LA-UR-94-2657 Rev. 2

Title:

HANFORD DEFINED WASTES: CHEMICAL AND RADIONUCLIDE COMPOSITIONS

Author(s):

Stephen F. Agnew,
Chemical Science and Technology Division

Submitted to:

Los Alamos National Laboratory (Dissemination Outside the Laboratory by Stephen F. Agnew)

Los Alamos
National Laboratory

LAUR-94-2657 Rev. 2

How to read this electronic version of the Hanford Defined Wastes

File Information

This electronic document is comprised of five separate Acrobat® pdf files. All files can be retrieved with your web browser and stored on your local hard drive or each file can be retrieved individually and stored in memory as you read through the document. If you are presented with a "file not found" message when clicking on a link, simply retrieve the file with your web browser. Do *NOT* change any of the file names since there are embedded links within each document which reference the other file names.

Contents and Report Text (00285745.pdf 158 Kb)
Figures 1-14 (00285747.pdf 349 Kb)
Tables 1-17 (00285749.pdf 221 Kb)
Appendices A-D and F (00285746.pdf 250 Kb)
Appendix E, HDW spreadsheet tables (00285748.pdf 87 Kb)

Links

This document contains hyper-links which allow you to "jump" to the desired location in the document. Some of these links are to external files which load and display the appropriate information. Usually this will be for figures, tables, and appendices. This allows for multiple views of the document at the same time, ie. the main text file can be in one window and the associated figure or table can be in a separate window. This is handy for side by side viewing.

Printing

Printing of this electronic document is strongly discouraged. It is structured differently for the specific purpose of electronic viewing. If you desire the hardcopy version, please let us know and we will be more than happy to send you a copy.

Contacts

If there are any problems or concerns, we can be reached at the following e-mail addresses:

Kenneth A. Jurgensen
kjurgensen@lanl.gov

Stephen F. Agnew
sfagnew@lanl.gov

Hanford Defined Wastes:

Chemical and Radionuclide Compositions

by

Stephen F. Agnew
Chemical Science and Technology Division
Los Alamos National Laboratory
Los Alamos, NM 87545

Rev. 2
September 1995

Abstract

This report is a key part of a four part strategy for estimating the contents of the waste tanks at Hanford. For this portion of the strategy, chemical compositions for around fifty Hanford Defined Wastes (HDW's) are estimated based on various sources including overall chemicals used in a process versus the actual waste that that process produced, and flowsheet information is used to tie various species together. Each species precipitates once its concentration reaches a fixed solubility limit. These solubility limits are derived from analytical data for supernatants from Hanford waste tanks that have been reported over the years. The solids that precipitate are packed according to a solids volume per cent that is also typical for that type of waste in the Hanford waste tanks.

Radionuclides estimated in this report are restricted to plutonium-239, uranium-238, thorium-232, cesium-137, and strontium-90. Total radionuclides are estimated based on tons of fuel processed and an average exposure rate for that fuel in MWD/Ton. Once the total amounts of the extracted species (Pu, U, and Th) are estimated, their residual amounts within the waste are calculated based on process efficiencies.

There are four waste concentrates that are estimated based on blends of feed within each of four evaporator campaigns: the 242-B, the first 242-T, the self-evaporating tanks with Redox wastes in S and SX Farms, and the ITS campaign in BY Farm. Each of these four evaporator campaigns involved a supernatant blended feed volume, an average waste reduction factor, and a total salt cake production for the respective campaigns. Later evaporator campaigns and other liquids are handled on a tank by tank basis within the Supernatant Mixing Model.

Acknowledgments

Many thanks to a number of people for valuable comments and suggestions for this report. In particular, Rob Corbin for help in waste volumes, John FitzPatrick for help with corrosion and calcium source terms, George Borsheim of Westinghouse Hanford Co. for his many very useful suggestions, and Bonnie Young for help in assembling the glossary and final document.

This work has been performed under the auspices of the Department of Energy.

I. Strategy for Estimating Tank Chemical and Radionuclide Inventories

One of the more difficult tasks involving the Hanford waste tanks is the estimation of those tanks' contents. Nevertheless, such estimates are often necessary in order to establish safety limits during intrusive activities associated with these tanks, as well as needed for a planning basis for future disposal. The present report is part of a four step strategy, as shown in Fig. 1, for estimation of tank inventories.

The first step is to compile a spreadsheet of qualified fill records[4] with information extracted from Jungfleisch-83[5] and Anderson-90[6], and checked against quarterly summary reports by Ogden Environmental and LANL. These qualified transaction records are called the Waste Status and Transaction Record Summaries (WSTRS). The WSTRS reports, although largely representative of the waste histories of the tanks, are nevertheless incomplete in that there are a number of unrecorded transactions that have occurred for many tanks. Included within the WSTRS report, then, is a comparison of the tank volume that is calculated based on the fill records that are present in WSTRS with the measured volume of each tank. This comparison is made for each quarter to record any unknown waste additions or removals that may have occurred during that quarter.

Using these fill records, the second step in this strategy is an analysis that provides a definition of the solids layers within each tank and is called the Tank Layer Model or TLM. The TLM[7,8] is a volumetric and chronological description of tank inventory based on a defined set of waste solids layers. Each solids layer is attributed to a particular waste addition or process, and any solids layers that have unknown origin are assigned as such and contribute to the uncertainty of that tank's inventory. The Tank Layer Model for each tank, then, simply associates layers of solids within each tank with a waste addition or a process campaign. In order to derive an inventory of tank chemicals and radionuclides, one must provide a composition for each of these waste streams. These compositions are provided by the Hanford Defined Wastes report.

The third step is to describe the composition of supernatants within each of the tanks (note that interstitial liquid is part of the solids definition, not the supernatant), for which purpose an ideal mixing model has been developed, called the Supernatant Mixing Model.[9] This model describes supernatants in terms of fractions of each of the HDW supernatants along with corresponding volume reduction due to active evaporation. The SMM is very important for

---

[4] (a) Agnew, S. F., et al., "Waste Status and Transaction Record Summary for the NE Quadrant" WHC-SD-WM-TI-615, Rev. 1, October 1994. (b) Agnew, S. F., et al. "Waste Status and Transaction Record Summary for the SW Quadrant, " WHC-SD-WM-TI-614, Rev. 1, October 1994. (c) Agnew, S. F., et al. "Waste Status and Transaction Record Summary for the NW Quadrant, " WHC-SD-WM-TI-669, Rev. 1, October 1994. (d) Agnew, S. F., et al. "Waste Status and Transaction Record Summary for the SE Quadrant, " WHC-SD-WM-TI-689, Rev. 1, March 1995. (e) Agnew, S. F., et al. "Waste Status and Transaction Record Summary (WSTRS Rev. 2), " WHC-SD-WM-TI-614, -615, -669, -689, Rev. 2, September 1995.

[5](a) Jungfleisch, F. M. "Hanford High-Level Defense Waste Characterization—A Status Report," RH-CD-1019, July 1980. (b) Jungfleisch, F. M. "Supplementary Information for the Preliminary Estimation of Waste Tank Inventories in Hanford Tanks through 1980," SD-WM-TI-058, June 1983. (c) Jungfleisch, F. M. "Preliminary Estimation of Waste Tank Inventories in Hanford Tanks through 1980," SD-WM-TI-057, March 1984.

[6]Anderson, J. D. "A History of the 200 Area Tank Farms," WHC-MR-0132, June 1990.

[7](a) Brevick, C. H., et al., "Supporting Document for the Historical Tank Content Estimate for A Tank Farm," WHC-SD-WM-ER-308, Rev. 0, June 1994. Likewise, reports and numbers for each farm are as follows: AX is 309, B is 310, BX is 311, BY is 312, C is 313, S is 323, SX is 324, and U is 325. These supporting documents contain much of the detailed information for each tank farm in a concise format, all released as Rev. 0 in June 1994.

[8]Agnew, S. F., et al. "Tank Layer Model (TLM) for Northeast, Southwest, and Northwest Quadrants," LA-UR-94-4269, February 1995.

[9]Agnew, S. F.; Corbin, R. "Supernatant mixing model," in preparation.

definition of waste in DST's, since a large fraction of the waste supernatants now reside in DST's.

The fourth and final step in the strategy, then, is the purpose of the present report, which is to provide chemical and radiochemical concentrations for each of the Hanford Defined Wastes (HDW). The HDW compositions coupled with the tank layering information provide a basis for estimation of each tank's chemical and radionuclide inventories (see Fig. 1). The inventory estimates for each tank appear in the Historical Tank Content Estimate (HTCE) reports for each quadrant.[10]

II. Background

High level radioactive waste (HLW) generated at Hanford from 1945 until 1989 all derived from the chemical dissolution and extraction of plutonium and uranium (and some thorium and neptunium) from reactor fuel elements (see Fig. 2). Over these years, the extractions evolved through three different processes. The first process was a bismuth phosphate precipitation (BiPO4), which operated from 1945 until 1956 in B and T Plants. This rather inefficient method was eventually supplanted by a more efficient method that involved contacting a methyl isobutyl ketone (hexone) phase with an aqueous aluminum nitrate solution of plutonium and uranium from dissolved fuel slugs. This process was known as Redox and operated from 1952 to 1966 in the Redox or S Plant. The Redox process was later replaced by Purex, a much-improved solvent extraction based on an organic phase that is a mixture of NPH (normal-paraffinic hydrocarbon or kerosene) and TBP (tributyl phosphate) contacting an aqueous nitric acid solution of plutonium and uranium. Purex began in 1956 at Hanford, and ran until 1972, then restarted in 1983 and ran until 1988. All Purex operations were performed in the Purex Plant, or A Plant.

The wastes from each of these three processes were neutralized and placed into 75' and 25' diameter storage tanks, but a variety of further processing occurred to the wastes after this initial disposal. This further processing, which was usually concentration of the waste by evaporation of water, nevertheless resulted in new wastes that were then returned to the waste tanks. The difficulty of using this process plant knowledge and tank transaction records to estimate the contents of each of the waste tanks is obvious, and is compounded by the often inadequate and conflicting records that have been kept for each of the waste tanks at Hanford.

There are over a thousand analytical assays of existing tank waste with the assays for supernatants being most numerous. Analytical assays of solids layers within a given tank have proven to be quite variable. For example, solid wastes within the tanks are often highly stratified, with both vertical and horizontal inhomogeneities. Unless a tank's waste is homogeneous, we need to determine the vertical and lateral distribution functions of that waste layers within the tank—otherwise there is no valid manner to derive a tank inventory from analytical data. This distribution function derives from the fact that the tank "remembers" when and how waste solids were added and removed, and how subsequent operations affected the layers that were already within the tank.

Thus, two tanks could very well have significantly different inventories but different distribution functions, which could lead to identical sample results. Without independent knowledge of those distribution functions, it would be impossible to know that the two tanks actually had different inventories. The difficulties in deriving tank inventories from limited sample information are compounded by other factors, such as less than 100% recovery for cores, the

---

[10](a) Brevick, C. H., et al., "Historical Tank Content Estimate of the Northeast Quadrant of the Hanford 200 East Area," WHC-SD-WM-ER-349, Rev. 0, June 1994. (b) Brevick, C. H., et al., "Historical Tank Content Estimate of the Southwest Quadrant of the Hanford 200 West Area," WHC-SD-WM-ER-352, Rev.0, June 1994. (c) Brevick, C. H., et al., "Historical Tank Content Estimate of the Northwest Quadrant of the Hanford 200 West Area," WHC-SD-WM-ER-351, Rev.0, March 1995. (d) Brevick, C. H., et al., "Historical Tank Content Estimate of the Southeast Quadrant of the Hanford 200 West Area," WHC-SD-WM-ER-350, Rev.0, June 1995.

limited number of sampling points for each tank, and the fact that the same risers that are available for sampling are the fill and removal points of the tank. Furthermore, the fill and removal points are exactly where the largest inhomogeneities exist.

III. Three Methods for Establishing Defined Wastes

There are three distinct methods that have been used by previous workers to set the concentrations of each component in the various waste streams at Hanford. These three methods are based on either one or a combination of knowledge of process, chemical used and waste produced, and analysis of characteristic waste. However, while these methods provide necessary information for waste stream definition, these methods do not provide sufficient information to define the waste streams.

That is, once the component concentrations (i.e. source terms) are determined for each of the Defined Wastes, there are still two critical pieces of information that are needed for each component to relate the actual compositions of the solids and supernatant components within each tank. That is, one needs to know both the total solids volume per cent for that waste stream and the solubility of each component in the supernatant of those waste streams. Therefore,

Fig. 2. *Hanford Timeline.*

these two parameters, the solids volume per cent as well as the solubilities of each component within each waste stream must be independently determined before the waste stream source terms can be related to what is in each tank that received that waste.

Furthermore, the model that we have developed for the defined wastes compositions uses *representative* values for the speciation of the components in the solids phases. In other words, the solids that precipitate within this model are those listed in Methodology, Section V. For example, phosphate solubility is determined by the ranges observed in tank supernatants, but the solid phases that precipitate are limited to a combination of $BiPO_4$, $Na_3PO_4 \bullet 10H_2O$, and $Na_3PO_4 \bullet 12H_2O$, depending on the circumstances of the waste stream. We argue that this approach adequately approximates the major features of each solid layer without the complexity that undoubtedly exists in the real waste forms. Therefore, we do not use any further speciation in our solids layers. Another example is Cs-137, which is precipitated within our model formally as the metal, when in fact we fully realize that it is actually precipitated as a monopositive cation in some kind of salt.

—Knowledge Of Process

Basically, this strategy uses process information, such as flowsheets, to derive waste compositions based on some process driver. At Hanford, the driver for HLW was tons of uranium fuel processed per quarter. Therefore, based on this feed, a certain amount of waste was generated for a given Hanford process, such as Purex, and expressed as gallons of waste per ton fuel.

The advantages of this strategy are its simplicity and straightforward application to waste streams. The disadvantages are that often the flowsheet information is incorrect or incomplete. In fact, ancillary or cleanup operations not described explicitly within the flowsheet can end up creating larger waste volumes, and add different constituents to the waste as well.

Specifically, actual waste volumes usually differ from predicted waste volumes based on flowsheet information, and it is not clear how to scale the composition of the primary stream. For example, if a Purex flowsheet indicates that 51 gal. of P waste is generated per ton of uranium, but actually 275 gal/ton occurred, how do the constituents within the stream scale? Is the additional volume just water?

—Chemicals Used / Waste Volume Produced

This approach uses observed waste stream volumes, both liquid and settled solids, to establish an actual waste generation rate in gallons of waste per ton of uranium processed for each waste stream. Thus, volume conservation is enforced from the beginning. Then, total chemicals added during processing allows one to unambiguously derive *average* waste compositions. Thus, total mass is always conserved with this approach. (Note that this is the approach that Allen used[11] in his report in 1976.)

The disadvantage of this approach is that it concentrates on only the total amount of chemical used during a campaign. There is often limited information about how the chemicals used changed *during* a campaign. As a result, while this Chemicals Used/Waste Produced approach provides an accurate average waste composition, variations in the compositions of the waste streams are not represented unless one has independent information about the amounts of chemicals used during each of those process variations within the campaigns.

—Analysis of Characteristic Waste

Deriving waste inventories from analytical information of course begs the whole issue of determining a waste type composition. If a tank's waste is fairly homogeneous, straightforward sampling and analysis will provide an inventory for that tank. The real issue, then, is how can the information from an analysis of tank A's waste be used to predict the contents of tank B. On the one hand, direct analytical information constitutes the bottom line for any tank inventory. On the other hand, there are mitigating factors that show that this approach also has severe limitations.

Sampling has been and will continue to be a very uncertain source of waste composition information for many different reasons, not the least of which is that it is a very difficult and expensive thing to achieve for 177 tanks. For example, pulling a sample from a waste tank is in and of itself a very difficult task, but even when that is done, the question of whether that sample is representative of the tank waste is sometimes impossible to answer—even with additional sampling.

Then, there are the inevitable analytical errors that derive from the procedures used to homogenize, dissolve, and finally analyze each sample. And there is the over arching uncertainty, once these other issues are resolved, of exactly which waste type a tank's waste is representative. In other words, given that SY-101 is a mixture of DSS and CC wastes, what does the analysis of that tank's waste tell us about either of these two waste types?

—Method Used for Defined Wastes

We believe that the Chemicals Used / Waste Produced approach is the best for defining waste compositions, and therefore will favor that method. However, much use will also be made of Knowledge of Process (KOP), since it is necessary to change the manner in which the chemicals are partitioned in the waste stream over the years in order to account for changes in the process. Unfortunately, these two sources of information are often in severe disagreement. For example, there was 3.3 Mmol (1 Mmol = one million moles) of citrate reportedly used in B Plant, but the flowsheets suggest that 32 Mmol would have been used, based on the flowsheet concentration and volumes of waste produced. We do not feel that it will ever be possible to resolve all of these discrepancies between these two sources of information. Therefore, we will only use Knowledge of Process to account for notable changes in the waste processes. For example, in 1962, the Purex waste (termed P) decreased from 844 gal/ton to 288 gal/ton—a factor of 2.9 reduction. Obviously there was a change in the process in 1962 that had a dramatic affect on the volume of P waste that was generated. At that same time, CWP volume stayed at 291 gal/ton, but OWW volume went from 108 gal/ton to 336 gal/ton, an increase of a factor of 3.1.

---

[11] Allen, G. K. "Estimated Inventories of Chemicals Added to Underground Waste Tanks, 1944 through 1977," ARH-CD-6108, March 1976.

IV. Review of Campaigns

—Overview

Some 496 million gallons of waste was placed into single-shell and double-shell tanks at Hanford from 1944 to 1988 (see Table 1), but this amount includes Metal Waste (MW) that was reprocessed in U Plant from 1952-56 and Purex sludge and supernatants that were reprocessed in B Plant 1967-76. After reprocessing and water additions, there was a net of 347 million gallons of waste placed into various tanks. Then, 301 million gallons were removed by evaporation (and condensate placed in cribs) while 86 million was placed into cribs either directly or following scavenging operations, leaving 46 million gallons of waste in the tanks from the 1944-80 era.

Since that time, another 30 million gallons of waste has been generated and concentrated to 15 million as of January 1994, leaving 61 million gallons in Hanford waste tanks. Of this amount, 36 million gallons are now in single-shell tanks (all derive from the early era), while the 25 million gallons reside in the double-shell tanks (deriving from both eras), as shown in Table 1.

—$BiPO_4$ campaign

The bismuth phosphate process began in T Plant in December 1944, and in B Plant in April 1945. This process ran until 1952 in B Plant and until 1956 in T Plant and generated some 98,000 kgal of MW, 1C, 2C, and 224 wastes. The farms T, TX, and TY were used for wastes from T Plant, while B, BX, and BY were used for wastes from B Plant. The term Metal Waste (MW) derived from the code word for plutonium during the war years, "metal." The other terms 1C, 2C, and 224 represent the wastes from first cycle, second cycle and the plutonium finishing operation in building "224."

This waste was generated from 1944 to 1956 and our compositions reflect those of Anderson and Jungfleisch. A summary of the wastes generated during this campaign are shown in App. E. A synopsis of the process is shown in Fig. 3.

Anderson-91 reported that, starting in September 1947, second cycle decontamination waste from T Plant was to be cribbed or placed in the ground, at which time the $BiPO_4$ process had been running some two-and-a-half years. Then in February 1948, second cycle wastes from B Plant were directly cribbed as well. Thus, the ~2,400 gal/ton waste rate shown in App. E for 2C waste probably reflects the fact that a large portion of the 2C waste had already gone into the ground at the plant.

Around 1950, there was an abrupt change in both the 1C and 2C waste rates. The 2C rate increased from ~2,400 to an average of ~4,600 gal/ton, nearly twice the volume rate that it had been. Moreover, in 1954 the rate actually peaked at 25,000 gal/ton, as shown in Fig. 4. During this same period, the actual amount of fuel that was processed was quite low, as shown in Fig. 5, and therefore there is not a large effect on the average rate over the period 1950-56. Anderson-91 noted that canyon cell drainage waste, previously disposed of to dry well via 361 Settling Tank, was added to 2C after 1951, and that stack drainage (from decladding off gas?) was combined with 2C up until 1951. If this change in volume were due to this drainage waste, it suggests that some 12,043 kgal of drainage waste was cribbed at B and T Plants from 1945-51. Likewise, there was a change in the solids volume per cent for 2C waste, which we estimate to have been 6.8 vol% from 1945-49 and 3.4 vol% from 1950-56.

The main receiver of 2C waste from T Plant was T-110, which cascaded to T-111 and T-112, and then to various cribs. From B Plant, 2C waste was placed into B-110, which cascaded to B-111 and B-112. All told, 21,000 kgal of 2C was cribbed from T-112, and 4,700 cribbed from B-112.

The 1C vol% solids increased rather dramatically from 14 vol% from 1945-47 to 25 vol% from 1947-51 (see Table 6), while the waste rate only increased from ~3,700 gal/ton to ~4,900 gal/ton from pre 1950 to post 1950 (see App. E and Fig. 4). We do not completely understand this change in 1C solids per cent, but it is important in the solids layering predictions. We assume in our model that the change in solids volume per cent was due to a reduction in sodium hydroxide added to neutralize the waste stream. With less sodium hydroxide, more aluminum precipitates as the oxide and less remains in solution as aluminate. Accordingly, we adjust the caustic downward for 1C2 versus 1C1, and adjust the fraction aluminum precipitated as oxide accordingly. Note that the 1C2 waste rate was quite variable during its period, ranging from 1,800 to 6,800 gal./ton fuel, while the 1C1 waste rate ranged from 2,000 to 4,000 gal./ton during its period.

Anderson-91 reported that alkaline coating removal waste (CW) was combined with 1C for storage, and that stack drainage was combined with 1C after May 1951. Whether either of these wastes had anything to do with the waste rate changes is uncertain at this time. In any event, 1C wastes were largely added to T-107, U-107, B-107, and C-107 overfilled to the corresponding tanks in a three tank cascade.

The fuel slugs were coated with a bronze layer (Cu and Sn) prior to being welded in their jackets. Neither of these elements are currently within the HDW chemicals added and so are not included in the cladding waste estimates. Moreover, there are other reports of lead dips being used instead of bronze for some fuel slugs. We also have not included any lead in the cladding waste chemicals added.

The 1C supernatant was not generally cribbed, although Anderson-91 reported that 4,807 kgal of 1C supernatant and 1,938 kgal of 1C evaporator bottoms were cribbed. In fact, we have shown via the SMM (ref. 6) that effectively some 12,439 kgal of 1C HDW supernatants were placed into cribs during this time. This is because the cribbing of concentrated 1C supernatants. Other 1C supernatants were "scavenged" in TY Farm during the ferrocyanide campaign. These scavenging operations resulted in production of ferrocyanide sludges that are termed 1CFeCN in the defined waste list (see App. B, waste type #12) and now reside in TY-101 and TY-103.

Waste from the plutonium concentration facility, so-called "224" waste, was generated by a plutonium finishing process known as the Lanthanum Fluoride process. According to Anderson-91, all the 224 wastes were cribbed at the plant, and therefore never entered the waste farm. However, WSTRS (and even Anderson-91 waste summaries) show that some "224" waste was placed into the farms. In particular, WSTRS reported 1,220 kgal of "224" waste was added to T-110, -111, -112 from 1951-53, 173 kgal was added to T-201, -202, -203, and -204, and another 372 kgal was added to B-204, -203, -202 from 1952-56. It is not clear why only this amount of "224" ended up in the farms. It is possible, for example, that only accumulated sludges and not the all of the waste was placed into waste tanks, or perhaps there was some process upset that occurred.

The solids amount for "224" waste is very uncertain at this time, but an estimate for the solids fraction comes from the per cent water reported[12] from an analysis of T-111 waste. Note that some 154 kgal of solids accumulated in B-204, -203, -202, and -201, while only 372 kgal was recorded as having been added to this cascade by WSTRS, for a 41 vol% solids. This solids content is very high and it is probable that much more than 372 kgal was actually added to this cascade. In particular, estimates of per cent solids obtained by using an 80 wt% water would be 4 vol%, which would suggest that more like 3,900 kgal was added to this cascade. Likewise, some 124 kgal solids accumulated in T-203, -202, -201, -204, while only 173 kgal "224" is recorded as having been added to this cascade. Using a nominal 4 vol% solids, this actual volume added to the T-200 cascade would have been more like 4,300 kgal. Thus, we have assumed that a total of 8,300 kgal of "224" waste was placed into these various cascades over the history of this process.

Figure 5. *Total waste volumes from $BiPO_4$ campaign.*

[12]Preliminary analysis of T-111 courtesy of Roger Bean, PNL.

The compositions of the $BiPO_4$ wastes came from Anderson-91, Jungfleisch-84, Allen-76, and other information.[13] Anderson states that 1C waste contained 10% of fission products and 2C had 1%, but this description does not further define the partitioning of fission products, such as Sr-90 versus Cs-137. Therefore, we have partitioned 90% of Cs-137 to 1C waste, 10% into MW, and only 1% into 2C. Likewise, we partition 98% of Sr-90 to MW, 1% to 1C, and 0.1% to 2C.

—Uranium Recovery

The $BiPO_4$ process did not remove uranium from the process stream. A second campaign, the uranium recovery campaign, began that involved sluicing the MW tanks and extracting the uranium from those wastes. This uranium campaign involved U Plant and a process that was based on a TBP/NPH solvent extraction, and produced a waste that has been referred to as TBP. This report, however, it is termed UR waste to make clear the distinction among the process wastes that involved the chemical, TBP. A description of the overall uranium recovery process is shown in Fig. 6.

The uranium recovery campaign began in 1954 and recovered the MW that was stored in B, C, BX, BY, T, TX, and U Farms. This campaign reportedly produced about two gallons of waste for each gallon of MW that was processed (actually ~2.5 by WSTRS, see App. E, adding UR, PFeCN1, PFeCN2). Therefore, more waste was created than could be accommodated by the tank farms and a scavenging program based on the precipitation of $Na_2NiFe(CN)_6$ within the waste stream to scavenge or entrap the Cs-137 began. With the Cs-137 precipitated in the sludge, the supernatant was then placed into the ground in cribs or trenches. As a result, about 30,000 kgal of scavenged waste was sent to the cribs following an in-plant addition of ferrocyanide and 12,000 kgal was sent to the crib with in-farm or CR-Vault addition of ferrocyanide (see Table 1).

Evidently, there were heel remnants of MW solids in many of the tanks following sluicing and as much as 40 kgal of solids remained in some tanks following sluicing operations. We assume that some of these heels were left behind because of expediency and not because the solids weren't sluicable. However, there were reports of hard pan forming in well-aged MW sludges and the suggestion was that a very hard uranium carbonate phase was formed in aged MW sludges. The Uranium Recovery manual states[14] that although sluicing and then acid digesting MW sludge in tank farm vaults was the baseline process, dissolution of uranium in caustic water and/or sodium carbonate solutions would also be attempted within the waste tanks. It is not clear, though, what happened to the sludge remnants that would have resulted following acid digestion in TXR, BXR, and CXR tank farm vaults during feed preparation of recovered MW sludge. We have found that more than 15-20% of the expected 4,309 kgal of MW sludge still remain as heels within various tanks. We have used the reported sludge levels for MW as 12 vol%, although values as high as 25 vol% were mentioned in the Uranium Recovery manual.

Although the solubility of the uranium/carbonate complex in MW supernatants was reported in the UR manual to be 0.11 M, that same source also claimed that 75% of the uranium was present as a solid in the sludge. Our calculations show that if 75% of the uranium were in the sludge, a supernatant of only 0.04 M U would result. If we assume that the 0.11 M solubility point is correct (uranium solubility is ~0.004 M for typical tank waste supernatants), this would have meant that only 35 % of the uranium was in MW sludge. Thus, we suggest that caustic sludge leaching may have been performed in the later stages of the Uranium Recovery Campaign in lieu of actual sludge removal and acid digestion in the vaults.

For these MW heels, we have assumed that 80% of the plutonium and strontium and 95% of the cesium associated with MW sludge were removed and ended up in the uranium recovery wastes as either UR, PFeCN1, and PFeCN/2 sludges, while the remainder of the

---

[13] no author "Hanford Technical Manual," HW-10475, May 1944.

[14] no author "Uranium Recovery Technical Manual," HW-19140, November 1951, section 1.1, p. 109.

plutonium and strontium remained with the MW heels. There were frequent problems with pump failures and other difficulties sluicing the so-called "hard-pan" out of tanks with well-aged MW, as previously detailed.[15] It is possible that these difficulties resulted in some expediency with regards to the MW heel remnants that were left within the tanks.

For UR waste, there is a problem with the composition—it is not consistent with expectations based on the flowsheet. This is shown by the phosphate levels, for example, which lead to a solids volume per cent that is much larger than that observed for this waste. We assume that the decision to leave many MW solids in the waste tanks was based on the leachability of uranium from the solids. That is, agitation of the solids with a basic carbonate solution should have been sufficient to leach the uranium out of the solids and into the supernatant. The supernatant could then be passed on to Uranium Recovery for processing, and therefore preventing the unnecessary transfer of large amounts of solids.

Since only supernatants were scavenged for TFeCN and 1CFeCN wastes, there were very small amounts of plutonium and Sr-90 in these wastes and we have neglected them. We have used a Cs-137 concentration identical to that of the supernatant of UR and 1C wastes, respectively.

The compositions of the UR wastes were taken from Anderson-91 and Jungfleisch-84, but the ferrocyanide sludges were defined[16] from Borscheim and Simpson. Also used to some extent was the Uranium Recovery Manual.[17] However, we have found that there is evidently some double counting of species within the MW and UR waste streams. That is, the 810 Mmols of $NaNO_3$ mentioned by Allen evidently included the $NaNO_3$ added during MW. Therefore, many estimates of the total sodium used for these two processes are in error since they add these two source terms together. Likewise, Allen shows 50 Mmols of Na_3PO_4 added during UR, when no phosphate at all was actually added during the uranium recovery campaign. All of the phosphate was actually carried over from the $BiPO_4$ operation. Therefore, there has been some double counting of added chemicals in past estimates of site inventories.

—Redox

The Redox process was based on the extraction or salting out of plutonium and uranium from an aqueous aluminum nitrate solution into an organic phase, methyl isobutyl ketone also known as hexone (see Fig. 7). Anderson-91 describes the various stages in the development of the Redox process, which began in January 1952 at S or Redox Plant.

According to Anderson, waste was originally generated at 4,378 gal/ton in 1952, and that rate was reduced to 594 gal/ton in 1966. We have found by analyzing the fill records, on the other hand, that the waste rate peaked at around 4,600 gal/ton in 1952 and after around 1958, leveled off to around 1,100 gal/ton.

Thus, there were essentially two eras for the Redox waste, the first era from 1952-58 averaged 2,106 gal/ton, followed by a reduction to 1,119 gal/ton from 1959-66 (see Fig. 8). We do find a waste rate as low as 500 gal/ton in the last quarter of 1966, but averaged for all 1966, the last full year of operation, Redox generated waste at the rate of 1,085 gal/ton.

We have also found that the cladding waste generation rate (CWR) was fairly constant at 266±30 gal/ton over the entire history of Redox, as opposed to a remark by Anderson-91, that cladding waste volumes were cut in half in 1956-57. We have found no such decrease in CWR waste rates averaged for any year of operation over the entire Redox campaign. There are some 980 kgal of CWR that is reported by WSTRS after all fuel was no longer processed in Redox in

[15] Rodenhizer, D. G. "Hanford Waste Tank Sluicing History," WM-TI-302, September 1987.

[16] Borsheim, G. L. and Simpson, R. C. "An Assessment of the Inventories of the Ferrocyanide Watchlist Tanks," WHC-SD-WM-ER-133, October 1991.

[17] no author "Uranium Recovery Technical Manual," HW-19140, November 1951.

mid 1966 (see Fig. 9). We assume that the fuel slugs from this decladding operation were actually processed in Purex Plant.

The fuel slugs were coated with a bronze layer (Cu and Sn) prior to being welded in their jackets. Neither of these elements are currently within the HDW chemicals added and so are not included in the cladding waste estimates. Moreover, there are other reports of lead dips being used instead of bronze for some fuel slugs. We also have not included any lead in the cladding waste chemicals added.

Anderson also mentions that Redox processed some Zircaloy cladded fuel, which came from N-Reactor. However, Jungfleisch indicated that the first Zircaloy cladding waste was created in Sept. 1967, and Redox plant shut down in 1966. Other sources (HWN-1991, p. 130) have indicated, on the other hand, that some 269 tons of Zircaloy clad fuel was indeed processed in Redox in 1966. Since the last cladding waste from Redox (CWR) was place in S-107 in 1967q1, and we expect that some 18 kgal of CWZr1 sludge would be in the layers of this tank.

The early solids accumulation in Redox waste tanks during 1952-8 is associated with the era where the Redox waste rate underwent substantial change, as noted before. These tanks were also self-concentrating the waste, which increases the tanks' solids load even further. We have used a value of solids volume per cent of 4.4 vol%, which is based on accumulations in SX-105 and SX-111, neither of which tanks were reported to have undergone significant self-concentration over the period in question. These solids per cents are derived based on consistency with the 2.3 vol% that we have found for the second Redox period, R2.

For the second Redox period, solids accumulation in Redox waste dropped to 2.3±1.3 vol%, even as the waste rate for dropped from 2,106 to 1,119 gal/ton from R1 to R2 (App. E).

Many tanks in S and SX Farms were allowed to self-concentrate and therefore accumulated solids in excess of those from the primary additions. In particular, S-101, S-104, and S-107 were all primary receivers of R1 waste and also were reported self-concentrating waste tanks. Unfortunately, we do not have enough information to always differentiate between the two types of solids accumulation within the waste tanks. However, S-110 was also a primary receiver of R1, but never was reported to have reached boiling. If we assume that the solids for R1 were actually 4.5 vol%, that would provide an estimate for the concentrated solids, RSltCk, in S-101, S-104, and S-107. Thus, we assume that R waste has an implicit component within it that we attribute to the concentrate.

Tank SX-109 accumulated 14 vol% solids from its 1,756 kgal Redox waste. An analysis[1b] of the fill history of this tank reveals that it self-concentrated the Redox supernatants, and therefore deposited salt cake. Consequently, we attribute much of the solids accumulation in SX-109 to this salt accumulation and not to Redox sludge. We find that a series of tanks accumulated this Redox salt cake, which amounted to 1,065 kgal in a number of tanks in S and SX Farms. This resulted in a particular waste type, RSltCk, which is #43 in App. B.

Compositions of Redox wastes were taken from Anderson-91, Jungfleisch-84, Allen-76, as well as published flowsheets.[18] However, there is a difficulty in the amount of silica that is present in the Redox waste tanks is far greater that the amount that is listed as being present in the flowsheet. We have found a similar excessive silica source for Purex and other processes. Thus, we have added an amount of silica to the Redox waste that amounts to 50 mol Si per ton of fuel processed. The fuel that was processed did actually have a silica component, which is

[18] (a) no author "Redox Technical Manual," HW-18700, July 1951. (b) Crawley, D. T.; Harmon, M. K. "Redox Chemical Flowsheet HW-No.6," October 1960, HW-66203. (c) Isaacson, R. E. "Redox Chemical Flowsheets HW No.7 and HW No.8," RL-SEP-243, January 1965. (d) Jenkins, C. E.; Foster, C. B. "Synopsis of Redox Plant Operations," RHO-CD-505-RD-DEL, July 1978, declassified with deletions.

listed in the flowsheets as 21 mol Si/ton. At the present time, we cannot explain why the silica is actually much larger.

The amount of iron present in Redox sludge reflects the process vessel corrosion source term that we have found is a significant contribution to the Purex sludges. We have not found any information about the process vessel corrosion rates during the Redox campaign and have therefore assumed that the rates are identical with Purex.

—Purex Primary Process

The Purex process was based on the extraction or salting out of an aqueous plutonium and uranium nitric acid solution into a tributyl phosphate/normal paraffinic hydrocarbon (TBP/NPH) organic phase (see Fig. 10). Purex came on line in January 1956 in A Plant or Purex Plant after having run as a pilot in the Hot Semiworks (C Plant). The Purex campaigns and the subsequent processing that occurred in B Plant produced the most complicated combination of wastes at Hanford. We have found twenty-one distinct waste types that have derived from the Purex campaign from 1956-88.

An analysis of the waste history shows that there were three eras for the Purex process. From 1956 until 1962, the Purex high level waste rate averaged 877 gal/ton, OWW 150 gal/ton and CWP 346 gal/ton, although there is a large variability associated with the P waste rate. Also in this period, we are missing OWW (actually called CARB) for the years 1959 and 1961. During this period, there was a large variability in the waste rate of Purex as compared with other operations as well as other periods of Purex. The waste rate for P waste peaked at 1,400 gal/ton in 1960, and again at 1,000 gal/ton. These waste rates suggest that the OWW wastes were actually routed to P waste receivers in 1959 and 1961. In fact, Anderson-91 mentions that OWW were added to boiling waste tanks until 1969, and Jungfleisch-84 states that for some unspecified period, P and OWW were mixed together.

In 1960-61, it was reported[19] that a sulfate strike (i.e. precipitation) was used in Purex Plant to precipitate Sr-90 and separate it from the other fission products in HAW. The P waste rate reportedly went from 53 gal/ton to 193 gal/ton during this time. Thus, we suggest that the increase in waste rates in 1960-61 may have been due to a combination of this sulfate strike and redirection of the OWW streams. We have not, however, included any strontium depletion for this P waste. Evidently, this impure product was worked up later in either HS or B Plant operations.

The Purex waste receivers in 1959-61 were A and AX Farms. We suggest that the redirection of the OWW to these farms was due to the desire to concentrate these wastes by self-boiling. However, successive failures of two tanks in A Farm due to overheating evidently modified that strategy, and from then on, OWW was placed into other receivers and reduced in separate operations. There was a sizable self-concentration that occurred in A and AX Farms as a result of this self-boiling. However, unlike the Redox self-concentration campaign, no salt cake accumulated as a result of Purex waste self-concentration. Therefore, the volume reduction that occurred is accounted in other evaporator campaigns.

From 1963-67, the average waste rate for Purex decreased by a factor of two from 877 to 378 gal/ton while that for OWW rose by a factor of three from 150 to 391 gal/ton as compared to the period 1956-62. These changes in waste rates coincided with two fundamental changes for the Purex process. In Sept. 1962, the solutions from the second cycle uranium extraction were recycled instead of sent to the waste tanks and in Sept. 1963, sugar denitration was introduced, which reduced the nitric acid in HAW and therefore the amount of caustic that was needed to neutralize the waste. During 1962-67, the Strontium Semiworks facility was directly processing PAW as well. The variability of the Purex waste rate remained fairly high during this period of operation. The inherent amount of high level waste generated by the Purex operation (i.e. HAW) was quite small, on the order of 50 gal/ton, and we suggest that other more a periodic

[19] Monthly summaries, 1959-60.

sources, such as vessel cleanout and canyon drainage wastes, now began to dominate over the primary process waste.

Another spike in the P waste rate occurred in 1966, where the rate climbed to 900 gal/ton. We do not yet know why.

