ Adjust	Isopropanol	Bed Media
Rate or Volume	1.11E+04	9.05E+02	4.67E+02	3.12E-02	1.13E+00	8.21E+01	1.38E+00
Volume Flow (standard, wet)*	1.09E+04	2.56E+03					
Volume Flow (standard, dry)*	1.09E+04	2.56E+03					
Rate Units	ft3/hr	ft3/hr	gal/hr	gal/hr	gal/hr	gal/hr	lb/hr
Rate or Volume, metric	3.10E+02	7.26E+01	1.77E+03	1.18E-01	4.29E+00	3.11E+02	6.26E-01
Rate Units	wscm/hr	wscm/hr	L/hr	L/hr	L/hr	L/hr	kg/hr
Temperature, °C	580	25	25	25	25	15	15
Temperature, °F	1076	77	77	77	77	59	59
Pressure, psia	42.30	42.30	112.30	14.70	42.30	14.70	14.70
Specific Gravity	1.81E-03	5.19E-03	9.93E-01	1.80E+00	1.23E+00	1.03E+00	1.58E+00
Chemical Composition	Mol %	lb/wscf	Mol/liter	Mol/liter	Mol/liter	Mol/liter	Wt frac
H+			9.95E-08		1.33E+01		
Al+3				2.20E+00			0.529
Sb+5							
As+3							
Ba+2							
Be+2							
B+3							
Cd+2							
Ca+2							
Cr+3							
Co+2							
Cs+							
Cu+2							
Fe+3							
Pb+2							
Hg+2							
Mn+4							
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3							
U+4							
V+3							
Zn+2							
Zr+4							
Cl-							
F-							
SO4-2							
NO3-				6.60E+00	1.33E+01		
CO2	100						
OH-			9.95E-08	7.31E-08			
H2O			5.51E+01	7.41E+01	2.17E+01		
O (oxides)							0.471
C (organic)		9.35E-02				5.15E+01	
H (organic)		2.09E-02				1.37E+02	
O (organic)						1.72E+01	
Mass Flow (kg/hr):	5.66E+02	1.33E+02	1.76E+03	2.13E-01	5.28E+00	3.20E+02	6.26E-01

Table A-22. Mass balance, Tank WM-189 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-2	PFD-2	PFD-3
Stream Number	305	401	402	404	404	503	505
Stream Name	Grout Mix for Scrub Blowdown	Scrub Recycled to Feed	Scrub Blowdown to Grout Mixer	MLLW Grout from Scrub	MLLW Grout Drums	Feed Atomizing Gas	Oxygen to Oxidizer
Rate or Volume	6.61E+00	5.23E+00	2.57E-01	8.82E+00	2.29E-01	5.09E+03	5.45E+03
Volume Flow (standard, wet)*						1.46E+04	3.37E+04
Volume Flow (standard, dry)*						1.46E+04	3.37E+04
Rate Units	lb/hr	gal/hr	gal/hr	lb/hr	Drums/day	ft3/hr	ft3/hr
Rate or Volume, metric	3.00E+00	1.98E+01	9.74E-01	4.00E+00	4.00E+00	4.13E+02	9.53E+02
Rate Units	kg/hr	L/hr	L/hr	kg/hr	kg/hr	wscm/hr	wscm/hr
Temperature, °C	25	70	70	54	54	21	25
Temperature, °F	77	158	158	129	129	70	77
Pressure, psia	14.70	29.98	29.98	14.70	14.70	42.30	92.30
Specific Gravity	2.01E-01	1.03E+00	1.03E+00	2.10E+00	2.10E+00	5.25E-03	8.21E-03
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
H+		9.36E-01	9.36E-01	2.30E-04	2.30E-04		
Al+3		9.19E-03	9.19E-03	0.01%	0.01%		
Sb+5		2.58E-07	2.58E-07	7.64E-09	7.64E-09		
As+3		1.29E-06	1.29E-06	2.35E-08	2.35E-08		
Ba+2							
Be+2							
B+3		2.61E-04	2.61E-04	6.87E-07	6.87E-07		
Cd+2							
Ca+2							
Cr+3							
Co+2		6.10E-07	6.10E-07	8.75E-09	8.75E-09		
Cs+							
Cu+2							
Fe+3		1.10E-04	1.10E-04	1.49E-06	1.49E-06		
Pb+2							
Hg+2		7.92E-02	7.92E-02	3.87E-03	3.87E-03		
Mn+4		2.35E-04	2.35E-04	3.14E-06	3.14E-06		
Ni+2							
K+							
Se+4							
Ag+							
Na+							
Tl+3		6.79E-08	6.79E-08	3.38E-09	3.38E-09		
U+4							
V+3							
Zn+2							
Zr+4							
Cl-		4.00E-04	4.00E-04	3.45E-06	3.45E-06		
F-		4.86E-03	4.86E-03	2.25E-05	2.25E-05		
SO4-2		4.51E-06	4.51E-06	1.05E-07	1.05E-07		
NO3-		8.98E-01	8.98E-01	1.35E-02	1.35E-02		
PO4-3							
Am+4		9.31E-10	9.31E-10	5.51E-11	5.51E-11		
Br-		5.30E-09	5.30E-09	1.03E-10	1.03E-10		
Ce+4		5.65E-07	5.65E-07	1.93E-08	1.93E-08		
Eu+3		6.43E-09	6.43E-09	2.38E-10	2.38E-10		
Gd+3		1.93E-06	1.93E-06	7.39E-08	7.39E-08		
Ge+4							
In+3		1.79E-08	1.79E-08	5.00E-10	5.00E-10		
I-		5.89E-08	5.89E-08	1.82E-09	1.82E-09		
La+3		1.17E-07	1.17E-07	3.94E-09	3.94E-09		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	305	401	402	404	404	503	505
Chemical Composition	Wt frac	Mol/liter	Mol/liter	Wt frac	Wt frac	lb/wscf	lb/wscf
Li+							
Mg+2							
Mo+6							
Nd+3		3.76E-07	3.76E-07	1.32E-08	1.32E-08		
Np+4		3.90E-08	3.90E-08	2.25E-09	2.25E-09		
Nb+5							
Pd+4							
Pu+4							
Pr+4		1.06E-07	1.06E-07	3.64E-09	3.64E-09		
Pm+3		2.13E-11	2.13E-11	7.52E-13	7.52E-13		
Rh+4		4.57E-08	4.57E-08	1.15E-09	1.15E-09		
Rb+							
Ru+3		1.26E-05	1.26E-05	3.11E-07	3.11E-07		
Sm+3		7.01E-08	7.01E-08	2.57E-09	2.57E-09		
Si+4	4.67E-01			3.51E-01	3.51E-01		
Sr+2							
Tc+7		9.15E-08	9.15E-08	2.18E-09	2.18E-09		
Te+4							
Tb+4		2.68E-11	2.68E-11	1.04E-12	1.04E-12		
Th+4							
Sn+4							
Ti+4							
Y+3		8.69E-08	8.69E-08	1.88E-09	1.88E-09		
OH-		1.32E-06	1.32E-06	5.45E-09	5.45E-09		
H2O		5.30E+01	5.30E+01	2.32E-01	2.32E-01		
SO2		1.39E-06	1.39E-06	2.16E-08	2.16E-08		
H2S							
CO		2.90E-09	2.90E-09	1.97E-11	1.97E-11		
CO2		2.08E-04	2.08E-04	2.23E-06	2.23E-06	1.14E-01	
H2		3.71E-08	3.71E-08	1.82E-11	1.82E-11		
N2		6.83E-09	6.83E-09	4.66E-11	4.66E-11		
NO		8.55E-08	8.55E-08	6.24E-10	6.24E-10		
NO2		1.33E-05	1.33E-05	1.49E-07	1.49E-07		
O2		1.82E-08	1.82E-08	1.42E-10	1.42E-10		8.30E-02
S (other)		2.08E-08	2.08E-08	1.62E-10	1.62E-10		
CO3							
C (reductant)							
O (oxides)	53.26%	1.65E-04	1.65E-04	39.94%	39.94%		
C (organic)							
H (organic)							
O (organic)							
Mass Flow (kg/hr):	3.00E+00	2.03E+01	1.00E+00	4.00E+00	4.00E+00	7.56E+02	1.27E+03
Canister Rate, canisters/day					0.23		
Total Canisters Generated					31		
Heat Generation	w/m3	w/m3	w/m3	w/m3	w/Drum	w/m3	w/m3
Heat Generation		2.78E-03	2.78E-03	1.42E-03	2.84E-04		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
H-3							
C-14		1.82E-16	1.82E-16	4.44E-17	1.86E-14		
Co-60		4.16E-07	4.16E-07	1.01E-07	4.26E-05		
Ni-59							
Ni-63							
Se-79							
Sr-90							
Y-90		4.94E-04	4.94E-04	1.20E-04	5.05E-02		
Zr-93							
Nb-93m							
Nb-94							
Tc-99		2.15E-07	2.15E-07	5.23E-08	2.20E-05		
Ru-106		1.59E-08	1.59E-08	3.88E-09	1.63E-06		
Rh-102		1.08E-11	1.08E-11	2.62E-12	1.10E-09		
Rh-106		1.59E-08	1.59E-08	3.88E-09	1.63E-06		
Pd-107							
Cd-113m							
Sn-121m							
Sn-126							
Sb-125		5.85E-06	5.85E-06	1.42E-06	5.98E-04		
Sb-126		7.18E-10	7.18E-10	1.75E-10	7.34E-08		
Te-125m							
I-129		1.25E-09	1.25E-09	3.03E-10	1.27E-07		
Cs-134							
Cs-135							
Cs-137							
Ba-137m							
Ce-144		1.08E-08	1.08E-08	2.62E-09	1.10E-06		
Pr-144		1.08E-08	1.08E-08	2.62E-09	1.10E-06		
Pm-146		6.35E-10	6.35E-10	1.55E-10	6.50E-08		
Pm-147		2.90E-06	2.90E-06	7.06E-07	2.97E-04		
Sm-151		5.74E-06	5.74E-06	1.40E-06	5.87E-04		
Eu-152		3.68E-08	3.68E-08	8.96E-09	3.76E-06		
Eu-154		2.20E-06	2.20E-06	5.35E-07	2.25E-04		
Eu-155		2.07E-06	2.07E-06	5.04E-07	2.11E-04		
Th-230							
Pa-233							
U-232							
U-233							
U-234							
U-235							
U-236							
U-237							
U-238							
Np-237		6.52E-09	6.52E-09	1.59E-09	6.67E-07		
Pu-236							
Pu-238							
Pu-239							
Pu-240							
Pu-241							
Pu-242							
Pu-244							
Am-241		1.02E-06	1.02E-06	2.48E-07	1.04E-04		
Am-242m		1.91E-10	1.91E-10	4.64E-11	1.95E-08		