Finally, from 1968-72 the Purex HAW stream was sent directly to B Plant for strontium removal and so very little P waste was added to the tank farms after 1967. Eventually, this waste appears as B Plant high and low level wastes (B and BL). On the other hand, OWW increased once again during this latter era to 575 gal/ton.

We assume that the CWP/Al waste rate for the period 1961-72 remained at 346 gal/ton, which is the rate that occurred for 1956-60. During the period 1968-72, some 708 tons of Zircaloy N-Reactor fuel was processed in Purex (and 269 tons went to Redox, as noted above), and the waste rate for this Zirflex process (termed CW/Zr) was much higher than CWP/Al. In fact, a later flowsheet projected[20] 927 gal/ton for Zirflex waste, although the rate we calculate from WSTRS would have been 1,650 gal/ton, provided that the CWP/Al rate was 346 gal/ton. Since the two types of cladding wastes, CWP/Al and CWP/Zr were not segregated, i.e. both were added to C-104 during 1968-72, we have simply proportioned the CWP/Al and CWP/Zr waste solids accordingly over this period.

Figure 11. *Waste volume rates for Purex campaign.*

The fuel slugs were coated with a bronze layer (Cu and Sn) prior to being welded in their jackets. Neither of these elements are currently within the HDW chemicals added and so are not included in the cladding waste estimates. Moreover, there are other reports of lead dips being used instead of bronze for some fuel slugs. We also have not included any lead in the cladding waste chemicals added.

The solids volume per cent for the CWZR1 waste of this period is assumed to be the same as that of the '83-'88 campaign, CWZR2, which was 10.5 vol%. Moreover, there are indications that significant amounts of mercury were added to the dissolver solution to limit the emission of I-131 during dissolution of the fuel cladding. We have included mercury additions in our definition of cladding wastes.

Figure 12. *Total waste volumes for Purex campaign.*

The composition of Purex waste was taken from several sources. An early flowsheet[21] was used for the first era, a second flowsheet[22] was used for N Reactor fuels, and a later flowsheet[23] was used that updated the Purex process for N Reactor fuels. These compositions were adjusted to account for the changes in waste volume that are recorded in WSTRS combined with the total chemicals used reported by Allen-76. Basically, we have taken the waste rate of 50 gal/ton for all of the process chemicals except iron and silica, and diluted those chemicals to the observed waste rates of either 877 or 378 gal/ton.

For both iron and silica, we have used Allen-76 to set the total chemicals used and the Chemicals Used/Waste Produced approach to define the waste compositions for these two species. This Si amount is on the order of 130-160 mol Si/ton fuel which is much larger than the

---

[20] Allen, G. K.; Jacobs, L. L.; Reberger, D.W. "Purex Flowsheet—Reprocessing N Reactor Fuels," PFD-P-020-00001, Sept. 1982.

[21] Swift, W. H.; Irish, E. R. "Purex Two Cycle Flowsheet, Revision No.1," October 1957, HW-52389-DEL, declassified with deletions.

[22] Jeppson, D. W. "Purex Flowsheet Reprocessing N Reactor Fuels," November 1976, ARH-F-103.

[23] Allen, G. K.; Jacobs, L. L. "Purex Flowsheet Reprocessing N Reactor Fuels," September 1982, PFD-P-020-0001.

21 mol Si/ton fuel reported in various flow sheets. The concentration of SiO_2 in the waste stream from the plants amounts to 3,000 to 6,000 ppm, which is very large compared to a normal impurity level that is expected from hard water.

Estimates of organic lost during solvent processing[24] have shown 8.4 gal organic per ton of fuel processed during Purex. For a 70/30 mixture of NPH/TBP, this suggests a loss of 2.5 gal TBP/ton fuel processed. We then assume that all of this TBP is hydrolyzed to DBP and butanol and place those in the corresponding waste streams.

The waste rate for PL2 (PXMISC in WVP notation) amounts to nearly 3,000 gal/ton of fuel processed for the '83-'88 campaign. Since no OWW was reported at all during this period (flowsheet values suggest ~400 gal/ton fuel), we assume that PL2 is actually a combination of both PL1 and OWW, despite the fact that the 3,000 gal/ton value is substantially larger than the 400 gal/ton expected from the flowsheet. The weighting that we have used is as follows:

$$\text{PL2 chemicals added} = (2100 * \text{PL1} + 800 * \text{OWW3}) / 2900$$

The P3 waste (Neutralized Current Acid Waste, NCAW) is derived from flowsheet values that are scaled to the actual waste volume. For example, neutralized ZAW flowsheets predict 160 gal/ton, while the actual volume sent to the tanks averaged 288 gal/ton. We therefore scale all neutralized ZAW flowsheet chemicals by 160/288 = 0.556.

The sugar denitration of acid ZAW used a sugar solution that would have resulted in about 25 g TOC/L of waste had it not reacted with the nitric acid. Complete consumption of the sugar was assumed, which reduced the HNO_3 from 2.8 to 0.95 M in the waste, with the carbon lost as CO_2. During this denitration, an anti-foam agent was used to keep the solution from foaming. The amount added was 2.2 fl.oz/ton fuel, which amounts to about 6e-5 M Si in the waste stream, assuming the anti-foam agent is 3 wt% Si. However, we have previously found that the Si amounts in Purex waste are significantly greater than this. Accordingly, we use a value of 0.092 M Si in the P3 waste stream.

—Purex to Hot Semiworks

The Hot Semiworks or C Plant was used as a pilot for both Redox and Purex in the 1950's, and was then used as a pilot for strontium extraction in the 1960's, prior to B Plant operation (see Fig. 2). Purex HAW was processed[25] with this pilot and only a fairly small amount of waste was generated, amounting to 1,003 kgal over the years 1962-67. We do not know exactly how much HAW was processed for the whole campaign, but for the first hot run in 1962, 16 kgal of HAW was processed resulting in 50 kgal of waste. If we assume that the rest of the campaign progressed with the same waste rates, then 1,003 / 50 x 16 = 321 kgal of PAW were processed in the Hot Semiworks Plant, corresponding to 321 kgal / 0.3 kgal/ton = 1,070 tons of fuel. During the period 1962-67, on the other hand, about 25,000 tons of fuel were processed, so the amount of PAW processed in the Semiworks amounted to a relatively small fraction of the total PAW waste.

According to the report for this first hot run, about 1.04 MCi Sr-90 was extracted from 1.2 MCi Sr-90 total within the crude PAW (it not clear if this includes the Y-90 daughter) leaving 0.14 MCi Sr-90 in the waste. Scaling this by the ratio of overall waste with just this run (1,003/50), suggests that 2.8 MCi Sr-90 were left in the waste over the entire campaign, or 1.4 MCi, decayed to 1994.

---

[24] Camaioni, D. M.; Samuels, W. D.; Lenihan, B. D.; Clauss, S. A.; Wahl, K.L.; Campbell, J. A. "Organic Tanks Safety Program Waste Aging Studies," PNL-10161, Nov. 1994.

[25] Richardson, G. L.; Schultz, W. W.; Mendel, J. E.; Burns, R. E.; Rushbrook, P. R.; Alford, M. D.; Cooley, C. R. "Hot Semiworks Strontium-90 Recovery Program, Part1: Program Synopsis, Part 2: Technical Basis, Part 3: Laboratory Studies, Part 4: Cold Semiworks, Part 5: Hot Semiworks Runs" HW-72666-RD, February-November 1962.

Another indication of the Sr-90 concentration in HS waste comes from a report of C-112 sampling in 1993, the very top layer of which was SSW sludge and was ~6 Ci/L. If we assume that all HS sludge was nominally 6 Ci/L Sr-90, this results in an HS waste inventory of 0.45 MCi Sr-90 (decayed to 1994) in HS sludge, which is a factor of three less than the amount estimated by the hot run report.

The chemical composition of HS from the Lucas[26] draft report, disagrees with the information from the first hot run report, and we have used this hot run report to define our HS waste. However, there is no Pu or Cs-137 in this waste, and the Pb concentration of 0.034 M results in a very high Pb value in the sludge. Therefore, we arbitrarily choose to adjust the Pb down by a factor of ten to 0.0034 M. We have also added an amount of Pu to the waste that is volume-scaled to the P2 waste stream.

Although there are records of HS and SSW wastes being added to C-107,-108,-109,-111,-112, there was another addition of 200 kgal of these semiworks wastes to the C-200 series tanks as well. Anderson-91 assigns the waste in tanks C-201, -202, -203, and -204 to SSW and HS and notes starting dates for HS additions in 1955 and 1956, even though we have otherwise no information about the fill history of the C Farm 200-series tanks following the MW sluicing. Therefore, there were undoubtedly unrecorded additions of HS as early as May 1955, which would have been during the Purex pilot operation in the C Plant. Further additions occurred in 1966 from SSW to C-204, which were presumably decontamination operations for C Plant, and then all of the C-200 tanks were pumped to their sludge heels in 1970 and 1977.

—Purex to B Plant Cs-137 Recovery

Although B Plant was used from 1945-1952 for the $BiPO_4$ process, it was later reconfigured for the cesium and strontium extraction campaign. From 1967 to 1976, B Plant extracted strontium from both Purex acid waste (PAW) (from Purex Plant) and Purex sludges (sluiced from A and AX Farms), and extracted cesium from a variety of neutralized supernatants taken from the tank farms.

Our model for the cesium recovery approximates the feed for this campaign by deriving volumes of waste supernatant that was processed from the tank farms. In (App. E) we show the nominal composition of the feed for CSR along with the sum of supernatants from which it was derived. Note that many concentrated wastes were processed during this campaign and we find that the average concentration factor was ~2.7 for the CSR feed. The following equation represents the majority of the contributions to the CSR waste in terms of other HDW supernatants:

$$\text{CSR in} = 0.34\ \text{P1} + 0.11\ \text{P2} + 0.11\ \text{B} + 0.05\ \text{AR} + 0.07\ \text{R1} + 0.03\ \text{R2} + 0.21\ \text{OWW}.$$

Supernatants were fed to the cesium recovery process through C-105, which was the staging tank for the caustic sludge washing in AR vault. As shown, 45% of the CSR feed was Purex supernatants, 21% organic wash waste, and 10% Redox supernatants. These waste supernatants were concentrated on average by a factor of 2.7 prior to CSR processing but our model does not allow for any solids to form in this waste type. All of this material in CSR is transferred to the CSR waste receivers except for the Cs-137.

There were two different processes for extracting Cs-137. The first was a chromatographic extraction of Cs-137 onto zeolites from the caustic supernatants that were drawn from various tank wastes. We find that 92% of the Cs-137 was extracted from these supernatants with this process. The second process by which Cs-137 was extracted was by precipitation of Cs-137 with phosphotungstic acid added to the HAW acid feed that was obtained directly from Purex plant. This process evidently produced the B and BL wastes. Finally, the crude cesium product purification produced additional B and BL wastes as well.

---

[26] Lucas, G. E. "Waste Types in Hanford Single-Shell Tanks," WHC-SD-ER-TI-001, draft report, 1989.

—Purex to B Plant Sr-90 Recovery

The strontium recovery operation was much more complex than the cesium recovery as shown in Fig. 13. The origin of the complexant wastes at Hanford are attributed to this process. The waste volumes from the various processes are shown in Fig. 14. Note that the production of B and BL wastes evidently derived from PAW (or HAW) processing, although we do not know the volume processed. We estimate that about 4,000 kgal of PAW would have been processed in B Plant from 1968-72, which resulted in the production of 11,763 kgal of B and 4,000 kgal of BL wastes (App. E). There was about 397 kgal of P and 1,233 kgal of PL placed in waste tanks during this time, some of which was then sluiced for the later Sr-90 extraction from PAS (Purex Acidified Sludge).

Although sluicing operations began to send sludge to AR Vault in 1967, the production of SRR waste did not begin until 1973. We cannot explain this time difference, but note the SRR waste came primarily from the purification of the Sr product. The Cs-137 recovery operation, on the other hand, ran fairly consistently from 1967 to 1973, and then slowed down substantially after that time. There were two different processes for separating cesium from waste, depending on whether the waste was alkaline or acidic. For neutralized or alkaline supernatants Purex Sludge Supernatant (PSS), resins were used to extract cesium. For acidic supernatants, phosphotungstinic acid was used to precipitate the cesium before neutralization.

B	waste from PAW
BL	low level waste from all operations
AR solids	"washed" P sludge. Also used to derive SRR.
SRR	strontium recovery waste from sluiced P sludge—based on washed Purex sludge plus added EDTA, HEDTA, and glycolate.
CSR	waste from cesium recovery from supernatants—not a characteristic waste type, but rather a supernatant from which the ^{137}Cs has been removed. Need only to add citrate to supernatants to track this component.

The amount of Cs-137 and Sr-90 extracted during this campaign has been reported[27] and is shown in Table 2. The difference is very important, since that is the residual Cs-137 and Sr-90 that is present in the waste tanks. We have assumed that the residual Sr-90 is distributed among P, AR, SRR, B, BL, and HS wastes, while the residual Cs-137 is distributed among CSR and B wastes.

Overall, the campaign succeeded in extracting 42% of the Sr-90 from various wastes. Since B waste derived from the extraction of Sr-90 from PAW, we assume that 80% of that Sr-90 was extracted and 20% ended up in B waste. With this assumption in hand, we find that 27% of the Sr-90 in neutralized Purex sludge ended up in the WESF capsules, while the remaining was distributed as shown in Table 2.

There are some 4.3 MCi Sr-90 (decayed to 1993q4) for which we can not yet account. It is not clear at this time if this "missing" Sr-90 was actually extracted from the sludge and shipped off site or is otherwise present on the site and its apparent absence indicates an inaccuracy in our model. For example, increasing the solubility of the Sr-90 in the wastes would naturally accommodate more Sr-90 in concentrates of waste supernatants. Another possibility is that there is unaccounted Sr-90 within and underneath damaged tank A-105. That there is a significant heat source underneath this tank is indicated by the very high temperatures within a

[27]ORNL document (no author), "Integrated Data Base for 1991: U. S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW-0006, Rev. 7, 1991, Mike Cooney is Hanford contact.

lateral well underneath the tank as well as the high dome space temperature for the tank itself. The "missing" 4.3 MCi would amount to a ~100,000 Btu/hr heat source, which would presumably be more than enough to raise the lateral-well temperature to the ~212°F reported today. Therefore, some or all of the missing Sr-90 may be in or under A-105.

Two tanks that are key in containing the amount of Sr-90 in BL waste are C-106 and B-101. Independent estimates of tank waste heat loads from tank temperatures suggest that C-106 is 100,000±20,000 Btu/hr, while B-101 is around 14,000±6,000 Btu/hr. Strontium-90 levels in BL also impact the heat load in AY-102, since this tank was a primary receiver for B Plant non-complexed waste in the years 1981-8. We have assigned this B Plant waste as BL.

The strontium extraction process as applied to tank sludges required the sluicing and acid dissolution of Purex sludges in AR vault. The dissolution of these sludges did not proceed exactly as planned, in that the sedimentation rates of the washed sludges in tank AR-002 evidently varied widely, which resulted in the inadvertent transfer of AR solids from AR-002 to C-106. Furthermore, there were some acid insoluble solids that resulted which had to be neutralized and returned to the tank farms as well. These AR solids had very high levels of strontium, which resulted in high heat loads being placed into C-106, C-103, and A-106. We have defined AR waste (Defined Waste #31, App. B) as essentially a Purex sludge with all of the soluble components removed. We have estimated that about 166 kgal of AR sludge still remains distributed around A, AX, and C Farms.

Of the 981 kgal of P/PL sludge that was placed into the tanks, 99 kgal remains as P/PL sludge and 166 kgal remains as AR sludge, leaving 716 kgal of sludge processed as PAS in B Plant. However, we estimate that only 201 kgal of solids accumulated from BL and SRR waste additions in the tank farm and therefore can only account for roughly 28% of the solids that were processed in B Plant. At this time it is not clear whether the complexants present in SSR waste mitigated sludge formation for this waste or if we simply have an incomplete record of the transfers for this type of waste.

Compositions of B Plant waste streams are derived from Jungfleisch-84, as well as flowsheet information and total chemicals used reported in Allen-76. The solubility of Sr-90 has been increased in SRR and BL wastes (see Table 2 and App. E), which is consistent with the presence of complexants in these two waste streams. We have not increased the solubility of any other components in these waste streams although we expect that all other metal ions will have enhanced solubility in these wastes. In particular, iron and plutonium will be significantly more soluble in these waste supernatants.

—Purex to Thorium Campaigns

There were two thorium campaigns that ran in the Purex facility. The first ran in 1966 and involved a very low burnup (1.7 MWD/ton) of only 191 tons of fuel and generated 443 kgal of waste, all of which was placed into C-102. The second campaign ran in 1970 and involved 390 tons of fuel at a very high burnup of 1,606 MWD/ton, generated 912 kgal of waste, and was all placed into C-104. All of the Pu values in App. E for TH1 and TH2 wastes are actually for U-233, not Pu, while the U concentrations refer to Th-232, not U-238, the normal isotope of uranium. The details of these thorium campaigns are not clear enough to discern the amount of fission products present within each fuel. Therefore, the fission products are added in the same manner as with other HLW.

This leaves 0.9 MCi of Sr-90 into C-104, which increases this tanks heating by a factor of three or four. The predicted heat load based on this amount of Sr-90 is 31,000 Btu/hr as opposed to the predicted 8,000 Btu/hr based on tank temperatures. At this time, we do not understand this discrepancy.

The volume per cent solids for these thoria wastes is uncertain, since such small amounts were generated. Therefore, a nominal value of 5.8 vol% is assumed, which corresponds to a void fraction of 0.63 in the precipitated sludge layer.

Figure 14. *Total waste volumes for B Plant campaign.*

—Purex to Z Plant

Estimates for Z Plant wastes are complicated by the fact that the two receiver tanks, SY-102 and TX-118, were both evaporator feed tanks and therefore the Z waste was co-mingled with precipitated salt accumulations from recycle additions to these feed tanks. Some 1,910 kgal of Z waste was added to TX-118 from 1973-76 and during this time, TX-118 was an active feed tank for 242-T evaporator. Therefore, it is likely that any sludge from the Z waste would have been distributed around the TX Farm bottoms receivers.

From 1981-88, 1,656 kgal Z waste was added to SY-102. During that time, SY-102 was no longer an active feed tank for 242-S, but only a cross site supernatant transfer tank for to the 242-A evaporator feed tank, AW-102. Thus, the sludge that accumulated in SY-102 from Z waste largely still remains within this tank. However, a bottom remnant of accumulated salts still remains in SY-102 from the recycle additions during the 1976-80 242-S operation. The addition of this dilute Z waste evidently eroded or redissolved a substantial layer of this precipitated salt as well as mingling the Z sludge with that salt layer.

—Diatomaceous Earth

Diatomaceous earth is a highly effective and inexpensive absorbent and was used in six tanks at Hanford in an attempt to sequester residual liquids within those tanks. These tanks are BX-102, SX-113, U-104, TX-116, TX-117, and TY-106. We have used a reported[28] composition and density to establish the composition of DE layer, which is included within the TLM. This reference suggests that the DE is 0.651 kgal/ton (packed) and composed almost entirely of silica, (SiO_2), with some minor amounts of Al, Fe, and Ca. However, we have included two equivalents of NaOH in the composition, since our model assumes the form of silica in all tanks is waterglass, Na_2SiO_3. Note that the authors of the diatomaceous earth report also found that after two years, the form of silica within each of this tanks converted from SiO_2 to waterglass and some small amount of cancrinite, $NaAlSiO_4$.

—Cement

We have used a composition for Type 1 Portland cement[29] to represent the 63 tons of cement that was added to BY-105 in 1972. This cement was added in an attempt to sequester the residual fluids within BY-105 tank, which was a suspected leaker. Evidently, the cement did not set in the high-caustic, high-salt liquid and no further additions of cement were made to this or any other tank. Type 1 Portland cement is 46 wt% Ca, 10 wt% Si, with the balance being oxygen, Al, Fe, Ca, Mg, sulfate, and water. Since the basic constituent of cement is calcium silicate, ($CaSiO_3$), we are able to adapt it to our composition vectors. We assume that the cement was added with a specific volume of 0.13 kgal/ton, for a total amount of 8 kgal added to BY-105. As far as we know, this is the only addition of cement to any tank at Hanford.

—Other Wastes:

N	phosphate waste from N-Reactor decontamination
DW	various decontamination wastes, mainly from T Plant.
Salt Slurry	estimated from a chemical model by precipitation of soluble salts following concentration via evaporator. DSS derives from the supernatants of a variety of wastes following evaporation of water.
DSSF	supernatant feed for production of DSS.

[28] Buckingham, J. S.; Metz, W. P. "Characterization of the Effects of Diatomaceous Earth Additions to Hanford Tanks," WHC-MR-0302 (ARH-CD-222), Dec. 1974.

[29] Helmuth, R. A.; Miller, F. M.; O'Conner, T. R.; Greening, N.R. "Cement," Encyclopedia of Composite Materials and Components, M. Grayson, Ed., 1983, p. 273.

For certain evaporator campaigns, an average blend is derived, concentrated, and redistributed among the bottoms receivers as salt cake and supernatant. These wastes are:

BSltCk
T1SltCk
RSltCk
BYSltCk

Other blended concentrates are listed in the HDW rev. 2, but not used as an HDW in the inventory estimates. The SMM keeps track of all of later concentrates on a tank by tank basis. (These were used in HDW rev. 1.)

T2SltCk	
S1SltCk	
S2Sltslr	
A1SltCk	
A2Sltslr	
BP/Cplx	Complexant waste from B Plant 1981-8, assigned SRR.
BP/NCplx	non-complexant waste from B Plant 1981-8, assigned BL.

There are various other waste designations that appear in Hanford documentation. Here is a list and to what they have been assigned.

LW, HLO, BNW	various lab wastes, assigned to water
CSKW	don't know what this is yet, assigned to water
CARB	same as OWW55-62
EB	same as salt cakes
IX	folded into salt cakes, same as CSR
NCPL	not actually a waste type
TL	Terminal Liquor, same as DSS
HDRL	Handford Defense Residual Liquor, same as DSS
RESD	residual liquor, can be same as DSS
RIX	Redox ion exchange, same as CSR
RSN	same as supernatant from R, sent to CSR
SIX	S Plant ion exchange, same as RIX, asssigned to CSR
SRS	Sr Solids, same as AR solids

V. Methodology

—Radionuclide Inventories

The starting point in this derivation is the total tons of fuel that were processed for each campaign, along with the average exposures of those fuel elements in MWD/ton. This information derives from Jungfleisch-83. These two values provide a basis for calculating the plutonium that was created for each campaign, as well as the uranium, cesium-137, and strontium-90. Then, using the extraction efficiencies (or per cent plutonium and uranium extracted) for each waste stream shown in Table 3, the residual Pu and U are placed in each waste stream. The isotope of plutonium that is calculated is Pu-239. The amounts of Pu-240, Pu241, and Pu-242 that are present depend on the fuel type and exposure times and are not included within this model.

In particular, the Pu-240 specific activity at 0.218 Ci/g is much larger than that for Pu-239, 0.061 Ci/g. Thus, a 90/10% Pu-239/240 mixture would have a specific activity of 0.077 Ci/g. When the Pu-241 isotope is included, the situation is even more complicated since $T_{1/2}$ = 13.2 yrs. for this isotope. The Pu-241 decays to Am-241 and is the main source for Am-241 in the waste tanks.

The plutonium dissolution efficiency is similar to the extraction efficiency, but this residual Pu ends up in cladding waste. That is, the amounts of Pu that dissolved during decladding and that remained in the undissolved fines from the slug dissolver both contributed to the residual Pu in cladding waste. The values shown in Table 5 are those from a Redox flowsheet, and we assume for now that all cladding waste has the value.

The plutonium production is based on either 0.76 or 0.64 g Pu/MWD, depending on the campaign, while the Cs-137 and Sr-90 production are scaled upon the MWD's, 200 MEV/fission, standard fission yields corrected for burn up and other factors (5.8 and 6.2%, respectively), and either 0.88 and 0.76 and 0.74 and 0.64 depending on campaign of theoretical based on MWD. All Cs and Sr amounts are stated as produced and also as decayed to 1993q4, and are in MCi of Cs-137 and Sr-90 (1 MCi = 1 million Curies). To include daughters, convert to CsBa-137 by multiplying Cs-137 by 1.94, convert to SrY-90 by multiplying Sr-90 by two.

—Deriving Solids Volume Per Cent

It is necessary to derive or assign a characteristic solids or sludge volume per cent for each waste type. This is done by one of two means. First, we attempt to use the fill and solids volume histories of various tanks to derive a characteristic solids vol% for a given waste type. Following the reported solids volumes for those tanks as a function of total primary waste added, then, gives a vol% solids in a straightforward manner as shown in Tables 6-11.

For waste types with insufficient solids information, we begin the TLM analysis with a nominal vol% solids for those waste types and at the end of the analysis, produce a total solids for those waste types which is usually distributed among several tanks. This total solids value then forms the basis of an adjusted solids vol%, and we repeat the analysis until the values converge producing our best estimate for the solids vol%. The wastes AR, HS, B, BL, and SRR all have very small solids remnants distributed among a handful of tanks. The resultant solids vol% has a greater uncertainty for these waste types.

The solids vol% is a very important parameter, since it determines the sludge void fraction and therefore the amount of interstitial liquid within each waste sludge. It also bounds the amount of precipitated solids, since it is very unlikely that a sludge will have a void fraction any less than about 0.30-0.40.

Certain wastes, DW, N, OWW1, OWW2, OWW3, and CSR have no solids by definition. For these wastes, no solids are allowed to precipitate in these waste streams and all their material is carried by their supernatants into concentrate receivers as determined by the SMM.

—Precipitation of Solids

The solids that precipitate in each waste is set by adjusting the fraction precipitated parameter so that the solubility of that component falls within the correct range. That range is set for each component by an analysis of data from supernatant samples from the tank farm and evaporator operations. By plotting the concentrations of species that have been measured for tank supernatants, we obtain a limiting solubility[30] of a species as well as its range of solubility. These values provide the method by which we partition the solids in the waste into supernatant and sludge fractions. However, the concentration of those solids in the sludge layer is dependent on the solids volume per cent for that waste as well. The concentration of each component in the sludge depends on a combination of three factors—concentration of precipitated solids, concentration of supernatant, and volume per cent solids.

Aluminum is a special case and is precipitated in two stages. We assume that during neutralization, a set fraction of the aluminum precipitates as aluminum oxy/hydroxide before the soluble aluminum ends up as $Al(OH)_4^-$ in solution. Therefore, the fraction of aluminum precipitated as oxide is adjusted in our model, both to produce reasonable void fractions (0.6 to 0.7) in the precipitate and to correspond to sludge analyses for those waste types. The

---

[30] Agnew, S. F. and Watkin, J. G. "Estimation of Limiting Solubilities for Ionic Species in Hanford Waste Tank Supernates," LA-UR-94-3590, October 1994.

aluminum remains in solution as aluminate and only precipitates when the aluminate solubility limit is reached (see Table 13). This occurs following concentration of waste as a result of evaporator operation.

Jungfleisch-84 referenced a report by Barney[31] that said below 1.6 M hydroxide, $Al(OH)_3$ precipitates, while above 1.6 M hydroxide, sodium aluminate precipitates. Later work reported[32] that, for the range 2.0-6.5 M hydroxide, the aluminate solubility *decreased* as the square of the hydroxide molarity (with no correction for activity). Aluminate solubility in this report ranged from a high of 2.3 M with 2 M hydroxide to a low of ~0.9 M with 6 M hydroxide. This suggests that while $Al(OH)_3$ precipitates at neutral pH, as hydroxide increases, aluminate solubility peaks at hydroxide concentrations between 1.6 and 2.0 M. At its maximum, then, aluminate concentration lies between 2.0 and 2.5 M. But note that as aluminate precipitates, one equivalent of sodium hydroxide also precipitates. Therefore, as the solution is concentrated and the aluminate solubility limit is reached, the hydroxide and sodium concentrations are buffered at that concentration by the aluminate.

These rules for aluminum are necessary since we are often lacking the exact details associated with the waste neutralization process for each of the waste types. Depending on the rate of addition, the stirring time, the excess hydroxide, and so on, very different fractions of the aluminum will precipitate as oxyhydroxides. The wastes that are most affected by this rule are 1C, R, CWR, and CWP.

Once the solid volume per cent is derived, we use it along with the precipitated solids to calculate the void fraction for a given sludge. The composition of each sludge, then, is a combination of precipitated solids and interstitial liquid, while the composition of the supernatant is simply what remains in solution. The supernatant and the interstitial liquid are one and the same at the time of precipitation. After the sludge is placed into a tank, we assume that the interstitial liquid remembers what it was, even if the supernatant layer has been altered by later waste additions or removals.

The solubility limit for Sr-90 in SRR was increased from 0.034 to 0.091 Ci/L. This was done because analyses of CC waste tanks clearly show greater solubility for a number of cations, including Sr-90. Such an increase in Sr-90 solubility is also consistent with the heat distribution in tanks with SRR sludge.

—Calculating Density

An equation derived from previous work to calculate the density of the supernatant is based on fitting the densities of a series of solutions reported by Herting and Reynolds[33] with a minimal parameter set. This equation is:

$$\text{density} = 1+0.038 * [Na^+] + 0.07 * [Al(OH)_4^-] - 0.015 * [\text{ free } OH^-] \;\; g / cm^3.$$

All concentrations are in mol/L and are uncorrected for activity. This expression calculates density within ±0.2 g/cm^3 for over 400 analytical results.

An alternative calculation for density that is much more accurate (±0.01 g/cm^3) is as follows (all concentrations in mol/L):

$$\text{density } (g/cm^3) = 1+ 0.0206 [Na^+] - 9.96e-4 [Na^+]^2$$

---

[31] Barney. G. S. "Vapor-Liquid Solids Phase Equilibrium of Radioactive Sodium Salt Waste at Hanford," ARH-ST-133, January 1976.

[32] Reynolds, D. A.; Herting, D. L. "Solubilities of Sodium Nitrate, Sodium Nitrite, and Sodium Aluminate in Simulated Nuclear Waste," RHO-RE-ST-14P, May 1984.

[33] Reynolds, D. A.; Herting, D. L. "Solubilities of Sodium Nitrate, Sodium Nitrite, and Sodium Aluminate in Simulated Nuclear Waste," RHO-RE-ST-14, May 1984.

$$+ 0.0794 [Al] - 0.0200 [Al]^2$$
$$+ 8.52e-4 [OH^-] + 0.00404 [OH^-]^2$$
$$+ 0.0394 [NO_3^-] + 2e-4 [NO_3^-]^2$$
$$+ 0.074 [NO_2^-] - 0.0146 [NO_2^-]^2$$

However, this expression comes with ten parameters as opposed to just three for the first expression. We will use the simpler expression for this first version of the Defined Wastes.

The density of the sludge phase is calculated using that of the interstitial liquid, its fraction, and each of the solid phases with their corresponding densities. The void fraction is calculated by summing the volumes of all of the solids that have precipitated and subtracting that from the solids volume per cent parameter for that waste type. Generally, void fractions in the range 0.2 to 0.8 are possible for sludges, with the range 0.4-0.7 most likely. Void fractions below this range are highly suspect, while those above the range imply an increasingly flocculant precipitate.

—Ion balance calculation

Ion balance is calculated for each HDW sludge and supernatant. The result is shown in the row labeled "balance." The ion balance for the sludge layers is calculated as:

sludge ion balance =

Na + Al*3 + Fe*3 + Cr*3 + Bi*3 + La*3 + Hg*2 + Zr*4 + Pb*2 + Ni*2 + Sr*2 + Mn*4 + Ca*2 + K + U*6
-
[OH(total)+NO_3+NO_2+CO_3*2+PO_4*3+SO_4*2+SiO_3*2+F+Cl+$C_6H_5O_7$*3+EDTA*4+HEDTA*3+glycolate+acetate+oxalate*2+$Fe(CN)_6$*4]

Note in particular that silicon is always counted as silicate, SiO_3^{2-}, zirconium is counted at the free 4+ ion, not zirconyl, ZrO^{2-}, aluminum is counted as the 3+ cation, not as aluminate, and uranium is counted as 6+, not uranyl, UO_2^{2+}. Therefore, the total hydroxide reported within the sludge includes hydroxides bound to all species except Si. The free hydroxide value reported for sludges is the hydroxide concentration associated with only the interstitial liquid.

The ion balance for the supernatant is calculated slightly differently since the hydroxide value in the supernatant does not include the hydroxide ion complexed to the aluminum. The supernatant ion balance is calculated as:

supernatant ion balance =

Na - Al + Fe*3 + Cr*3 + Bi*3 + La*3 + Hg*2 + Zr*4 + Pb*2 +Ni*2 + Sr*2 +Mn*4 + Ca*2 +K + U*6
-
[OH + NO3 + NO2 + CO3*2 + PO4*3 + SO4*2+SiO3*2+ F + Cl + $C_6H_5O_7$*3 + EDTA*4 + HEDTA*3 + glycolate + acetate + oxalate*2]

Therefore, the hydroxide reported for the supernatants does not include either that bound to the aluminate nor that bound to silicate. All other ligated hydroxides are included within the supernatant hydroxide value.

—TOC and wt% H_2O

These values are calculated in a straightforward manner. Note that the wt% water for a solution can be derived from its density and the total grams of dissolved species. The wt% of the sludge that of the solution as well as the various solid phases have specific states of hydration for the various solid phases that are defined within the speciation. The equation for the solution is:

$$\text{wt\% } H_2O = (1 - \text{grams dissolved species / grams per L solution}) * 100$$

while that of the solids is that of the interstitial liquid plus the waters of hydration of the solids. Note that silicate and aluminate will consume or produce water depending on their speciation. For example,

$$Al(OH)_4^- \longleftrightarrow AlO_2^- + 2\ H_2O$$

$$SiO_3^{2-} + H_2O \longleftrightarrow SiO_2(OH)_2^{2-}.$$

The two equivalents of water for $Al(OH)_4^-$ are counted in the supernatant water wt%, since the molecular weight used is for AlO_2^-. Likewise, one half equivalent of water from dissolved hydroxide is included, since

$$NaOH \longleftrightarrow 1/2\ Na_2O + 1/2\ H_2O.$$

For the precipitated solids, the waters of hydration that are included for the sludge wt% water are those shown in Table 12. The sludge wt% water comprises both the waters of hydration of precipitated solids and the water from the interstitial liquid, which is that calculated for the supernatant.

The TOC is calculated using the equivalent of organic carbon present in each molecule as shown in Table 14. Also shown is a list of tentative ratios of measured to predicted TOC's to facilitate comparison of HDW calculated TOC's with measured values. For example, only roughly one half of the organic carbon that is predicted in ferrocyanide actually shows up in a measured TOC.

—Evaporator Operations

There have been a variety of evaporator operations at Hanford, as shown in Table 15. These campaigns involved various facilities and tanks as follows:

1) separate in-farm evaporators (242-B, 242-T, 242-S, or 242-A);
2) use of either B or Redox Plant evaporators for tank supernatants;
3) in-tank heaters as in BY Farm;
4) boiling waste self-concentration in S, SX, A, and AX Farms.

Each of these operations involved heating the waste and accumulating and separately disposing the condensate. The concentrate (or bottoms) are then transferred to various waste tanks (bottoms tanks) and the salts within the concentrate are allowed to accumulate in those tanks (as salt cake).

We have adopted a strategy with the 242-T (1950's), 242-B, Redox self-concentrates, and BY Farm ITS campaigns wherein all waste input to each of these campaigns is blended to produce one salt cake and one supernatant for each campaign. The HDW blends for each of these campaigns is shown in App. E. These definitions allow for later reconcentration of previously concentrated supernatants from each campaign.

For all of the other evaporator campaigns, we have used the SMM to allow the prediction of a concentrated blend of HDW supernatants for each tank. However, we have nevertheless calculated the blended feeds for other evaporator campaigns as shown in App. E.

In principle, there are two states of hydration for each of the salt cakes—wet (i.e. as created) and in various stages of hydration. In fact, Allen reported two sets of values for salt cakes from 242-S (S1SltCk) bottoms receivers—one set for low water contents (3-5 wt%) and a second set for larger water contents (~15-30 wt%). However, Allen did not report density measurements for any of his samples, and therefore we do not know the solid fraction of any of those samples. All salt cakes reported here are kept hydrated as formed.

242-B and First 242-T

These evaporators both began in 1951 with 242-B running through 1953, and 242-T running through 1956. They were primarily used to concentrate 1C and UR waste supernatants. Anderson-91 reported 242-B reduced 6,027 to 1,151 kgal (80.9 vol% reduction), while 242-T, in two passes, reduced 8,638 to 1,546 kgal (82.1 vol% reduction).

The WSTRS transaction records, on the other hand, show different total numbers. WSTRS shows that 242-B reduced 15,089 to 7,240 kgal (52.0 vol% reduction) and that 242-T reduced 18,191 to 8,330 kgal (54.2 vol% reduction). Anderson-91 actually reports the total waste volume reduction for 242-B as 7,172 kgal, and that for 242-T as 9,181 kgal, or a total volume reduction of 16,353 kgal, while our volume reduction is 17,710 kgal for this same period. Our main difference with Anderson-91 is with the total volume processed. Note that our estimates are not broken down by 1C, 2C, or UR supernatants. Our estimate in fact comprise all three. We have found that some 786 kgal salt cake was formed in B Farm as a result of 242-B operation, or 6.1 vol% of the original volume, and 764 kgal was formed for 242-T.

S and SX Farms self-concentration

As shown in Table 15, tanks in S and SX Farms that had been filled with waste from the Redox plant were allowed to boil and self-concentrate. We have found that there a number of tanks in which the salts from this concentration accumulated and we have termed that waste RSltCk, Redox Salt Cake. These sixteen tanks are: S-101, -104, -107, -110, and SX-101, -102, -103, -104, -107, -108, -109, -110, -111, -112, -114, -115. The composition of RSltCk is a blend of all of the supernatants that were fed into any of these tanks during the years noted in Table 15. Thus, this blend of the concentrate will actually be distributed among all of these tanks.

A and AX Farms self-concentration

Corresponding to the self-boiling tanks in S and SX Farms for Redox wastes, there were a series of self-boiling tanks in A and AX Farms as well. However, no salt precipitates formed as a result of their concentration and so there are no salt cake remnants formed. However, the supernatants did concentrate appreciably. Then, the supernatants were recovered; their Cs-137 extracted; and the supernatants returned to the waste tanks, where they were then concentrated. The self-concentrating tanks are: A-101, -102, -103, -104, -105, while the remaining tanks in A and AX, although equipped for boiling waste, never actually boiled.

In Tank Solidification campaign in BY Farm

In 1965, a prototype heater was placed into BY-101 and the demonstration of evaporation driven by in tank heaters was performed. In 1966, a second heater was placed into BY-102 with tank BY-103 acting as a primary feed tank. The strategy of this campaign was to circulate the feed to the heated tank and then from there transferred to other tanks in BY Farm. As the concentrate cooled, the idea was to solidify an entire series of waste tanks by continuously recycling the concentrate around this loop.