Table A-22. Mass balance, Tank WM-189 waste (continued).

Stream #	305	401	402	404	404	503	505
Radiological Composition	Ci/kg	Ci/L	Ci/L	Ci/kg	Ci/Drum	Ci/wscm	Ci/wscm
Am-243		3.25E-10	3.25E-10	7.92E-11	3.33E-08		
Cm-242							
Cm-243							
Cm-244							
Cm-245							
Cm-246							
TRU		1.02E-06	1.02E-06	2.49E-07	1.05E-04		
Gas Stream Bulk Composition (Wet Basis)	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv	mol% or ppmv
H2O, mol %							
O2, mol %							100%
N2, mol %							
H2, mol %							
CO2, mol %						100%	
COgas, ppmv							
NO, ppmv							
NO2, ppmv							
SO2, ppmv							
Cl, ppmv							
F, ppmv							
C (organic), ppmv							
H (organic), ppmv							
Hg, ug/wscm							
PM, mg/wscm							9.46E-02
SVM, ug/wscm							
LVM, ug/wscm							
Gas Stream Bulk Composition (Dry Basis)	mol%	mol%	mol%	mol%	mol%	mol%	mol%
O2, mol %, dry basis							
N2, mol %, dry basis							
H2, mol %, dry basis							
CO2, mol %, dry basis							
Gas Stream Bulk Composition (Dry Basis, Corrected to 7% O2 with 100% O2 Combustion Air)	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm	ppmv, or ug/dscm or mg/dscm
COgas, ppmv, dry basis							
NO, ppmv, dry basis							
NO2, ppmv, dry basis							
SO2, ppmv, dry basis							
Cl, ppmv, dry basis							
F, ppmv, dry basis							
C (organic), ppmv, dry basis							
H (organic), ppmv, dry basis							
Hg, ug/dscm							
PM, mg/dscm							
SVM, ug/dscm							
LVM, ug/dscm							

Table A-22. Mass balance, Tank WM-189 waste (continued).

PFD Number	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3	PFD-3
Stream Number	510	511	512	513	514	515	516	517
Stream Name	Gas to Cool Product	Hot Gas after Product Cooling	Backpulse Gas for Candle Filters	Bed/ Solid Reductant Transport Gas	TF Transfer & Tank Sparge Air	Ventilation Air	New GAC	Off-gas Preaheater Steam
Rate or Volume	2.19E+02	6.85E+02	2.22E+02	6.48E-01	1.52E+01	2.89E+01	4.73E+00	1.31E+03
Volume Flow (standard, wet)*	1.48E+03	1.48E+03	6.51E+02	1.90E+00	4.45E+01	2.94E+01		6.52E+03
Volume Flow (standard, dry)*	1.48E+03	1.48E+03	6.51E+02	1.90E+00	4.45E+01	2.94E+01		0.00E+00
Rate Units	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	ft3/hr	lb/hr	ft3/hr
Rate or Volume, metric	4.18E+01	4.18E+01	1.84E+01	5.37E-02	1.26E+00	8.34E-01	2.15E+00	1.84E+02
Rate Units	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	wscm/hr	kg/hr	wscm/hr
Temperature, °C	0	580	15	15	15	15	25	177
Temperature, °F	32	1077	59	59	59	59	77	350
Pressure, psia	92.30	92.30	42.30	42.30	42.30	14.70	14.70	112.30
Specific Gravity	7.85E-03	2.51E-03	3.41E-03	3.41E-03	3.51E-03	1.22E-03	4.81E-01	3.73E-03
Chemical Composition	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	lb/wscf	Wt. %	lb/wscf
C (reductant)							100%	
Gas Composition, wet basis	mol %	mol %	mol %	mol %	mol %	mol %	mol %	mol %
H2O, mol %					0.01%	0.01%		100%
O2, mol %					21%	21%		
N2, mol %	100%	100%	100%	100%	79%	79%		
PM, mg/wscm	1.99E+01	1.99E+01	1.98E+01	1.95E+01	1.55E+01	1.57E+01		1.20E+01
kg/hr	4.87E+01	4.87E+01	2.15E+01	6.26E-02	1.51E+00	1.00E+00	2.15E+00	1.38E+02

A-7. UTILITIES SUMMARY

Utilities directly supporting the TTT reforming process are listed in Table A-23 along with an estimate of the consumption rate (electrical) or total consumption (steam use, cooling water, and cooling air). It is assumed that low pressure steam (35 psig) will be available to supply heat to the nitrogen and oxygen vaporizers (HE-300 and HE-301) as well as the off-gas heater (HE-304) upstream of the carbon bed. The primary user of cooling water is the scrub cooler (HE-303), while cooling air is used for the off-gas cooler (HE-305) upstream of the sintered metal sinter. The largest electrical loads are drawn by the off-gas compressor and auxiliary heating of the steam reforming vessel.