Finally, in 1966 a third heater was placed into BY-112 with BY-109 acting as primary feed. During this third heater's operation, the heater in BY-102 was used as a cooler instead and hot concentrate from BY-112 was routed then to BY-102. The ITS campaign ended in 1976 and resulted in about 38 million gallons of volume reduction and the formation of 3,887 kgal of salt cake, BYSltCk.

Acid additions during evaporator runs

From 1977 through 1980, a series of acid/permanganate additions were performed during 242-S evaporator runs which were designated NIT (neutralization in transfer) by Jungfleisch or PNF (partial neutralization of feed) by Anderson. Evidently, this campaign was an attempt to precipitate more sodium as the nitrate salt and thereby enhance the solidification of the waste within the bottoms receivers. For each NIT transaction, Jungfleisch started with that volume of the receiving tank, adjusted the hydroxide of that volume to a maximum of 0.9 M by adding nitric acid, and finally increased the concentration of $NaNO_3$ by 0.3 M and $KMnO_4$ by 1.3e-3 M. This volume was then added back to the tank and mixed with the waste already in the tank. This model was meant to simulate the actual NIT additions that occurred continuously during an evaporator run. For example, WSTRS reports that 52 kgal of NIT was added to SY-102 during this campaign (see Table 16) and NIT was also added to S-102, S-103, SX-106, U-102, U-103, U-107, U-111.

These transactions also added to each waste stream a variable amount of nitric acid that depended on the tank waste composition at the time of the addition. In the HDW, we have assumed that the composition of the NIT was on average 0.5 M HNO_3, as well as the other two components, 0.3 M $NaNO_3$ and 0.0013 M $KMnO_4$. It is not clear how much nitric acid was actually added during each of these runs nor is it clear that the hydroxide that is bound to the aluminate ion is included in this neutralization scheme.

—Resolution of Unknown Transactions

Transactions were added to WSTRS to resolve the many unknown transactions for each quarter according to a set of rules. Therefore, we are using an updated WSTRS that is known as Rev. 2 for the basis of this report. This unknown transaction resolution was completed for all unknowns larger than 50 kgal, although many smaller transaction unknowns were accommodated as well.

Evaporator feed and bottoms receivers:

During an evaporator campaign, unknown waste transfers at the end of each quarter are resolved by sending or receiving wastes to or from an evaporator feed tank for tanks identified as either bottoms receivers or feed tanks for those campaigns.

Self-concentrating tanks:

Certain tanks in S, SX, A, and AX Farms were allowed to self- concentrate. Any losses or additions to these tanks are assigned to condensate or water, respectively.

Sluicing receivers:

For tanks associated with a sluicing campaign (either UR or SRR), unknown transactions are resolved by either sending to or receiving from the sluicing staging tank for that campaign. Unknown losses of supernatant from any tank during sluicing are directed to the sluicing staging tank.

Salt-well pumping and stabilization:

If an unknown transaction occurs during salt well pumping stabilization of a tank, then the transaction is resolved by sending waste to the active salt well receiver at that time.

Historical use of tank:

If none these above rules applies, then the historical use of the tank is used to assign the transaction. For example, C-105 was used as a supernatant feed for the CSR campaign and feed ~1,500 kgal per quarter for several years. However, we have one quarter (1971q2) where C-105 loses 1,748 kgal without an assignment. We have therefore assigned it to CSR feed.

There are volume reductions among the S and SX Farm tanks in the fifties and early sixties. We attribute these losses to the Redox waste self-concentrating tanks and these tanks also accumulated solids as they concentrated, which we assign as Redox salt cake. Likewise, the Purex waste tanks in A and AX Farms were self-concentrating, but no salt cake formed from this self-concentration. Volume losses for such tanks are assigned as condensate transactions out of the tank and additions are assigned as water in.

The two Purex cladding waste (CWP) cascades, B-103 and B-109 had large unknown transfers in 1963q4. These were resolved by transferring supernatants to A-102, which was the staging tank for A Farm sluicing as well as a feed for the self-boiling tanks in A and AX Farms. Excess volume added to A-102 amounts to over 2,000 kgal in '63q4, which is assumed to have been associated with the sluicing required for initial feed to HS or SSW (Hot or Strontium Semiworks), and eventually ended up blended into the A/AX self-boiling tanks. Likewise, other later excess losses that accumulated in A-102 are assumed to have been used as feed for the self-boiling tanks in A/AX Farms.

Sluicing of A and AX Farms resulted in many unrecorded transactions for these tanks during that period. As shown in Table 15, we have resolved all large transactions by creating transactions between tanks and the sluicing receiver in A and AX Farms as indicated in Table 15. The sluicing receivers evolved from A-102, A-106, to AX-103 over the course of the campaign.

For each of the evaporator campaigns, we have identified the feed and bottoms receivers. All unknown transactions for the feed and bottoms receivers are sent to or received from the evaporator feed tank. This allows us to resolve all evaporator campaign transactions and to therefore track the waste compositions as a function of time.

Any unknown transactions that cannot be resolved by either sluicing or evaporator campaigns, we apply a historical use criterion. That is, if there was a process that sent or received waste to or from a tank in previous and subsequent quarters, we used this to assign the unknown transaction. For example, C-105 was the source tank for feed for the cesium recovery operation in B Plant. In 1971q2, 1,748 kgal of supernatant disappeared from C-105 in an unrecorded transaction. Since similar amounts of supernatant were being sent to cesium recovery from C-105 every previous quarter and no such transaction was listed for this quarter, we assign this transaction to a transfer of supernatant to CSR.

Cross-site transfer tanks S-107 to/from BX-104 and BX-105 were used to transfer wastes back and forth to and from west and east areas prior to 1981. We assume this linkage was used for most cross site transactions between East and West areas.

—Radiolysis of Nitrate to Nitrite to Ammonia

A previous report[34] has shown a yield of 4.5 molecules of nitrite in 2 M nitrate solutions per 100 eV of absorbed dose (G = 4.5). If we express this in terms of cesium and/or strontium radiolysis, a 1 Ci/L (or 3.7e10 Bq/L) solution of these species would correspond to 4.5 molecules nitrite / 100 eV / (2 M nitrate) x 1.1e6 eV / decay x 1 Ci/L x 3.7e10 decays / sec / Ci x 3.16e7 secs / year / 6.023e23 molecules / mol which is

$$= 0.048 \text{ mol } NO_2^-/\text{mol } NO_3^-/\text{Ci/yr}.$$

For a waste tank at 0.5 Ci/L and 2.5 M nitrate, this would amount to 0.06 M nitrite produced per year. For SY-101, this suggests that from 1981 to present, there has been ~0.8 M nitrite created by radiolysis. Of course, the decay of the radionuclides must also be taken into account for any long term radiolysis.

For the further issue of the radiolytic production of ammonia from the radiolysis of nitrite, we have not been able to find a G value for ammonia production from nitrite. If we assume, however, that there is some channel for which nitrite undergoes further radiolysis, i.e.

$$NO_3^- \xrightarrow{\text{rad.}} NO_2^- \xrightarrow{\text{rad.}} \longrightarrow \longrightarrow \longrightarrow NH_3.$$

[34] Hyder, M. L. "The Radiolysis of Aqueous Nitrate Solutions," J. Phys. Chem., 69, 1858-65, 1965.

Ammonia production for SY-101 has been reported[35] to be 2.4 mol NH_3/year, which suggests that the actual ammonia production from radiolysis of nitrite is only 7% that of the radiolysis of nitrate to nitrite. We further assume that ammonia production for SY-101 exceeds that of radiolysis alone by factor of three, which is the amount of hydrogen gas production over that of radiolysis alone (because of the presence of complexant). Therefore, we derive a value of

$$1.2e\text{-}3 \text{ mol } NH_3/\text{mol } NO_2^-/\text{Ci/yr.}$$

Production of ammonia from nitrite is assumed to proceed as

$$NO_2^- + 2H_2O \longrightarrow NH_3 + OH^- + 3/2\ O_2.$$

Therefore, for each mol ammonia produced, two mols water are consumed and one mol of hydroxide and three halves mols oxygen are produced. Ammonia production is accumulated in each waste as NH_3 and no solubility limit is imposed. Therefore, all of the ammonia that has been produced for the entire history of a tank's waste remains within that waste within our model.

To account for decay of the Cs-137 and Sr-90, we have used the expression

$$= (\text{Cs-137} + \text{Sr-90})^*\ t_{1/2}/\text{LN}(2)^*(\text{EXP}(1994\text{-camp.yr.})^*\text{LN}(2)/t_{1/2})\text{-}1)$$

and have used an average half life of 29.15 years. This expression provides the total dose of a waste in Ci.-yr.'s when the Cs-137 and Sr-90 are expressed in 1994 curies. This does not account for any other radionuclide source terms besides Cs-137, Sr-90, and their daughters. For example, we have not accounted for any of the short lived fission products in aging waste.

—Degradation of Organic

Within the HDW model, there is no degradation of organic residues. However, there is ample indication that the organic residues have degraded with time. Presumably, the degradation of organic complexants proceeds at different rates for the different organics and their decomposition products and many of these rates are uncertain. There has been much suggestion that the organics that were passed through the 242-T evaporator were substantially degraded. This evaporator operated at 130°C and the residence times were on the order of 13 hours.

A scheme that uses a minimum set of "representative reactions" to represent the degradation of organics is shown below. Note that the reactions of this scheme do not need to be "real," but only representative of the overall system. Such a scheme is more amenable to using partial information and naturally allows the conservation of mass, once the reactions are balanced. Such a minimum set might be, for example, the following (which are not balanced):

$\text{citrate}^- + 2\ H_2O \longrightarrow 3\ \text{glycolate}^-$

$\text{acetate}^- + NO_3^- \longrightarrow \text{glycolate}^- + NO_2^-$

$\text{glycolate}^- + 2\ NO_3^- + OH^- \longrightarrow \text{oxalate}^{2-} + 2\ NO_2^- + H_2 + H_2O$

$\text{glycolate}^- + 2\ NO_2^- \longrightarrow \text{oxalate}^{2-} + N_2O + H_2 + OH^-$

$\text{oxalate}^{2-} + NO_3^- + 2\ OH^- \longrightarrow 2\ CO_3^{2-} + NO_2^- + H_2O$

---

[35] Norton, J. D. and Pederson, L.R. "Ammonia in Simulated Hanford Double-Shell Tank Wastes: Solubility and Effects on Surface Tension," PNL-10173, Sept. 1994.

$EDTA^{4-} + H_2O + 2\ NO_3^- + OH^- \longrightarrow NTA^{3-} + 2\ glycolate^- + NH_3 + 2\ NO_2^-$

$HEDTA^{3-} + 3\ NO_3^- + 2\ OH^- \longrightarrow NTA^{3-} + 2\ glycolate^- + NH_3 + 3\ NO_2^-$

$NTA^{3-} + 3H_2O \longrightarrow 3\ glycolate^- + NH_3$

$TBP \longrightarrow H_3PO_4$ + butanol

butanol —> evaporates

NPH —> evaporates

CCl_4 —> evaporates

hexone —> evaporates

$FeCN \longrightarrow Fe^{3+} + 6CN^-$

$CN^- + NO_3^- \longrightarrow CNO^- + NO_2^-$

$CNO^- + H_2O + OH^- \longrightarrow CO_3^{2-} + H_2N\text{-}OH$

$H_2N\text{-}OH + H_2 \longrightarrow NH_3 + H_2O$

$H_2N\text{-}OH + NO_2^- \longrightarrow N_2O + OH^- + H_2O$

$NH_3 + NO_3^- \longrightarrow N_2O + OH^- + H_2O$

$N_2O + 2/3\ NH_3 \longrightarrow 4/3\ N_2 + H_2O$

$N_2O + H_2 \longrightarrow N_2 + H_2O$

$C_{12}H_{22}O_{11}$(sucrose) + $24\ HNO_3 \longrightarrow 12\ CO_2 + 11\ H_2O + 24\ HNO_2$

$C_{12}H_{22}O_{11}$(sucrose) + $24\ HNO_2 \longrightarrow 12\ CO_2 + 23\ H_2O + 12\ N_2O$

$C_{12}H_{22}O_{11}$(sucrose) + $24\ N_2O \longrightarrow 12\ CO_2 + 11\ H_2O + 24\ N_2$

—Corrosion source term for Fe, Cr, Ni

We have found that the iron concentrations in Hanford sludges are much higher than can be accounted for with the iron that was added during processing. Therefore, we have added an additional iron source that we attribute to corrosion of process vessels and lines primarily within a plant. In order to add this source term, we needed to derive a corrosion source term.

A previous report[36] has suggested that about 1,200 g of iron are produce per ton of fuel processed, with about one half of this coming from iron in the fuel element itself while the other half derives largely from corrosion of various process equipment that has been in contact with the solution. Over the history of Hanford, approximately 108,000 tons of fuel have been processed. This would suggest that about 2.3 Mmol of Fe would be due to this source.

[36]Van der Cook, R. E. and Walser, R. L. "Purex Alternate Reductant Study," ARH-1649, June 1970.

We have found, on the other hand, that the "extra" source of iron is much larger than this. In fact, we estimate that 10-15 Mmol of iron (which is about as much as was added during processing) must have come from various pieces of equipment that were used in processing and transporting waste. This is equivalent to 0.04 M iron in the 390,000 kgal of waste that has been generated at Hanford totaling 341 metric tons of iron.

With the iron fixed at 0.04 M, we can estimate both chromium and nickel assuming that the source term is stainless steel 304. We have used Cr = 0.2 x Fe while Ni = 0.1 x Fe, which is close to reported ranges for this alloy.[37]

We have reduced the corrosion source term for the $BiPO_4$ and all decladding processes to 40% of this value. This value was chosen such that analytical results for these classes of wastes agreed with predictions generated by the model and also because we expect that these processes would have produced much less corrosion because of the involved lower acid or caustic processing.

—Silicate source terms

There were many different sources of silicate in waste streams. We have found, though, that a particular source that has been often overlooked is the silicate that derived from silicone anti-foaming agents used in the sugar denitration of the Purex acid waste prior to its neutralization and disposal to tanks.

—Calcium impurity source term

The primary source of calcium in the waste is another mystery at this time. We estimate that there is some 28 Mmol of calcium in Hanford wastes (based on extrapolation of analytical data on sludges to all tanks), but have only accounted for 4 Mmol by flowsheet additions. Thus, we do not have a source term for 24 Mmol of calcium. In order to provide an estimate for calcium, we have considered three additional sources.

First, the calcium may have derived from the fuel elements themselves. This amount of calcium in 108,000 tons of fuel would amount to 1 wt% Ca, which is not listed at all as a component of N-Reactor fuel.[38] Calcium would be a potential component of the silica binder that is used in the fuel elements, but we have not found any reference to calcium in the fuel.

A second source of calcium would be that added as needed during operation to control the Sr-90 in solution. Although such additions are not documented in any of the flowsheets that we have examined, there are anecdotal references to calcium additions to precipitate as a phosphate or carbonate, enhancing Sr-90 decontamination of solutions.

Another possible source for the calcium is a larger than expected amount of Ca in the sodium hydroxide that was used to neutralize the waste stream. There were approximately 1,927 Mmol NaOH added to the various waste streams. We have assumed that it was added as a 50 wt% caustic solution at 30 ppm Ca (0.0012 M), which only amounts to a fraction of a Mmol Ca. If, on the other hand, we assumed that all of the Ca came from NaOH solution, the solution would have been 5 wt% Ca. This seems like an unreasonably large amount of Ca in the neutralization stream.

Crushed limestone ($CaCO_3$) rock was often used in holding tanks prior to release of condensate and other water sources to cribs and trenches. However, we have no indication that any of this limestone ended up in waste tanks. Twenty Mmol of $CaCO_3$ would amount to 2,000 metric tons of limestone.

---

[37] CRC Handbook of Chemistry and Physics, 58th ed., 1977-78.

[38] Chapter five "Fuel Element Dissolution and Waste Treatment Technology," WHC-SP-0479.

A final calcium source would be that in normal water. The level of calcium in ground water at Hanford is 20-40 ppm (that of the Columbia River is ~30 ppm) which is equivalent to 7.5e-4 M Ca. The process solutions used in plant operation were normally deionized, but there were undoubtedly many flush and cleaning water additions that used simple tap water. The volume of waste at Hanford excluding reprocessing is 433,000 kgal (see Table 1). We estimate that there is on the order of 24 Mmol Ca in the Hanford waste tanks, which amounts to 0.015 M Ca (~600 ppm). Therefore, the amount of calcium is greater than a factor of twenty greater than we can explain based on calcium in hard water. Combined with the fact that the process solutions, which constitute a large fraction of the total waste produced, were deionized is inconsistent with hard water as being the calcium source.

We will nevertheless assume for the purposes of our estimates that the calcium source was distributed across most all process solutions and that it amounted to 0.015 M Ca in these original wastes. We suggest that the most probable source for this calcium was rinse and flush water, with added calcium for Sr-90 decontamination being a second factor.

—Chloride and potassium impurity source terms

The primary source of chloride and potassium in the waste is from the added sodium hydroxide. The reported chloride amounts are added in each waste stream according to the reported ppm of Cl^- in the NaOH feed. Chloride impurities in NaOH are reported to be 1 wt%. This amounts to a chloride inventory of 28 Mmol, as opposed to the chloride in process additions—around 1 Mmol Cl^- added during the Uranium Recovery campaign.

We use a value of potassium in NaOH of around 0.5 wt%, which results in a potassium inventory of 15 Mmols for all tanks.

VI. Calculating Tank Inventories from Defined Wastes Compositions

Final tank inventory estimates are then derived by using amounts for each of the HDW sludge and supernatants present in each tank. These amounts are derived separately for the tank sludges and supernatants. The sludge layers are assigned by the Tank Layer Model (TLM), where the total volumes of waste types and corresponding solids volume per cent for each of those wastes are used. This results in layers of sludges that are expressed in kgal and have a chronology or order within the tank. However, the lateral heterogeneity present in many tanks precludes interpreting these layers as necessarily flat and level. For the supernatants and their concentrates, the Supernatant Mixing Model (SMM) provides a composition in terms of a combination of HDW supernatants. Unlike the TLM, though, there is no chronology to the HDW components since the SMM assumes ideal mixing within each tank following a transaction.

These derived compositions can then be compared to analytical results from sampling events, taking into account the unsampled dish volume, as well as any segment recoveries less than 100%—merely weight that particular layer with a lower factor. Lateral inhomogeneities, however, are still a big problem when a comparison between this historical fill data and measured data is performed.

Table 1.
Overview of Hanford Waste Volumes*

		kgal	kgal
total waste generated 1944-80			496,200
	less MW sluiced	35,800	
	less P sludge sluiced	900	
	less P/R/B supernatants to B Plant	26,500	
net waste after reprocessing			433,000
	less 2C and 224 to crib	30,000	
	less 1C to crib	12,400	
	less 1C/UR/FeCN scavenged to crib	43,300	
net waste after cribbing			347,300
	less water added and evaporated	74,500	
	less condensate (recorded) water to crib	43,900	
	less further evaporator reduction	182,900	
net waste remaining from 1944-80			46,000
	sludge	14,000	
	salt cake	19,000	
	other liquids	13,000	
total waste generated 1981-88			30,000
	less volume evaporated	15,000	
net waste remaining			15,000
	sludge from '83-88	1,100	
	other liquids from '83-88	13,900	
	waste from 1944-80	46,000	
total waste 1-1-94			61,000
	SST	36,000	
	DST	25,000	

**As of January 1994.*

Table 2. Partitioning following CSR and SRR.

	MCi* Cs-137	MCi* Sr-90	MCi* Sr-90 to supernatant
original Purex sludge		43	
original tank supernatant to CSR	49		
original Purex acid waste (HAW)	21	18	
total processed	70	61	
BL sludge remnant		1.8	1.9
SRR sludge remnant	0.4	2.6	1.3
AR sludge remnant	0.1	7.5	0.7
P sludge remnant (not sluiced)		4.3	4.7
HS sludge remnant		0.8	0.9
B sludge remnant	5	2.7	1.3
CSR sludge remnant	4.3		
unaccounted		4.3	
total in capsules	63	26.2	

**All values decayed to January 1994 and do not include daughters.*

Table 3. Plutonium Extraction Efficiencies.

Waste	Pu extraction efficiency	U extraction efficiency	Source
MW	99.0		Anderson
1C	99.0		Anderson
2C	99.0		Anderson
224	??	—	
UR	—		
Redox, '52-'58	99.6	99.6	assumed
Redox, '59-'67	99.6	99.6	1965 flowsheet
Purex, '57-'62	99.6	99.6	assumed
Purex, '63-'72	99.6	99.6	assumed
Z	??	—	

Table 4. Radionuclide* Production Totals.

Nuclide	MW1	MW2	R1, R2 P1, P2	P2'	TH	P3	totals
Cs-137	1.2 MCi	1.8 MCi	71 MCi	21 MCi	1.8 MCi	12 MCi	109
Sr-90	0.9 MCi	1.4 MCi	58 MCi	18 MCi	1.5 MCi	10 MCi	90
Tc-99	0.4 kCi	0.5 kCi	18 kCi	4.5 kCi	0.2 kCi	1.7 kCi	25 Ci‡
I-129	0.9 Ci	1.1 Ci	37 Ci	9.1 Ci	0.4 Ci	3.5 Ci	52 Ci‡
Co-60							13,000 Ci‡
U-233					464 kg		464 kg
Np-237							64 kg‡ (93 kg‡‡)
Pu-239	902 kg	1,156 kg	39,541 kg	9,717 kg		3,702 kg	55,018 kg
Pu-240							
Pu-241							
residual Pu-239	31 kg	45 kg	342 kg	201 kg		52 kg	671 kg
residual Pu-240							
cooling time	0.5 yrs.	0.5 yrs.	0.5 yrs.	0.5 yrs.	0.5 yrs.	~2.0 yrs.	
residual Am-241			~16 kg			~14 kg	30 kg‡ (13 kg‡‡)
short tons fuel	5,115	3,465	78,711	16,449	581	4,302	108,623
avg. MWD/ton	232	439	661	923	1,606	1,163	

**All values decayed to January 1994 and do not include daughters.*

‡Values from IDB, ref. 24.

‡‡Values from 1981 TRAC output, ref. 2.

Table 5. Plutonium (fuel slug) Loss During Decladding.

Waste	Pu % loss	source
BiPO4-CW	0.4	assumed
CWR	0.4	1965 flowsheet
CWP	0.4	assumed
CWZr1 and CWZr2	1.5	assumed

Table 6. 1C Waste vol% Solids.

tank	start	qtr.	end	qtr.	waste type	pri.vol.	acc.sol.	vol%
B-107	1945	2	1946	2	1C	1590	220	13.8
C-110	1946	2	1947	4	1C	1589	231	14.5
T-107	1945	1	1947	4	1C	1590	201	12.6
avg.	**1945**	**1**	**1947**	**4**	**1C**	**4769**	**652**	**13.7**
BX-107	1948	3	1951	2	1C	1590	437	27.5
C-107	1947	1	1947	4	1C	1588	399	25.1
TX-109	1949	1	1950	2	1C	3032	722	23.8
U-110	1946	3	1951	1	1C	1394	336	24.1
avg.	**1947**	**1**	**1951**	**2**	**1C**	**7604**	**1894**	**24.9**

Table 7. Redox Solids.

tank_n	year	qtr	lineal date	kgal CWR	kgal Redox	Acc. solids	vol%	comments
SX-105	1955	2			961	43	4.5	
SX-111	1956	2			963	41	4.3	
							4.4	4.5 R1
SX-110	1966	2	1966.3		1621	62	3.8	
SX-113	1958	2	1958.3		487	10	2.1	
SX-115	1960	3	1960.5		967	10	1.0	
					3075	82	2.7	2.3 R2

Table 8. In Plant PFeCN/1 and PFeCN/2 Ferrocyanide Sludges.

	PFeCN/1	PFeCN/2	units	HDW totals	B&S totals	units
FeCN M	0.005	0.0025	M			
pri. vol.	10901	22460	kgal	33361	33861	kgal
acc.sed.	403	718	kgal	1115	1393	kgal
vol% sed.	3.7	3.2	vol%	3.4	4.1	vol%
FeCN sed.	0.14	0.078	M			
density	1.45	1.45	g/cm3			
pred. wet exotherm	42	24	cal/g			
pred. dry exotherm	106	61	cal/g			

Table 9. In-Tank (or in-farm) TFeCN Waste vol% Solids.

waste type	tank	primary volume	accumul. solids	vol% solids
TFeCN	C-108	1034	15	1.5
	C-109	2954	44	1.5
	C-111	2732	35	1.3
	C-112	4442	67	1.5
TFeCN	**avg.**	**11162**	**161**	**1.4**

Table 10. Purex P Waste vol% Solids.

tank	start	qtr.	end	qtr.	waste type	pri.vol.	acc.sol.	vol%
A-101	1956	1	1973	4	P	4545	83	1.8
A-102	1956	1	1961	3	P	7138	102	1.4
A-103	1956	2	1960	3	P	3813	102	2.7
A-104	1959	3	1961	4	P	6765	171	2.5
AX-104	1966	3	1969	2	P	1202	47	3.9
avg.	**1956**	**1**	**1973**	**4**	**P**	**23463**	**505**	**2.2**
A-106	1960	4	1962	2	P	1460	118	8.1
AX-101	1968	2	1969	2	P	40	??	??
AY-101	1971	2	1971	4	P	14	??	??
C-104	1970	4	1976	2	P	91	??	??

Table 11. Purex Cladding Waste (CWP) Waste vol% Solids.

tank	start	qtr.	end	qtr.	waste type	pri.vol.	acc.sol.	vol%
C-101	1960	4	1962	2	CWP/Al	660	56	8.5
C-103	1960	2	1960	4	CWP/Al	479	35	7.3
C-104	1956	1	1957	2	CWP/Al	1118	90	8.1
C-105	1957	3	1960	2	CWP/Al	3130	262	8.4
C-106	1958	2	1960	2	CWP/Al	420	28	6.7
avg.	**1956**	**1**	**1965**	**2**	**CWP/Al**	**5807**	**471**	**8.1**
C-102	1960	3	1965	2	CWP/Al	5355	184	3.4
C-104	1969	4	1970	1	CWP/Zr	535		
C-104	1970	2	1972	3	CWP/Al	3816	108	2.5
C-102	1965	3	1969	4	CWP/Al&Zr	6448	??	??
C-107	1961	3	1962	2	CWP/Al	1364	??	??
C-108	1961	2	1961	2	CWP/Al	502	??	??
C-111	1957	1	1960	4	CWP/Al	347	??	??
C-112	1960	3	1961	2	CWP/Al	254	??	??

Table 12a. Chemicals Added and Species Precipitated.

chemicals added	defined precipitates	H2O's	comments
HNO3	NaNO3	0	Sodium nitrate precipitates as a result of evaporator concentration of neutralized wastes.
NaAlO2	NaAlO2, Al2O3.3H2O	0 and 3	Aluminum precipitates first as oxyhydroxide. Only after concentration does aluminate precipitate.
Al(NO3)3	NaAlO2, Al2O3.3H2O	0 and 3	A set fraction of aluminum always precipitates as oxide upon neutralization, generally about 7%, but as high as 60% for cladding waste.
Fe(HSO4)2 **Fe(NO3)3**	FeO(OH) (Na2SO4)	0.5	Iron is added as Fe(II) and Fe(III) but is precipitated only as Fe(III), producing hydrogen and hydroxide. Note iron also in FeCN.
NaCrO4	Cr(OH)3	1.5	Chromium is added as VI, but precipitated as III, consuming water.
BiPO4	BiPO4, Na3PO4.10H2O, Na3PO4.12H2O	0	Phosphate precipitates first as BiPO4, then as the sodium 12 hydrate. After evaporator concentration, the sodium 10 hydrate precipitates.
ZrO(OH)2	ZrO(OH)2	2	Zirconium actually derives from Zirconium alloy cladding.
NiSO4	Ni(OH)2, Na2NiFe(CN)•6.6H2O	1	Nickel first precipitated as ferrocyanide, then as hydroxide.
NaOH		0.5	Not precipitated.
NaNO2	NaNO2	0	Precipitates as a result of evaporator concentration.
Na2CO3	Na2CO3.7H2O, CaCO3.6H2O	7	Only the sodium seven and calcium six hydrates precipitate in this model.
Na3PO4	BiPO4, Na3PO4.10H2O, Na3PO4.12H2O	0, 10 and 12	See BiPO4 for phosphate details. Na is used as surrogate for whatever cation actually precipitates.
Na2SO4	Na2SO4	10	Even though metathesis is likely, Na is used as cation surrogate.
Na2SiO3	Na2SiO3	0	Once again, Na is used as surrogate for cation.
Na2SiF6	Na2SiO3, NaF	0	Assume all SiF hydrolyzes to silicate.
NaF	NaF	0	Use Na as cation surrogate.
NaCl	NaCl	0	Not precipitated.
La(NO3)3	LaF3	0	Precipitated in "224" waste.
NH3		0	Not precipitated.

Table 12b. Chemicals Added and Species Precipitated.

KNO3	NaNO3	0	Potassium is not precipitated in model, only present in interstitial liquid.
Ca(NO3)2	CaCO3.6H2O	6	Another sink for carbonate.
KMnO4	MnO2	0	Manganese is added as VII, but precipitated as IV, consuming water.
Sr(NO3)2	Sr(OH)2	1	non radioactive strontium only.
PbSO4	Pb(OH)2 (Na2SO4)	1	
H3C6H5O7	Na3cit.5H2O	5	Not precipitated.
H4EDTA	Na4EDTA	0	Not precipitated.
H3HEDTA	Na3HEDTA	0	Not precipitated.
Hglycolate		0	Not precipitated.
Hacetate	Na Acetate	0	Not precipitated.
H2oxalate	Na 2 Oxalate	0	Precipitated in "224" waste.
Na4Fe(CN)6	Na2NiFe(CN)•6.6H2O	6.6	Always precipitated as sodium nickel ferrocyanide six hydrate.
Pu	Pu	0	Precipitate formally as metal, neglect oxidation.
U	UO2(OH)2•6H2O	7	Precipitated as U(VI) by consuming water and producing hydroxide.
Cs	Cs	0	Precipitate formally as metal, neglect oxidation.
Sr	Sr	0	Precipitate formally as metal, neglect oxidation.
DBP	dibutyl phosphate	0	Not precipitated.

Table 13. Solubility Limits.

species	mol/L	lower	upper	comments
Na				Sodium precipitates with other species.
Al	1.6	1.44	1.75	Oxyhydroxides precipitate with arbitrary factor for each waste stream. This limit only pertains to aluminate in evaporator runs.
Fe	0.002	0.0075	0.029	Set by SU solubility, excluding complexant wastes.
Cr	0.03	0.0145	0.0523	Set by SU solubility.
Bi	0.004	0.0032	0.0048	Set by SU solubility.
La	0.006			Set by SU solubility.
Hg	1e-5			Set by SU solubility.
Zr	0.003	0.0024	0.0034	Set by SU solubility.
Pb	0.0016	0.0008	0.0032	Set by SU solubility.
Ni	0.0018			Set by SU solubility except for Na2NiFe(CN)6.
Sr	0.002			
Mn	0.009	0.0055	0.013	Set by SU solubility.
Ca	0.009	0.0045	0.014	Set by SU solubility.
K				No precipitates.
OH				Hydroxide precipitates with other species.
NO3	2.8	2.5	3.1	Set by evaporator run concentrates.
NO2	3.1	2.2	2.7	Set by evaporator run concentrates(2.2 M), then scaled to solubility at 60°C, since temperature dependence is so high.
CO3	0.4	0.3	0.6	Set by evaporator run concentrates.
PO4	0.15	0.12	0.18	Set by SU solubility.
SO4	0.35	0.25	0.44	Set by SU solubility.
SiO3	0.034	0.011	0.052	Set by SU solubility.
F	0.24	0.14	0.34	Set by SU solubility.
Cl				No precipitates.
FeCN	0.0			Simplest assumption precipitates all FeCN.
Pu-239/ 240	30 µCi/L			Effective value set by 95% limit of data, excluding complexant wastes.
U	0.004	0.00	0.019	Set by SU solubility.
Cs-137	equal			Solubility set to same in solid and solution (volumetrically).
Sr-90	0.034 Ci/L			Set by NCAW SU solubility.

Table 14. Grams Organic Carbon per mol Species.

species	g organic carbon per mol	meas./pred.	measured g carbon per mol
EDTA	120	0.8	96
HEDTA	120	0.8	96
glycolate	24	1.0	24
citrate	72	1.0	72
acetate	24	1.0	24
oxalate	24	0.5	12
TBP	144	1.0	144
NPH	144	1.0	144
hexone	60	1.0	60
FeCN	72	0.5	72

Table 15.
Evaporation and Cs/Sr Extraction Campaigns

Evaporator	st.date		en.date		Tank(s)	kgal out	kgal reduction	kgal salt cake
242-T	1951	2	1955	3	TX-118	8,060	7,849	764
242-B	1951	4	1954	4	B-106	8,048	7,861	786
Redox self- conc.	1952		1965		S/SX Farms	8,240	8,400	514
A/AX self- conc.	1960		1965		A/AX Farms			
HS or SSW	1961	4	1965	2	C-109, C-111, C-112			
Redox Plant	1967		1972					
ITS proto.	1965	1	1966	3	BY-101			
ITS#1	1966	4	1971	2	BY-102, BY-103 feed			
ITS#2	1967	4	1976	1	BY-112, BY-109 feed	9,585	38,111	3887
B Plant Cell 23	1967	4	1967	4	B-112 feed, B-111 bottoms			
242-T	1965	4	1976	1	TX-118 feed	20,014	42,242	5874
242-S	1972	4	1977	1	S-102 feed	21,126	34,642	5123
242-A	1976	4	1980	4	A-102 feed	20,465	7,405	1073
242-S	1977	2	1980	4	SY-102 feed	7,793	7,000	
242-A	1981	1	1991		AW-102 feed	10,794	8,053	
A-102 sluicing	1963	4	1969	1	A-102			
A-106 sluicing	1969	2	1973	4	A-106 sl to AR, su feeds C-105			
AX-103 sluicing	1974	1	1977	3	AX-103 sl to AR, su feeds C-105			
CSR	1967	4	1979	1	C-105 su feed			
SRR	1969	1	1977	2	A-106 sl feed			
totals							161,563	18,937

Table 16.
Evaporator Partial Neutralization (PNF) Campaign

tank	kgal NIT	from	to
SY-102	52	1977.75	1977.75
U-102	29	1977.75	1978
U-103	26	1977.75	1977.75
S-103	220	1978	1980.75
U-107	109	1978	1980.75
S-102	63	1979.5	1979.75
U-111	17	1979.5	1979.5
SX-106	138	1980.5	1980.75
kgal Total	**654**	**1977.75**	**1980.75**

Table 17.
Degradation of Organics in Waste Tanks

species	alias	decomp. mol frac. / year	critical factor
C6H5O7---	citrate	?	
EDTA----	$(-OOCCH_2)_2NC_2H_4N(CH_2COO-)_2$	?	
HEDTA---	$(HOCH_2CH_2)(-OOCCH_2)NC_2H_4N(CH_2COO-)_2$	1	
NTA---	$(-OOCCH_2)_3N$	?	
glycolate-	HOCHCOO-	0	
acetate-	CH_3COO-	0	
oxalate--	-OOCCOO-	0	
TBP	$OP(OC_4H_9)_3$		
NPH	$CH_3(CH_2)_{10}CH_3$	0.2	evap.
CCl4	carbon tetrachloride	1	
hexone	$CH_3(CO)CH(CH_3)_3$	1	
Fe(CN)6----	ferrocyanide	0.1	radiolysis

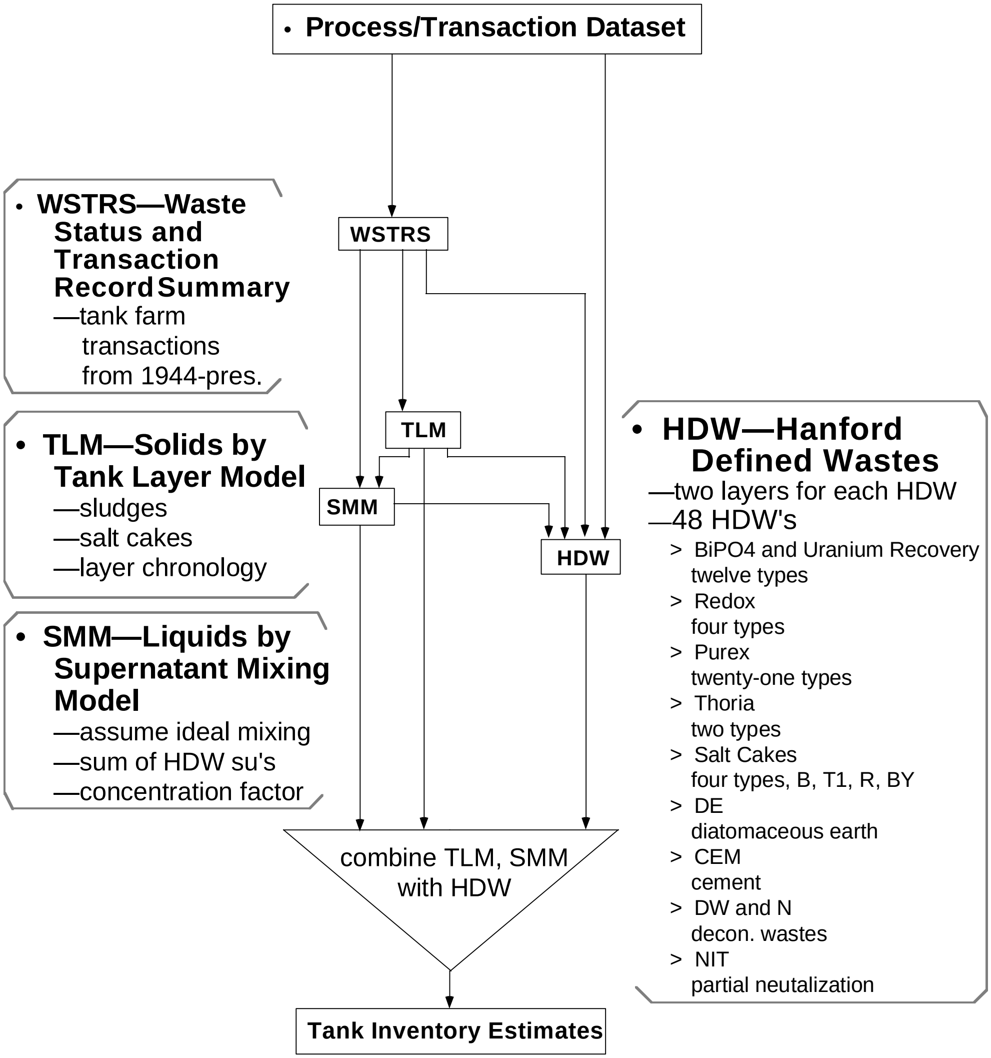

Fig. 1. Schematic of overall strategy

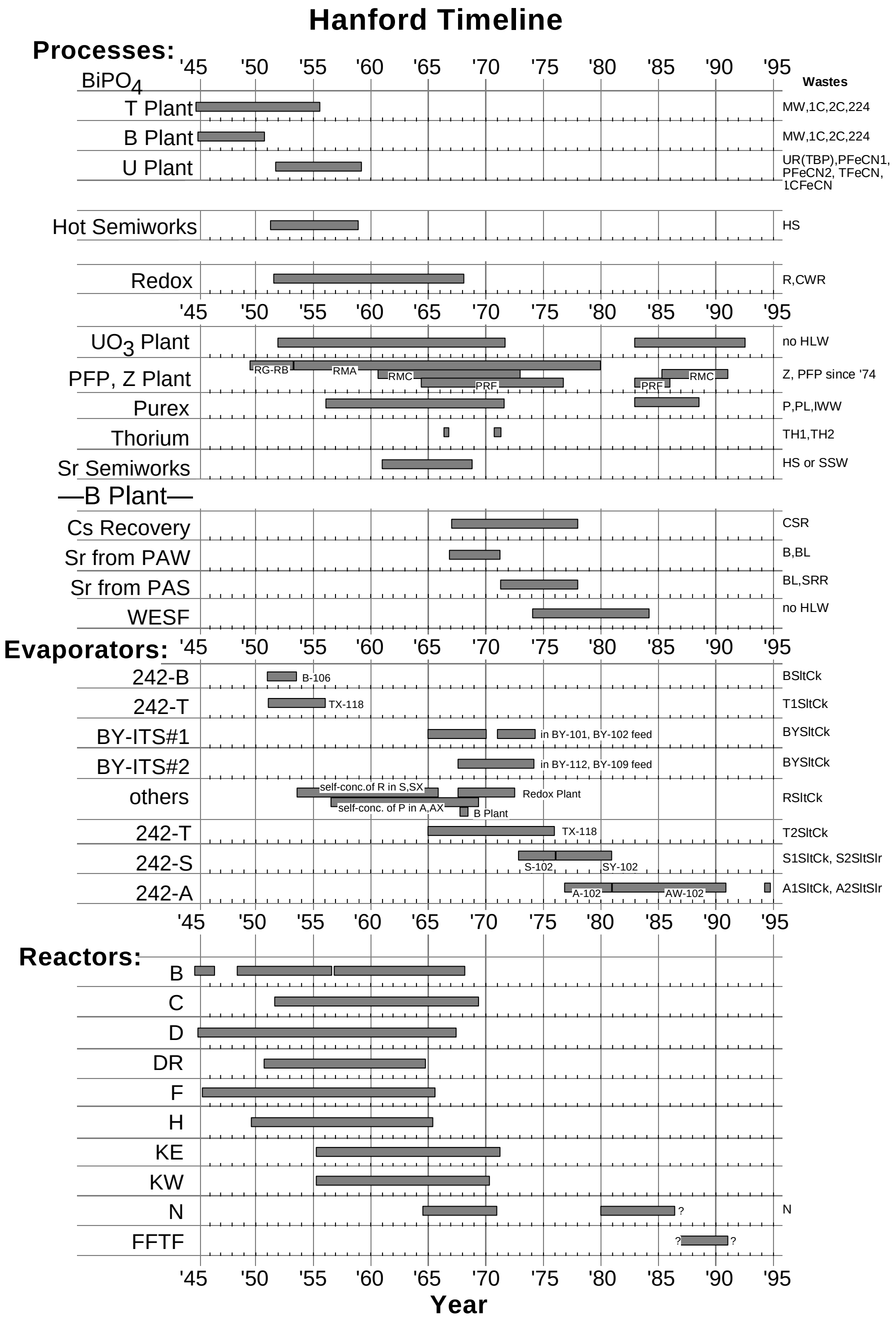

Fig. 2. *Hanford Timeline.*

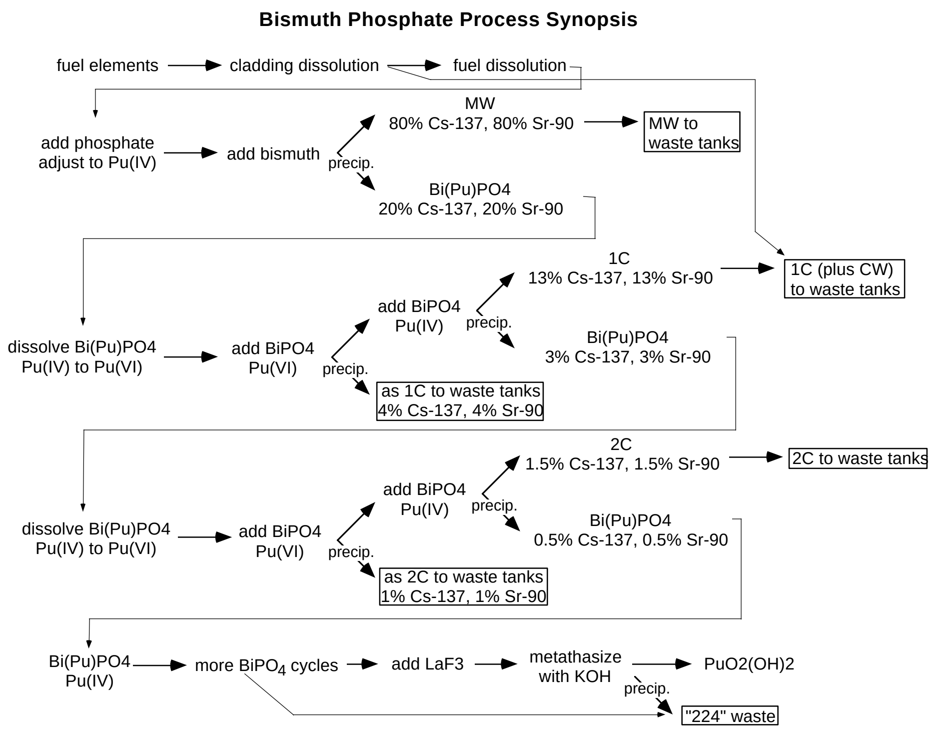

Fig. 3. *Diagram of BiPO4 process.*

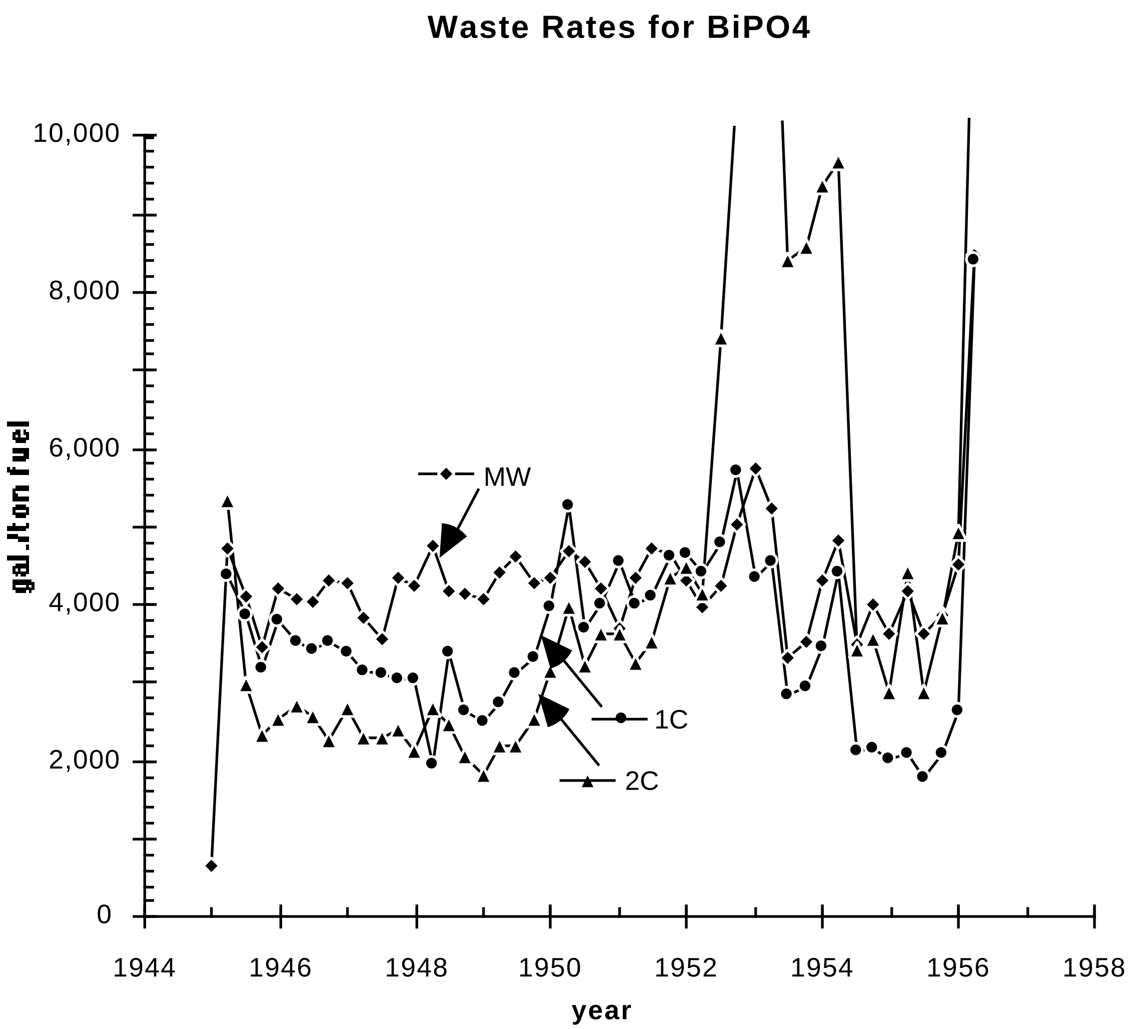

Figure 4. *Waste volume rates for BiPO$_4$ campaign.*

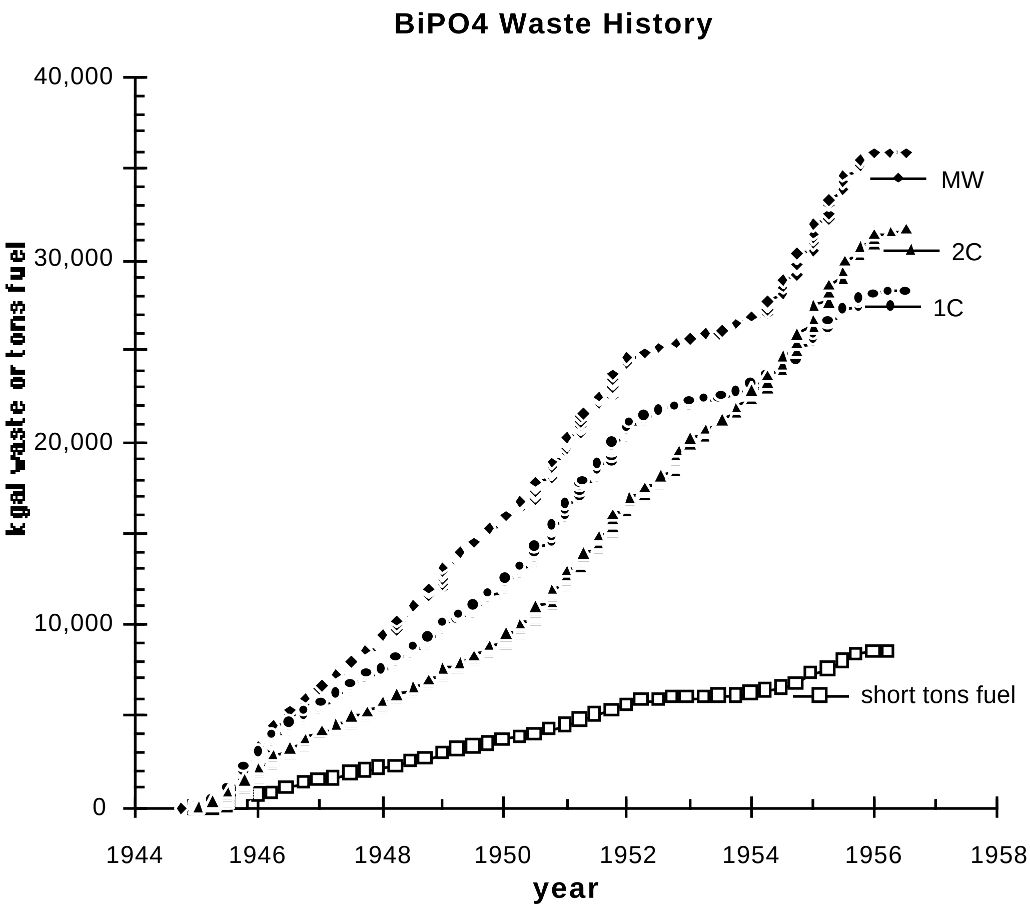

Figure 5. *Total waste volumes from $BiPO_4$ campaign.*

Uranium Recovery Process Synopsis

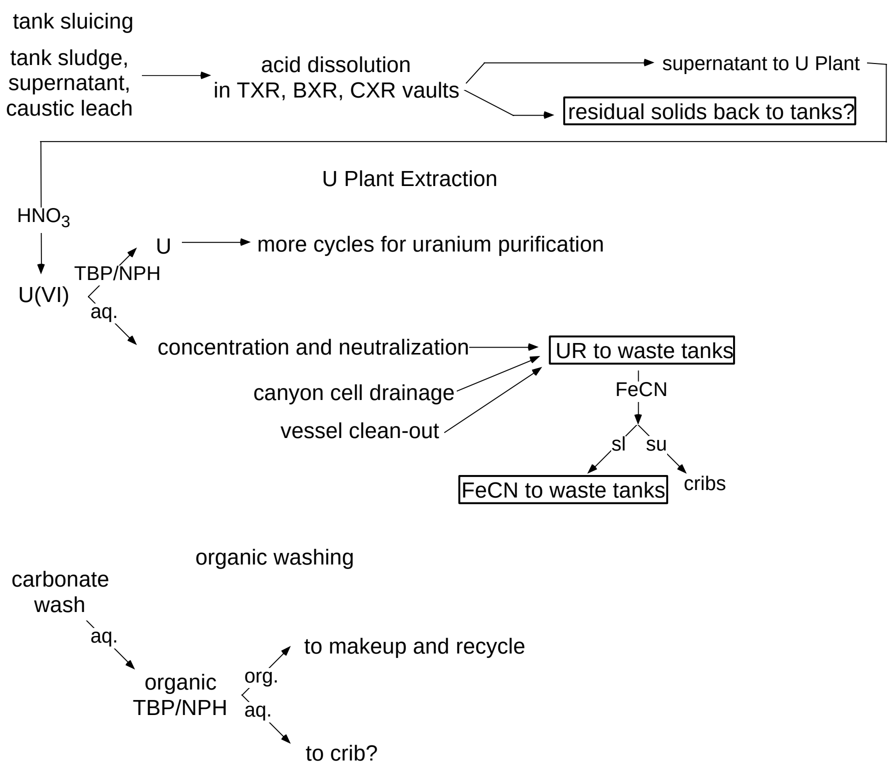

Figure 6. *Uranium Recovery process synopsis*

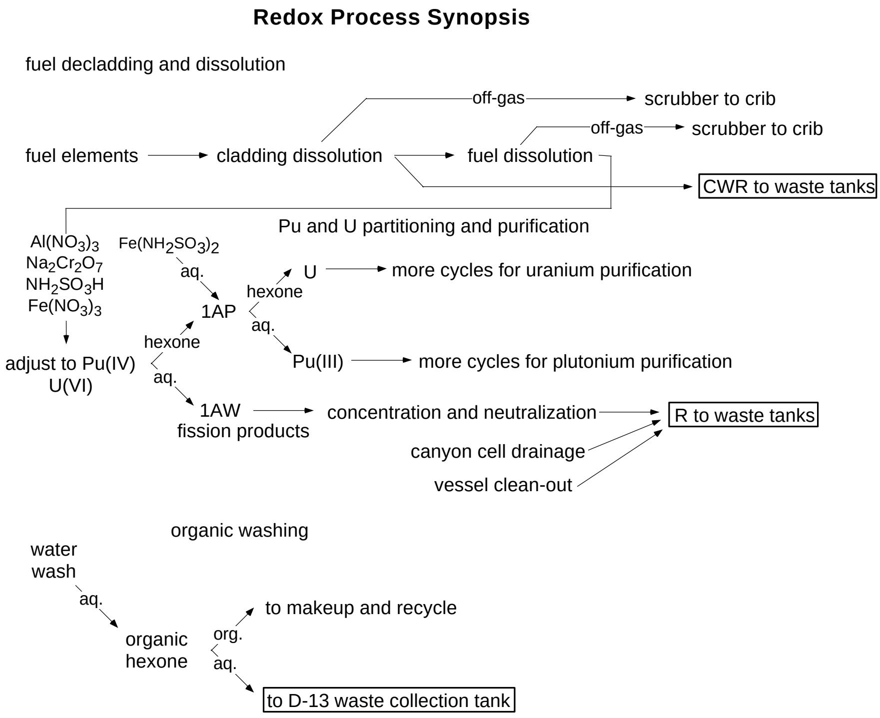

Figure 7. *Redox process synopsis.*

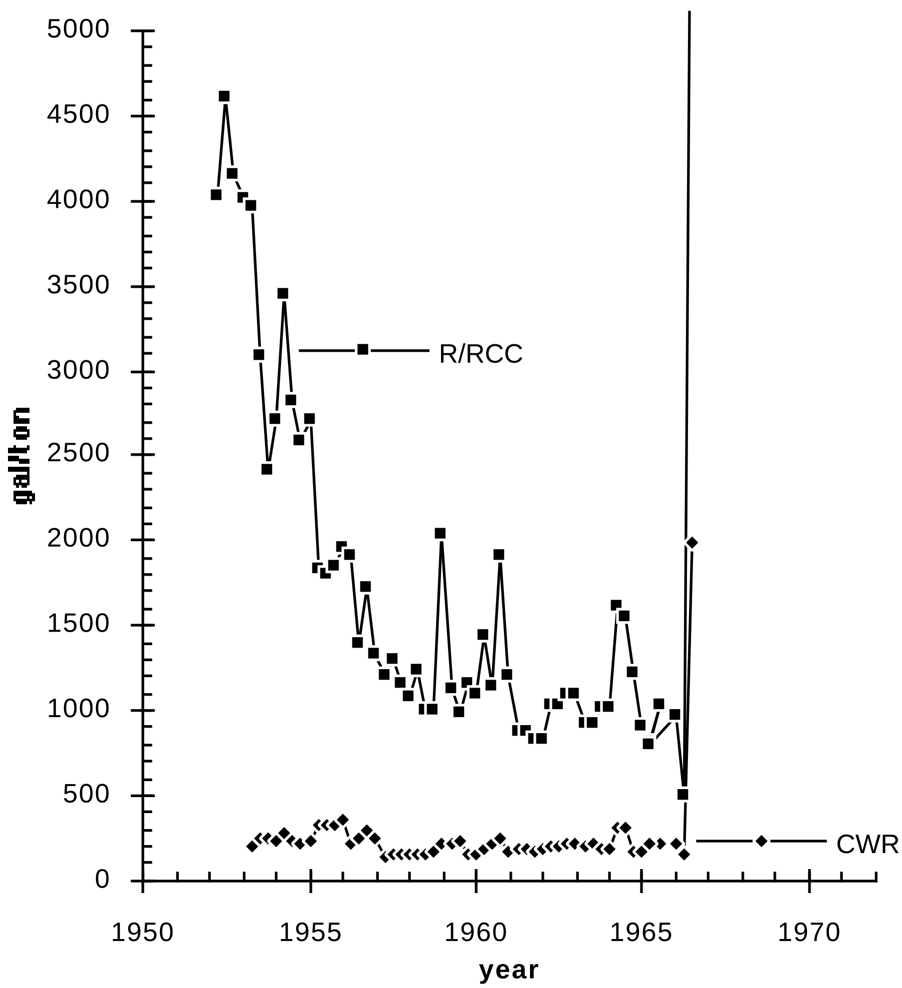

Figure 8. *Waste volume rates for Redox campaign.*

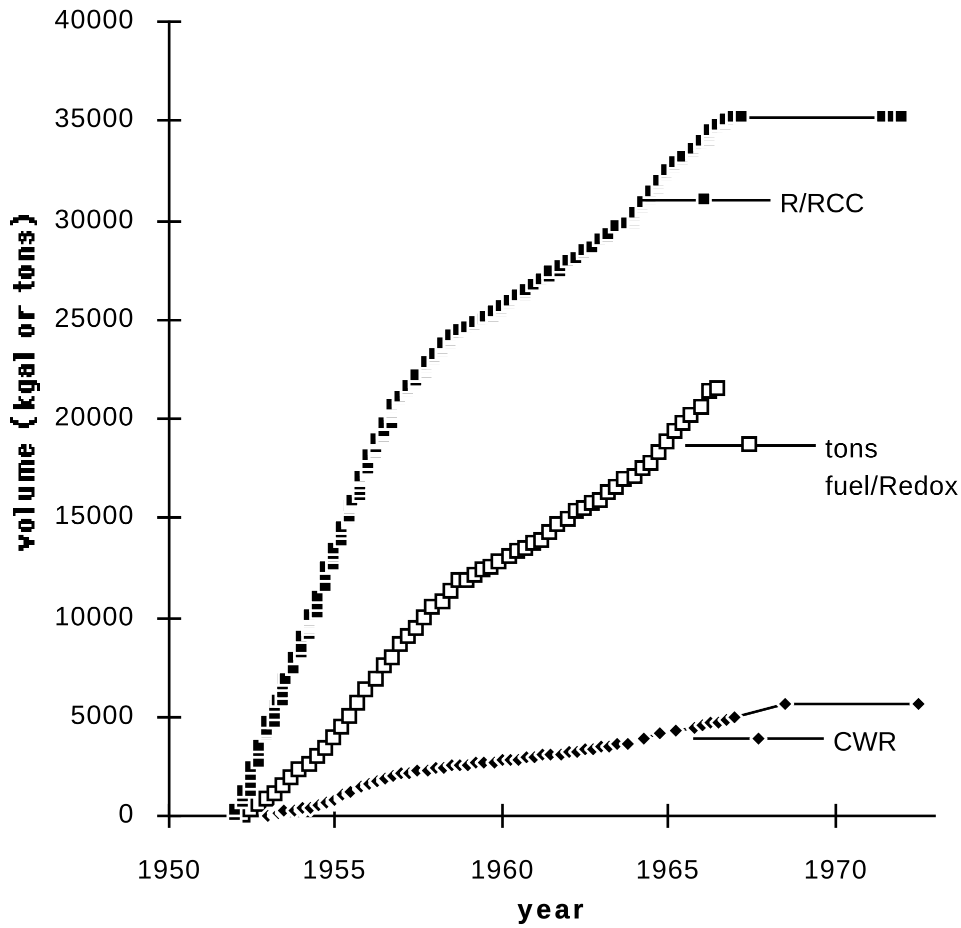

Figure 9. *Total waste volumes for Redox campaign.*

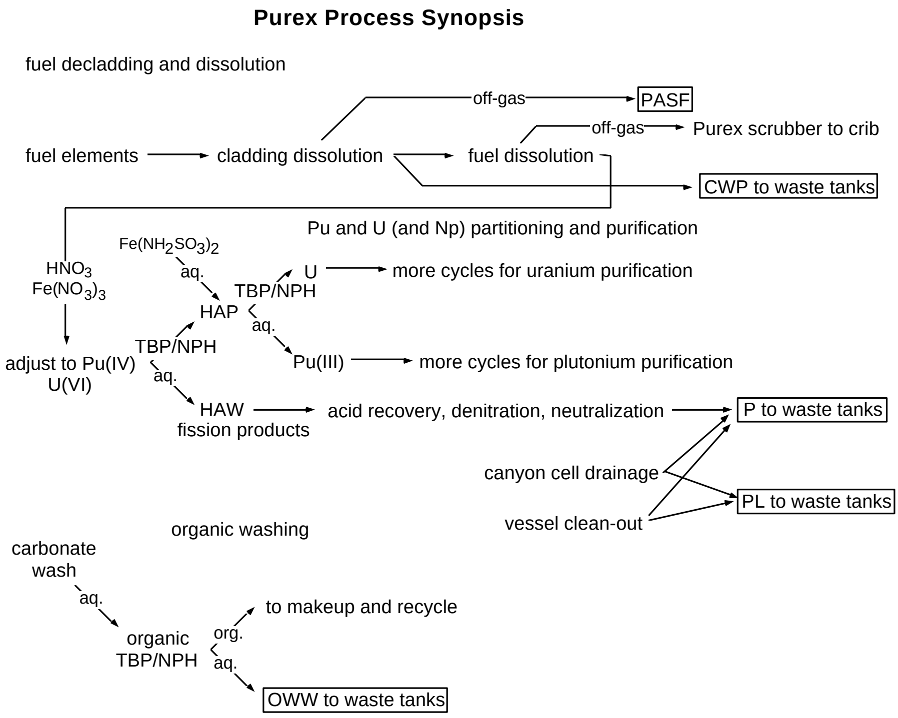

Figure 10. *Synopsis of Purex process wastes.*

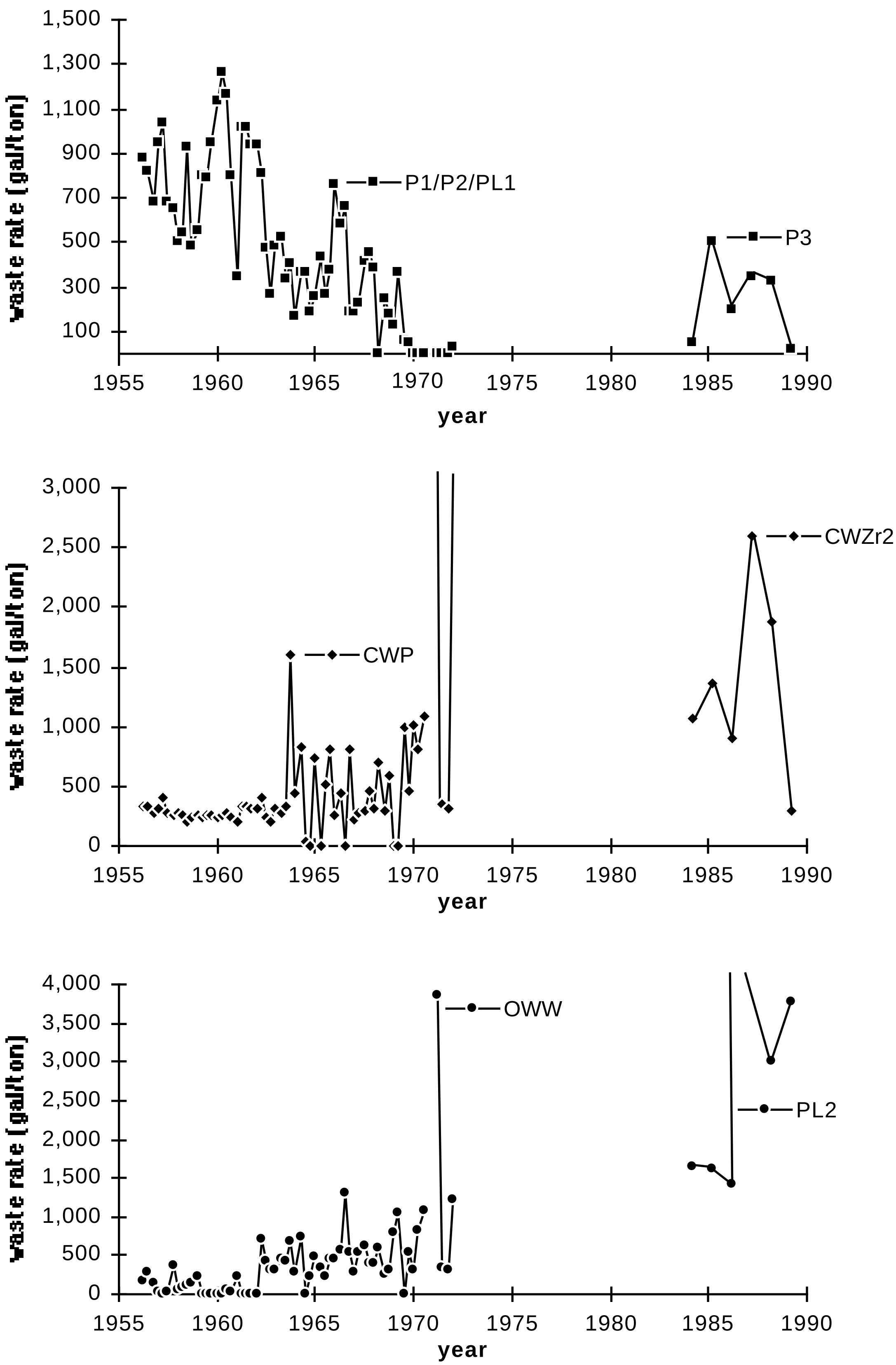

Figure 11. *Waste volume rates for Purex campaign.*

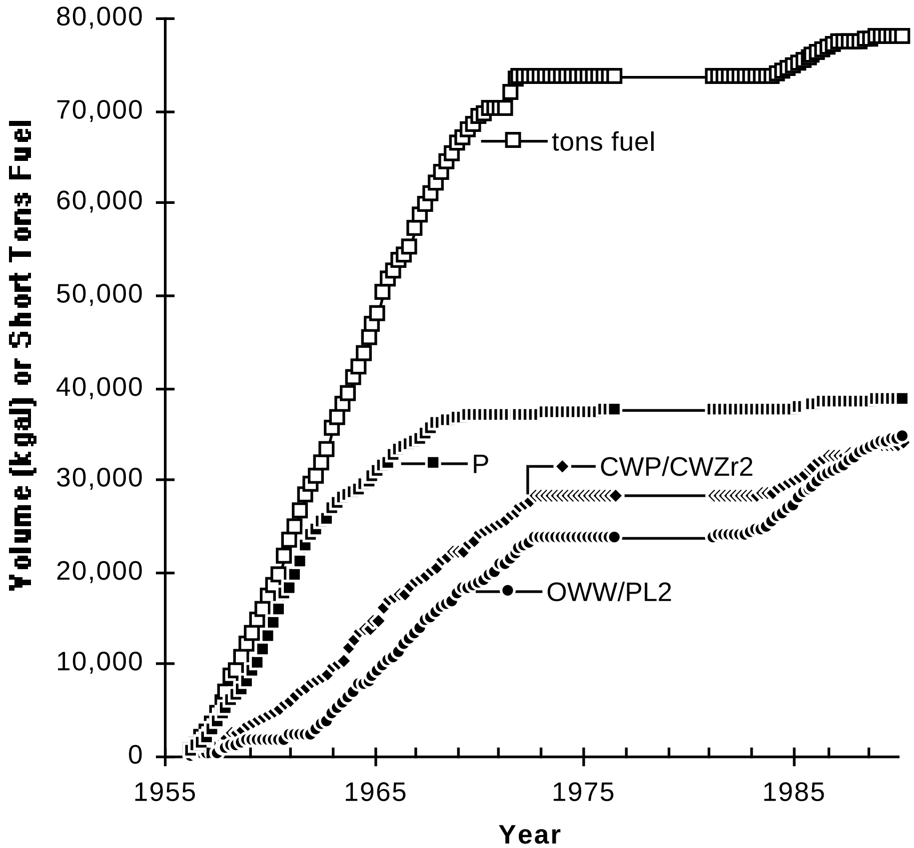

Figure 12. *Total waste volumes for Purex campaign.*

Strontium Recovery Process Synopsis

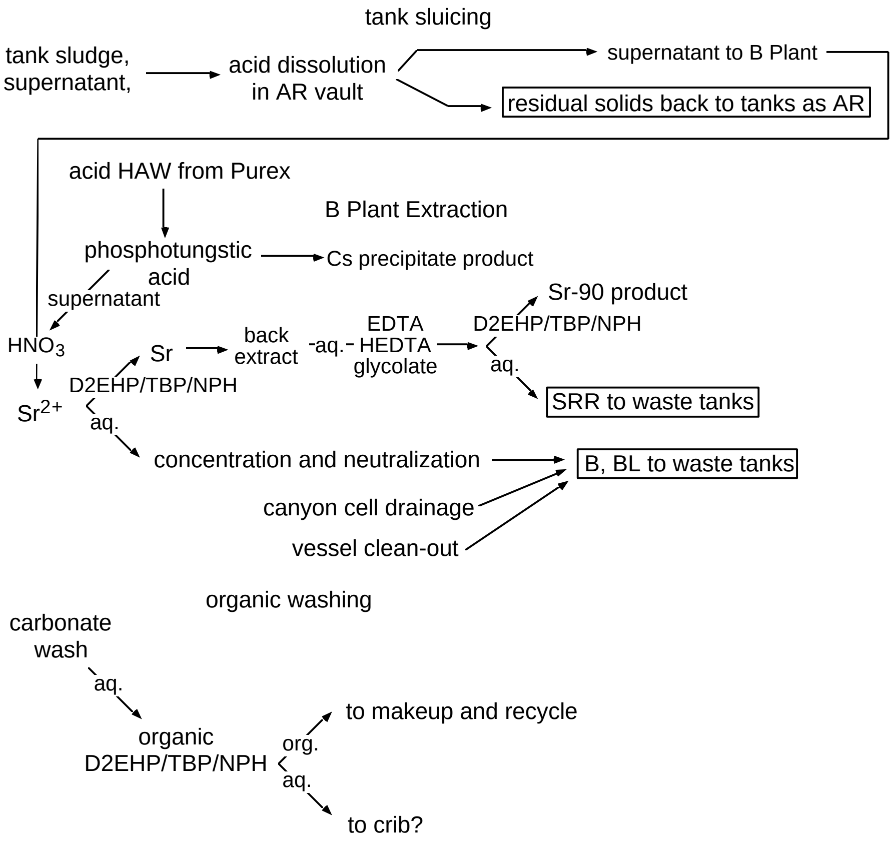

Figure 13. *Strontium recovery process synopsis*

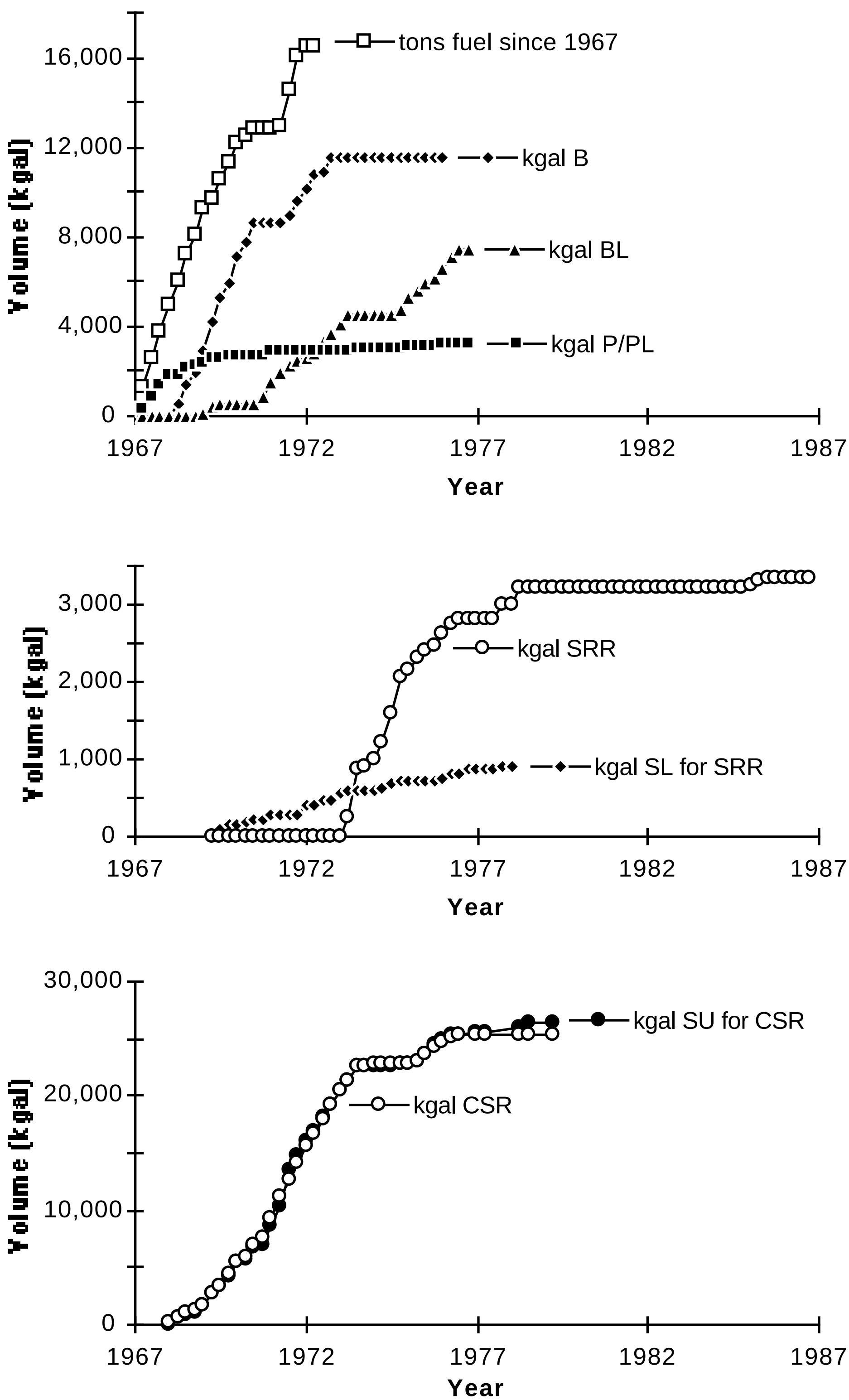

Figure 14. *Total waste volumes for B Plant campaign.*

Appendix A.

Other Approaches Used to Derive Tank Inventories

Allen 1976

There have been a number of reports describing the compositions of Hanford Wastes. A report by G. K Allen[1] provided estimates of total chemicals used in each of several "standard" waste types, and thereby derived "theoretical" sludge compositions for Purex, Redox, BiPO4, and UR (or TBP) waste additions. Allen's strategy was based on the assumption that all of the insoluble components of each waste type ended up in the sludge. Thus, even without having detailed transaction information (how much and when waste was placed into a tank) one could derive a characteristic sludge composition for each waste type. Furthermore, Allen provided analytical data for a series of tanks, the contents of which he termed either Redox or Purex sludges, and attempted to derive an average composition for both Redox and Purex sludges based on this information. Allen also presented analytical data on salt cakes from 242-S and ITS operations, and presented a composition for these two salt cakes as well.

This approach has a great deal of validity, but there were many flaws in the details of this particular analysis. For example, many of the tank "sludges" identified as either Redox or Purex were actually mixtures that included other waste sludges as well, sometimes in major fractions. The contents of tank U-110, for example, were identified as a Redox sludge, but U-110 contains primarily 1C sludge from the BiPO4 process. Also Allen's use of unbalanced compositions led to ambiguous compositions. Allen's results for S-105, for example, show nitrate at 100.3 wt%, with other components at 6.8 wt%. Presumably this actually meant that $NaNO_3$ was 100.3 wt%, but that does not leave anything for the other 6.8 wt%.