Table A-23. Summary of the anticipated major utility uses for the TTT process.

	WM-180	WM-187	WM-188	WM-189	Total
Low pressure steam[a] (MMBtu)	1910	1200	1960	2020	7090
Low Pressure steam[a] (lbs)	2.06×10^6	1.30×10^6	2.11×10^6	2.19×10^6	7.66×10^6
Cooling water (gal)	1.16×10^6	$.58\times10^6$	$.61\times10^6$	1.24×10^6	3.6×10^6
Cooling air (scf)	1.08×10^9	$.68\times10^9$	1.12×10^9	1.15×10^9	4.0×10^9
Electrical:					
Compressor (kW)	230	227	233	247	
Reformer (kW)	472	425	443	425	

a - low pressure steam assumed available at 35 psig.

Utilities directly supporting the TWR reforming process are listed in Table A-24 along with an estimate of the consumption rate (electrical) or total consumption (steam use, cooling water, and cooling air). It is assumed that low pressure steam (47.5 psig) will be available to supply heat to the carbon dioxide and oxygen vaporizers (HE-300 and HE-301), as well as the off-gas heater (HE-304). The primary user of cooling water is the scrub cooler (HE-303), while cooling air is used for the off-gas cooler (HE-305). The largest electrical loads are drawn by the off-gas compressor, the heating of the fluidization gas (HE-302), and auxiliary heating of the steam reforming vessel.

Table A-24. Summary of the anticipated major utility uses for the TRW process.

	WM-180	WM-187	WM-188	WM-189	Total
Low pressure steam[a] (MMBtu)	3,130	2,000	3,150	3,060	1.13×10^4
Low pressure steam[a] (lbs)	3.38×10^6	2.16×10^6	3.40×10^6	3.30×10^6	12.2×10^6
Cooling water (gal)	1.31×10^6	0.84×10^6	1.35×10^6	1.30×10^6	4.81×10^6
Cooling air (scf)	1.087×10^9	0.67×10^9	1.10×10^9	1.07×10^9	3.92×10^9
Electrical:					
Compressor (kW)	226	223	224	228	
Reformer (kW)	510	443	457	431	
Fluid. gas heater (kW)	147	147	147	147	

a. Low pressure steam assumed available at 47.5 psig.

A-8. EQUIPMENT LISTS AND PLANT SCALE

A preliminary equipment list for the TTT process is given in Table A-25. Equipment sizing was based on ASPEN simulation results and knowledge of the performance of existing equipment at the NWCF.

Most process operations in the Steam Reforming Treatment Facility are performed on the lower floor. Changing the scale of the process, i.e., designing for a shorter treatment schedule, would have the most effect on this plan. Two areas of the facility in particular – the process hot cells and the lag storage area for full waste canisters – would be most affected.

The major equipment in the process hot cells includes the SBW feed tanks, the reformer, product cooling bins, the oxidizer, and other off-gas treatment equipment. Keeping all other factors equal, decreasing the processing schedule would increase the floor space required for most of this equipment by the inverse 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 for tanks would increase by $(2.5/1)^{0.667} = 1.84$ or an 84% increase. A more detailed evaluation would be needed to determine if multiple trains would be needed for any equipment or process systems. If so, the floor space increase would be greater than 84%.

The rate at which RH canisters of reformer product are produced is inversely proportional to the processing schedule. For the 2.5-year schedule, on average, one canister is filled in about 14 hours. A single fill station could likely accommodate shorter processing schedules. Even a one-year schedule would allow an average of about 5.5 hours to fill a canister. Thus it is likely that the effect of a shortened treatment schedule on floor space to package the reformer product is small or negligible.

Finally, the interim storage for RH waste is dependent upon the initial lag period between producing the first container of waste and having approval to ship that container to WIPP and the rate at which WIPP can accept waste. Based on discussions with WIPP personnel, it is expected that the disposal facility can receive at least 6 RH canisters per week from the INEEL, or about 300 per year. For a 2.5-year operating schedule and assuming six months operation prior to waste shipment, storage for 176 canisters would be needed for the initial production. Storage for another 128 would be needed for the excess between the number produced and the number shipped in the later 2 years of operation. For a 1-year schedule, these storage requirements increase to 439 and 289 canisters respectively. Thus the lag storage area would need to increase by the factor (439 + 289)/(176 + 128) or 239%.

In terms of floor space, for a 1-year schedule the lower floor hot cell space would increase to about 11,000 ft^2 from 7,000 ft^2 (for the 2.5-yr schedule) and the required storage area for canisters to about 4,400 ft^2 from 2,000 ft^2.

The preceding discussion pertains to the TWR process without change. A preliminary equipment list with estimated sizing is given below in Table A-26 for TWR. Similar unit operations are common between the TTT and TWR flowsheets. The TWR process modeled in this study uses a single liquid reductant in the feed (isopropyl alcohol) and also a single gas (carbon dioxide) for flows within the system. This results in an overall simplification of the equipment in the flow sheet.

Table A-25. Preliminary list of TTT steam reforming equipment with a description and approximate size.