Another problem with these waste definitions is one of mistakenly double counting of certain species. For example, the definition of UR waste includes some 50 Mmol of Na_3PO_4 and 19 Mmol of Na_3SO_4 (see Table C1), but these species were not added during the UR process but rather were remnants of the $BiPO_4$ MW sludges that were being reprocessed. However, the $BiPO_4$ process only added 36 and 5.2 Mmol, respectively, of Na_3PO_4 and Na_2SO_4. Therefore, not only are these species often double counted as a result of Allen's data, but increased substantially in total amount as well. The same error appears in B Plant reprocessing of Purex wastes.

Anderson 1979

Another attempt at quantifying the waste compositions was made by Anderson[2] in 1979 (and updated in 1990). This report primarily contained quarterly summaries of tank levels and waste types for Hanford tanks from 1945 to 1980, but Anderson also included an introduction describing a variety of waste types and operations as well. In particular, Anderson detailed the following waste processes and types:

BiPO4—Bismuth phosphate process for extracting Pu.

MW	Metal waste
1C	1st cycle decontamination (from 1951-56, included coating waste)
2C	2nd cycle decontamination (from 1945-50, included coating waste)
CW	cladding waste, included with 2C from 1945-50, and with 1C from 1951-56.

TBP (or UR)—waste from uranium recovery operation on MW.

[1] Allen, G. K. "Estimated Tank Inventories of Chemicals Added to Underground Waste Tanks, 1944 through 1975," ARH-CD-610B, March 1976.

[2] ibid Anderson.

Appendix A.

Redox—first solvent based extraction of Pu and U, used hexone.

CW-Al	aluminum cladding waste
CW-Zr	zircaloy cladding waste
R	Redox high-level waste

Purex—organic solvent based extraction, used NPH/TBP mixture.

CW-Al	aluminum cladding waste
CW-Zr	zircaloy cladding waste
OWW	organic wash waste
P	Purex high-level waste

Thoria

TH	thoria high-level waste.

Unfortunately, Anderson never identified many other waste types within the body of the report. These waste types were:

Evap.	Probably short for evaporator feed
Evap. Feed	Evaporator feed tank
Evap. Feed Dil.	Evaporator feed dilute
Resid.	Residual liquor, same as terminal liquor
HDRL	Hanford Defense Residual Liquor
DSSF	Double Shell Slurry Feed
NCPLX	Non-complexant waste
CPLX	Complexant waste
CCPLX	Concentrated Complexant waste
CC	Concentrated Complexant waste
PSS	Purex Sludge Supernatant
IX	Ion Exchange resin waste, usually from cesium recovery.
CCW	Concentrated Customer Waste.
CS FD	Cesium Feed?
Aging	Aging waste or NCAW, neutralized acid waste.
EB	Evaporator bottoms
BNW	Battelle North West lab waste
N	N reactor decontamination waste
LW	Lab Waste, usually 222-S Lab.
DW	Decontamination Waste, usually from T Plant operation.
HLO	Hanford Lab Operation Waste.
5-6	Cell #5-6 waste (dissolver?) in B Plant?
FP	Fission Product waste, assigned same as P waste
SSW	Strontium Semiworks, C Plant waste for SRR pilot
HOT-SEMI	Hot Semiworks is same as C Plant
PNF	Partial Neutralization of Feed, part of 242-S evaporator, '77-80
CON. EVAP.	Concentrated Evaporator feed, same as DSSF?
1X	Typographical error of IX
TL	Terminal Liquor, same as residual liquor, final product of evaporation.
RIX	Redox ion exchange waste, part of cesium recovery?

Some of these terms are not exactly "waste types", but rather processes to which a given waste was subjected, the net effect was to obscure the true nature of each tank's waste. Nevertheless, many subsequent attempts at defining waste compositions were based largely on Anderson's report. Anderson's strategy, which was not consistently applied to all of the tank wastes, was to track of the relative *volumes* of each waste addition to a tank over time, thereby deriving information about what waste was in a tank at a given time with this historical trace of a tank's fill history.

Appendix A.

Once again, the same double counting of waste inventories that occurred for Allen's analysis can occur for these waste inventories as well.

Jungfleisch 1984

A more sophisticated analysis using a similar strategy as Anderson was performed by Jungfleisch,[3] who developed an elaborate fill history program known as TRAC. TRAC was based on three key pieces of information: 1) fuel element tonnages dissolved for each process and their MWD/ton exposures; 2) compositions for each process waste stream; 3) comprehensive fill histories for each waste tank. Integrating this information with various fill models, Jungfleisch derived radionuclide and chemical waste inventories for all single-shell and double-shell tanks from 1945 thru 1980, and included many waste forms that Anderson had not defined. In particular, Jungfleisch used four distinct compositions for Purex waste based on the year of the operation, as opposed to a single Purex waste type that had before been used.

In particular, there were 32 primary waste streams, 4 reprocessing waste streams, and 2 ferrocyanide scavenging streams for a total of 38 "characteristic" wastes. A chemical model was applied to each tank's waste following all transactions, but the nature of these waste streams basically determined the solids precipitates.

BiPO4

MW	
1C	
2C	
224	

Redox

R,	1950-61
R,	1962
R,	1963-64
R,	1965-72
CWR,	1950-61
CWR,	1962
CWR,	1963-64
CWR,	1965-72, Zircaloy

Purex

P,	1955-64
P,	1965-66
P,	1967-68
P,	1969-72
PL	
OWW,	1955-64
OWW,	1965-66
OWW,	1967-68
OWW,	1969-72
CWP,	1955-57
CWP,	1958-64
CWP,	1965-66
CWP,	1967-68, Zircaloy
CWP,	1969
CWP,	1970-72

[3]ibid Jungfleisch, 1984.

Appendix A.

Others

1CS	set to 1C
Z	
TH	
THL	set to TH
B	
PAW	set to B
BL	
RSN	set to R
IWW	set to P
CARB	set to OWW
CON	
DE	

DW, FLSH, FP, HLO, HS, LW, N, BNW, 5-6, CST, DCS, MWF, PSS, and 1CF were all set to WTR (water at 0.01 M NaOH)

P02 to P58	individual compositions for in-plant scavenging.
T03 to T25	compositions for in-tank or in-farm scavenging.

The six *implicit* waste types added chemicals to existing wastes and returned the new waste to the tanks. These implicit wastes were TBP (or UR) for uranium recovery operation on MW, in-plant ferrocyanide CS-137 scavenging, in-farm ferrocyanide Cs-137 scavenging, CSR for cesium recovery of tank supernatants, SRR for strontium recovery from Purex sludges in A and AX Farms, and partial neutralization feed (NIT or PNF) for 242-S evaporator transfers.

The strategy was to begin with a calculated radionuclide inventory based on fuel element information, add these radionuclides to a given set of characteristic waste types, and then add the wastes to the tanks. A variety of models were applied to the wastes within each tank, thereby producing tank by tank radionuclide and chemical inventories. Unfortunately, there were many severe errors in the waste stream compositions, the transaction data set was filled with unrecorded transactions, many of the models were too simplistic (no interstitial liquid allowed in sludges and assumed densities for solids and liquids), and there were "bugs" in the computer program. All of these factors contributed to notable anomalies, such as impossibly large inventories of sodium and/or nitrate in many tanks. For example, TRAC derived a concentration of sodium nitrate tank C-103, for example, of 256 mol/L, or roughly ten times the value for pure solid sodium nitrate.

Lucas 1989

Lucas[4] has reported compositions for many additional waste forms. Many of these compositions were derived from the previous workers (Allen, Jungfleisch, or Anderson), but others were derived from different information, as shown.

B	Jungfleisch 1984
BL	Jungfleisch 1984
CARB	Purex 1955
CC	analysis 1985 (of SY-103?)
CPLX	Eding, 1980
CW-Al	Purex 1980
CW-Zr	Purex 1955
CWR-Al	Redox 1966
CWR-Zr	Redox 1966
DSSF	Strode, et al. 1989
EB	Allen, 1976
EF-dilute	Van der Cook 1976

[4]ibid, Lucas.

Appendix A.

EF-concentrate	Van der Cook 1976
IWW	Purex 1955
IX	Buckingham 1967
MW	Technical Manual, no date
N	Strode, et al. 1989
NCPL	Eding 1980
OWW	Purex 1980
P	Anderson 1979
PL	Jungfleisch 1984
PSS	Buckingham 1967
R	Redox 1966
RIX	Buckingham 1967
RSN	Buckingham 1967
SIX	Buckingham 1967
SRSa	Allen's 1976 report, analysis date unknown
SRSb	core composite from 1976
SRSc	Allen's average Purex sludge composition
SSW	SSW 1965
TBP	Uranium Recovery Manual 1951
TL	Van der Cook 1976
1C	Technical Manual, no date
2C	Technical Manual, no date
224	Technical Manual, no date
Z	Barrington analysis 1989

In fact, many of these waste compositions are analytical results of tank waste, as opposed to being based on either flowsheet or chemicals used information. Lucas described three different versions for SRS waste that differed in constituents significantly. Therefore, not only are many of these compositions unbalanced, it is very difficult to judge whether these various waste formulations are even consistent with one another. Is, for example, P waste consistent with SRS? SRS is a sludge that was sluiced from sediments in tanked P waste, and washed in AR vault. As noted above, many of the previous versions of waste were not ion balanced, leading to ambiguous waste types.

Tank Waste Technical Options—1993

Another report[5] that provides tank by tank inventories for the Hanford site is based largely on the TRAC data, but also relies on information from the Environmental Impact Statement and other sources as well. The Environmental Impact Statement[6] for the Hanford site provides tank by tank chemical and radionuclide inventories, much of which was also based on the TRAC output. Much of the information from these two studies as well as additional information then provide a basis for the Hanford Site input to the Integrated Data Base[7] for the US. DOE.

---

[5]Boomer, K. D. "Tank Waste Technical Options Report," WHC-EP-0616 rev.0, April 1993.

[6]no author, "Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic, and Tank Waste, Hanford Site, Richland, Washington," DOE/EIS-0113, Dec. 1987.

[7]no author, "Integrated Data Base for 1991: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW/0006 rev. 7, October 1991.

AppendixB.

Hanford Defined Waste List Solids Vol%

September 1995

The Hanford Defined Waste List is a set of wastes that can be used to define all of Hanford's waste types. Implicit within this list is a solids and a supernatant fraction for each waste type. Note that some HDW's are derived from other Defined Wastes, as BSltCk, for example, is actually a mixture of supernatants from other waste types that have been concentrated by removal of water. The Defined Wastes for these concentrates are derived from the evaporator campaigns from which they were formed.

$BiPO_4$ and Uranium Recovery Wastes 1944-56

no.	waste type	vol%	comments
1	MW1	12.0	1944-49
2	MW2	12.0	1950-56
3	1C1	13.7	1944-49, includes cladding waste.
4	1C2	24.9	1950-56, includes cladding waste.
5	2C1	6.8	1944-49
6	2C2	3.4	1950-56, includes supernatants formerly cribbed at T-plant.
7	224	3.9	LaF finishing waste.
8	UR	2.8	same as TBP waste.
9	PFeCN1	3.7	Ferrocyanide scavenged UR supernatants in Plant.
10	PFeCN2	3.2	Ferrocyanide scavenged UR supernatants in Plant.
11	TFeCN	1.4	Ferrocyanide scavenged CR Vault.
12	1CFeCN	4.8	Ferrocyanide scavenged 1C supernatants.

REDOX Wastes 1952-62

13	R1	4.5	1952-57
14	R2	1.9	1958-66
15	CWR1	8.1	1952-60, aluminum clad fuel.
16	CWR2	2.9	1961-72, aluminum clad fuel with some Zr fuel

AppendixB.

PUREX Wastes 1956-76

17	P1	2.2	1955-62
18	P2	3.9	1963-67, also called IWW, FP.
19	P2'		1968-72, assigned to P2.
20	PL1	2.2	
21	CWP1	8.1	1956-60, Al cladding
22	CWP2	2.9	1961-72, Al cladding
23	CWZr1	10.5	1968-72, Zr cladding
24	OWW1	0.0	1956-62, called CARB, low solids.
25	OWW2	0.0	1963-67, low solids.
26	OWW3	0.0	1968-72, low solids.
27	Z	2.3	derived from analysis of SY-102, 1,910 kgal from 1976-80 sent to TX-118, 1,656 kgal from 1981-86 sent to SY-102.
28	HS	1.2	also SSW, Strontium semiworks.
29	TH1	5.8	1966 thoria
30	TH2	5.8	1970 thoria
31	AR	3.1	"washed" P sludge. Also used to derive SRR.
32	B	0.50	acid waste from PAW, processed through B-Plant for Sr extraction.
33	BL	0.68	low level waste from all B Plant operations.
34	SRR	2.6	strontium recovery waste from sluiced P sludge—based on washed PUREX sludge plus added EDTA, HEDTA, and glycolate.
35	CSR	0.0	waste from cesium recovery from supernatants—not a characteristic waste type, but rather a supernatant from which the 137Cs has been removed. Need only to add citrate to supernatants to track this component.

Other wastes

36	DE	all	Diatomaceous earth added to six tanks.
37	CEM	all	Cement added to only one tank, BY-105.
38	NIT	no solids	Partial Neutralization Feed for evaporator campaigns '77-81.
	Salt Slurry		same as DSS, estimated from chemical model by precipitation (via evaporator). Once again, DSS derives from the supernatants of a variety of wastes following evaporation of water.

AppendixB.

Decontamination Waste

39	DW	1.0	decontamination waste, from D&D of plants, but mainly from T Plant operations, mostly Turco residues (phenol, alkyl phosphate esters, hydroxy alkyl amines) with neutralized phosphoric acid.
40	N	1.0	N-Reactor decontamination waste, mainly neutralized phosphoric acid. Concentrates of N are CP (Concentrated Phosphate) waste, which are in AN-106 and AP-102.

Salt Cakes and Salt Slurries

41	BSltCk		Salt cake from 242-B operation, 1951-3, B-106 feed.
42	T1SltCk		Salt cake from 242-T, 1951-6, TX-118 feed.
43	RSltCk		Salt cake from self-concentration in S and SX Farms.
44	BYSltCk		Salt cake blend from ITS in BY Farm, 1965-74.

The following salt cakes were used in HDW rev. 1 and are now replaced by the SMM.

T2SltCk	Salt cake from 242-T, 1965-76, TX-118 feed.
S1SltCk	242-S campaign 1973-6, S-102 feed.
S2SltSlr	242-S campaign, 1977-80, SY-102 feed.
A1SltCk	242-A campaign, 1976-80, A-102 feed.
A2SltSlr	242-A campaign, 1981-88, AW-102 feed.

PUREX Wastes from 1983-88 Campaign

45	P3	3.9	1983-88, now called PXNAW or NCAW.
46	PL2	2.0	1983-88, now called PXMSC, among other things.
47	CWZr2	10.5	1983-88, now called PD or NCRW.
	BP/Cplx83-88		1983-88, was SSR, CSR, B, BL now it's all in AY-101.
	BP/NCplx83-88		1983-88, assigned to BL, now in AY-102
48	PASF	0.6	PUREX Ammonia Scrubber Feed, never before seen.

AppendixC.

Derivation of Chemicals Added

Table C1 shows the chemicals added in Mmols during various process campaigns according to Allen-76. Table C2 shows the average concentration of those chemicals given the volume of waste for each campaign. For comparison, Table C3 shows the chemicals added in the corresponding HDW streams in Mmols.

Note that these amounts are greater than the inventory of chemicals in the waste tanks for two reasons. First, there is significant double counting of some chemicals added. For example, Table C1 shows phosphate added during $BiPO_4$ campaign at 36 Mmol and phosphate added during UR as 50 Mmol. Actually, no phosphate was added to wastes at all during the UR campaign. The phosphate in UR was evidently calculated based on flowsheet feeds, those feeds of which comprised the phosphate within the $BiPO_4$ campaign. However, in any event, the phosphate feed to UR could never exceed that placed into $BiPO_4$ in the first place.

The second reason that these chemicals added necessarily over predict the tank inventories is due to the neglect of the amount of chemicals that were placed into cribs during the 1950's. For example, we estimate that ~1,000 Mmol of Na went into the cribs out of a total of ~2,800 Mmol Na used in various processes.

AppendixC.

Table C1.
Chemicals Added from Allen-76 in Mmol (1Mmol = 1e6 mol)

Mmol	BiPO4	UR	Redox-R/RCC	Redox-CWR	Purex-P/PL	Purex CWP /Al	Purex CWP /ZR	Purex-OWW	B Plant CSR	B Plant SRR	Thoria TH /THL
HNO3	190	810	360	20	54						2.8
NaAlO2	53			40		240					
Al(NO3)3			70								
Fe(HSO4)2					0.04						0.04
FeO(OH)	3.4	4.8	1.2		12						
NaCrO4			13.4								
BiPO4	1.2										
ZrO(OH)2	0.04		0.31				2.4				
NiSO4		1.5									
NaOH	190	810	360	20	54						
NaNO2	37			11		170					
Na2CO3								28			
Na3PO4	36	50			0.6						0.13
Na2SO4	5.2	19	2.4		27						
Na2SiO3	1.8		0.03		8.7						
Na2SiF6	3.9										
NaF			2.2				17				
NaCl		1.2									
Na2S											
Ba(NO3)2											
KNO3			0.18				0.18				
Ca(NO3)2		1.8			0.75						
KMnO4								1.73			
Sr(NO3)2		0.42									
PbSO4											
H3C6H5O7									3.3		
H4EDTA										0.57	
H3HEDTA										2.7	
Hglycolate										9	
Hacetate											
H2oxalate											
Na4Fe(CN)6		1.5									
kgal waste	95863	90077	35229	5709	38618	24365	1650	21783	26290	2810	1355
		44523									

AppendixC.

Table C2.
Chemicals Added from Allen-76 in mol/L

mol/L	BiPO4	UR	Redox-R/RCC	Redox-CWR	Purex-P/PL	Purex CWP /Al	Purex CWP /ZR	Purex-OWW	B Plant CSR	B Plant SRR	Thoria TH /THL
HNO3	0.524	2.376	2.7	0.926	0.369						0.546
NaAlO2	0.146			1.851		2.602					
Al(NO3)3			0.525								
Fe(HSO4)2					3e-04						0.008
FeO(OH)	0.009	0.014	0.009		0.082						
NaCrO4			0.1								
BiPO4	0.003										
ZrO(OH)2	.0001		0.002				0.384				
NiSO4		0.004									
NaOH	0.524	2.376	2.7		0.369						
NaNO2	0.102			0.509		1.843					
Na2CO3								0.34			
Na3PO4	0.099	0.147			0.004						0.025
Na2SO4	0.014	0.056	0.018		0.185						
Na2SiO3	0.005		2e-04		0.06						
Na2SiF6	0.011										
NaF			0.016				2.722				
NaCl		0.004									
Na2S											
Ba(NO3)2											
KNO3			0.001				0.029				
Ca(NO3)2		0.005			0.005						
KMnO4								0.021			
Sr(NO3)2		0.001									
PbSO4											
H3C6H5O7									0.033		
H4EDTA										0.054	
H3HEDTA										0.254	
Hglycolate										0.846	
Hacetate											
H2oxalate											
Na4Fe(CN)6		0.009									

AppendixC.

Table C3.
Chemicals Added for Defined Wastes in Mmol.

Chemical Added	BiPO4 Mmol	UR Mmol	Redox Mmol	Purex '56-73 Mmol	Purex B Plant Mmol	Purex Thoria Mmol	Purex '83-8 Mmol
NaNO3	197	811	398	207	6.38	13.2	6
NaNO2	16.1	7.47	18.7	44.6	1.77	0.05	0.63
Na2CO3.H2O					20.29		
Na2CO3.7H2O							
LaF3	0.47						
Na2CO3.10H2O	4	20.8		31.2	15.40		5.82
Na3PO4.10H2O							
Na3PO4.12H2O	49.9	33.7		0.48	0.30	0.46	3.03
Na2SO4							
Na2SO4.10H2O	0.0	26.1			0.21		
Na2SiO3	7.31		3.45	8.74	2.37		0.39
NaAlO2	21.6	21.56	138	97.4		1.74	
Al(NO3)3					20.3		
FeO(OH)	9.1	8.5	6.98	16.7	3.19	0.33	3.24
Cr(OH)3	1.23	0.69	11.1	2.30	0.08	0.04	
MnO2	0.14			3.55			
BiPO4	2.51						
Pb(OH)2				0.013	4e-05		0.00189
Na3cit.5H2O				0.152	3.25		
NH3							
Na Acetate							
Na 2 Oxalate	0.94						
Na3HEDTA					3.19		
Na4EDTA					1.60		
CaCO3.6H2O	4.42	4.84	2.88	4.65	1.48	0.09	1.11
Ni(OH)2	0.39	1.22	0.57	1.15	0.38	0.02	
ZrO2•2H2O	0.37		0.17	0.45			1.52
UO2(OH)2*6H2O	0.09	2.02	1.15	3.31	1.12		0.23
Hg(NO3)2	0.002		0.0060	0.02173			0.0044
Na glycolate					9.25		
organic C	1.88	4.01		32.01	88.87		1.64
NaF	53.4			4.81		0.62	16.3
FeCN (Fe included above)		0.66					
Na2S		0.26					
NaCl	5.89	21.9	8.50	4.51	3.59	0.33	0.35
Sr(OH)2	1.98						
DBP		0.0027		2.59	1.7889		0.14
butanol		0.0027		2.59	1.7889		0.14
NaOH							

AppendixD.

Glossary of Hanford Terminology

September 1995

This is a glossary of Hanford terminology that has been compiled to aid in definition of Hanford tank "jargon". These definitions have come from so many different sources that it is difficult to name them all. A lot of these terms have come from Anderson-91, Jungfleisch-84, and from Strode-93. Where there have been conflicting uses of the same term, it is indicated, and where there is uncertainty as to an exact meaning, a "??" appears to indicate that uncertainty.

If you have any corrections/additions/deletions to this glossary, please send them to: Stephen F. Agnew, M/S J586 Los Alamos National Laboratory, Los Alamos, New Mexico 87545, or fax to 505-667-0851.

ACL	Air Circulator lines (term located WHC-SD-WM-ER-204, Rev.0)
Active	Currently operating or scheduled for further operation
Active Drywell	Drywell in which radiation readings of greater than 50 counts/second are detected. To be considered "active", these readings must be consistent as to depth and radiation level for repeated readings.
Active Tank	A tank that contains more than 33,000 gal. of waste and/or is still involved in waste management operations.
ADD	Add primary waste from process.
ADJ	Adjustment to waste amount. See also CORR, COOL, and LEAK.
AEC	Atomic Energy Commission. See also ERDA, and DOE
AFPC	High total beta activity in the evaporator process condensate
AG	Above Grade (term located WHC-SD-WM-ER-204, Rev.0)
AGE	Aging Waste. See also AGING, AGING WASTE, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
AGING	Aging Waste. See also AGE, AGING WASTE, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
AGING WASTE	High level, first cycle solvent extraction waste from the PUREX plant See also AGE, AGING, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
AIR LIFT CIRCULATOR	The air lift circulators are installed in aging tanks to promote mixing of the supernate. By maintaining motion within the body of the liquid, the circulators minimize superheat buildup and, consequently, minimize burping.
AL	Analytical Laboratories
ALARA	As Low As Reasonably Achievable
ALE	Fitzner-Eberhardt Arid Land Ecology Reserve
ANCHAR	Analysis of characteristic waste deriving waste compositions from analytical information.
ANL	Argonne National Laboratory
ANNULUS	The annulus is the space between the inner and outer shells on DSTs. Drain channels in the insulating and/or supporting concrete carry any leakage to the annulus space where conductivity probes are installed. (term located Tank and Surveillance and Waste Status Summary Report)
ANSI	American National Standard Institute
APC	Alpha proportional counting
A Plant	Where PUREX process ran from Jan. 1952 - Jun. 1972, then was in standby and ran again from Nov. 1983 - 1991, and is now shutdown). See also PUREX-Plant, CARB, CWP, and OWW
APM	Ammonium Phosphomolybdate (term located WHC-EP-0791)
AQUELLW	Aqueous liquids (term located WHC-EP-0791)
AR	“Washed” P sludge. Also used to derive SRR. See also SRR.
ARM	Area Radiation Monitor

AppendixD.

AR Vault	PSL (PUREX sludge) was sluiced from A - and AX-Farms and placed here for caustic wash to remove Cesium and acid dissolution for feed to B Plant. AR-002 (or TK-002) was slurry receiver in AR-Vault. Solids are then transferred to TK-004, acidified, and the PAS (PUREX Acidified Sludge) transferred to TK-003. Any solids left in TK-004 following acid dissolution are caustic digested and transferred to back TK-002 for the next cycle.
ASF	Ammonia Scrubber Feed
ASME	American Society of Mechanical Engineers
Assumed Leaker	The integrity classification of a waste storage tank for which surveillance data indicate a loss of liquid attributed to a breach of tank integrity.
Assumed Leaking Tank	In 1984, the criteria designations of “suspect leaker”, “questionable integrity”, “confirmed leaker”, “declared leaker”, “borderline”, and “dormant” were merged into one category now reported as “assumed leaker”.
Assumed Re-Leaker	A designation that exists after a tank has been declared an “assumed leaker” and then the surveillance data indicate a new loss of liquid attributed to a breach of integrity.
ASTM	American Society for Testing and Materials
AW	NEUTRALIZED CURRENT ACID WASTE
AWC	Aging Waste Condensate
A1SltCk	Salt cake waste generated from the 242-A Evaporator-Crystallizer from 1977 until 1980.
A2SltSlry	Salt Slurry waste generated from the 242-A Evaporator-Crystallizer from 1981 until 1994.
B86ON	DILUTE, NON-COMPLEXED WASTE FROM B PLANT CELL DRAINAGE
B	B Plant HLW. Also identifies waste returned to tanks from Sr recovery. Also used as destination, B Plant, for Cs/Sr recovery. $BiPO_4$ ran in B PLANT from Apr. 1945 to Oct. 1952, while Cs/Sr recovery from tank farms ran from 1967 to 1976, and Cs/Sr recovery from NCAW and CAW ran from 1967-72, and then from 1983-91. B Plant's mission from '67 was to take the acid stream from PUREX through Cesium and Strontium recovery operations.
BARCT	Best Available Radionuclide Control Technology
BAT/AKART	Best Available Technology/All Known And Relevant Technology
BC	TRU SOLIDS FROM B PLANT PROCESSING OF CC
BCD	Binary Code Decimal
BEMR	Baseline Environmental Management Report
BF	Breather Filter (term located WHC-SD-WM-ER-204, Rev.0)
BFSH	B Plant Flush
BG	Below Grade (term located WHC-SD-WM-ER-204, Rev.0)
BHI	Bechtel Hanford Inc.
BiPO4	Bismuth Phosphate Process. First precipitation process used at the Hanford Site for separating plutonium from the irradiated uranium fuels. This process was replaced by REDOX and PUREX processes to gain the advantages of separation and recovery of the uranium and plutonium fission products in B-222 and U-222, 1944-56. Left U in waste. See also MW, 1C, and 2C.
BIPP	B Plant Immobilization Pilot Plant
BIX	B Plant Ion Exchange
BIXBN	??
BIXRI	??
BL	B Plant Low Level. From '68-'76 added to AX-103, BX-101, B-101, and C-106. Wash(?) waste after concentration in cell 23 (i.e. low solids).
BLEB	B Plant Low level Evaporator Bottoms.
BLIX	B Plant Low Level Ion Exchange?
BLIXB	B Plant Low Level Ion Exchange bottoms?
BN	??
BNW	Battelle Northwest Laboratory Waste

AppendixD.

Boiling Waste Waste containing sufficient radioactive decay heat to self-boil.

Bottoms Receivers Tank designated for receiving evaporator bottoms.

Bottom Referenced Tank Either a dished bottom tank or a flat bottom tank where the zero point for liquid-level gages is the lowest elevation in the tank.

BP TRU SOLIDS FROM B PLANT PROCESSING OF PFP

BPC Beta proportional counting

BP/CPLX83-88 SSR, CSR, B, BL all in AY-101

BP/NCPLX83-88 now in AY-101

BPDCC DILUTE, COMPLEXED WASTE FROM B PLANT CESIUM PROCESSING. See also CSR and BPDCC.

BPDCS DILUTE, COMPLEXED WASTE FROM B PLANT STRONTIUM PROCESSING

BPDCV DILUTE, COMPLEXED WASTE FROM B PLANT VESSEL CLEAN-OUT

BPFPS B PLANT HIGH TRU SOLIDS FROM RETRIEVED PFP SOLIDS

B Plant One of the three original Bismuth-Phosphate processing facilities. Later converted to waste fractional plant. B Plant used for $BiPO_4$ 1944-52, then for FP recovery. See also 222-B and TK.

BPLCS DILUTE, NON-COMPLEXED WASTE FROM B PLANT STRONTIUM PROCESSING

BPLDC DILUTE, COMPLEXED WASTE FROM B PLANT CESIUM PROCESSING

BPLDN DILUTE, NON-COMPLEXED WASTE FROM B PLANT CESIUM PROCESSING

BR TRU SOLIDS FROM B PLANT PROCESSING - NCRW

BS B PLANT PRETREATED SOLIDS

B SLTCK Salt cake waste generated from the 242-B Evaporator from 1951 until 1955.

BUMPING, TANK BUMP A tank bump occurs when solids overheat in the lower portion of the tank. The hot solids are mixed with the cooler fluid either by operation of the airlift circulators (ACLs) or by natural means. The hot solids rapidly transfer heat to the liquid, some of which quickly vaporizes. The sudden pressurization caused by vapor generation is called a "bump".

Burial Ground (garden) A land area specifically designated to receive packaged contaminated wastes and equipment for burial. Rated volume at the time of construction.

BVCLN DILUTE, NON-COMPLEXED WASTE FROM B PLANT VESSEL CLEAN-OUT

BWIA B Plant Waste Immobilization Annex. See also B Plant

BWIP Basalt Waste Isolation Project.

BY SLTCK Salt cake waste generated from in-tank solidification units 1 and 2 between 1965 and 1974.

Caisson An underground structure used to store high-level waste; typical designs include corrugated metal or concrete cylinders, 55-gal. drums welded end-to-end, and vertical steel pipes below grade.

Calcine To heat a substance to a high temperature, but below its melting point, causing loss of volatile constituents such as moisture; refers also to the material produced by this process.

CAM Continuous Air Monitor

CARB CARBONATED WASTE—same as OWW. See also A Plant, PUREX Plant, CWP, and OWW.

CAS Cascade, this process filled three or more tanks with one pump by using overflow lines. Normal use was with a sequence of tanks numbers 101, 102, 103, or 110, 111, 112. See also SET and END.

Cascade Eleven of the Single-Shell Tank Farms (all except the AX-Tank Farm), were equipped w/ overflow lines between tanks. The tanks were connected in series and were placed at different elevations creating a down hill gradient for liquids to flow from one tank to another. See also CAS, SET, and END.

CASS Computer Automated Surveillance System (AY and AZ Farm)

Catch Tank Small-capacity single-wall tank, primarily associated with diversion boxes and diverter stations. The tanks collect liquid from diversion boxes, diverter stations, catch stations, and other facilities.

AppendixD.

CAW	Current Acid Waste—this is PUREX acid waste, also called HAW or IWW. See also HAW, IWW, and PAW.
CB	??
CBUSTL	Combustible Solids and Liquids
CC	COMPLEXANT CONCENTRATE. Term refers to concentrates of solutions that have TOC's greater than 10 g/L. Usually associated with EDTA and HEDTA salts. See also CCPL, CCPLX, and CPLX.
CCGL	B PLANT HIGH TRU SOLIDS FROM RETRIEVED COMPLEXED CONCENTRATE
CCGR	DILUTE, NON-COMPLEXED WASTE FROM RETRIEVED COMPLEXED CONCENTRATE
CCPL	COMPLEXANT CONCENTRATE. See also CC, CCPLX, and CPLX
CCPLX	Complexant Concentrate. See also CC, CCPL, and CPLX
CCW	Complex Concentrated Waste
CCW	Concentrated Customer Waste
CCW	Counter-Clockwise ref. (LA-UR-92-3196)
CD	??
CDE	Committed Effective Dose Equivalent
CDF	TRAC Composition Data File or Transaction Flag Key—unit volume assumed to make stream active.
CE	Evaporator Concentrate
CE	Crown Ether
Cell 23	Waste from Cell 23 at B Plant. Cell 23 contained an evaporator and was used not only during B Plant operations, but to reduce tanked waste as well.
CEM	Cement added to BY-106 in 1977, see also CON.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	Cesium Feed
CFR	*Code of Federal Regulations*
CHP	Cascade Heel Pit
C Layer	Convective Layer
CLEAN 31	CLEAN Option HLW stream
CLELLW	CLEAN Option LLW stream
CLU	Chemical Laboratory Unit
CMPO	N-diisobutylcarbmoylmethylphosphine oxide
CON	Cement added to BY-105 in 1977, see also CEM. Also designated concentrated waste in SX-103 (1965-66), SX-107 (1965), SX-108 (1965), and SX-110 (1965).
COND	CONDENSATE. See also EVAP, AND EB.
COND	Condition
Conductivity Probe	Measures surface level of conductive liquid (or waste) by detecting electrical conductivity between probe tip and liquid/waste surface as it is lowered into contact.
Confirmed or Declared Leaker	The designation of any underground waste storage tank where the data is considered sufficient to support a conclusion with 95 percent confidence that the tank has leaked.
COOL	Change in waste volume due to cooling. See also ADJ, COOL, CORR, and LEAK.
CORR	Correction to tank waste level. See also ADJ, COOL, and LEAK.
CP	Condenser Pit
CP	CONCENTRATED PHOSPHATE WASTE (FROM 100 N-REACTOR DECONTAMINATION). See also N.
C Plant	Strontium Semiworks. Called C Plant or Hot Semiworks earlier, was pilot for both REDOX and PUREX, Jul. 1952 to Jul. 1956. Then reconfigured for Strontium Recovery Pilot Plant from July 1960 to July 1967. See also 222-C, SSW, and HS.
CPLX	Complexed waste. See also CC, CCPLX, and CCPL.
CPP	Cascade Pump Pit

AppendixD.

CPW	Concentrated Phosphate Waste. Waste originating from the decontamination of 100-N Area reactor. concentration of this waste produces concentrated phosphate waste.
CRIB	Ground site for low level supernatants (from tanks) or condensates (from evaporators). NW (T-105 - T-107, T-018, T-021 - T-023, T-025, T-026, T-032, TY-CRIB, TY-1) and NE (B-##, S-##, T-##, A-008, A-024, B-007, B-008, B-014, B-016, B-018, B-035, B-037, B-040, B-042, and B-049).
CRUST	A hard surface layer that has formed in many waste tanks containing concentrated solutions.
CR Vault	Facility located adjacent to C Farm, used for scavenging campaign following Uranium recovery, 1952-58. Ferrocyanide was added to tank supernatants in CR-Vault, and then the slurry was returned to C Farm for settling, forming in-farm sediments.
CRW	Cladding Removal Waste
CSFD	Cesium Feed
CSIX	Cesium ion Exchange
CSKW	??
CSP	Cascade Sluice Pit
CSR	Tank supernatant was sent to B Plant for Cesium recovery using C-105 as a staging tank. From 1967-76, 21,724 kgal was sent to and 26,290 kgal returned from B Plant. See also IX, and BPDCC.
CSS	Concentrated supernatant solids
CST	Caustic Solution, 0.01 M NaOH.
CSWLE	COMPLEXED SALT WELL LIQUID EAST AREA
CSWLW	COMPLEXED SALT WELL LIQUID WEST AREA
CTW	Caustic waste for makeup
CUWP	Chemicals Used and Waste Volume Produced
CVAA	Cold vapor atomic absorption (Waste)
CVR	Metal Cover Plate
CVS	Compostion Variability Study
CW	Cladding Waste, included with 2C from 1945-50, and with 1C from 1951-56.
CW-Al	Aluminum cladding waste
CWHT	Concentrated Waste Holding Tank
CWP	Cladding Waste PUREX. See also A Plant, PUREX Plant, and OWW.
CWP2	Cladding waste. PUREX 2?
CWR	Cladding Waste-REDOX. See also REDOX and R.
CWR1	REDOX cladding waste from 1952 to 1960.
CWR2	REDOX cladding waste from 1961 to 1967.
CWZr1	Cladding waste from PUREX 1966-70 that used Zirflex process on Zircaloy clad fuel elements. See also PD and NCRW.
CWZr2	Coating waste (REDOX), zirconium cladding
CWP/Zr83-88	now called PD or NCRW
CX70	DILUTE, COMPLEXED (MIXTURE) HOT SEMI-WORKS TRU SOLIDS
D	Dilute
DACS	Data Acquisition Control System
DAS	Data Acquisition System
DBA	Design Basis Accident
DBP	Dibutyl Phosphate
DBPW	Dilute “B” Plant Waste

AppendixD.

DC	DILUTE COMPLEXED. Waste characterized by a high content of organic carbon including organic complexants: ethylenediaminetetra-acetic acid (EDTA), citric acid, hydroxethylenediaminetriacetic acid (HEDTA), and iminodiacetate (IDA) being the major complexants used. Main sources of dilute complexed waste in the double-shell tanks system are salt well liquid inventory. See also, EDTA, HEDTS, and IDA
D & D	Decontamination and Decommissioning
DCG	Derived Concentration Guide
DCH 18-Cr-6	Dicyclohexano 18-Crown-6 Ether
DCS	Dilute Caustic Solution
DCW	Dilute Complexed Waste
DDSSF	Dilute Double Shell Slurry Feed
DDT	Deflagration to Detonation Transition
DDWSF	Dilute Double-Shell Slurry Feed. Product from run 86-1. See also DSS, and DSSF.
DE	Diatomaceous Earth added to BX-102 (1971), SX-113 (1972), TX-116 (1970), TX-117 (1970), TY-106 (1972) U-104 (1972).
DEF	??
DF	Decontamination Factor (term located WHC-EP-0791)
DIL	Dilute Feed for Evaporator input. Interstitial liquid that is not held in place by capillary forces, and will therefore migrate or move by gravity. See also DILFD
DILFD	Dilute Feed. See also DIL.
DISS	Dissolver
Ditch	A linearly oriented excavation often used for the temporary diversion or disposal of process waste streams.
Diversion Box	A below-grade concrete enclosure containing the remotely maintained jumpers and spare nozzles for diversion of waste solution to storage tank farms.
DN	DILUTE NON-COMPLEXED WASTE (DN) (i.e. contains no complexants) defined as waste with TOC <1wt% (10 g/L). See also DN/PD, DN/PT, PFP, PRF, TRU Solids, TRU, Z, and 224
DNCPW	Dilute Noncomplexed Waste
DN/PD	Dilute Non-Complexed Waste (DN) with P TRU solids. See also DN, DN/PT, P, PFP, PRF, PRF TRU Solids, TRU, Z, and 224..
DN/PT	Dilute Non-Complexed Waste (DN) with PFP TRU solids. See also DN, DN/PD, P, PFP, PRF, PRF TRU Solids, TRU, Z, and 224.
DNSFB	Defense Nuclear Facilities Safety Board
DoD	US Department of Defense
DOE	US Department of Energy. See also AEC and DOE.
DOE/RL	DOE/Richland (Field Office)
DOH	Washington Department of Health
DP	DILUTE PHOSPHATE WASTE
DP	Differential Pressure (term used LA-UR-92-3196 Rev 0)
DP	Distributor Pit (term used WHC-SD-WM-ER-204, Rev.0)
DPDS	Dilute PUREX Decladding Supernate
Drainable Interstitial Liquid	Liquid that is not held in place by capillary forces, and will therefore migrate or move by gravity. Drainable liquid remaining minus supernate. Drainable Interstitial Liquid is calculated based on the salt cake and sludge volumes, using average porosity values or actual data for each tank, when available.
Drainable Remaining Liquid	Supernate plus drainable interstitial.
DRCVR	Dilute Receiver Tank

AppendixD.