Equipment Number	Equipment Name	Min. Capacity or Throughput	Basis	Service Environment
B-300	Steam Generator	5×10^6 Btu/hr	From ASPEN, assuming feed water flow of 343 gal/hr and producing steam at 1240°F and a pressure of 42 psia.	Non-rad
BLO-200	System Blower	212,000 wet scfh	From ASPEN, requires 250 hp blower for off-gas at 239°F.	Rad
BLO-201	CEM Sample Blower		Not modeled	Rad
F-100-1, 2	Sintered Metal Filters	112,000 wet scfm, 986°F	Bank of cylindrical sintered-metal filters with 2 μ nominal pore size; gas blowback to dislodge filter cake to bottom drain. Dimensions: 6 ft diameter × 28 ft height, Pall Schumacher quote (Williams 2002).	Rad-remote
F-101-1, 2, 3, 4	HEPA Filter Bank	198,000 wet scfh, 248°F	Based on similarity with existing NWCF filter bank (F-NCC-130) where each filter housing contains a pre-filter and two HEPA filters. Dimensions: 2 ft × 4 ft × 20 ft height.	Rad
F-102	Discharge Filter	198,000 wet scfh	Requires that MACT particle standard of 34 mg/dscm be met.	Rad
F-103	Inlet Air Filter	19,800 scfm	Assumes a bleed-in of air at 10% of off-gas flow to allow control of system vacuum.	Non-rad
FEED-400	Sucrose Hopper/Feeder	400 lb/hr (min. feed rate)	Associated should be based on bulk density of 6.3 lb/gal (a one hour capacity corresponds to 65-gal).	Non-rad
FEED-401	Carbon Hopper/Feeder	200 lb/hr (min. feed rate)	Associated should be based on bulk density of 4.2 lb/gal (a one hour capacity corresponds to 50-gal).	Non-rad
FEED-402	Iron Oxide Hopper/Feeder	less than 0.0005 lb/hr	A small feed cell or an alternate means of feeding may be specified if a catalyst is used.	Non-rad
FEED-404	Product Hopper/Densifier	175 lb/hr	This device will mix/compress bed product and filter fines to reduce final waste volume.	Rad
FEED-405	Portland Cement Hopper/Feeder	10 lb/min	Mix neutralized scrub blow down solution at 25 wt% waste loading to stabilize it for disposal at MLLW. At 10 lb/min, processes about one drum per hour.	Rad
FEED-406	Calcium Sulfide Hopper/Feeder	1.5 lb/min	Associated hopper should be specified based on available standard hopper size. 5000 gal of spent scrub requires about 900 lbs of CaS (solid). Assuming 10-hr addition of CaS to precipitate 5000 gal requires a feed rate of 90 lb/hr (1.5 lb/min).	Non-rad

Equipment Number	Equipment Name	Min. Capacity or Throughput	Basis	Service Environment
HE-300	Nitrogen Heater	200,000 Btu/hr	From ASPEN, provides a nitrogen feed rate of about 21,000 scfh. Heated with low pressure steam, although resistance heating may be suitable. This heater may be included as part of a purchased liquid nitrogen system.	Non-rad
HE-301	Oxygen Heater	150,000 Btu/hr	From ASPEN, provides an oxygen feed rate of about 11,400 scfh. Heated with low pressure steam, although resistance heating may be suitable. This heater may be included as part of a purchased liquid oxygen system.	Non-rad
HE-302	Steam Superheater	61,300 scfh steam	Recuperator to superheat 343 gal/hr feed water to steam at 1238^{o}F and 42 psia.	Non-rad
HE-303	Scrub Cooler	200,000 Btu/hr	Water-cooled heat exchanger with scrub liquid outlet temperature assumed as 179°F.	Rad
HE-304	Off-Gas Heater	300,000 Btu/hr	Off-gas outlet temperature assumed as 248°F (120°C); from ASPEN. The flow sheet shows this exchanger heated by low pressure steam.	Rad
HE-305	Steam Reformer Off-gas Cooler	700,000 Btu/hr	Cools reformer off-gas from 1238^{o}F to 986°F, based on TTT "optimization" bench-scale tests. Cooling to 752°F may be specified in detailed design.	Rad
HOP-800	Sucrose Storage Bin	10,500 gal	7-day supply at a flow rate of 380 lb/hr; bulk density assumed as 6.26 lb/gal (sp.gr. = .75).	Non-rad
HOP-801	Activated Carbon Storage Bin	7,000 gal	7-day supply at a flow rate of 170 lb/hr; bulk density assumed as 4.2 lb/gal (sp.gr. = .50).	Non-rad
HOP-803	Alumina Storage Bin	1250 gal	Total of 4 bed change outs. Bulk density about 62.4 lb/ft^3.	Non-rad
HOP-804-1, 2, 3	Reformer Product Collection and Cooling Bins (3 bins)	8,000 gal	Each bin sized to accept 2-day accumulation at a product flow rate of 175 lb/hr; bulk density assumed that for uncompressed filter fines of 1.2 lb/gal (sp.gr. = 0.14).	Rad-remote
MIX-100	Cement Mixer	53 gal (0.2 m^3)	Sized to accommodate placement of contents into a single drum.	Rad
P-200	Waste Feed Pump	140 gal/hr	Based on SBW feed rate plus feed additives and recycle.	Rad-remote
P-201	Boiler Feed Water Pump	350 gal/hr	Steam rate based on mass ratio of mass steam/mass of SBW of 2.75.	Non-rad

Equipment Number	Equipment Name	Min. Capacity or Throughput	Basis	Service Environment
P-202	Scrub Pump	11,000 gal/hr	Scrub flow is based on a gas/liquid ratio of 135 scf/cf (8.0 kg gas/kg liquid).	Rad
P-203	Scrub Blow down Pump	1 gal/min	Pumps treated spent scrub to cement mixer, assume desired flow rate at 1 gal/min.	Rad
P-204	Nitric Acid Pump	0.0075 gpm	Flow of 13 M nitric acid required to maintain scrub acidity of 1 M.	Non-rad
P-205	Aluminum Nitrate Pump	<0.3 gal/hr	For periodic addition to maintain an Al/F ratio of greater than 2 in the scrub to control fluoride corrosion, if deemed necessary, in the scrub system.	Non-rad
P-206	Lime Slurry Pump	0.5 lb/hr	Assumed to be 50 wt% lime slurry for neutralization of approximate 1 M acid spent scrub.	Non-rad
VES-100-1, 2	Waste Feed Tanks	5,000 gal	Sized for minimum one day hold time, based on a volumetric feed rate (SBW, additives, plus recycle) of 140 gal/hr.	Rad
VES-101	Nitrogen Storage Tank	42,000 gal	7-day supply at a volumetric rate of 21,300 scfh. Liquid nitrogen density of 6.74 lb/gal (sp.gr. = .808).	Non-rad
VES-102	Oxygen Storage Tank	20,000 gal	7-day supply at a volumetric rate of 11,500scfh. Liquid oxygen density of 9.51 lb/gal (sp.gr. = 1.14).	Non-rad
VES-103	Steam Reformer Vessel	Reaction zone: cylindrical geometry with 2.2 ft diameter × 11 ft height. Free-board section 4.3 ft diameter × 22 ft height.	Reaction zone dimensions based on a reactor space time (vol. of reaction zone ÷ vol. flow rate of liquid feed) of 2.5 hr and a height to diameter ratio of 5 (from TTT bench-scale tests). Free-board section based on similar geometry as bench-scale tests	Rad
VES-104	Reductant Injection Cell	500 lb/hr solid transfer rate	Pneumatically inject 500 lb/hr (210 kg/hr) solid reductant with pressurized nitrogen. Assumed nitrogen usage at 1.5 lb solid per lb of nitrogen based design value for pneumatic transport of calcine.	Rad
VES-105	Oxidizer	Cylindrical geometry with 11 ft diameter × 18 ft length	Size estimated assuming similarity with existing on-site Gas Recuperative Thermal Oxidizer from Thermatrix. A reactor space time (vol. of reaction zone ÷ vol. flow rate of feed) of 0.82 min is used with a radius to length ratio of 0.3.	Rad