DRYWELL	Vertical boreholes with 6-inch (internal diameter) carbon steel casings positioned radially around single-shell tanks. Periodic monitoring is done by gamma radiation or neutron sensors to obtain scan profiles of radiation or moisture in the soil as a function of well depth, which could be indicative of tank leakage. These wells range between 50 and 250 feet in depth, and are monitored between the range of 50 to 150 feet. The wells are sealed when not in use. The wells are called drywells because they do not penetrate to the water table and are therefore usually "dry".
Drywell (in tank)	A sealed casing within a tank that is attached to a riser and used for access of a gamma or neutron detector, or an acoustical probe to determine the level of interstitial liquid.
DSS	DOUBLE-SHELL SLURRY (from EOFY 77 inventory?). This waste is a concentrate of DSSF, but with a TOC<10g/L (<1wt% TOC is NC). Waste that exceeds the sodium aluminate saturation boundary in the evaporator without exceeding receiver tank composition limits. DSS is considered a solid. See also DDWSF and DSSF
DSSF	DOUBLE-SHELL SLURRY FEED. Waste concentrated just before reaching the Sodium Aluminate saturation boundary in the evaporator without exceeding receiver tank composition limits. This form is not as concentrated as DSS. See also DSS and DDWSF.
DST	Double Shell Tank. The newer one million gallon underground waste storage tanks consisting of a concrete shell and two concentric carbon steel liners with an annular space between the liners.
DTPA	diethylene-triamine-penta-acetic acid (term located WHC-EP-0791)
DUMM, DUMMY	Dummy Waste.
DW	Decontamination Waste
DWBIX	DECONTAMINATION WASTE AND B PLANT ION EXCHANGE
DWPF	Defense Waste Processing Facility
DWVD	Defense Waste Vitrification Demonstration
E	Emergency
E-Stop	Emergency stop
EAC	Energy Absorption Capacity
EB	Evaporator Bottoms. See also COND and EVAP.
Ecology	Washington State Department of Ecology
EDE	Effective Dose Equivalent
EDTA	Ethylenediaminetetraacetic acid (term located WHC-EP-0791). See also, DC, HEDTA, and IDA
EF	Evaporator Feed
EFD	Evaporator Feed Dilute
EGR	Episodic Gas Release (term located WHC-EP-0702, Rev 0)
EIS	Environmental Impact Statement
ELEVATION	Surveyed at riser flange (term used SD-RE-TI-053 Rev. 8)
END	Disconnect Cascaded Tanks. See also CAS, and SET.
EP	Enclosure Pit (term used WHC-SD-WM-ER-204, Rev.0)
ERA	Expedited Response Action
ERDF	Environmental Restoration Disposal Facility
EPRI	Electric Power Research Institute
ERPG	Emergency Response Planning Guideline
ERDA	Energy Research and Development Administration. See also AEC, and DOE.
ES&H	Environment, Safety, and Health
ESPIP	Efficient Separations and Process Integrated Program (term used WHC-EP-0791)
ETF	Effluent Treatment Facility
EV	Evaporation
EV	Evaporation Entry

AppendixD.

EVAP	EVAPORATOR LOSSES
EVAP	Evaporator connected to tank. See also COND and EB.
EVAP	Evaporator Feed (post 1976)
EVAPF	DILUTE, NON-COMPLEXED WASTE FROM EVAPORATOR PAD FLUSH
EVAP Feed	Any waste liquid that can be concentrated to form salt cake; e.g., aged waste, low heat waste, dilute interstitial liquor, and other radioactive waste solutions.
Evap Feed Dil	Evaporator Feed Dilute. See also EFD
EVFD	Evaporator Feed Tank
EVS	Partial neutralization in 242-S Evaporator.
EVT	HEDTA destruction in 242-B or 242-T evaporators.
Evaporator Crystallizer	242-A and 242-S waste concentration facilities that operate at a reduced pressure (vacuum) and are capable of producing a slurry containing about 30 volume percent solids at a specific gravity of greater than 1.6.
Evaporator Feed	Any waste liquid that can be concentrated to form salt cake; e.g., low heat waste, dilute interstitial liquor, aged waste, and other radioactive waste solutions.
F	Food Instrument Company (FIC) Automatic Surface Level Gauge (term used Tank and Surveillance and Waste Status Summary Report)
FAILED	Thermocouples with either open circuits or loop resistance. (term used WHC-SD-WM-TI-553, Rev.0)
F/B	flange with bale (term used WHC-SD-WM-ER-204, Rev.0)
FCT	flux-corrected transport
FD	Feed Dilute
FDC	functional design criteria
FeCN	Ferrocyanide wastes created during a scavenging campaign in 1953-57. See also SCAV, P00, T00, PFeCN1, PFeCN2, and TFeCN
FFTF	Fast Flux Test Facility
FIC gauge	A Food Instrument Corporation Automatic Liquid Level Gauge based on a conductivity probe. At Hanford they are electrically connected to a computer for data transmission, analysis, and reporting. Local readings may also be obtained from a dial. (term located Tank and Surveillance and Waste Status Summary Report)
FIRST AND SECOND CYCLE DECONTAMINATION WASTES	Waste contained 10 percent of the original fission product activity and 2 percent of the product. By-product cake solution was mixed with product waste and neutralized with 50 percent caustic. This waste contained a mixture of suspended solids, hydroxides, carbonate and phosphate, scavenger metals, and chromium, iron and sodium, silicofluoride. See also 1C and 2C.
F/L	Flange with lead
FLSH	Flush water.
FM	Flow meter (term located LA-UR-92-3196 Revised)
FM-Approved	Factory Mutual-Approved (term located LA-UR-92-3196 Revised)
FP	Fission Product Waste. Cs and Sr recovery began in 222-B in 1967. Cs was removed from PUREX SU (PAW) and Sr from PUREX SL (PAS), and both from Acidic Waste.
FSPLIT	Separates or slots the flow of one or more input streams into two or more output streams.
FTIR	Fourier Transform Infrared (term located WHC-EP-0702, Rev 0)
FV	Field Verify
GA	Gain to Tank
GAS	SLURRY GROWTH AS A RESULT OF GAS GENERATION
GC	Gas Chromatograph (term located LA-UR-92-3196 Revised)
GEA	Gamma Energy Analyses (see SD-WM-PE-029 Rev. 0, 242-A Evap/Crystallizer FY 84-86 Campaign Run.
GIT	Georgia Institute of Technology (term located WHC-EP-0702, Rev 0)
GM Instrument	Instrument for detecting low-level beta and gamma radiation using a Geiger-Mueller tube.

AppendixD.

GRD	Riser at Grade (term located WHC-SD-WM-ER-204, Rev.0)
GRE	Gas Release Event (term located WHC-EP-0702, Rev 0)
GROUP	A group of tanks where ITS averaged the supernatant phases. See also ITS.
GROUT	OUTFLOW TO THE GROUT FACILITY
GRTFD	Grout Feed Tank
GTCC	Greater than Class C (term from WHC-EP-0791)
GUNITE	A building material consisting of a mixture of cement, sand, and water that is sprayed onto a mold.
HAMMER	Hazardous Materials Management and Emergency Response Training Center
Hanford Coordinates	A set of offsets, in feet, from a reference point on the site. These are the units used to lay out these facilities. Conversion to latitude and longitude is possible.
Hard Pan	Term used to describe uranium carbonate phase that formed in solids from MW additions. Proved to be very difficult to sluice.
HASP	Health and Safety Plan
HAW	Aging waste from PUREX/PFM Processing NPR Nuclear Fuel. See also AGE, AGING, AGING WASTE, IWW, NCAW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
HazOP	Hazards and Operability Study
HDRL	Hanford Defense Residual Liquid
HEAT	A tank level correction due to thermal expansion. See also CORR, COOL, and LEAK.
HEDL	Dilute sulfate waste. See also UNC.(see SD-WM-PE-029 Rev..0, 242-A Evap/Crystallizer FY 84-86 Campaign Run)
HEDTA	N-(2-hydroxyethyl)ethylenediamine tetra acetate
Heel	The waste that remains in a tank after the tank is emptied.
HEPA	High-Efficiency Particulate Air . A filter designed to achieve 99,995 percent minimum efficiency in the containment of radioactive particulates greater than 0.3 micrometer in size. (term located WHC-EP-0702, Rev 0)
HFW	Hanford Facility Wastes
HHI	Health Hazard Index (term from WHC-EP-0791)
HHW	High Heat Waste
HIC	High Integrity Container
HJ	Heel Jet (term from WHC-SD-WM-ER-204, Rev.0)
HLO	Hanford Laboratory Operations Waste
HLW	High-Level Waste—generic for all Hanford Tank Wastes. Waste from the fuel reprocessing operations in separations plants.
HP	Heel Pit (term from WHC-SD-WM-ER-204, Rev.0)
HMS	Hanford Meteorological Station
HMS/TRAC	Hydrogen Mixing Study Transient Reactor Analysis Code (term located LA-UR-92-3196 Revised)
HS	Hot Semiworks. A pilot facility that had a variety of operations. See also C Plant, and SSW.
HSA	Hanford Strategic Analysis (term located WHC-EP-0791)
HSRAM	Hanford Site Risk Assessment Methodology
HTCE	*Historical Tank Content Estimate*
HTWRS	Hanford Tank Waste Remediation System
HVAC	Heating, Ventilating, and Air Conditioning
HWVP	Hanford Waste Vitrification Plant.
HWVP	DILUTE, NON-COMPLEXED WASTE FROM THE VITRIFICATION PLANT (term From WHC-EP-0791)
I&S	Tank Isolated and Stabilized
IC	Synonym (misspelling?) for 1C-1st cycle decontamination waste-$BiPO_4$. See also MW, 2c, and $BiP0_4$.

AppendixD.

ICE	Implicit Continuous Eulerian (term located LA-UR-92-3196 Revised)
ICEBC	?? (1st cycle evaporator bottoms concentrate??) See 1CEBC
ICF	Consolidated Incinerator Facility (term located WHC-EP-0791)
ICO	DILUTE NON-COMPLEXED WASTE FROM TERMINAL CLEANOUT.
IDA	Iminodiacetate. See also, DC, EDTA, and HEDTA.
IDEF	Integrated Computer-Aided Manufacturing (ICAM) Definition (Language) (term located WHC-EP-0791)
IDLH	Imminently (or immediately) Dangerous to life or health (term located LA-UR-92-3196 Revised)
Inactive Tank	A tank that has been removed from liquid-processing service, has been pumped to less than 33,000
IH	Instrument House (term from WHC-SD-WM-ER-204, Rev. 0)
II	Interim Isolated. The administrative designation reflecting the completion of the physical effort required to minimize the addition of liquids into an inactive storage tank, process vault, sump, catch tank, or diversion box. In June 1993, Interim Isolation was replaced by Intrusion Prevention. (term located Tank and Surveillance and Waste Status Summary Report)
ILL	Interstitial Liquid Level. Liquid that resides in the voids/interstices of the solids.
Inactive Tank	A tank that has been removed from liquid processing service, has been pumped to contain less that 33,000 gallons of waste, and is not yet or in the process of stabilization and interim isolation. This includes all tanks not in active or active-restricted categories. Also included are inactive spare tanks that would be used if an active tank failed.
INEL	Idaho National Engineering Laboratory (term located WHC-EP-0791)
In-Service Tank	The waste classification of a tank being used, or planned for use, for the storage of liquid (in excess of a minus supernatant liquid heel) in conjunction with production and/or waste processing. All Hanford double-shell tanks are in-service; none of the single-shell tanks are in-service.
INST	CHANGE IN TANK LEVEL DUE TO CHANGE IN INSTRUMENTATION.
Interim Isolation	An administrative designation reflecting the completion of the physical effort required to minimize the addition of liquids into an inactive storage tank, process vault, sump, catch tank, or diversion box. See Intrusion Prevention.
Interim Stabilization	A tank which contains less than 50,000 gallons of drainable interstitial liquid and has less than 5,000 gallons of supernatant. If the tank was jet pumped to achieve interim stabilization, then the jet pump flow must have been at or below 0.05 gallons per minute before interim stabilization is completed.
Intrusion	The unintended entry of any liquid into a waste storage tank.
Intrusion FIC	A mode of operating the FIC surface level monitoring equipment typically used when a waste surface is non-electrically conductive. The conductivity probe (plummet) is positioned a small distance above the waste surface. Should that gap be spanned by an intruding liquid, conductivity between the plummet and the waste surface would be established this triggers an alarm in the CASS system. Note that the intrusion FIC levels is not an actual measurement of the current waste surface.
Intrusion Mode FIC Setting	The FIC probe is positioned a short distance above the waste surface. If the surface level of the waste in the tank increases, thereby touching the probe tip, a pointive indication is received.
IP	Intrusion Prevention. This is an administrative designation reflecting the completion of the physical effort required to minimize the addition of liquid into an inactive storage tank, process vault, catch tank, sump, or diversion box. (term located Tank and Surveillance and Waste Status Summary Report) See also IP.
IP	Instrument House (term from WHC-SD-WM-ER-204, Rev.0)
IRAP	Integrated Risk Assessment Program

AppendixD.

IS	Interim Stabilized. A tank which contains less than 50,000 gallons of drainable interstitial liquid and has less than 5,000 gallons of supernatant liquid. If the tank was jet pumped to achieve interim stabilization, then the jet pump flow must also have been at or below 0.05 gallons per minute before interim stabilization is completed.
ISO	Tank is Interim-Isolated
Isolation	The act of sealing a tank against liquid intrusion from credible sources and confining the atmosphere in the tank. Filtered airways are not sealed. The balance the pressure to the atmosphere, and in some cases provide cooling airflow.
ISV	In-situ Vitrification (term located WHC-EP-0791)
ITS	In-Tank Solidification-Program using steam evaporators inside of certain tanks on BY Farm. ITS#1 ran 1965-70 in BY-102 (a pilot demonstration was also run in BY-101) and ITS#2 ran 1968-74 in BY-112. During 1971-74, ITS#1 used as cooler instead of a heater. See also GROUP
IWW	INORGANIC WASH WASTE TO SST—same as P or NCAW. Refers to HAW or PAW. See also AGE, AGING, AGING WASTE, HAW, NCAW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
IX	Ion Exchange Waste. Assumed ion exchange (IX) removal efficiency for radionuclides (i.e., americium, strontium, cesium, and technetium). Ion Exchange identifies waste returned from Cs recovery. See also CSR, and BPDCC.
IXROW	??Ion-Exchange REDOX Organic Wash??
JEG	Joint Evaluation Group (term located LA-UR-92-3196 Revised)
JET PUMP	A modified commercially available low capacity jet pump used as a salt well pump.
KNUCKLE	Point where the side wall and the bottom curved surface of a tank meet.
KOP	Knowledge of Process uses process information to derive waste compositions based on some process driver.
L	Inactive/Leaker
LaF	Lanthanum Fluoride waste generated in Plutonium Finishing Plant Operation from 1945-??. See also 224, and 224-F.
LANCE	OUT FLOW DUE TO LANCING OF TANK
Lance/Lancing	A long steel pipe, usually 2-to-3 inches in diameter. The top is bent at a 90-degree angle, and contains a check valve, gate valve, and nose connection. The bottom end of the lance is tapered to a 1/2-inch diameter. Water enters the top of the lance, which is forced out the bottom at high pressure. This creates a passage way which may be used for equipment installation.
LANH	Heavy Lanthanides (term located WHC-EP-0791)
LANL	Los Alamos National Laboratory
LANL	Light Lanthanides (term located WHC-EP-0791)
LATA Consortium	Los Alamos Technical Associates; British Nuclear Fuels, LTD; Southwest Research Institutes; and TRW, Inc.
Lateral	Horizontal drywell positioned under single-shell waste storage tanks to detect radionuclides in the soil which indicate leakage. Lateral drywells are monitored by radiation detection probes. Laterals are 4-inch ID steel pipes located 8 to 10 feet below the tank's concrete base. There are three laterals per tank in A and SX Farms. There are no lateral drywells in any other farms.
LB	Lifting Bale. Riser top has plate flange with lifting bale - possible concrete plug under
LE	Lead Encasement (term From WHC-SD-WM-ER-204, Rev.0)
LEAK	Tank leak volume. See also ADJ, COOL, and CORR.
LEAK DETECTOR	Fixed liquid level sensor - tape with weight (term located SD-RE-TI-053 Rev. 8)
LEAK DETECTION PIT	Collection point for any leakage from AM Farm Tanks. The pits are equipped with radiation and liquid detection instruments.
LEL	Lower Explosive Limit (term located WHC-EP-0702, Rev 0)
LERF	Liquid Effluent Retention Facility.
LETF	LIQUID EFFLUENT TREATMENT FACILITY FROM N REACTOR.

AppendixD.

Level Adjustment	Any update in the waste inventory (or tank level) in a tank. The adjustments usually result from surveillance observations or historical investigations.
Level History	A diagram that shows the history of the waste level and waste level changes in a tank. The diagram also includes other related data.
LFL	Lower Flammability Limit (term located WHC-EP-0702, Rev 0)
Liquid Level Best Engineering Judgment Line	During the initial filling of certain single-shell tanks, only the liquid level was reported. To adjust for the big increase in level height, which occurred when solids were added to the record, a sloped line was used to reflect solids volume between the initial fill and the time the solids data were recorded.
LIT	Automatic Liquid indicator Tape (term located SD-RE-TI-053 Rev. 8)
LLI	Manual Liquid Level Indicator (term located SD-RE-TI-053 Rev. 8)
LLR	liquid level reel (term located WHC-SD-WM-ER-204, Rev.0)
LLR	manual liquid level sensor - tape with weight (term located SD-RE-TI-053 Rev. 8)
LLW	low-level waste (term From WHC-EP-0791)
LO	Loss from tank. (term From WHC-SD-WM-ER-204, Rev.0)
LOW	Liquid Observation Well. Liquid observation wells are used for monitoring the interstitial liquid level (ILL) in single-shell waste storage tanks. The wells are constructed of fiberglass, or tefzel-reinforced epoxy-polyester resin. They extend to within 1 inch of the bottom of the tank steel liner. They are sealed at their bottom ends and have a nominal outside diameter of 3.4 inches. See also ADJ, COOL, and CORR.
LUNC	DILUTE, NON-COMPLEXED WASTE FROM UNC FUELS FABRICATION FACILITY
LW	Laboratory Waste
L222S	222S LAB DILUTE NON-COMPLEXED WASTE FROM S PLANT.
L3A4A	DILUTE NON-COMPLEXED LABORATORY WASTES FROM 300 AND 400 AREAS.
M	Manual Tape Surface Level Gauge (term located Tank and Surveillance and Waste Status Summary Report)
MAB	Maximum Allowable Burp (term located LA-UR-92-3196 Revised)
MAPs	Mitigation Action Plans
MARGINAL	Thermocouple with higher than normal (0.5 ohms to 20 ohms depending on length) loop resistance, higher than normal resistance in one lead to ground, or having some other abnormality, e.g. inconsistent resistance measurements. (term located WHC-SD-WM-TI-553, Rev.0)
MAWB	Maximum Allowable Window Burp (term located LA-UR-92-3196 Revised)
MAXSPD	Maximum Speed Parameters (term located LA-UR-92-3196 Revised)
MCC	Motor Control Center (term located LA-UR-92-3196 Revised)
MDW	Miscellaneous Dilute Waste
MEB	Maximum Expected Burp (term located LA-UR-92-3196 Revised)
MIE	Minimum Ignition Energy (term located WHC-EP-0702, Rev 0)
MIT	Multifunction Instrument Tree (term located WHC-SD-WM-TI-553, Rev 0)
MPR	Multiport Riser (term located LA-UR-92-3196 Revised)
MS	Mass Spectrometer (term located LA-UR-92-3196 Revised)
MW	Metal Waste from $BiPO_4$. 90% of FP, all of U, 1% of Pu . Waste from the extraction containing all the Uranium, approximately 90% of the original fission product activity, and approximately 1% of the Pu product. This waste was brought just to the neutral point with 50% caustic and then treated with and excess of sodium carbonate. This procedure yielded almost completely soluble waste at a minimum total volume. The exact composition of the carbonate compounds was not known but was assumed to be a Uranium Phosphate Carbonate mixture. See also 1C, and 2C.
MW	Maximum Window (term located LA-UR-92-3196 Revised)
MW1	Metal waste from $BiPO_4$, 1944 to 1951
MW2	Metal waste from $BiPO_4$, 1952 to 1956

AppendixD.

MWB	Maximum Window Burp (term located LA-UR-92-3196 Revised)
MWF	Metal Waste Feed? Set to water in TRAC.
N	N-Reactor waste. See also CP.
N2	Nitrogen
NBAW	NEUTRALIZED B PLANT ACID WASTE
NCAW	LIQUID WASTE, HIGH CS, SR, AND TRU CONTENT. Neutralized Current Acid Waste primary HLW stream from PUREX process. See also AGE, AGING, AGING WASTE, HAW, IWW, NFAW, NHAW, NRAW, PAW, PFM, and P83-88.
NCBUSTS	Noncombustible Solids (term located WHC-EP-0791)
NC layer	Nonconvective Layer (term located LA-UR-92-3196 Revised)
NCPL	Non-Complexed Waste general term applied to all Hanford site liquids not identified as complexed. See also NCPLX and NCPLEX.
NCPLEX	Non-Complexed Waste. See also NCPL and NCPLX.
NCPLX	Non-Complexed Waste term applied to all Hanford Site liquors not identified as complexed.. See also NCPL and NCPLEX.
NCRW	Neutralized Cladding Removal Waste—Same as CWP/Zr. See also CWP, CWP/Zr, and PW.
NDAA	National Defense Authorization Act (term located WHC-EP-0702, Rev 0)
NE	Northeast quadrant of tank (term from WHC-SD-WM-ER-204, Rev.0)
NEC	National Electrical Code (term located LA-UR-92-3196 Revised)
NEPA	National Environmental Policy Act (term located WHC-EP-0702, Rev 0)
Neutralized PUREX Acid Waste	The original plant in 1956 neutralized all of the high-level waste and sent it to the A-241 Tank Farm. As fission product recovery started, a portion of the waste was treated for Strontium Recovery and then neutralized. As of 1967 all of the High-Level Waste left PUREX as an acid solution for treatment at B Plant. See also P, and PL.
NFAW	Aging waste from PUREX/PFM high level waste.
NFPA	National Fire Protection Association (term located LA-UR-92-3196 Revised)
Neutron Probe	Probe equipped with a neutron source and detector. They are used in dry well monitoring to determine the moisture content of the soil as one way to detect leaks in underground waste storage tanks or pipelines.
nf	does not show at surface, not in a pit - no surface access
NFAW	AGING WASTE FROM PUREX/PFM HIGH LEVEL WASTE (FFTF-NCAW) See also AGE, AGING, AGING WASTE, HAW, IWW, NCAW, NHAW, NRAW, and P83-88.
NFPA	National Fire Protection Association
NHAW	AGING WASTE FROM PUREX/PFM PROCESSING OF NPR FUEL
NIOSH	National Institute of Occupational Safety and Health (term located LA-UR-92-3196 Revised)
NIST	National Institute of Standards and Technology (term located LA-UR-92-3196 Revised)
NIT	$HNO_3/KMNO_4$ solution added during evaporator operation (Neutralization in Transfer?) See also PNF.
NOx	Oxides of nitrogen (term located WHC-EP-0791)
NPH	Normal Paraffin Hydrocarbon was diluent used in Uranium recovery and PUREX processes, and is close to Dodecane, $C_{12}H_{26}$.
NRAW	AGING WASTE FROM PUREX/PFM RESIDUE ACID WASTE (FFTF-NCAW). See also AGE, AGING, AGING WASTE, HAW, IWW, NCAW, NHAW, PAW, PFM, and P83-88.
NRC	US Nuclear Regulatory Commission (term from WHC-EP-0791)
NRP82	DILUTE, NON-COMPLEXED WASTE FROM FY82 100-N AREA WASTE TRANSFER
NRPO4	DILUTE, PHOSPHATE WASTE FROM 100 N AREA
NRSO4	DILUTE, NON-COMPLEXED WASTE FROM 100 N AREA

AppendixD.

NSTF	Near Surface Test Facility (NSTF) is a full-scale demonstration facility designed for testing, engineering, and training.
NTA	Nitrilotriacetic acid
OFFGAS	Cell air and offgas (term located WHC-EP-0791)
OP	Observation Port (term from WHC-SD-WM-ER-204, Rev.0)
Open Hole Salt Well	A well in which a pump is inserted in solid waste. Frequently used to remove the liquid from tanks containing less than 2 feet of sludge. See also Salt Well.
ORR	Operational Readiness Review (term located WHC-EP-0702, Rev 0)
OSD	Operational Safety Document
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
OTHHI	Other upper limit (term located WHC-EP-0791)
Out-of-Service	A tank which does not meet the definition of an in-service tank. All single-shell tanks are out of service.
OUTX	Transfer from Tank_n out to either a secondary processing operation or to a crib. See also TR.
OVM	Organic Vapor Monitor (term located WHC-EP-0702, Rev 0)
OWW **OWW1, OWW2, OWW3**	ORGANIC WASH WASTE FROM PUREX. Evidently, this was combined with P waste in 1960-61, but usually kept separate. The solvent used in PUREX was treated before reuse by washing with potassium permanganate and sodium carbonate, followed by dilute nitric acid and then a sodium carbonate wash. See also A-Plant, CWP, CARB, OWW PUREX Plant, and.
P	PUREX HLW, 1956-72. Sometimes assumed to be 50% OWW. Used NPH/TBP to extract both Pu and U. Np was also extracted from 1963-72. See also DN, and PL.
P	Photo Evaluation (term located Tank and Surveillance and Waste Status Summary Report)
P1	PUREX high-level waste generated between 1955 and 1962.
P2	PUREX high-level waste generated between 1963 and 1967.
P83-88	now called PXNAW or NCAW. AZ-101 and AZ-103. See also AGE, AGING, AGING WASTE, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PAW, and PFM.
PL83-88	now called PXMSC
P-10 Pump	A turbine pump used in the first stage of removing liquids from a waste storage tank.
P&IDs	Piping & Instrument Diagrams
P00-P##	In-Plant scavenging with FeCN. See also SCAV, T00-T##
PADFG	PUREX AMMONIA DESTRUCTION WASTE, FROM FUELS GRADE FUEL
PADWG	PUREX AMMONIA DESTRUCTION WASTE, FROM WEAPONS GRADE FUEL
Partially Interim Isolated	The administrative designation reflecting the Interim Isolated completion of the physical effort required for Interim Isolation except for isolation of risers and piping that is required for jet pumping or for other methods of stabilization.
PAL	222-S Process and Analytical Laboratory
PAS	PUREX Acidified Sludge—refers to sludge that has been sluiced from waste tanks and acidified to 0.1 M HNO_3 (as part of Cs/Sr recovery) in AR-Vault.
PASF	PUREX AMMONIA SCRUBBER FEED. Waste that derives from the scrubber for the cladding dissolves off gas.
PASF83-88	PUREX Ammonia Scrubber Fee, never before seen
PAW	PUREX Acidified Waste. Also used to refer to Aluminum Cladded Fuel (as opposed to ZAW for Zirconium Cladded Fuel). See also AGE, AGING, AGING WASTE, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PFM, and P83-88.
PCOND	PUREX condensate
PCONDCRIB	PUREX condensate to crib.
PD	PUREX decladding waste. See also CWP/Zr, NCRW, and PN.
PDBNG	DECLADDING SLUDGE (NON-TRU) FROM B PLANT PROCESSING

AppendixD.

PDBSU	DILUTE, NON-COMPLEXED WASTE FROM B PLANT DECLADDING WASTE
PDBTG	B PLANT AGING WASTE SOLIDS FROM PUREX DECLADDING WASTE
PDCSS	DILUTE NON-COMPLEXED PUREX DECLADDING WASTE, FY 1986 ONLY
PDL87	PUREX DECLADDING SUPERNATANT, 1987
PDL89	PUREX DECLADDING SUPERNATANT, NON TRU, SPENT METATHESIS REMOVED
PD/PN	Plutonium-Uranium Extraction (PUREX) Neutralized Cladding Removal Waste (NCRW), transuranic waste (TRU). See also PUREX Decladding.
PDNSG	NON-TRU DECLADDING SLUDGE FROM PUREX
PDS87	PUREX DECLADDING SLUDGE
PDS89	PUREX DECLADDING SLUDGE AFTER FY89
PDSLG	PUREX DECLADDING SLUDGE SOL PUREX
PDSUP	DILUTE, NON-COMPLEXED WASTE PUREX DECLADDING WASTE
PFD	Process Flow Diagram (term located WHC-EP-0791)
PFeCN	Ferrocyanide sludge produced by in-plant scavenging of waste from uranium recovery.
PFeCN1	Ferrocyanide sludge produced by in-plant scavenging of waste from Uranium recovery. Used 0.005 M Ferrocyanide. See also FeCN, TFeCN, UR, P00, and T00.
PFeCN2	Same as PFeCN1, except used 0.0025 M Ferrocyanide used.
PEL	Permissible Exposure Limit
PFM	Process Facility Modification (PFM) Project provides a head end facility for the PUREX Plant in which N-fuel and FFTF fuel can be processed. See also AGE, AGING, AGING WASTE, HAW, IWW, NCAW, NFAW, NHAW, NRAW, PAW, and P83-88.
PFMMS	DILUTE, NON-COMPLEXED WASTE FROM SHEAR/LEACH PROCESSING OF NPR FUEL
PFP	Z Plant Plutonium Finishing Plant. Pu Finishing Plant waste. See also DN, DN/PD, DN/PT, P, PRF, PFPNT, PFP TRU Solids, TRU, Z Plant, and 224
PFPGR	DILUTE, NON-COMPLEXED WASTE FROM RETRIEVED PFP SOLIDS
PFPNT	NON-TRU SLUDGE FROM THE PFP SOL Z PLANT. See also DN, DN/PD, DN/PT, P, PRF, PFP TRU Solids, TRU, Z Plant, and 224
PFPPT	DILUTE, NON-COMPLEXED WASTE FROM THE PFP (WITH TRUEX). See also TRUEX
PFPSL	HIGH-TRU SLUDGE FROM THE PFP SOL Z PLANT. See also DN, DN/PD, DN/PT, P, PRF, PFPNT, PFP TRU Solids, TRU, Z Plant, and 224
PFP TRU Solids	TRANSURANIC SOLIDS FRACTION FROM PLUTONIUM FINISHING PLANT OPERATIONS. See also DN, DN/PD, DN/PT, P, PRF, PFPNT, PFP, TRU, Z Plant, and 224
PhW	Phosphorous Waste
PI	Partially Interim Isolated. The administrative designation reflecting the completion of the physical effort required for Interim Isolation except for isolation of riser and piping that is required for jet pumping or for other methods of stabilization. (term located Tank and Surveillance and Waste Status Summary Report)
PL	PUREX low-level waste. See also DN, DN/PD, DN/PT P, PL, PFP, PFP TRU Solids, PRF, TRU, PFP TRU Solids, Z Plant, and 224.
PML89	PUREX SPENT METATHESIS LIQUID AFTER FY89
PMS89	PUREX SPENT METATHESIS SOLIDS AFTER FY89
PMW	PUREX miscellaneous waste
PN	PUREX, neutralized cladding waste. See also CWP, NCRW and PD.
PNF	Partial Neutralization Feed. Indicates addition of nitric acid at an evaporator in an attempt to produce more salt cake during volume reduction. See also NIT.
PNL	Pacific Northwest Laboratory
PNW	Partial Neutralization Waste

AppendixD.

Pond (Swamp)	Ground area where uncontaminated or low-level waste water is discharged to seep into the ground.
PP	pump pit (term located WHC-SD-WM-ER-204, Rev.0)
PRA	Probabilistic Risk Assessment
PRF	Plutonium Reclamation Facility—Type of waste generated in Z-Plant for "finishing wastes". Solvent based extraction process using CCl4/TBP. See also DN, DN/PD, DN/PT, P, PFP, PFP TRU Solids, Z Plant, 224, and 236-B.
PRTR	Plutonium Recycle Test Reactor
Primary Addition	An addition of waste from a specific plant or process vault. These additions come from the *Waste Status and Transaction Summary*, WHC-SD-WM-TI-614 & -615, Rev. O, DRAFT.
PRTR	Plutonium Recycle Test Reactor
PS	Primary Stabilization . The condition of an inactive waste storage tank after all liquid above the solids, other than isolated surface pockets has been removed. Isolated surface pockets of liquid are those not pumpable by conventional techniques.
PSA	Probabilistic Safety Assessment
PSICSF	Pump System installation containment seal fixture
PSL	PUREX sludge sluiced during recovery of Sr.
PSS	PUREX Sludge Supernatant.
PSSF	PUREX Sludge Supernatant Feed?
PT	Plutonium Finishing Plant (PFP) TRU Solids. TRU solids from 200W.
PT100	TRU waste from ??
PUREX	Plutonium Uranium Extraction Plant. Also called A Plant where PUREX process ran from Jan.1952-Jun. 1972, then was in standby and ran again from Nov. 1983 to 1991, and is now shutdown. See also A Plant, CWP, CARB, OWW , and P.
PWM	Pulse width modulated
PWR	Pressurized Water Reactor Core II from Shipping Port Atomic Power Station
PX86S	DILUTE, NON-COMPLEXED WASTE FROM PUREX MISC. STREAMS (NPR FUEL) FY 86
PXBAW	B PLANT AGING WASTE SUPERNATANT FROM RETRIEVED AGING WASTE
PXBSG	B PLANT AGING WASTE SOLIDS FROM RETRIEVED AGING WASTE
PXFTF	DILUTE, NON-COMPLEXED WASTE FROM PUREX MISC. STREAMS (FFTF)
PXLOW	PUREX LOW LEVEL WASTE THAT WENT TO SST
PXMET	PUREX DILUTE, NON-COMPLEXED DECLADDING: SPENT METATHESIS
PXMSC	DILUTE, NON-COMPLEXED WASTE FROM PUREX MISC. STREAMS (NPR FUEL)
PXNAW	AGING WASTE FROM PUREX HIGH LEVEL WASTE
QA	Quality Assurance
QATF	Quality Assurance Task Force
Questionable Integrity	Any tank that has a small decrease in liquid level or a radiation increase in an associated dry well, for which the remaining data for the tank is insufficient to support a conclusion with 95% confidence that the tank is sound.
R	REDOX High Level Waste (HLW) was generated from 1952 to 1966. It used methylisobutylketone (hexone) as a solvent, and extracted both uranium and plutonium. (S-Plant) Ran from Jan. 1952 to Dec. 1967.
R1	REDOX waste generated between 1952 and 1957.
R2	REDOX waste generated between 1958 and 1966.
R202S	
RCC	??REDOX CC??
RCOND	REDOX Condensate.
RCONDCRIB	REDOX Condensate to Crib.
REC	Receive from Trans_tank and are always positive. Trans_tank will always be one of the primary 177 waste tanks. See also SEND, TR, and XFER.

AppendixD.

REDOX	Also know as S-Plant where REDOX process ran 1952-66? See also R, and CWR.
Removed from Service (Tanks)	Any tank that is a confirmed leaker or is not intended for reuse.
RESD	Residual Evaporator Liquor
RISER	Pipe leading into tank dome See also Blank Space.(term located SD-RE-TI-053 Rev. 8)
Riser P/CP	Riser is recessed below a cement pad with an access plate at grade (term located SD-RE-TI-053 Rev. 8)
RIX	REDOX Ion Exchange. See also RTX, and SIX
RP	Receiving Pit (term located WHC-SD-WM-ER-204, Rev.0)
RMA	Remote Mechanical A-Line.
RMC	Remote Mechanical C-Line—Process used in Z Plant.
RSltCk	Salt Cake precipitate from self-concentration in S and SX Farms.
RSN	REDOX Supernatant
RSS	REDOX Sludge Supernatant
RSS	Remote Supervisory Station
RTD	Resistance Temperature Detector (term located WHC-SD-WM-TI-553, Rev 0)
RTX	REDOX Ion Exchange. See also SIX, and RIX
S	Transaction Flag Key-Partial Neutralization (PNF).
S	Sludge Level Measurement Device (term located Tank and Surveillance and Waste Status Summary Report)
S1SltCk	Salt cake waste generated from the 242-S Evaporator/crystallizer from 1973 until 1976.
S2SltSlry	Salt cake waste generated from the 242-S Evaporator/crystallizer from 1977 until 1980.
SA	Safety Assessment
Salt Cake	Crystallized Nitrate and other salts deposited in waste tanks, usually after active measures are taken to remove moisture. (term located Tank and Surveillance and Waste Status Summary Report)
Salt Slurries	Same as DSS, estimated from chemical model by precipitation (via evaporator). DSS derives from the supernatants of a variety of wastes following evaporation of water. See also DSS, and A2Altslr.
Salt Well	A hole drilled or sluiced into a salt cake and lined with a cylindrical screen to permit drainage and jet pumping of interstitial liquors.
Salt Well Liquid	See also SWLIQ
Salt-Well Pump	A low-capacity pump used to remove interstitial liquid from wells.
SAR	*Safety Analysis Report*
SCAV	Scavenging campaign with FeCN on TBP, 1952-57. See also T00-T##, P00-P##, and Scavenged.
Scavenged	Waste which has been treated with ferrocyanide to remove cesium for the supernatant by precipitating it into the sludge. See also SCAV
SCBA	Self-contained Breathing Apparatus
SCO	*Safety Condition for Operation*
SCWO	Supercritical Water Oxidation (SCWO) destroys organics completed with metal ions and precipitates the multivalent metals out of solution as their hydroxides. Process conditions for SCWO are 500° C and 3,000 psi. (term located WHC-EP-0791)
SD	Slurry distributor (term located WHC-SD-WM-ER-204, Rev.0)
SDRCSF	Slurry distributor removal containment seal fixture
SVOA	Semi-volatile organic analysis
SEND	Transfer from Tank_n to Trans_tank and is always negative. Trans_tank will always be one of the primary 177 waste tanks. See also TR and XFER.
SET	Connect cascaded tanks together. See also CAS and END.