Equipment Number	Equipment Name	Min. Capacity or Throughput	Basis	Service Environment
VES-106	Off-gas Quench Tower	Tower with 5 ft diameter × 13 feet tall.	Similarity assumed with existing NWCF spray quench tower – 7500 acfm of NWCF for a tower 3.5 ft diameter × 11 ft height, for a residence time of about 1 second. ASPEN model of TTT steam reforming estimates 12,800 acfm (213 acfs) entering quench tower.	Rad
VES-107	Packed Column Scrubber	5 ft diameter × 24 ft height	Sized for a vapor-liquid ratio of 135 scf gas per ft^3 of scrub and two theoretical stages. Each stage assumed 12 ft.	Rad
VES-108	Mist Eliminator	Cylindrical geometry with 4 ft. diameter × 9 ft height.	Similarity with existing NWCF mist eliminator, which measures 3 ft diameter × 9 ft height. Approach velocity assumed the same (area adjusted to achieve this), while the height assumed the same.	Rad
VES-109	Activated Carbon Beds	Primary bed: 16 ft diameter × 6.3 ft depth Auxiliary bed: 16 ft diameter × 2 ft depth	Assumed same size as detailed in EDF-3292 for the Calcine MACT study, although anticipated gas flow is about half (3300 scfm versus 6200 scfm) which would provide additional residence time in bed. Total mercury burden is assumed to be the same as for EDF-3292 at 53% of the total mercury in the tank farm.	Rad
VES-110	Scrub Hold Tank	5500 gal	Based on accumulating 30 minutes of scrub flow into tank.	Rad
VES-111	Scrub Blow down Tank	7000 gal	Based on collecting 5500 gal (maximum) batch blow down, with 20% additional volume to accommodate additives.	Rad
VES-112	Nitric Acid Feed Tank	200 gal	Based on a 7-day supply when fed to the process at 1 gal/hr.	Non-rad
VES-113	Mixing vessel		Combine cooling nitrogen from the product hopper with reformer off-gas prior to the off-gas cooler HE-305.	Rad
VES-114	Aluminum Nitrate Tank	30 gal	Small tank for addition of small (<0.5 lb/hr) amounts of 2.2 M aluminum nitrate solution, if deemed necessary.	Non-rad
(Not shown)	Propane Storage Tank	1500 gal	Based on a 7-day supply when fed to the process at 320 scfh and gas availability at 36.82 scf/gal commercial propane.	Non-rad

Table A-26. Steam reforming list of TWR equipment with description and approximate size.

Equipment Number	Equipment Name	Minimum Capacity or Throughput	Basis	Service Environment
BLO-200	System Blower	190,000 wet scfh at 237°F	From ASPEN simulation for a ΔP = 6.5 psi, requiring an estimated 250 kW blower system.	Rad
BLO-201	CEM Sample Blower		Not modeled	Rad
F-100-1, 2	Sintered Metal Filter	62,400 scfh, 752°F	Bank of cylindrical sintered-metal filters with 2 micron nominal pore size, and gas blowback system to dislodge filter cake to a bottom drain.	Rad-remote
F-101-1, 2, 3, 4	HEPA Filter Bank	175,000 scfh at 248°F	Based on similarity with existing NWCF filter bank where each filter housing contains a pre-filter and two HEPA filters. Dimensions: 2 ft × 4 ft × 20 ft height.	Rad
F-102	Discharge Filter	175,000 scfh at 248°F	Final discharge filter (effluent must meet MACT particulate standard of 34 mg/dscm)	Rad
F-103	Inlet Air Filter	17,500 scfh	Assumes a bleed-in of air of about 10% of off-gas flow to allow control of system vacuum.	Non-rad
FEED-401 (contingency)	Solid Reductant (polypropylene beads) Hopper/Feeder	500 lb/hr (assumed min. feed rate)	Associated hopper of 120-gal assuming a one hour storage capacity and solids bulk density of (31.2 lb/ft^3 or 0.5 g/cc). This feeder is a contingency as no solid reductant used for bench-scale test.	Non-rad
FEED-402	Bed Media (alumina) Hopper/Feeder	42 lb/min (min. feed rate)	Associated hopper should be specified based on available standard hopper size. Steam reformer bed charge requires 42 ft^3, based on alumina bulk density of 60 lb/ft^3 , a charge mass of 2520 lbs fills the reactor. A one-hour charge time requires 42 lb/min feed rate.	Non-rad
FEED-404	Product Hopper/Densifier	290 lb/hr	These device mixes steam reforming product and filter fines while compressing to reduce waste volume. Bulk density must be determined based on compaction and compression process.	Rad
FEED-405	Portland Cement Hopper/Feeder	50 lb/hr	Mix neutralized scrub blow down solution at 25 wt% waste loading to stabilize it for disposal at MLLW. Assumes processing of 2400 gal of neutralized scrub solution over 8 weeks (1344 hrs).	Rad
FEED-406	Calcium Sulfide Hopper/Feeder	27 lb/hr (feed rate for 10 hour period)	Associated hopper should be specified based on available standard hopper size. About 268 lbs (122 kg) or 13 gallons of CaS solids needed to precipitate mercury from 1500 gal of spent scrub)	Non-rad

HE-300	Carbon Dioxide Vaporizer (atomization gas)	$0.26 x 10^6$ Btu/hr	From ASPEN simulation for a flow rate of 22,500 scfh when heated from -18°F (-28°C) to 70°F (21°C).	Non-rad
HE-301	Oxygen Vaporizer	$0.30 x 10^6$ Btu/hr	From ASPEN simulation, for a flow rate of 26,200 scfh when heated to 77°F (25°C).	Non-rad
HE-302	Carbon Dioxide Heater (fluidization gas)	0.50×10^6 Btu/hr	From ASPEN simulation for a flow rate of about 12,000 scfh with gas heated to 1076°F (580°C).	Non-rad
HE-303	Scrub Cooler	0.24×10^6 Btu/hr	Water-cooled heat exchanger with scrub solution cooled from 165°F (74°C) to 162°F (72°C) with a cooling water throughput of about 460 gal/hr. Cooling water assumed entering at 77°F (25°C).	Rad
HE-304	Off-Gas Heater	$0.30 x 10^6$ Btu/hr	Off-gas outlet temperature assumed as 248°F (120°C); from ASPEN simulation. The flow sheet shows this exchanger heated by low pressure steam.	Rad
HE-305	Steam Reformer Off-gas Cooler	$0.63 x 10^6$ Btu/hr	Cools reformer off-gas from 1040°F (560°C) to 752°F (400°C) as recommended for the TWR flowsheet ; from ASPEN simulation. This exchanger is shown being air cooled with a cooling air inlet temperature of 77°F (25°C), although a high temperature heat transfer fluid may be more appropriate.	Rad
HOP-801 (contingency)	Solid Reductant (polypropylene) Storage Bin	12,000 gal	4-day supply at a flow rate of 500 lb/hr (227 kg/hr); bulk density assumed as 31.2 lb/ft^3 (500 kg/m^3).	Non-rad
HOP-802	Bed Media Storage Bin	1,800 gal	Total of 4 bed change outs	Non-rad
HOP-804-1, 2, 3	Reformer Product Collection/Cooling Bins (3 bins)	12,000 gal	Each bin sized to accept 2-day accumulation at a product flow rate of 290 lb/hr (65 kg/hr); bulk density assumed that for uncompressed filter fines of 9.4 lb/ft^3 (150 kg/m^3).	Rad- remote
MIX-100	Cement Mixer	53 gal (0.2 m^3)	Sized to accommodate placement of contents into a single drum.	Rad
P-200	Waste Feed Pump	170 gal/hr, 0.2 hp	Based on SBW feed rate plus feed additives and recycle for a total of 167 gal/hr. This corresponds to SBW removal rate from tanks as 97 gph.	Rad- remote
P-202	Scrub Pump	9740 gal/hr, 5 hp	Recycle scrub and pressurize it to 30 psig for transfer to the scrubber. Scrub flow is based on a gas/liquid ratio of 135 scf/cf (8.0 kg gas/kg liquid).	Rad

P-203	Scrub Blow down Pump	1.0 gal/min	Sized to charge enough liquid to prepare a batch (55-gallon) of stabilized waste.	Rad
P-204	Nitric Acid Pump	0.0065 gal/min	Flow of 13 M nitric acid required to maintain scrub acidity of 1 M.	Non-rad
P-205	Aluminum Nitrate Pump	<0.005 gpm	For periodic addition to maintain an Al/F ratio of greater than 2 in the scrub to control fluoride corrosion in the scrub system.	Non-rad
P-206	Lime Slurry Pump	1.3 lb/hr	Assumed to be 50 wt% lime slurry for neutralizing 4.3 gal/hr of 1 M acid scrub.	Non-rad
VES-100-1, 2	Waste Feed Tanks	4,500 gal	Sized for one day hold time, based on a volumetric feed rate of 170 gal/hr (660 L/hr).	Rad
VES-101	Liquefied Gas (CO_2) Storage Tank	80,000 gal	7-day supply at a mass rate of 3,600 lb/hr (1630 kg/hr).	Non-rad
VES-102	Oxygen Storage Tank	35,000 gal	7-day supply at a mass rate of 2,170 lb/hr (988 kg/hr).	Non-rad
VES-103	Steam Reformer Vessel	Cylindrical geometry. Reaction zone: cylindrical geometry with 2.2 ft diameter × 11 ft height. Free-board section 4.3 ft diameter × 22 ft height.	Reaction zone dimensions based on a reactor space time (vol. of reaction zone ÷ vol. flow rate of liquid feed) of 2.5 hr and a height to diameter ratio of 5 (from bench-scale tests). Free-board section based on similar geometry as bench-scale tests.	Rad
VES-104 (contingency)	Reductant Injection Cell	500 lb/hr solid transfer rate	Pneumatically inject 500 lb/hr solid reductant with pressurized nitrogen. Assumed gas usage at 1.5 lb solid per lb of gas based on design value for pneumatic transport of calcine.	
VES-105	Oxidizer	Cylindrical geometry with 13 ft diameter × 21 ft length	Size estimated assuming similarity with existing on-site Gas Recuperative Thermal Oxidizer from Thermatrix. A reactor space time of 0.82 min is used with a radius to length ratio of 0.3.	Rad
VES-106	Off-gas Quench Tower	Tower with 5 ft diameter, 12.5 feet tall.	Similarity assumed with existing NWCF spray quench tower: 7500 acfm with 3.5 ft diameter and 11 ft height for NWCF. ASPEN model of TWR steam reforming predicts about 10,800 acfm.	Rad
VES-107	Packed Column Scrubber	5 ft diameter, 24 ft height	Sized for a vapor-liquid ratio of 135 scf gas per ft3 of scrub liquid and two theoretical stages.	Rad

VES-108	Mist Eliminator	Cylindrical geometry with 6 ft diameter and 9 ft height.	Similarity assumed with existing NWCF mist eliminator: Approach velocity assumed the same (the area adjusted to achieve this), while the height assumed the same.	Rad
VES-109	Activated Carbon Beds	Primary bed: 16 ft diameter × 6.3 ft depth Auxiliary bed: 16 ft diameter × 2 ft depth	Based on carbon bed sizing from EDF-3292 for the Calcine MACT study. Volumetric gas flow of Calcine CMACT 6200 scfm, ASPEN simulation of TWR process about 3000 scfm. The resulting increased residence time should improve Hg retention. Total mercury burden is assumed to be the same as for EDF-3292 at 53% of the total mercury in the tank farm.	Rad
VES-110	Scrub Hold Tank	5,000 gal	Based on accumulating about 30 minute scrub flow into tank.	Rad
VES-111	Scrub Blow down Tank	6,000 gal	Based on collecting 10,000 gal (maximum) batch of scrub blow down, with 20% additional volume to accommodate additives.	Rad
VES-112	Nitric Acid Feed Tank	200 gal	Based on a 7-day supply when fed to the process at 1.1 gph.	Non-rad
VES-113	Mixing vessel		Combine cooling gas from the product hopper with reformer off-gas prior to the off-gas cooler HE-305.	Rad
VES-114	Aluminum Nitrate Tank	30 gal	Small tank for addition of small (<0.005 gph)amounts of 2.2 M aluminum nitrate solution.	Non-rad
VES-115	Isopropyl Alcohol Tank	15,000 gal	Based on a 7-day supply when fed to process at about 85 gal/hr.	Non-rad
Not shown	Propane Storage Tank	12,000 gal	Based on a 7-day supply when fed to the process at 2,560 scfh and gas availability of 36.82 scf/gal of commercial propane.	Non-rad

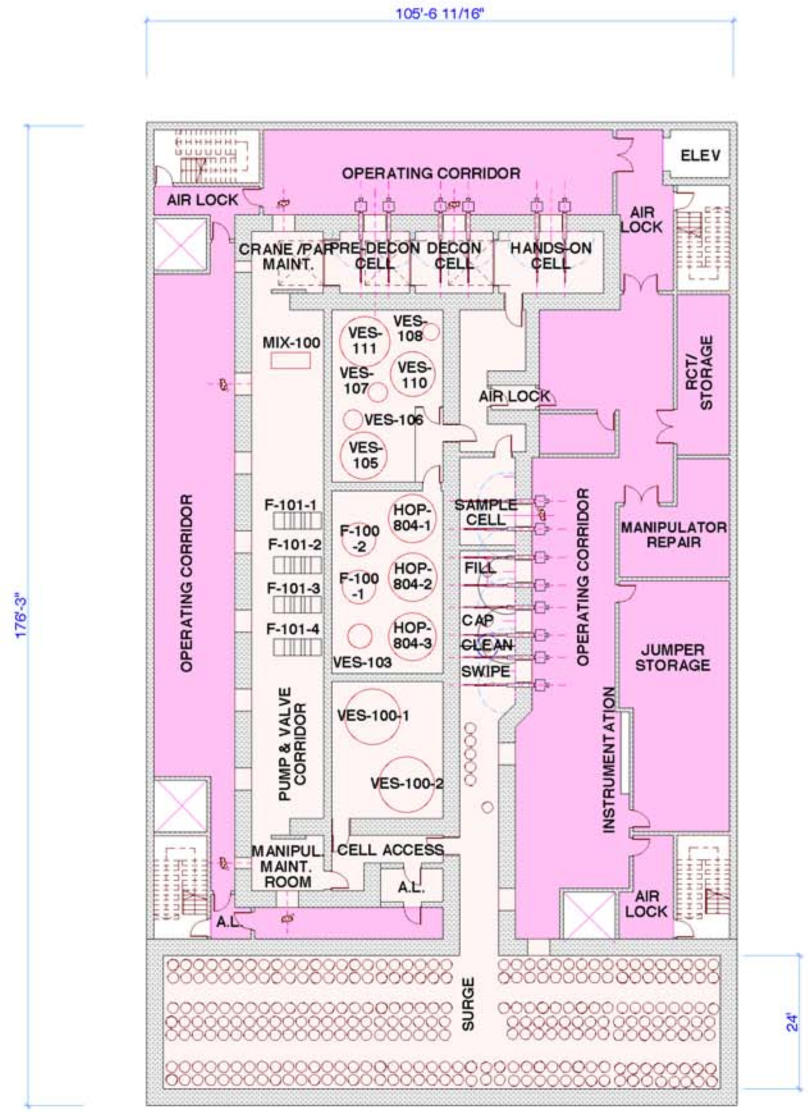
A-9. LAYOUT DRAWINGS

Layout drawings for each floor of the Steam Reforming 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 Steam Reforming Feasibility Study (Williams, 2002). Per the 2002 study, the layout drawings show a separate warehouse for empty waste canisters. Adequate storage space is provided on the lower hot cell floor for 280 filled canisters, sufficient for an initial six-month period plus storage of the difference between the production rate and the shipping rate.