AppendixD.

SF	Slurry feed?
Side referenced tank	A dished-bottom tank where the zero point for the liquid-level gauges is at the elevation that the dished bottom begins.
SIX	REDOX Ion Exchange. See also RTX, and RIX.
SL	DOUBLE-SHELL SLURRY
SL	Sludge (Solids formed during sodium hydroxide additions to waste. Sludge usually was in the form of suspended solids when the waste was originally received in the tank from the waste generator. In-tank photographs may be used to estimate the volume.
SLS	solid/liquid separation (term located WHC-EP-0791)
SLT	sludge level tape (term located WHC-SD-WM-ER-204, Rev.0)
SL3SY	DOUBLE-SHELL SLURRY FROM EOFY 80 SY-103 INVENTORY
Sludge	Solids formed after waste neutralization with sodium hydroxide additions. Sludges usually sediment and remain in the tanks into which the waste is originally added.
SLUD31	Sludge Wash C HLW stream (term located WHC-EP-0791)
Slugs	An term for uranium fuel elements which had been machined or extruded into short cylinders which were then clad or encased in corrosion-resistant metals.
Sluicing, or Sluiced	At Hanford, this means to dissolve or suspend in solution by action of a high pressure water stream.
SLULLW	Sludge Wash C LLW stream
SMM	*Supernatant Mixing Model* that calculates the composition of tank liquids and concentrates as linear combinations of HDW supernatants.
SMP	Sludge Measurement Port (term located WHC-SD-WM-ER-204, Rev.0 & SD-RE-TI-053 Rev. 8)
SN	Sluicing nozzle (term located WHC-SD-WM-ER-204, Rev.0)
SOE	Safe Operating Envelope
SOLEX	Solvent Extraction Option (term located WHC-EP-0791)
Sound or Sound Tank	The integrity classification of a waste storage tank for which surveillance data indicate no loss of liquid from a breach of integrity.
SP	Sluice pit (term located WHC-SD-WM-ER-204, Rev.0)
SPARE	Spare riser with no current function or planned use - possible concrete plug underneath plate (term located SD-RE-TI-053 Rev. 8)
S PLANT	The facility at Hanford which contains the original extraction process for recovery of both plutonium and uranium. See also REDOX
SREX	Strontium extraction and solvent extraction.(term located WHC-EP-0791)
SPRG	Sparge-transfer of water or volume?
SR	SST SOLIDS RETRIEVED
SR	Sluicing Riser (term located WHC-SD-WM-ER-204, Rev.0)
SRCVR	Slurry Receiver Tank
SREX	Strontium extraction
SRR	Slurred PUREX sludge from A and AX Farms was sent to B Plant for strontium recovery from 1967-76. Some 801 kgal was sent to and 2,810 kgal returned from B Plant with A-102, A-106, and AX-103 as a staging tanks sending sludge to AR vault and supernatant to C-105.
SRS	Strontium Recovery Supernatant. The sludges sluiced for SRR were washed in AR vault with supernatant from C-105. The resulting supernatants were sent to CSR.
SRS	Strontium sludge
SRS	Savannah River Site (term located WHC-EP-0791)
S.S.	Evidently refers to a direct addition from plant to a cascade series that bypassed the first tank in the cascade series.
SST	single-shell tank (term located WHC-SD-WM-ER-204, Rev.0)
SSW	Strontium Semiworks. Called C Plant or Hot Semiworks earlier, was pilot for both REDOX and PUREX, Jul. 1952 to Jul. 1956. Then reconfigured for Strontium recovery pilot plant from July 1960 to July 1967. See also C Plant and HS.

AppendixD.

STAB	Tank stabilized by removal of liquid. Both floating suction and salt-well jet pumps are used to remove liquid.
Stabilization	The removal or immobilization, as completely as possible, or the liquid contained in a radioactive waste storage tank by salt well pumping, open hole salt well pumping, adding diatomaceous earth, etc.
STAT	Tank level measurement for each quarter in kgal (1 kgal = 1,000 gallons) as reported by Anderson.
Static Tank	A tank with no significant change in liquid level or involvement in transfer operations during a stated period of time.
SU	Supernatant (Drainable Liquid Remaining minus Drainable Interstitial). Supernate is usually derived by subtracting the solids level measurement from the liquid level measurement.
SW	SST WASHED SOLIDS
SWA	Sludge Wash A (term located WHC-EP-0791)
SWB	Sludge Wash B (term located WHC-EP-0791)
SWC	Sludge Wash C (term located WHC-EP-0791)
SWLIQ	DILUTE, NON-COMPLEXED WASTE FROM EAST AREA SINGLE-SHELL TANKS
SWLQW	DILUTE, NON-COMPLEXED WASTE FROM WEST AREA SSTs
SWP	Salt well pump (term located WHC-SD-WM-ER-204, Rev.0)
SW RCR	Salt well receiver
SWPS	Salt well pump and screen (term located WHC-SD-WM-ER-204, Rev.0)
SWS	Salt well screen (term located WHC-SD-WM-ER-204, Rev.0)
T1SltCk	Salt cake waste generated from the 242-T Evaporator -crystallizer from 1951 until 1955
T2SltCk	Salt cake waste generated from the 242-T Evaporator -crystallizer from 1955 until 1965
Tank Farm	An area containing a number of storage tanks; i.e., a chemical tank farm for storage of chemicals used in a plant, or underground waste tank storage or radioactive waste.
TBP	Tri-Butyl Phosphate-waste from solvent based uranium recovery operation in '50's. Renamed to UR waste in the Defined Waste report. More usually refers to the chemical tributyl phosphate, $OP(OC_4H_9)_3$, which was used in uranium recovery and in PUREX.
TBX	Instrument leads of several kinds - usually on annulus of tank (term located SD-RE-TI-053 Rev. 8)
TC	Thermocouple (term located WHC-SD-WM-TI-553, Rev 0)
TCIX	Technetium ion exchange (term located WHC-EP-0791)
TCO	DILUTE NON-COMPLEXED WASTE FROM WEST AREA SINGLE-SHELL TANKS
TCT	Thermocouple tree
TEDF	Treated Effluent Disposal Facility
TEMP	Temperature probe (term located SD-RE-TI-053 Rev. 8)
Terminal Liquor	The liquid product from the Evaporation-Crystallization Process which, upon further concentration, forms an unacceptable solid for storage in single-shell tanks. Terminal liquor is characterized by caustic concentration of approximately 5.5M (the caustic molarity will be lower if the Aluminum Salt Saturation is reached first). See also HDRL.
TFeCN	Ferrocyanide sludge produced by in-tank or in-farm scavenging. See also FeCN, PFeCN, UR, P00, T00.
TFEPTU	Tank Farms and Evaporator Process Technology Unit (term located SD-WM-PE-029 Rev. 0, 242-A Evap/Crystallizer FY 84-86 Campaign Run)
TGA	Thermal Gravimetric Analysis
TH	Thoria HLW or Cladding waste
TH66	

AppendixD.

TH77	
Thermocouple Tree	A group of thermocouples assembled in a pipe and inserted into a waste tank for measuring temperatures at regular (normally 2 foot) vertical intervals.
Thermowell	A well in a waste tank which contains thermocouples
THFTCA	Tetrahydrofurantetracarboxylic acid (term located WHC-EP-0791)
THL	Thoria Low Level
TK	Tank
TK	TK-17-2 was an early name for B Plant. See also B Plant and 222-B.
TL	Terminal Liquor
TLM	*Tank Layer Model*derived from the Waste Status and Transaction Record Summary (WSTRS) database.
TLV	Threshold limit value
TLV-C	Threshold limit value-ceiling
TLV-STEL	Threshold limit value-short-term exposure limit
TLV-TWA	Threshold limit value-time weighted average
TMACS	Tank monitor and control system (term located WHC-SD-WM-TI-553, Rev 0)
TOC	Total organic carbon (term located WHC-EP-0791)
T00-##	In-Tank scavenging with FeCN. See also SCAV, P##
TP	Temperature probe (term located WHC-SD-WM-ER-204, Rev.0)
TP	Throughput nominal plant throughput PFR (Pu Nitrate), RMA (Pu Oxide), RMC (Pu Metal). See SD-WM-PE-029 Rev.0, 242-A Evap/Crystallizer FY 84-86 Campaign Run
TPA	Tri-Party Agreement includes DOE, Washington State Dept. of Ecology, and the EPA
TPLAL	DILUTE, NON-COMPLEXED WASTE FROM T PLANT
TPLAN	DILUTE, NON-COMPLEXED WASTE FROM T PLANT
T Plant	Decontamination plant for various equipment. Originally built for $BiPO_4$ process, but since only used for decontamination. $BiPO_4$ ran from Dec. 1944 to Aug. 1956. See also 222-T
TPLAS	SLUDGE FROM T PLANT OPERATIONS
TR	Transfer from tank. See also REC, SEND, and XFER
TRAC	Hanford radionuclide Tracking program devised by Jungfleisch. Also, Transient Reactor Analysis Code developed at LANL.
Trench	A deep furrow in the ground. At Hanford, they are used for the disposal of solid waste.
trFlag	Transaction Flag Keys—used by W-TRAC—See also CDF,D,E,S,SV,1,3,6,.17,.33.
TRG	Test Review Group
TRU	Transuranic. See also DN, DN/PD, DN/PT, P, PFP, PRF, Z, and 224.
TRUEX	Transuranic Extraction. See also PFPPT.
TRUEX-C	Transuranic Extraction Option C (term located WHC-EP-0791)
TRULLW	TRUEX-C LLW stream (term located WHC-EP-0791)
TRUX31	TRUEX-C HLW stream (term located WHC-EP-0791)
TSD	Treatment, Storage or Disposal Unit
TSR	Technical Safety Requirement
TTF	Thermal Treatment Facility
TWRS	Tank Waste Remediation System
TXR Vault	Vault in TX Farm used in FeCN scavenging in TX Farm.
Type I Tank	These are the 200 series tanks found in B, C, T, and U Farm. They have an operating capacity of 55,000 gal., a 20-ft., diameter, a 6-in. dish bottom, and a 3-ft. knuckle. Generation is not associated with Type I tanks.

AppendixD.

Type II Tank	These are the original (1st generation) tank designs, which are found in B,C,T, and U (excluding the 200 series tanks), and BX Tank Farms. See also 1st Generation Tank.
Type III Tank	These are the 2nd generation tank designs, which are found in BY, S, TX, and TY Tank Farms. See also 2nd Generation Tank.
Type IV Tank	These are 3rd, 4th, and 5th generation tank designs, which are found in SX, A, and AX Tank Farms, respectively. See also 3rd Generation Tank, 4th Generation Tank, and 5th Generation Tank.
Type V Tank	These are the first double-shell tank designs, which are found in AY, AZ, and SY Tank Farms.
U1U2	DILUTE, NON-COMPLEXED WASTE FROM U1/U2 GROUNDWATER PUMPING
UFL	Upper Flammability Limit (term located WHC-EP-0702, Rev 0)
UNC	Dilute sulfate waste . See also HEDL. (see SD-WM-PE-029 Rev.0, 242-A Evap/Crystallizer FY 84-86 Campaign Run)
UNC	UNC Nuclear Industries Inc.
UNC Fuels	
UNH Stream	See 224-UA
UNKN	UNKNOWN WASTE ORIGIN SINK
UOR	Unusual Occurrence Report
U1U2	Dilute, non-complexed waste from U1/Us ground water pumping.
U Plant	Uranium Recovery Plant from Mar. 1952 to Jan. 1958, UO_3 Plant from then until Sept. 1972. Restarted in Mar. 1984, and is now shutdown. See also 222-U, UR, and TBP.
UPS	Uninterruptible Power Supply
UR	Uranium Recovery Operation in 222-U, 1952-57. Created TBP (primary waste) and FeCN (scavenging wastes). TBP waste called UR waste in Defined Waste report. See also, TFeCN, PFeCN, P00, T00, FeCN. See also TBP.
UREX	Uranium Extraction
USNRC	US Nuclear Regulatory Commission
USBM	US Bureau of Mines (term located WHC-EP-0702, Rev 0)
USNRC	U S Nuclear Regulatory Commission
USQ	Unreviewed Safety Question (term located WHC-EP-0702, Rev 0)
UX-241	???
V & V	Validation and Verification
VAQUELLW	Varied aqueous liquids (term located WHC-EP-0791)
VCBUSTL	Varied combustible solids and liquids (term located WHC-EP-0791)
VDTT	Velocity, Density, Thermocouple tree
VM	Vapor Manifold (term located WHC-SD-WM-ER-204, Rev.0)
VOF	Volume Of Fluid
VOFFGAS	Varied Cell Air and OffGas (term located WHC-EP-0791)
VNCBUSTS	Varied Noncombustible Solids (term located WHC-EP-0791)
WASHF	OUTFLOW TO SST WASH FACILITY
Waste Tank Safety Issue	A potentially unsafe condition in the handling of waste material in underground storage tanks that requires corrective action to reduce or eliminate the unsafe condition. (term located Tank and Surveillance and Waste Status Summary Report)
Watch List Tank	An underground storage tank containing waste that requires special safety precautions because it may have a serious potential for release of high-level radioactive waste because of uncontrolled increases in temperatures or pressure. Special restrictions have been placed on these tanks by "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," Section 3137 of the National Defense Authorization Act for Fiscal Year 199l, November 5, 1990, Public Law 101-501 (Also known as the Wyden Amendment) (term located Tank and Surveillance and Waste Status Summary Report)

AppendixD.

WATER	FLUSH WATER FROM MISCELLANEOUS SOURCES. See also WTR.
WC	Weather Cover (polyurethane foam) (term located WHC-SD-WM-ER-204, Rev.0)
WESF-Plant	Construction complete in 1974. Capable of producing up to 350 capsules of cesium and 175 capsules of strontium per year. 1575 cesium capsules and 625 strontium capsules produced between 1974 and 1985. See also 225-B
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant (term located WHC-EP-0791)
WMIS	Waste Management Information System (term located WHC-EP-0791)
WRAP	Hanford's first major solid waste processing plant, serving to analyze and repackage containers of waste left from the Hanford defense mission and generated by cleanup activities.
WSCF	Waste Sampling and Characterization Facility
WSTRS	*Waste Status and Transaction Records Summary*
WTR	Water. See also WATER.
WVDP	West Valley Demonstration Project (term located WHC-EP-0791)
WVP	Waste volume projections
WVR	Waste volume reduction
XFER	Transfer of waste out of tank. See also REC, SEND, and TR.
XIN	Addition of primary waste from plant (always positive). This transaction also covers waste returning from secondary processing operations.
Z	Z Plant waste. 234-5Z waste/Z Plant Pu Finishing. See also DN, DN/PD, DN/PT, P, PFP, PRF, TRU, and 224.
ZAW	Zirconium Acidified Waste (PUREX waste stream from Zirconium (Zircaloy II) cladded fuel.
ZHIGH	DILUTE, NON-COMPLEXED WASTE FROM THE PFP (WITHOUT TRUEX)
ZLAB	DILUTE, NON-COMPLEXED WASTE FROM PFP LABORATORIES
ZLOW	DILUTE, NON-COMPLEXED WASTE FROM PRE-FY85 Z PLANT OPERATIONS
ZPA	Zero Period Acceleration
Z Plant	Pu finishing plant. See also DN, DN/PD, DN/PT, P, PFP, PRF, TRU, Z, and 224. Operated from 1949 to 1991, and is now in standby
ZPRFL	DILUTE, NON-COMPLEXED WASTE FROM PRF PROCESSING
ZPRFS	PFP TRU SOLIDS FROM PRF PROCESSING
ZRM	Waste abbreviation
ZRMCL	DILUTE, NON-COMPLEXED WASTE FROM PFP RMC PROCESSING
ZRMCS	PFP TRU SOLIDS FROM PFP RMC PROCESSING
1AYIN	CONCENTRATED COMPLEX WASTE FROM AY-101 INVENTORY
1AZIN	PRE 2-81 AZ-101 INVENTORY
1C	1st Cycle Decontamination-BiPO4 process. Often included cladding waste. Held 10% of FP, 1% of Pu. See also BiO_4, MW, and 2 C.
1C1	First cycle decontamination waste from the $BiPO_4$ process, 1944 to 1951.
1C2	First cycler decontamination waste from the $BiP0_4$ process, 1952 to 1956.
1C44-51	Includes CW
1C52-56	Includes CW
1CEB	1st Cycle Evaporator Bottoms
1CF	??1st Cycle Feed?? Set to WATER in TRAC.
1CFeCN	Ferrocyanide sludge produced by in-plant scavenging of 1C supernatant wastes. Used 0.005 M ferrocyanide. See also FECN, PFeCN, TFeCN.
1CS	1st Cycle Scavenging waste. TY-101 and TY-103 received 1C waste that was scavenged with FeCN before it was added to the tanks. Termed 1CFeCN.
1st Generation Tank	The original tank design encompassing Tank Farms B, C, T, U (excluding the 200 series tanks), and BX. These tanks have an operating capacity of 530,000 gal, a 75-ft. diameter, a 12-in. dish bottom, and a 4-ft knuckle. Also see Type II tanks.

AppendixD.

2C	2nd Cycle Waste from BiO_4 process. Supernatant often cribbed, 0.1% of FP, 1% of Pu. See also BiO_4,MW, and 1C.
2C1	2nd Cycle Waste from BiO_4 process, 1944 to 1951
2C2	2nd Cycle Waste from BiO_4 process, 1952 to 1956
2AYIN	PRE 2-81 AY-102 INVENTORY
2AZIN	PRE 2-81 CONCENTRATED COMPLEX WASTE FROM AZ-102 INVENTORY
2SYIN	PRE 2-81 SY-102 INVENTORY
2nd Generation Tank	Same as original tank design (1st generation or type II) except the operating capacity was increased to 758,000 gal. Also, see Type III tanks.
202-S	Also known as S-Plant where REDOX process ran 1952-66? See also R, CWR, AND S-PLANT
204-AR	Rail Car Unloading Facility, completed in 1981, replaced 204-S as Rail Car Unloading Facility. Completed in 1981.
211-T	Chemical storage area used for nitric acid and sodium hydroxide storage, low-level radioactive sludge storage.
221-B	See also B Plant
221-T	Head End facilities (two cells) in 221-T Building are used by HEDL as a containment systems test facility to develop sodium aerosol data needed for the design of air cleaning equipment for large-scale Liquid Metal Fast Breeder Reactors. 221-T Building (Cell 4) used for interim storage of Pressurized Water Reactor Core II fuel from Shippingport Atomic Power Station. See also T-Plant.
222-B	One of the three original bismuth-phosphate processing facilities. Later converted to waste fractional plant. B Plant used for $BiPO_4$ 1944-52, then for FP recovery. See also B Plant and TK.
222-C	Initially a pilot plant for REDOX, later a pilot plant for PUREX and B Plant waste partitioning. See also C Plant.
222-T	T Plant used for $BiPO_4$ 1944-52.
222-U	One of the three original Bismuth Phosphate Processing Facilities. Later converted to a uranium recovery plant. See also U Plant.
224	LaF finishing waste. 224-U Waste. See also DN, DN/PD, DN/PT, P, PFP, PRF, TRU, and Z
224-2	Same as 224?
224-AR Vault	Originally designed for treating and transferring tank farm sludges to B Plant and for interim lag storage and transfer of PUREX acid wastes to Plant. Also for lag storage of neutralized high-level waste enroute from B Plant to tank farm storage. Construction completed in 1968 put in standby mode in 1978.
224-F	224-U Waste. LaF Pu Finishing Plant. Same as Z-Plant? See also LaF.
224-U	Completed in 1944 as part of U Plant complex. Never used for original purpose used as training facility from 1944 to 1950, converted to UO_3 Plant in 1951. Plant shut down in 1972. Restarted 1984. Feedlines from REDOX and U Plant canyon disconnected. See also 224-F.
224-UA	Constructed in 1957 with six calciners installed. UO_3 Plant capability sufficient to handle UNH stream from REDOX, U-Plant, and PUREX.
225-B	See also WESF Plant
231-Z	DILUTE, PHOSPHATE WASTE FROM Z-231 LABORATORIES
241-Z	Underground sump pit.
242-A	Reduced pressure evaporator in East Area designed for 30% solids. A-102 was feed 1977-1980. AW-102 was feed 1981-present.
242-B	Atmospheric evaporator used for concentrating wastes, 1952-56. B-106 was feed tank.
242-S	Reduced pressure evaporator designed for 30% solids 1973-80. S-102 was feed '73-'77. SY-102 was feed '77-'81.
242-T	Atmospheric evaporator used to concentrate wastes. 1952-56 and 1965-76. TX-118 was feed tank.

AppendixD.

242-Z	Waste treatment facility. Equipment was used to treat PRF waste and extract americium from the waste. Scheduled for D&D.
244-AR Vault	Originally designed for treating and transferring tank farm sludges to B Plant and for interim lag storage and transfer of PUREX acid wastes to B Plant. Also for lag storage of neutralized high-level waste enroute from B Plant to tank farm storage.
2706-T	Used as equipment low-level decontamination facility. See also T Plant, 271-T and 221-T.
271-T	Building used for chemical make-up area and dry storage, and offices. See also T Plant, 2706-T, and 221-T.
2736-ZA	Plutonium Storage and Support Facility. Used to store plutonium in a variety of forms. Plutonium packaged in metal containers. Also used for shipping, receiving, repackaging, and nondestructive analysis of plutonium. See also 2736-ZAB.
2736-ZAB	Plutonium Storage and Support Facility. Used to store plutonium in a variety of forms. Plutonium packaged in metal containers. Also used for shipping receiving, repackaging, and nondestructive analysis of plutonium. See also 2736-ZA
3AWIN	PRE 2-81 AW-103 INVENTORY
3rd Generation Tank	The first generation of the type IV tanks, contains the SX Tank Farm only. These Tanks have a 1,000,000 gal. operating capacity, a 75-ft. diameter, a 14.875-in. dish bottom, and no knuckle. See also Type IV tanks.
4th Generation Tank	The second generation of the type IV tanks, contains the A Tank Farm only. These tanks are the same as the 3rd generation except they have a flat bottom. See also Type IV Tanks.
5	B Plant Tank 5 and 6 waste.
5-6#	Cells 5&6 from B Plant
5AWIN	PRE 2-81 AW-105 INVENTORY
5th Generation Tank	The third generation of the Type IV tanks, found only in the AX Tank Farm. These tanks are the same as the 4th generation with the addition of grid drain slots beneath the steel liner bottom.
6AWIN	CONCENTRATED PHOSPHATE WASTE IN AW-106 INVENTORY

Note on transactions involving:

CAS-Cascades that "overfill" are assumed to have been directed to low-level "sites" (cribs or trenches?). No MW or R was cascaded to low-level sites.

EVAP-Operations involving evaporators are assumed to change the waste by the difference in the transaction and status reports.

R-REDOX plant used concentrator 1967-72.

B-B PLANT used concentrator 1967-68.

Definitions in all caps are from the Waste Volume Projection Data Set.

AppendixE.

Defined Waste Compositions Spreadsheet

Each column represents one of the forty-eight Hanford Defined Wastes (HDW's), with some other columns for other wastes. A waste's definition begins with fuel processed information, then, from top to bottom, chemicals added (species that derive from the fuel processed and chemicals added lists), sludge composition followed by a supernatant composition, both in mol/L. Next is information about the solids precipitated followed by the are sludge and supernatant compositions in ppm. Finally, there is information about the amounts of supernatant feed that ended up in various evaporator campaigns.

The sludge and supernatant compositions are determined by the solubility of each species (see text and Table 13) as well as the solids volume per cent parameter (vol% solids) that is established for each waste type. The solids precipitated are shown in later rows as molarity within sludge layer, volume of pure solids, and fraction of total species precipitated. Solubilities are set by adjusting the fraction precipitated parameter until the supernatant molarity reaches the target value. This can be performed by hand or by a macro routine that has been written to do the entire spreadsheet.

Speadsheet contents:

campaign information

chemicals added (mol/L)

species total concentration (mol/L)

sludge species (mol/L)

supernatant species (mol/L)

solids concentration in layer (mol/L)

solids volumes (cc)

solids fraction precipitated

sludge concentration (ppm)

supernatant concentration (ppm)

supernatant volumes to evaporator campaigns (kgal)

AppendixF.

Spreadsheet Equations

	1
	MW1
st.date	1944
en.date	1949
short tons fuel	3676
kgal waste input	
volume factor	
kgal waste out	15325
gal/ton	=B9/B6*1000
avg. MWD/T	232
g Pu-239*/MWD	0.76
kg Pu-239*	=B13*B12*B6/1000
Pu* ex. %	99
res. kg Pu-239*	=B14*(100-B15)/100
Pu-239* µCi/L	=B16*1000*0.061/B9/3785*1000000
(* Pu-239 is U-233 for TH waste)	
then	
MCi Cs-137	=B12*B6*24*3600/(200*0.0000000000001602)/6.023E+23*0.062*11900*B13*1.156
MCi Sr-90	=B12*B6*24*3600/(200*0.0000000000001602)/6.023E+23*0.058*12700*B13
kCi Tc-99	=B12*B6*24*3600/(200*0.0000000000001602)/6.023E+23*0.061*1.69*B13*1000
Ci I-129	=B12*B6*24*3600/(200*0.0000000000001602)/6.023E+23*0.01*0.021*B13*1000000
1994	
MCi Cs-137	=B20*EXP(-LN(2)*(1994-(B3+B4)/2)/30.2)
MCi Sr-90	=B21*EXP(-LN(2)*(1994-(B3+B4)/2)/28.1)
	=B9*B215*3785/1000000
	=B33*B168*3785/1000000
kgal solids	=(B9+C9)*B31/100
vol% solids	12
uncertainty	
kgal solids left	736
CSR in—>	
	MW1
	FMJ
chemicals in mol/L	**MW1**
HNO3	0.1
NaAlO2	
Al(NO3)3	
Fe(HSO4)2	
Fe(NO3)3	=0.04*0.4
NaCrO4	=B42*0.2
BiPO4	
ZrO(OH)2	
NiSO4	=B42*0.1
NaOH	=B42*(3+2*0.1)+0.09
NaNO2	
Na2CO3	0.6
Na3PO4	0.18
Na2SO4	0.21
Na2SiO3	0.004

AppendixF.

Na2SiF6	
NaF	
NaCl	=B47*BQ3
Na2S	
La(NO3)3	
Hg(NO3)2	
KNO3	=B47*BQ4
Ca(NO3)2	=0.00012*B47+0.018
KMnO4	
Sr(NO3)2	
PbSO4	
H3C6H5O7	
H4EDTA	
H3HEDTA	
Hglycolate	
Hacetate	
H2oxalate	
Na4Fe(CN)6	
NH3	
Pu (µCi/L)	=(B17*B9+C17*C9)/(B9+C9)
U (M)	0.16
Cs (Ci/L)	=0.09*(B25+C25)/(B9+C9)/3785*1000000
Sr (Ci/L)	=0.98*(B26+C26)*1000000/(B9+C9)/3785
species mol/L	**MW1**
Na	=B39+B43+B47+B48+B49*2+B50*3+B51*2+B52*2+B53*2+B54+B55+B56*2+B70*4
Al	=B39+B40
Fe	=B41+B42
Cr	=B43
Bi	=B44
La	
Hg	=B58
ZrO(OH)2	=B45
Pb	=B63
Ni	=B46
Sr	
Mn	=B61
Ca	=B60
K	=B61+B59
balance	**=B78+B79*3+B80*3+B81*3+B82*3+B83*3+B84*2+B85*4+B86*2+B87*2+B88*2+ *4+B90*2+B91+B119*6- (B97+B98+B99+B100*2+B101*3+B102*2+B103*2+B104+B105+B106*3+B107*4 08*3+B110+B111+B112*2+B117*4)**
density	
vol%solids	=B31
void frac.	=1-SUM(B251:B284)/1000
species	
OH	=B47-B41-B53*6+B43*4+B45*4+B39*4-B38-B64*3-B65*4-B66*3-B67-B68-B69*2+B73*6+B61*5
NO3	=(B38+(B40+B42+B57)*3+B59+(B58+B60+B62)*2)
NO2	=B48
CO3	=B49
PO4	=B44+B50
SO4	=B41*2+B46+B51+B63
SiO3	=B52+B53

AppendixF.

F	=B53*6+B54
Cl	=B55
C6H5O7	=B64
EDTA	=B65
HEDTA	=B66
glycolate	=B67
acetate	
oxalate	=B69
DBP	
butanol	
NH3	=B71
Fe(CN)6----	=B70
Pu	=B72
U	=B73
Cs	200
Sr	
pred. sludge mol/L	**MW1**
Na	=B218+B219+B220+B221+(B222+B223+B224)*2+(B225+B226)*3+(B227+B228+B22 9)*2+B231+B239*3+B240+B241*2+B242*3+B243*4+B247*2+B170*B$95
Al	=B230+B231+B171*B$95
Fe(total)	=B232+B172*B$95
Cr	=B233+B173*B$95
Bi	=B235+B174*B$95
La	=B237+B175*B$95
Hg	=B238+B176*B$95
ZrO(OH)2	=B246+B177*B$95
Pb	=B236+B178*B$95
Ni	=B245+B179*B$95
Sr	=B88/B$94*100+B180*B$95
Mn	=B234+B181*B$95
Ca	=B244+B182*B$95
K	=B183*B$95
balance	**=B123+B124*3+B125*3+B126*3+B127*3+B128*3+B129*2+B130*4+B131*2+B13 +B133*2+B134*4+B135*2+B136+6*B166- (B144+B145+B146+B147*2+B148*3+B149*2+B150*2+B151+B152+B153*3+B15 +B155*3+B157+B158+B159*2+B164*4)**
density	=SUMPRODUCT(B218:B248,$BP218:$BP248)/1000+B185*B140
vol%solids	=B94
void frac.	=B95
wt.% H2O	=B185*B140/B138*B188+(SUMPRODUCT(B218:B248,$BS218:$BS248))*18/B138/10 00*100
TOC wt.%C	=SUMPRODUCT(B153:B164,$BP153:$BP164)/B138/1000*100
free OH-	=B191*B140
OH-	=B124*4- B230+B222*2+B232*3+B233*3+B234*4+B236*2+B237*3+B238*2+B245*2+B246*4+B 143+B248*6
NO3-	=B218+B192*B$95*B448
NO2-	=B219+B193*B$95+B192*B$95*(1-B448)
CO3--	=B223+B194*B$95+B244
PO4---	=B225+B226+B235+B195*B$95
SO4--	=B227+B228+B196*B$95
SiO3--	=B229+B197*B$95
F-	=B221+B198*B$95
Cl-	=B220+B199*B$95

AppendixF.

C6H5O7---	=B239+B200*B$95
EDTA----	=B243+B201*B$95
HEDTA---	=B242+B202*B$95
glycolate-	=B204*B$95
acetate-	=B240+B205*B$95
oxalate--	=B241+B206*B$95
DBP	=B207*B$95
butanol	=B208*B$95
NH3	=(B116+(B146+B145*(1-B448))*B449)*B$95
Fe(CN)6----	
Pu (µCi/g)	=B72*B317/B$138/1000/B$139*100+B212/B$185/1000*B$187
U (M)	=B248+B213*B$95
Cs (Ci/L)	=B74*B319/B$139*100+B214*B$187
Sr (Ci/L)	=B75*B320/B$139*100+B215*B$187
pred. su mol/L	**MW1**
Na	=(B78-B79*B300-B98*B287-B99*B288-B105*B289-B104*B290-2*(B100-B90*B313)*B292-3*(B101-B82*B304)*B295-2*B102*B297-2*B103*B298-3*B106*B308-4*B107*B312-3*B108*B311-B110*B309-B111*B309-2*B112*B310-2*B117*B316)/(1-(1-B$95)*B$94/100)
Al(OH)4 -	=B79*(1-B299-B300)/(1-(1-B$95)*B$94/100)
Fe	=B80*(1-B301)/(1-(1-B$95)*B$94/100)
Cr	=B81*(1-B302)/(1-(1-B$95)*B$94/100)
Bi	=B82*(1-B304)/(1-(1-B$95)*B$94/100)
La	=B83/(1-(1-B$95)*B$94/100)
Hg	=B84*(1-B307)/(1-(1-B$95)*B$94/100)
Zr	=B85*(1-B315)/(1-(1-B$95)*B$94/100)
Pb	=B86*(1-B305)/(1-(1-B$95)*B$94/100)
Ni	=B87*(1-B314)/(1-(1-B$95)*B$94/100)
Sr	=B88/(1-(1-B$95)*B$94/100)
Mn	=B89*(1-B303)/(1-(1-B$95)*B$94/100)
Ca	=B90*(1-B313)/(1-(1-B$95)*B$94/100)
K	=B91/(1-(1-B$95)*B$94/100)
balance	=B170-B171+B172*3+B173*3+B174*3+B175*3+B176*2+B177*4+B178*2+B179*2+B180*2+B181*4+B182*2+B183+B213*6-(B191+B192+B193+B194*2+B195*3+B196*2+B197*2+B198+B199+B200*3+B201*4+B202*3+B204+B205+B206*2)
density	=1+0.038*B170+0.07*B171-0.015*B191
vol%solids	=B94
void frac.	=B95
wt.% H2O	=(1-(SUMPRODUCT(B170:B183,$BP170:$BP183)+SUMPRODUCT(B191:B207,$BP191:$BP207)+B213*$BP213)/B185/1000)*100
TOC wt.%C	=SUMPRODUCT(B200:B211,$BQ200:$BQ211)/B185/1000*100
species	excludes hydroxide bound to Al
OH-	=(B97-B79*(4-B299)-2*B88*B291-3*B83*B306-2*B84*B307-3*B80*B301-3*B81*B302-4*B85*B315-2*B86*B305-2*B87*B314-4*B89*B303-6*B119*B318)/(1-(1-B$95)*B$94/100)
NO3-	=B98*(1-B287)/(1-(1-B$95)*B$94/100)*B446
NO2-	=B99*(1-B288)/(1-(1-B$95)*B$94/100)+B98*(1-B287)/(1-(1-B$95)*B$94/100)*(1-B446)
CO3--	=(B100-B90*B313)*(1-B292)/(1-(1-B$95)*B$94/100)
PO4---	=(B101-B82*B304)*(1-B295)/(1-(1-B$95)*B$94/100)
SO4--	=B102*(1-B297)/(1-(1-B$95)*B$94/100)
SiO3--	=B103*(1-B298)/(1-(1-B$95)*B$94/100)

AppendixF.

F-	=B104*(1-B290)/(1-(1-B$95)*B$94/100)
Cl-	=B105*(1-B289)/(1-(1-B$95)*B$94/100)
C6H5O7---	=B106/(1-(1-B$95)*B$94/100)
EDTA----	=B107/(1-(1-B$95)*B$94/100)
HEDTA---	=B108/(1-(1-B$95)*B$94/100)
	=B109/(1-(1-B$95)*B$94/100)
glycolate-	=B110/(1-(1-B$95)*B$94/100)
acetate-	=B111/(1-(1-B$95)*B$94/100)
oxalate--	=B112/(1-(1-B$95)*B$94/100)
DBP	=B113/(1-(1-B$95)*B$94/100)
butanol	=B114/(1-(1-B$95)*B$94/100)
	=B115/(1-(1-B$95)*B$94/100)
NH3	=(B116+(B193+B192*(1-B446))*B447)/(1-(1-B$95)*B$94/100)
Fe(CN)6----	=B117/(1-(1-B$95)*B$94/100)
Pu (µCi/L)	=B72*(1-B317)/(1-(1-B$95)*B$94/100)
U (M)	=B119*(1-B318)/(1-(1-B$95)*B$94/100)
Cs (Ci/L)	=B74*(1-B319)/(1-(1-B$95)*B$94/100)
Sr (Ci/L)	=B75*(1-B320)/(1-(1-B$95)*B$94/100)
prec. solids mol/L	**MW1**
NaNO3	
NaNO2	
NaCl	=B105/B94*100*B289
NaF	=B104/B94*100*B290
Sr(OH)2	
Na2CO3.7H2O	=(B100-B244)/B94*100*B292
Na3PO4.10H2O	=(B101-B235)/B94*100*B294
Na3PO4.12H2O	=(B101-B82)/B94*100*B295
Na2SO4	=B102/B94*100*B296
Na2SO4.10H2O	=B102/B94*100*B297
Na2SiO3	=B103/B94*100*B298
(Al2O3.3H2O)/2	=B79/B94*100*B299
NaAlO2	=B79/B94*100*B300
FeO(OH)	=B80/B94*100*B301
Cr(OH)3	=B81/B94*100*B302
MnO2	=B89/B94*100*B303
BiPO4	=B82/B94*100*B304
Pb(OH)2	=B86/B94*100*B305
(La2O3)/2	=B83/B94*100*B306
HgO	=B84/B94*100*B307
Na3cit.5H2O	
Na Acetate	
Na 2 Oxalate	=B112/B94*100*B310
Na3HEDTA	
Na4EDTA	
CaCO3.6H2O	=B90/B94*100*B313
Ni(OH)2	=B87/B94*100*B314
ZrO2•2H2O	=B85/B94*100*B315
Na2NiFe(CN)6.6H2O	
UO2(OH)2*6H2O	=B119/B94*100*B318
vol. solids cc	**MW1**
NaNO3	=B218*$BR218

AppendixF.

NaNO2	=B219*$BR219
NaCl	=B220*$BR220
NaF	=B221*$BR221
Sr(OH)2	=B222*$BR222
Na2CO3.7H2O	=B223*$BR223
Na2CO3.10H2O	=B224*$BR224
Na3PO4.10H2O	=B225*$BR225
Na3PO4.12H2O	=B226*$BR226
Na2SO4	=B227*$BR227
Na2SO4.10H2O	=B228*$BR228
Na2SiO3	=B229*$BR229
Al2O3.3H2O	=B230*$BR230
NaAlO2	=B231*$BR231
FeO(OH)	=B232*$BR232
Cr(OH)3	=B233*$BR233
MnO2	=B234*$BR234
BiPO4	=B235*$BR235
Pb(OH)2	=B236*$BR236
La2O3	=B237*$BR237
HgO	=B238*$BR238
Na3cit.5H2O	=B239*$BR239
NaAcetate	=B240*$BR240
Na2Oxalate	=B241*$BR241
Na3HEDTA	=B242*$BR242
Na4EDTA	=B243*$BR243
CaCO3.6H2O	=B244*$BR244
Ni(OH)2	=B245*$BR245
ZrO(OH)2	=B246*$BR246
Na2NiFe(CN)6.6H2O	
Pu	
UO2(OH)2*6H2O	=B248*$BR248
Cs	
Sr	
frac. prec. solids	**MW1**
NaNO3	0
NaNO2	0
NaCl	0
NaF	0
Sr(OH)2	
Na2CO3	0.1
Na3PO4	0.196602516392562
Na2SO4	0
Na2SiO3	0
Al2O3.3H2O	0.6
NaAlO2	0
FeO(OH)	0.879445986539662
Cr(OH)3	0
MnO2	1
BiPO4	1
Pb(OH)2	1

AppendixF.