FMT-D1-REV 3.3

REV	DESCRIPTION	EFFECTIVE DATE:

REVISIONS



6587 sq ft

10,137 sq ft HOT CELL AREA

LOWER HOT CELL FLOOR PLAN
FINISH FLOOR ELEVATION: - 30'-0"

0 5 10 15 20

FOR DRAWING INDEX SEE DRAWING NO. N/A
SUBCONTRACT NO. N/A
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
DESIGN PHASE:
SAFETY CATEGORY:
EFFECTIVE DATE:

INEEL

SODIUM BEARING WASTE TREATMENT

STEAM REFORMING FACILITY

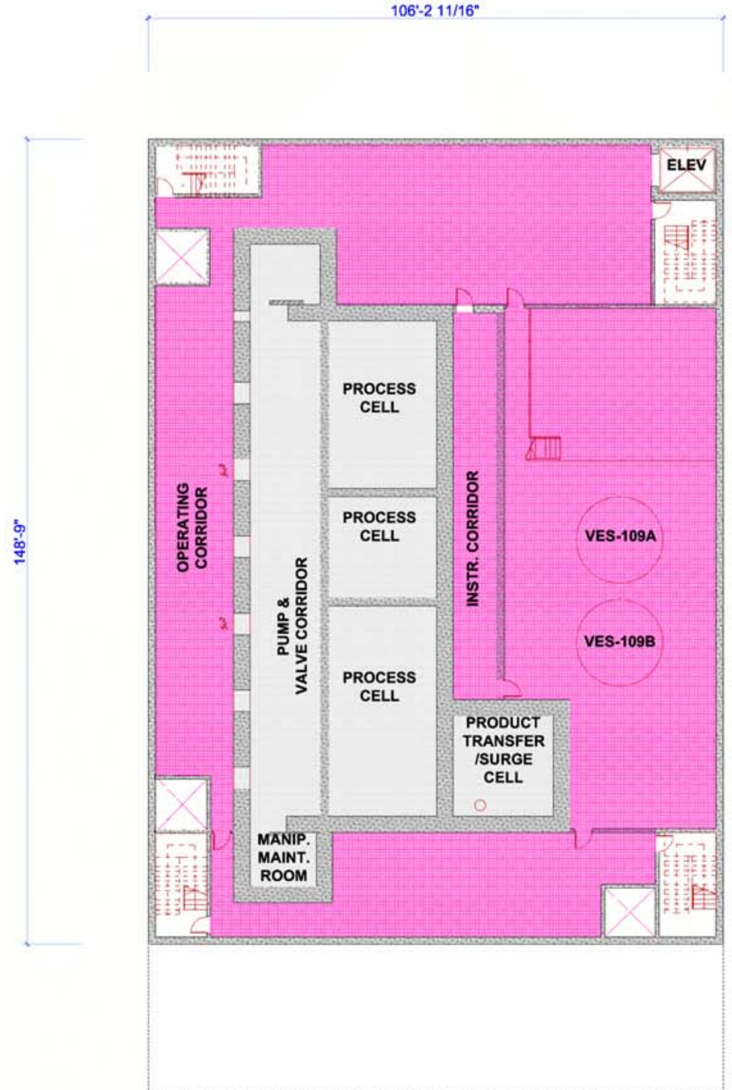
LOWER HOT CELL FLOOR PLAN

SIZE D | CAGE CODE | INDEX CODE NUMBER: AREA TYPE CL OPSQ | DWG- | REV

SCALE: NOTED | SHEET

FMT-D1-REV 3.3

REV	REVISIONS DESCRIPTION	EFFECTIVE DATE:



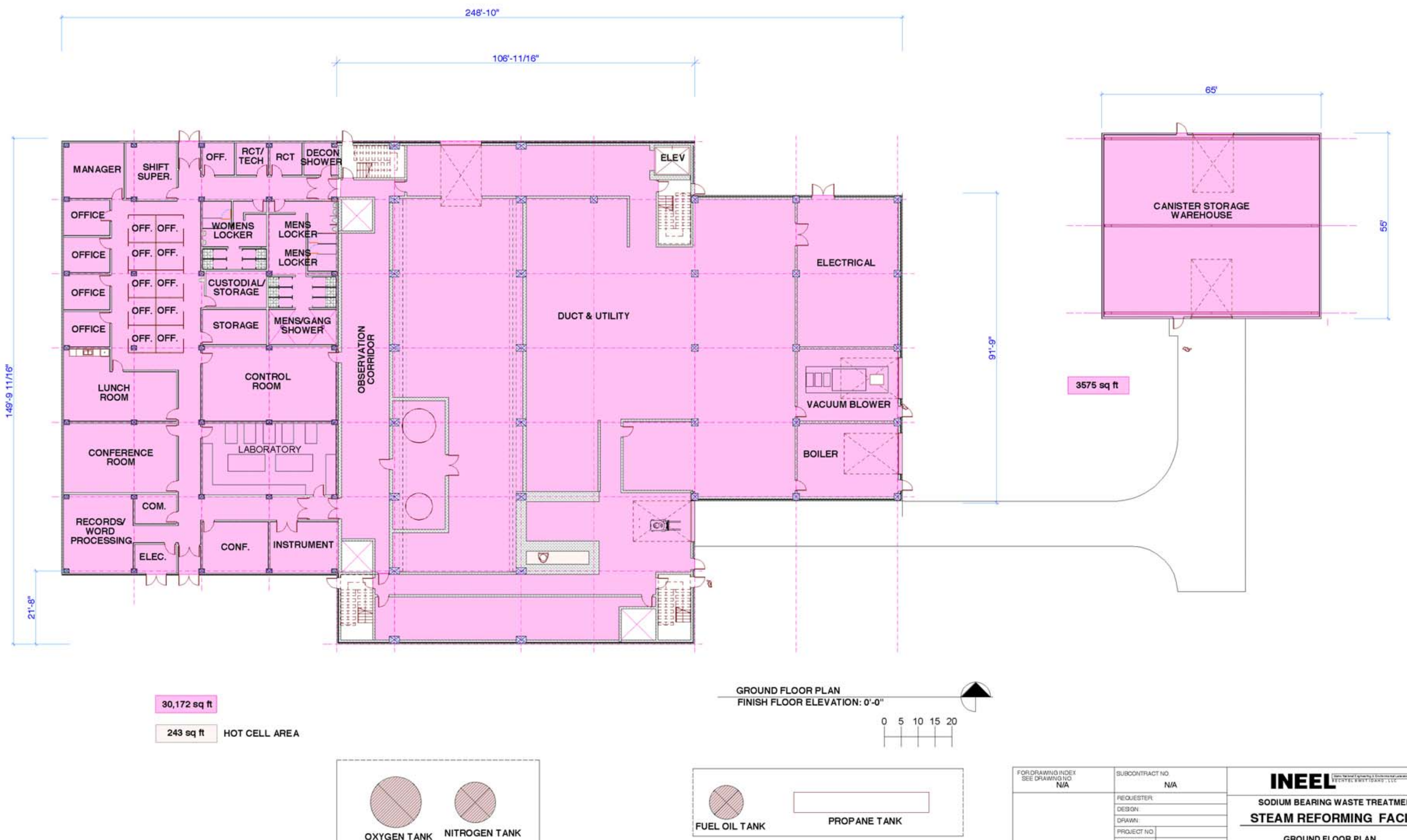
8882 sq ft

4983 sq ft HOT CELL AREA

LOWER CORRIDOR FLOOR PLAN
FINISH FLOOR ELEVATION: -18'-0"

0 5 10 15 20

FOR DRAWING INDEX SEE DRAWING NO. N/A	SUBCONTRACT NO. N/A	INEEL
	REQUESTER:	SODIUM BEARING WASTE TREATMENT
	DESIGN:	STEAM REFORMING FACILITY
	DRAWN:	
	PROJECT NO.	LOWER CORRIDOR FLOOR PLAN
	SPEC CODE	SIZE D · CAGE CODE · INDEX CODE NUMBER AREA TYPE CL ORIG · DWG- · REV
DESIGN PHASE:	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	
SAFETY CATEGORY:	EFFECTIVE DATE:	SCALE: NOTED · SHEET



REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE

FOR DRAWING INDEX SEE DRAWING NO. N/A

SUBCONTRACT NO. N/A

REQUESTER

DESIGN

DRAWN

PROJECT NO.

SPEC CODE

FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.

DESIGN PHASE

SAFETY CATEGORY

EFFECTIVE DATE

INEEL

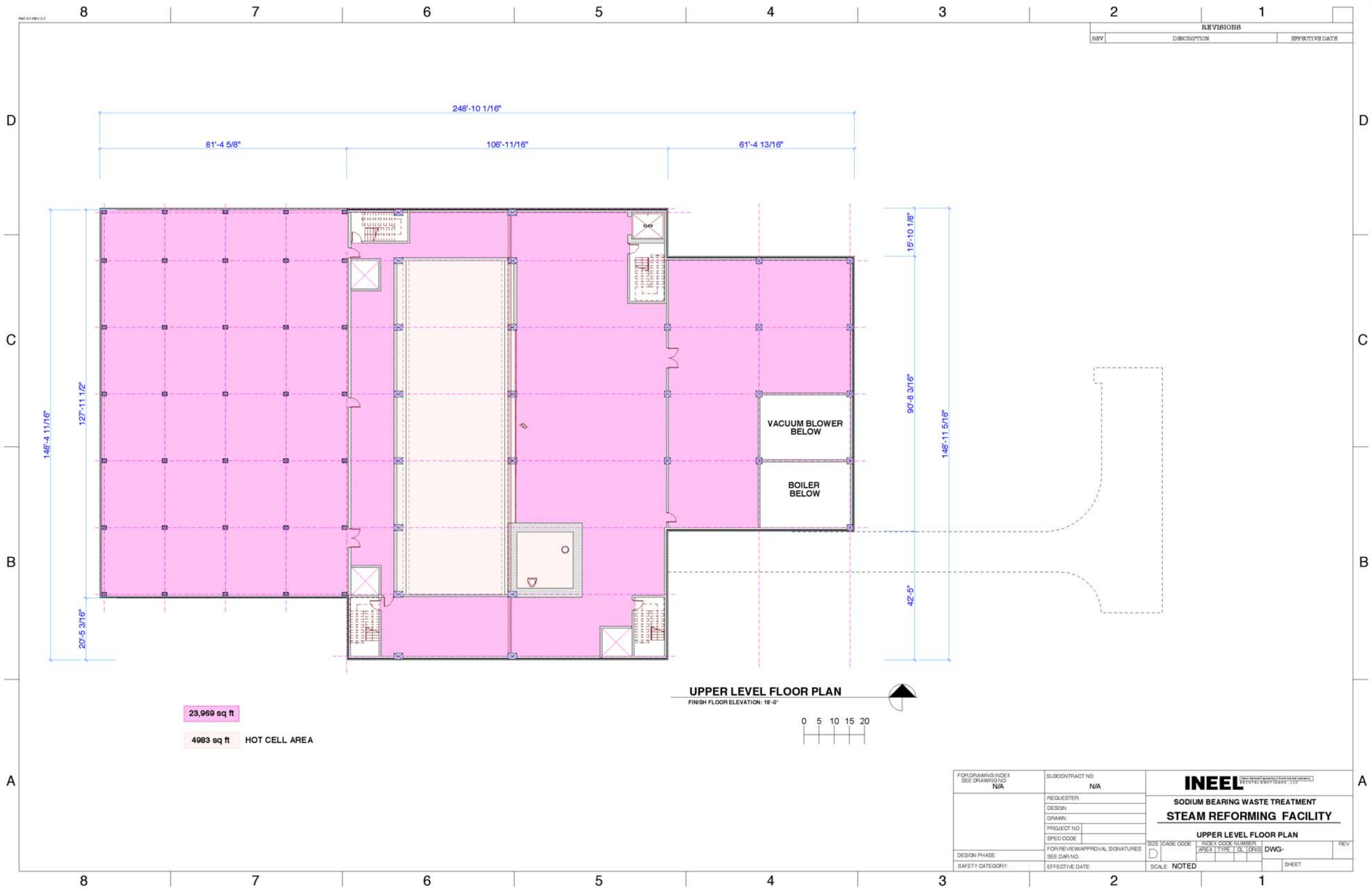
SODIUM BEARING WASTE TREATMENT

STEAM REFORMING FACILITY

GROUND FLOOR PLAN

SIZE D | CAGE CODE | INDEX CODE NUMBER: AREA, TYPE, QL, ORIG | DWG- | REV

SCALE NOTED | SHEET



REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
248'-10 1/16"
81'-4 5/8"
106'-11/16"
61'-4 13/16"
148'-4 11/16"
127'-11 1/2"
20'-5 3/16"
15'-10 1/8"
90'-8 3/16"
42'-5"
148'-11 5/16"
VACUUM BLOWER BELOW
BOILER BELOW
UPPER LEVEL FLOOR PLAN
FINISH FLOOR ELEVATION: 18'-0"
0 5 10 15 20
23,969 sq ft
4983 sq ft HOT CELL AREA
FOR DRAWING INDEX SEE DRAWING NO. N/A
SUBCONTRACT NO. N/A
REQUESTER:
DESIGN:
DRAWN:
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
DESIGN PHASE:
SAFETY CATEGORY:
EFFECTIVE DATE:
INEEL
SODIUM BEARING WASTE TREATMENT
STEAM REFORMING FACILITY
UPPER LEVEL FLOOR PLAN
SIZE D
CAGE CODE
INDEX CODE NUMBER
AREA TYPE CL ORIG
DWG-
REV
SCALE: NOTED
SHEET

A-10. REFERENCES

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