La2O3	0.602547357703699
HgO	1
Na3cit.5H2O	0
Na Acetate	0
Na 2 Oxalate	0
Na3HEDTA	0
Na4EDTA	0
CaCO3.6H2O	0.518228299725275
Ni(OH)2	0
ZrO(OH)2	1
Na2NiFe(CN)6.6H2O	
Pu	0
UO2(OH)2*6H2O	0.75
Cs	=B287+B288
Sr	0
pred. sludge ppm	**MW1**
Na	=B123*$BP323/B$138/1000*1000000
Al	=B124*$BP324/B$138/1000*1000000
Fe	=B125*$BP325/B$138/1000*1000000
Cr	=B126*$BP326/B$138/1000*1000000
Bi	=B127*$BP327/B$138/1000*1000000
La	=B128*$BP328/B$138/1000*1000000
Hg	=B129*$BP329/B$138/1000*1000000
ZrO(OH)2	=B130*$BP330/B$138/1000*1000000
Pb	=B131*$BP331/B$138/1000*1000000
Ni	=B132*$BP332/B$138/1000*1000000
Sr	=B133*$BP333/B$138/1000*1000000
Mn	=B134*$BP334/B$138/1000*1000000
Ca	=B135*$BP335/B$138/1000*1000000
K	=B136*$BP336/B$138/1000*1000000
balance	
density	=B138
vol%solids	=B139
void frac.	=B140
wt.% H2O	=B141
TOC wt.%C	=B142
free OH-	=B143*$BP343/B$138/1000*1000000
OH-	=B144*$BP344/B$138/1000*1000000
NO3-	=B145*$BP345/B$138/1000*1000000
NO2-	=B146*$BP346/B$138/1000*1000000
CO3--	=B147*$BP347/B$138/1000*1000000
PO4---	=B148*$BP348/B$138/1000*1000000
SO4--	=B149*$BP349/B$138/1000*1000000
SiO3--	=B150*$BP350/B$138/1000*1000000
F-	=B151*$BP351/B$138/1000*1000000
Cl-	=B152*$BP352/B$138/1000*1000000
C6H5O7---	=B153*$BP353/B$138/1000*1000000
EDTA----	=B154*$BP354/B$138/1000*1000000
HEDTA---	=B155*$BP355/B$138/1000*1000000
	=B156*$BP356/B$138/1000*1000000
glycolate-	=B157*$BP357/B$138/1000*1000000
acetate-	=B158*$BP358/B$138/1000*1000000
oxalate--	=B159*$BP359/B$138/1000*1000000

AppendixF.

DBP	=B160*$BP360/B$138/1000*1000000
butanol	=B161*$BP361/B$138/1000*1000000
	=B162*$BP362/B$138/1000*1000000
NH3	=B163*$BP363/B$138/1000*1000000
NiFe(CN)6--	=B164*$BP364/B$138/1000*1000000
Pu (µCi/g)	=B165
U (µg/g)	=B166*$BP366/B$138/1000*1000000
Cs (µCi/g)	=B167/B$138*1000
Sr (µCi/g)	=B168/B$138*1000
pred. su. ppm	**MW1**
Na	=B170*$BP372/B$185/1000*1000000
Al	=B171*$BP373/B$185/1000*1000000
Fe	=B172*$BP374/B$185/1000*1000000
Cr	=B173*$BP375/B$185/1000*1000000
Bi	=B174*$BP376/B$185/1000*1000000
La	=B175*$BP377/B$185/1000*1000000
Hg	=B176*$BP378/B$185/1000*1000000
Zr	=B177*$BP379/B$185/1000*1000000
Pb	=B178*$BP380/B$185/1000*1000000
Ni	=B179*$BP381/B$185/1000*1000000
Sr	=B180*$BP382/B$185/1000*1000000
Mn	=B181*$BP383/B$185/1000*1000000
Ca	=B182*$BP384/B$185/1000*1000000
K	=B183*$BP385/B$185/1000*1000000
balance	
density	=B185
vol%solids	=B186
void frac.	=B187
wt.% H2O	=B188
TOC wt.%C	=B189
species	
OH	=B191*$BP393/B$185/1000*1000000
NO3	=B192*$BP394/B$185/1000*1000000
NO2	=B193*$BP395/B$185/1000*1000000
CO3	=B194*$BP396/B$185/1000*1000000
PO4	=B195*$BP397/B$185/1000*1000000
SO4	=B196*$BP398/B$185/1000*1000000
Si	=B197*$BP399/B$185/1000*1000000
F	=B198*$BP400/B$185/1000*1000000
Cl	=B199*$BP401/B$185/1000*1000000
C6H5O7	=B200*$BP402/B$185/1000*1000000
EDTA	=B201*$BP403/B$185/1000*1000000
HEDTA	=B202*$BP404/B$185/1000*1000000
NTA	=B203*$BP405/B$185/1000*1000000
glycolate	=B204*$BP406/B$185/1000*1000000
acetate	=B205*$BP407/B$185/1000*1000000
oxalate	=B206*$BP408/B$185/1000*1000000
DBP	=B207*$BP409/B$185/1000*1000000
butanol	=B208*$BP410/B$185/1000*1000000
	=B209*$BP411/B$185/1000*1000000
NH3	=B210*$BP412/B$185/1000*1000000
NiFe(CN)6--	=B211*$BP413/B$185/1000*1000000
Pu (µCi/L)	

AppendixF.

U (M)	
Cs (Ci/L)	
Sr (Ci/L)	
	MW1
B	7
B'	
BY	1
BY'	
A1	
A1'	
T1	319
T1'	
R	
R'	
T2	
T2'	
S1	
S1'	
S2	
S2'	
A2	
A2'	
CC	
CC'	
pass thru	
frac NO3- left in su	=EXP(-(B214+B215)*42.05*(EXP((1994-(B3+B4)/2)/42.05)-1)*A451)
frac. NO2 to NH3 in su	=1-EXP(-(B214+B215)*42.05*(EXP((1994-(B3+B4)/2)/42.05)-1)*A453)
frac NO3- left in sl	=EXP(-(B167+B168)*42.05*(EXP((1994-(B3+B4)/2)/42.05)-1)*A451)
frac. NO2 to NH3 in sl	=1-EXP(-(B167+B168)*42.05*(EXP((1994-(B3+B4)/2)/42.05)-1)*A453)
0.05	mol NO2/mol NO3/Ci/yr.
=0.3*8.4	gal TBP lost per ton fuel
0.0012	mol NH3/mol NO2/Ci/yr.
su ionic strength	=SQRT((SUMPRODUCT(B170:B183,$BV170:$BV183)+SUMPRODUCT(B191:B215,$BV191:$BV215))/2)
complexability	=SUMPRODUCT(B191:B215,$BW191:$BW215)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	MW1	**MW2**	**1C1**	**1C2**	**2C1**	**2C2**	**224**	**UR/TBP**	**PFeCN1**	**PFeCN2**	**TFeCN**	**1CFeCN**	**R1**	**R2**	**CWR1**	**CWR2**	**P1**	**P2**	**P2'**	**PL1**	**CWP1**	**CWP2**	**CWZr1**
st.date	1944	1950	1944	1950	1944	1950	1952	1952	1955	1955	1955	1955	1952	1959	1952	1961	1956	1963	1968	1968	1956	1961	1968
en.date	1949	1956	1949	1956	1949	1956	1956	1958	1958	1958	1958	1958	1958	1967	1960	1967	1962	1967	1972	1976	1960	1967	1972
short tons fuel	3,676	4,904	3,676	4,904	3,676	4,904							11,905	9,554	13,660	7,799	30,236	27,016	16,449	16,449	18,141	54,583	977
kgal waste input								35,574															
volume factor								0.65	0.37	0.58	0.33												
kgal waste out	15,325	20,551	11,767	16,531	8,962	22,727	8,300	23,090	13,179	20,537	11,602	3,818	25,067	10,690	2,975	1,752	26,502	10,208	397	1,325	6,276	22,286	1,650
gal/ton	4,169	4,191	3,201	3,371	2,438	4,634		6,621	total waste rate				2,106	1,119	218	225	877	378	24	81	346	408	1,689
		35,876		28,298																			
avg. MWD/T	232	439											661	661	661	661	661	661	923		661	687	1600
g Pu-239*/MWD	0.76	0.76											0.76	0.76	0.76	0.76	0.76	0.76	0.64		0.76	0.76	0.64
kg Pu-239*	648	1,636											5,981	4,800			15,189	13,572	9,717		9,113	28,499	1,000
Pu* ex. %	99	99	99	98.6	98.6	99	99.6						99.6	99.6	99.6	99.6	99.6	99.6	99.6		99.6	99.6	99
res. kg Pu-239*	6.48	16.36	6.48	22.91	9.07	16.36	6.54	7.43	4.24	6.61			23.92	19.20	43.12	19.20	60.76	54.29	38.87		36.45	114.00	10.00
Pu-239* µCi/L	6.82	12.83	8.88	22.33	16.32	11.60	12.71	5.18	5.18	5.18			15.38	28.94	233.59	176.60	36.95	85.71	525.41		93.61	82.44	97.72
(* Pu-239 is U-233 for TH waste)																							
then																							
MCi Cs-137	2.48	6.25											22.84	18.33	26.20	14.96	58.00	51.83	37.10		34.80	108.83	3.82
MCi Sr-90	2.14	5.40											19.72	15.83	22.63	12.92	50.09	44.76	32.05		30.05	93.99	3.30
kCi Tc-99	0.30	0.76	0.00	0.00	0.00	0.00							2.76	2.22	3.17	1.81	7.01	6.26	4.48	0.00	4.21	13.15	0.46
Ci I-129	0.61	1.54											5.62	4.51			14.28	12.76	9.14				
1994																							
MCi Cs-137	0.83	2.44											9.33	9.00	10.95	7.51	25.98	26.64	21.39	74.00	15.23	54.66	2.20
MCi Sr-90	0.66	1.96											7.54	7.37	8.86	6.16	21.13	21.89	17.73	60.74	12.37	44.84	1.83
	1.14	0.00	0.01	0.02	0.00	0.00	0.00	2.11	0.17	0.27	0.00	0.00	3.23	1.38	0.04	0.02	3.41	1.31	0.00	0.13	0.05	0.00	0.01
	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.01	0.00	0.00	4.76	5.98	0.00	0.00	0.12	4.20		0.00	0.00	0.00	0.00
																				52.61			
kgal solids	4305	2466	1612	4116	609	773	324	647	403	719	156	183	1128	203	241	51	583	398	15	43	508	646	173
vol% solids	12	12	13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1	2.9	2.2	3.9	3.9	2.2	8.1	2.9	10.5
uncertainty			2.6	1.1	2	1							3	1.3	1.4	0.5	1.7	3	3		1.4	0.5	1
kgal solids left	736			3104		1597	322	636	359	437	112	119	1206	202	241	51	4	81	0	14	366	598	40
CSR in—>			140	42	51	149		697					4425	1865			20485	6374		679	543	1736	
	MW1	MW2	1C1	1C2	2C1	2C2	224	UR	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2	PL1	CWP1	CWP2	CWZr1

	24	25	26	27	28	29	30	31	32	33	34		35	36	37	38		39	40
	OWW1	**OWW2**	**OWW3**	**Z**	**HS**	**TH1**	**TH2**	**AR**	**B**	**BL**	**SRR**	**CSR in**	**CSR**	**DE**	**CEM**	**NIT**	**Salt Slurry**	**DW**	**N**
st.date	1956	1963	1968	1974	1962	1966	1970	1967	1967	1967	1969	1967	1967	1970	1977	1977	1967	1967	1976
en.date	1962	1967	1972	1988	1967	1966	1970	1976	1972	1976	1976	1976	1976	1972	1977	1980	1976	1976	1990
short tons fuel	30,236	27,016	16,449			191	390		16,449										
kgal waste input								3775			801	21,744	21,744			640	19,244	5,737	1,814
volume factor											4.81		1.16				0.85		
kgal waste out	4,543	10,563	8,094	1,656	1003	927	428	5,385	10,569	14,845	3,854		25,321	254	8	640	16,357	8,805	2,157
gal/ton	150	391	492	only SY-102		4,853	1,097		643										
				1,910 to TX-118										BX-102	BY-105				
avg. MWD/T						1.7	1606							SX-113					
g Pu-239*/MWD						0.74	0.74							U-104					
kg Pu-239*						0.2403	463.49							TX-116					
Pu* ex. %						99.6	99.6							TX-117					
res. kg Pu-239*				57.9		0.001	1.854		25.924		127.99			TY-106					
Pu-239* µCi/L				563.48		0.0026	10.872		6.1565		83.351								
(* Pu-239 is U-233						(* Pu is U-233 for TH waste)													
then																			
MCi Cs-137						0.00	1.77												
MCi Sr-90						0.00	1.53												
kCi Tc-99						0.00	0.21												
Ci I-129						0.00	0.44												
1994																			
MCi Cs-137						0.00	1.02	0.09	5.00	0.00	0.66	48.18	4.34						
MCi Sr-90					0.95	0.00	0.85	8.24	4.05	3.69	4.43								
	0.00	0.00	0.00		0.93	0.00	0.06	0.70	1.34	1.93	1.33		6.62						
	0.00	0.00	0.00		0.82	0.00	0.79	7.52	2.66	1.76	3.16		0.00	21.03					
kgal solids	27	116	49	82	12	54	25	167	53	101	100		253	254	8				
vol% solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6	2	1			0			
uncertainty																			
kgal solids left				82	12	54	25	166	23	100	101		7						
CSR in—>	3132	8468	691					3111	6440	442		59470							
	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR		CSR					DW	N

		41		42		43				44									45	46	47			48
	B in	**B-SltCk**	**T1 in**	**T1-SltCk**	**R in**	**RSltCk**	**T2 in**	**T2-SltCk**	**BY in**	**BY-SltCk**	**S1 in**	**S1-SltCk**	**S2 in**	**S2-SltSlr**	**A1 in**	**A1-SltCk**	**A2 in**	**A2-SltSlr**	**P3**	**PL2**	**CWZr2**	**BP /Cplx**	**BP /NCplx**	**PASF**
st.date	1951	1951	1951	1951	1952	1952	1965	1965	1965	1965	1973	1973	1977	1977	1977	1977	1981	1981	1983	1983	1983	1983	1983	1983
en.date	1955	1955	1955	1955	1965	1965	1976	1976	1974	1974	1976	1976	1980	1980	1980	1980	1989	1989	1988	1988	1988	1988	1988	1988
short tons fuel																			4,302	4,302	4,302			
kgal waste input	8,078	8,078	11,918	11,918	15,743	15,743	43,311	43,311	36,602	36,602	43,709	43,709	9,105	9,105	16,476	16,476								
volume factor	0.55	0.55	0.56	0.56	0.49	0.49	0.25	0.25	0.22	0.22	0.26	0.26	0.39	0.39	0.28	0.28								
kgal waste out	4,445	4,445	6,675	6,675	7,706	7,706	10,828	10,828	8,124	8,124	11,364	11,364	3,562	3,562	4,668	4,668			1,132	11,499	5,555	1,044	6,841	4,227
gal/ton																			263	2,673	1,291	243	1,590	983
avg. MWD/T																			1,163	1,163	1,163			
g Pu-239*/MWD																			0.74	0.74	0.74			
kg Pu-239*																			3,702		3,702			
Pu* ex. %																			99.6		99			
res. kg Pu-239*		0.5728		0.5753		10.2		56.559		56.172		66.877		13.75		19.874		0	14.81		37.02			
Pu-239* µCi/L																			210.85		107.42			
(* Pu-239 is U-233																								
then																								
MCi Cs-137																			14.14	14.14	14.14			
MCi Sr-90																			12.21	12.21	12.21			
kCi Tc-99																			1.71	1.71	1.71	0.00	0.00	
Ci I-129																			3.48					
1994																								
MCi Cs-137																			11.63	11.63	11.63			
MCi Sr-90																			9.90	9.90	9.90			
kgal solids		786		764		1065		5997		3978		6270		3243		2125		895	44	230	583	83	32	25.362
vol% solids		9.73		6.41						10.87		14.34				12.90			3.9	2	10.5	7.9502	0.4678	0.6
uncertainty																			1	0.6	2			
kgal solids left		855		767		1065		5997		3978		6270		3243		2125		895	44	192	583	83	32	25.362
CSR in—>																								
		BSltCk		T1SltCk		RSltCk		T2SltCk		BYSltCK		S1SltCk		S2SltSlr		A1SltCk		A2AltSlr	P3	PL2	CWZr2	ass.SRR	ass.BL	PASF

	FMJ		FMJ		FMJ		Lucas	HW-30399	HW-30399	B&S	B&S		CUWP	CUWP	FMJ		CUWP	FMJ		FMJ	FMJ	FMJ	FMJ
chemicals in mol/L	**MW1**	**MW2**	**1C1**	**1C2**	**2C1**	**2C2**	**224**	**UR/TBP**	**PFeCN1**	**PFeCN2**	**TFeCN**	**1CFeCN**	**R1**	**R2**	**CWR1**	**CWR2**	**P1**	**P2**	**P2'**	**PL1**	**CWP1**	**CWP2**	**CWZr1**
HNO3	0.1	0.1	0.5	0.5	1.15	0.605	1.06	3.3	3.3	3.3	2.3	0.5	2.3	4	0.8	0.8	0.28	0.55	0.55	2.7	0.6	0.6	0.01
NaAlO2			0.233	0.233							0.0283	0.1864	0.65	1.13	2	0.78					1.2	0.78	
Al(NO3)3																							
Fe(HSO4)2			0.03	0.03	0.024	0.0126		0.03	0.014	0.014		0.002001	0.0075	0.013			0.0198	0.0774		0.026			
Fe(NO3)3	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016			0.04	0.04	0.0152	0.0152	0.04	0.04	0.04	0.04	0.0152	0.0152	0.0152
NaCrO4	0.0032	0.0032	0.0052	0.0052	0.0042	0.0054	0.0041	0.0032	0.0032	0.0032		0.002	0.068	0.113	0.003	0.003	0.008	0.008	0.008	0.008	0.003	0.003	0.00304
BiPO4			0.014	0.014	0.01	0.0053	0.0062		0.013	0.013		0.014											
ZrO(OH)2			0.004	0.004								0.004											0.1
NiSO4	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.005	0.005	0.01	0.01	0.004	0.004	0.0015	0.0015	0.004	0.004	0.004	0.004	0.0015	0.0015	0.00152
NaOH	0.1412	0.1412	0.89	0.6712	1.3062	0.7383	1.2912	3.4512	3.6112	3.6012	2.34	0.84	2.11	3.888	0.4386	0.6786	0.628	1.128	0.328	2.943	0.2786	0.4786	0.24864
NaNO2			0.174	0.174							0.17	0.17			1.4	0.28	0.01	0.01	0.01	0.01	0.78	0.28	0.007
Na2CO3	0.6	0.942	0.0181	0.0181	0.0182	0.0181	0.0182	0.2	0.018433	0.0184321	0.021	0.009005	0.0183	0.0185	0.0181	0.0181	0.0181	0.0181	0.018	0.01835	0.018	0.0181	0.01803
Na3PO4	0.18	0.18	0.3	0.32	0.2	0.1052	0.043	0.13	0.13	0.13	0.13	0.151919											
Na2SO4	0.21	0.21						0.08	0.15	0.15										0.096			
Na2SiO3	0.004	0.004			0.037	0.0195							0.0147	0.0424	0.03		0.0469	0.0921			0.02		
Na2SiF6			0.038	0.038					0.035	0.035		0.038											
NaF					0.22	0.1157	0.31																0.77
NaCl	0.0032	0.0032	0.0205	0.0154	0.03	0.017	0.0297	0.10238	0.083058	0.0828276	0.0538	0.01932	0.0485	0.0894	0.0101	0.0156	0.0144	0.0259	0.0075	0.06769	0.0064	0.011	0.00572
Na2S											0.006	0.006											
La(NO3)3							0.015																
Hg(NO3)2			2E-05	2E-05											0.0003	0.0003					0.0002	0.0002	0.00022
KNO3	0.0007	0.0007	0.0045	0.0034	0.0065	0.0037	0.2665	0.01726	0.018056	0.018006	0.0117	0.0042	0.0106	0.0194	0.0022	0.0034	0.0031	0.0056	0.0016	0.01472	0.0014	0.0024	0.22124
Ca(NO3)2	0.018	0.018	0.0181	0.0181	0.0182	0.0181	0.0182	0.01841	0.018433	0.0184321	0.02	0.02	0.0183	0.0185	0.0181	0.0181	0.0181	0.0181	0.018	0.01835	0.018	0.0181	0.01803
KMnO4							0.0046																
Sr(NO3)2							0.063																
PbSO4																				6.00E-05			
H3C6H5O7																							
H4EDTA																							
H3HEDTA																							
Hglycolate																							
Hacetate																							
H2oxalate							0.03																
Na4Fe(CN)6									0.005	0.0025	0.005	0.005											
NH3																							0.77
Pu (µCi/L)	10.26		8.88	22.33	16.32	11.60	12.71	4.01267	1.87	1.87		11.33	15.38	28.94	233.59	176.60	36.95	85.71		154	93.61	82.44	97.72
U (M)	0.16	0.2408	0.0008	0.0007	0.0001	5E-05		0.0078	0.0078	0.0078	0.0078	0.000789	0.0048	0.009	0.0185	0.018	0.0046	0.0107			0.0117	0.0099	0.00239
Cs (Ci/L)	0.0022		0.0168	0.0351	0.0002	0.0003		0.00106	4.93E-04	4.93E-04	0.025	0.035069	0.10	0.22	0.0039	0.0045	0.259	0.6894		0.03	0.0026	0.0026	0.00141
Sr (Ci/L)	0.0189		0.0001	0.0003	1E-05	6E-05		0.02403	3.44E-03	3.44E-03		0.000314	0.08	0.18	0.0031	0.0037	0.2106	0.5665		0.026	0.0021	0.0021	0.00117

	FMJ	FMJ	HW-30399		HS report	from P	from P	from P	FMJ	FMJ	from P		fr/P	WHC-MR-0302	type 1 Portland Cement	FMJ	model	Lucas	Lucas
chemicals in mol/L	**OWW1**	**OWW2**	**OWW3**	**Z**	**HS**	**TH1**	**TH2**	**AR**	**B**	**BL**	**SRR**	**CSR in**	**CSR**	**DE**	**CEM**	**NIT**	**Salt Slurry**	**DW**	**N**
HNO3	0.516	0.519	0.782	3.5	0.86	2.57	2.57	0.5			0.6					0.8	2.8		
NaAlO2				0.5		0.34	0.34										2.2		
Al(NO3)3									0.083	0.56									
Fe(HSO4)2				0.0007	0.03	0.025	0.025		0.007	0.017	0.041								
Fe(NO3)3	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04										0.04	0.04
NaCrO4	0.008	0.008	0.008	0.0094	0.008	0.008	0.008	0.008	0.002	2E-07	0							0.008	0.008
BiPO4																			
ZrO(OH)2																			
NiSO4	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.002	0.01	0							0.004	0.004
NaOH	0.658	0.528	0.928	3.628	2.138	2.758	2.758	0.828	0.5524	2.6944	2.7112		0.2			0.3	3.2	0.138	0.138
NaNO2	0.01	0.01	0.01	0.014	0.01	0.01	0.01		0.01	0.01	0.01		0.01				4.05	0.024	0.014
Na2CO3	0.21781	0.3041	0.3041	0.2	0.0049	0.0183	0.0183	0.0019	0.0101	0.27	0.25		2E-05				1	0.011	0.011
Na3PO4				0.0001		0.09	0.09	0.02		0.01							0.1		0.36
Na2SO4				0.0014				0.02			0.02						0.03		
Na2SiO3								0.08	0.04	0.05	0.08								
Na2SiF6																			
NaF						0.12	0.12										0.06		
NaCl	0.01513	0.0121	0.0213	0.1144	0.0492	0.0634	0.0634	0.019	0.0127	0.062	0.0624		0.0046				0.5	0.0032	0.0032
Na2S																			
La(NO3)3																			
Hg(NO3)2																			
KNO3	0.00329	0.0026	0.0046	0.0181	0.0887	0.0278	0.0278	0.0041	0.0028	0.0135	0.0136		0.001				0.016	0.0007	0.0007
Ca(NO3)2	0.01808	0.0181	0.0181	0.0184	0.0049	0.0183	0.0183	0.0019	0.0101	0.0103	0.0123		2E-05					0.018	0.018
KMnO4		0.0882	0.0009													0.0013			
Sr(NO3)2																			
PbSO4					0.0034				1E-06										
H3C6H5O7					0.04				0.01	0.015			0.025						
H4EDTA					0.08						0.15								
H3HEDTA											0.3		4E-05						
Hglycolate										0.2	0.3								
Hacetate					0.51														
H2oxalate																			
Na4Fe(CN)6																			
NH3																			
Pu (µCi/L)				625				300	132	65	127.99		60.933				0		
U (M)						0.0021	0.0094		0.0063	0.0078	0.03		0						
Cs (Ci/L)						0.0001	0.6298	0.01	0.32		0.0452		0.0452				0.5		
Sr (Ci/L)					0.25	0.0001	0.522	0.4044	0.1861	0.0657	0.3038		0.0691				0.005		
						(U is Th for TH waste)													

chemicals in mol/L	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
HNO3	0.03		0.03																0.41	0.1	0.01			
NaAlO2																			0.34					
Al(NO3)3																								
Fe(HSO4)2																			0.0674					
Fe(NO3)3																			0.05	0.04	0.04			0.01
NaCrO4																				0.008				
BiPO4																								
ZrO(OH)2																					0.1			
NiSO4																				0.004				
NaOH	0.09		0.09		0.04		0		0		0		0		0		0		2.2	0.17	0.2			0.04
NaNO2																			0.01	0.01	0.007			
Na2CO3												0							0.0183	0.12	0.01802			0.009
Na3PO4																				0.069517				
Na2SO4																								
Na2SiO3																			0.0921					
Na2SiF6																								
NaF																			0.03		0.77			
NaCl																			0.0506	0.00391	0.0046			0.0009
Na2S																								
La(NO3)3																								
Hg(NO3)2																					0.00023			
KNO3																			0.011	0.00085	0.221			0.0002
Ca(NO3)2																			0.0183	0.01802	0.01802			0.018
KMnO4																				0.006				
Sr(NO3)2																								
PbSO4																				4.34E-05				
H3C6H5O7																								
H4EDTA																								
H3HEDTA																								
Hglycolate																								
Hacetate																								
H2oxalate																								
Na4Fe(CN)6																								
NH3																					0.77			0.05
Pu (µCi/L)	6.4318	11.689	6.8506	12.231	23.044	47.078	23.654	94.617	27.403	123.46	27.334	105.13	25.286	64.634	23.461	82.806	0	0	210.85	4.641064	107.42			
U (M)																			0.0384	4.62E-04	0.00313			
Cs (Ci/L)	0.0071	0.0129	0.0081	0.0145	0.1448	0.2959	0.0618	0.2472	0.0423	0.1906	0.0832	0.32	0.2065	0.5278	0.1027	0.3623	0	0	2.7149	0.03	0.00221			
Sr (Ci/L)	0.0135	0.0245	0.0137	0.0244	0.0321	0.0656	0.0249	0.0998	0.0171	0.077	0.0324	0.1245	0.0238	0.0607	0.0219	0.0773	0	0	2.3108	0.026	0.00188			

species mol/L	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
Na	2.3156	2.9996	2.3349	2.171	2.2708	1.2672	1.8003	4.50678	4.514324	4.4940919	3.0561	1.799487	2.9425	5.3422	3.9479	1.7935	0.7905	1.3925	1.0043	3.3534	2.3442	1.5888	1.07046
Al	0	0	0.233	0.233	0	0	0	0	0	0	0.0283	0.1864	0.65	1.13	2	0.78	0	0	0	0	1.2	0.78	0
Fe	0.016	0.016	0.046	0.046	0.04	0.0286	0.016	0.046	0.03	0.03	0	0.002001	0.0475	0.053	0.0152	0.0152	0.0598	0.1174	0.04	0.066	0.0152	0.0152	0.0152
Cr	0.0032	0.0032	0.0052	0.0052	0.0042	0.0054	0.0041	0.0032	0.0032	0.0032	0	0.002	0.068	0.113	0.003	0.003	0.008	0.008	0	0.008	0.003	0.003	0.00304
Bi	0	0	0.014	0.014	0.01	0.0053	0.0062	0	0.013	0.013	0	0.014	0	0	0	0	0	0	0	0	0	0	0
La							0.015																
Hg	0	0	2E-05	2E-05	0	0	0	0	0	0	0	0	0	0	0.0003	0.0003	0	0	0	0	0.0002	0.0002	0.00022
ZrO(OH)2	0	0	0.004	0.004	0	0	0	0	0	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0.1
Pb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00006	0	0	0
Ni	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.005	0.005	0.01	0.01	0.004	0.004	0.0015	0.0015	0.004	0.004	0	0.004	0.0015	0.0015	0.00152
Sr							0.063																
Mn	0	0	0	0	0	0	0.0046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ca	0.018	0.018	0.0181	0.0181	0.0182	0.0181	0.0182	0.01841	0.018433	0.0184321	0.02	0.02	0.0183	0.0185	0.0181	0.0181	0.0181	0.0181	0.018	0.01835	0.018	0.0181	0.01803
K	0.0007	0.0007	0.0045	0.0034	0.0065	0.0037	0.2711	0.01726	0.018056	0.018006	0.0117	0.0042	0.0106	0.0194	0.0022	0.0034	0.0031	0.0056	0	0.01472	0.0014	0.0024	0.22124
balance	**4E-16**	**0**	**0**	**-4E-16**	**-9E-16**	**2E-16**	**4E-16**	**-1.8E-15**	**-8.88E-16**	**-8.88E-16**	**4E-16**	**0**	**-2E-15**	**0**	**2E-15**	**0**	**-2E-16**	**0**	**-0.354**	**0**	**0**	**-9E-16**	**2.2E-16**
density																							
vol%solids	12	12	13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1	2.9	2.2	3.9	3.9	2.2	8.1	2.9	10.5
void frac.	0.7042	0.5801	0.6979	0.7922	0.7803	0.942	0.8634	0.91417	0.934508	0.9230049	0.8956	0.935004	0.7988	0.5737	0.8136	0.776	0.8413	0.8077	0.7832	0.86177	0.8386	0.7762	0.85731
species																							
OH	1.014	1.4989	1.1055	0.8865	0.1496	0.1427	0.2106	0.1808	0.1468	0.1368	0.1999	0.884334	2.7033	4.9011	7.762	3.1186	0.3878	0.5967	0.3646	0.249	4.5608	3.0701	0.66514
NO3	0.1847	0.1847	0.5887	0.5876	1.2408	0.6928	1.5818	3.40208	3.402923	3.4028703	2.3517	0.5442	2.4671	4.1764	0.8846	0.8858	0.4393	0.7119	0.7077	2.87142	0.6835	0.6845	0.31334
NO2	0	0	0.174	0.174	0	0	0	0	0	0	0.17	0.17	0	0	1.4	0.28	0.01	0.01	0.01	0.01	0.78	0.28	0.007
CO3	0.6	0.942	0.0181	0.0181	0.0182	0.0181	0.0182	0.2	0.018433	0.0184321	0.021	0.009005	0.0183	0.0185	0.0181	0.0181	0.0181	0.0181	0	0.01835	0.018	0.0181	0.01803
PO4	0.18	0.18	0.314	0.334	0.21	0.1105	0.0492	0.13	0.143	0.143	0.13	0.165919	0	0	0	0	0	0	0	0.096	0	0	0
SO4	0.2116	0.2116	0.0616	0.0616	0.0496	0.0269	0.0016	0.1416	0.183	0.183	0.016	0.020002	0.019	0.03	0.0015	0.0015	0.0436	0.1588	0.2348	0.05606	0.0015	0.0015	0.00152
SiO3	0.004	0.004	0.038	0.038	0.037	0.0195	0	0	0.035	0.035	0	0.038	0.0147	0.0424	0.03	0	0.0469	0.0921	0.0921	0	0.02	0	0
F	0	0	0.228	0.228	0.22	0.1157	0.31	0	0.21	0.21	0	0.228	0	0	0	0	0	0	0	0	0	0	0.77
Cl	0.0032	0.0032	0.0205	0.0154	0.03	0.017	0.0297	0.10238	0.083058	0.0828276	0.0538	0.01932	0.0485	0.0894	0.0101	0.0156	0.0144	0.0259	0	0.06769	0.0064	0.011	0.00572
C6H5O7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glycolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
acetate																							
oxalate	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DBP								3.1E-05															
butanol								3.1E-05															
NH3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.77
Fe(CN)6----	0	0	0	0	0	0	0	0	0.005	0.0025	0.005	0.005	0	0	0	0	0	0	0	0	0	0	0
Pu	10.262	0	8.8772	22.332	16.318	11.602	12.708	4.01267	1.86574	1.8657403	0	11.33114	15.38	28.943	233.59	176.6	36.947	85.708	0	154	93.609	82.437	97.718
U	0.16	0.2408	0.0008	0.0007	0.0001	5E-05	0	0.0078	0.0078	0.0078	0.0078	0.000789	0.0048	0.009	0.0185	0.018	0.0046	0.0107	0.037	0	0.0117	0.0099	0.00239
Cs	200																						
Sr																							

species mol/L	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
Na	1.12675	1.1664	1.5756	4.6691	2.215	3.6061	3.6061	1.1188	0.6772	3.4364	3.4836	3.5679	3.7826			0.3	12.37	0.1952	1.2652
Al	0	0	0	0.5	0	0.34	0.34	0	0.083	0.56	0	0.2958	0.2958			0	2.2	0	0
Fe	0.04	0.04	0.04	0.0407	0.07	0.065	0.065	0.04	0.007	0.017	0.041	0.0269	0.0269			0	0	0.04	0.04
Cr	0.008	0.008	0.008	0.0094	0.008	0.008	0.008	0.008	0.002	2E-07	0	0.0256	0.0256			0	0	0.008	0.008
Bi	0	0	0	0	0	0	0	0	0	0	0	6E-05	6E-05			0	0	0	0
La												0	0						
Hg	0	0	0	0	0	0	0	0	0	0	0	1E-06	1E-06			0	0	0	0
ZrO(OH)2	0	0	0	0	0	0	0	0	0	0	0	3E-05	3E-05			0	0	0	0
Pb	0	0	0	0	0.0034	0	0	0	1E-06	0	0	2E-06	2E-06			0	0	0	0
Ni	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.002	0.01	0	0.0061	0.0061			0	0	0.004	0.004
Sr												0	0						
Mn	0	0.0882	0.0009	0	0	0	0	0	0	0	0	0.0344	0.0344			0.0013	0	0	0
Ca	0.01808	0.0181	0.0181	0.0184	0.0049	0.0183	0.0183	0.0019	0.0101	0.0103	0.0123	0.0287	0.0288			0		0.018	0.018
K	0.00329	0.0908	0.0055	0.0181	0.0887	0.0278	0.0278	0.0041	0.0028	0.0135	0.0136	0.0475	0.0485			0.0013	0.016	0.0007	0.0007
balance	**-2E-16**	**0**	**0**	**0**	**-4E-16**	**9E-16**	**0**	**0**	**0**	**0**	**0**	**0**	**0.001**			**-6E-17**	**4E-15**	**-6E-17**	**0**
density																			
vol%solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6	2	1	100	100	13.6	80	1	1
void frac.	1	1	1	0.549	0.8226	0.9349	0.9349	0.8865	0.8459	0.5749	0.8505	0.3401	1			1	0.8	0.7152	0.7152
species																			
OH	0.174	0.482	0.1824	2.1649	0.33	1.5678	1.6116	0.36	0.5611	2.4791	0.4501	1.7687	1.8936			-0.4935	9.2	0.17	0.17
NO3	0.67545	0.6778	0.9429	3.675	1.0785	2.7545	2.7545	0.6279	0.2719	1.7141	0.6382	1.4967	1.4968			0.8	2.816	0.1567	0.1567
NO2	0.01	0.01	0.01	0.014	0.01	0.01	0.01	0	0.01	0.01	0.01	0.8002	0.8102			0	4.05	0.024	0.014
CO3	0.21781	0.3041	0.3041	0.2	0.0049	0.0183	0.0183	0.0019	0.0101	0.27	0.25	0.1891	0.1891			0	1	0.011	0.011
PO4	0	0	0	0.0001	0	0.09	0.09	0.02	0	0.01	0	0.0126	0.0126			0	0.1	0	0.36
SO4	0.004	0.004	0.004	0.0068	0.0674	0.054	0.054	0.024	0.016	0.044	0.102	0.1133	0.1133			0	0.03	0.004	0.004
SiO3	0	0	0	0	0	0	0	0.08	0.04	0.05	0.08	0.0646	0.0646			0	0	0	0
F	0	0	0	0	0	0.12	0.12	0	0	0	0	0.0033	0.0033			0	0.06	0	0
Cl	0.01513	0.0121	0.0213	0.1144	0.0492	0.0634	0.0634	0.019	0.0127	0.062	0.0624	0.0612	0.0658			0	0.5	0.0032	0.0032
C6H5O7	0	0	0	0	0.04	0	0	0	0.01	0.015	0	0.0033	0.0283			0	0	0	0
EDTA	0	0	0	0	0.08	0	0	0	0	0	0.15	0	0			0	0	0	0
HEDTA	0	0	0	0	0	0	0	0	0	0	0.3	0	4E-05			0	0	0	0
												0	0						
glycolate	0	0	0	0	0	0	0	0	0	0.2	0.3	0.0041	0.0041			0	0	0	0
acetate					0.51							0							
oxalate	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
DBP	0.06134	0.0236	0.0187		0	0.0019	0.0084				3E-05	0.0186	0.0186						
butanol	0.06134	0.0236	0.0187		0	0.0019	0.0084				3E-05	0.0186	0.0186						
												0	0						
NH3	0	0	0	0	0	0	0	0	0	0	0	0.0201	0.0201			0	0.0717	0	0
Fe(CN)6----	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Pu	0	0	0	625	0	0	0	300	132	65	127.99	60.933	60.933						
U	0	0	0	0	0	0.0021	0.0094	0	0.0063	0.0078	0.03	0.0079	0.0079			0	0	0	0
Cs												0.5854							
Sr												0.0691	0.0691						

species mol/L	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
Na	3.141	5.7082	3.0684	5.4785	3.4142	6.9751	2.6236	10.494	2.2868	10.303	3.3255	12.79	6.6212	16.925	3.8521	13.596		0	2.8514	0.640462	1.01765			0.0589
Al	0.072	0.1308	0.067	0.1196	0.7625	1.5577	0.2839	1.1357	0.3895	1.7549	0.4693	1.8049	0.9478	2.4228	0.5655	1.9961		0	0.34	0	0			0
Fe	0.002	0.0036	0.002	0.0036	0.0023	0.0047	0.0074	0.0295	0.0119	0.0536	0.0079	0.0303	0.0027	0.0069	0.0036	0.0126		0	0.1174	0.04	0.04			0.01
Cr	0.0041	0.0075	0.0039	0.0069	0.028	0.0573	0.0112	0.0449	0.0084	0.0379	0.0179	0.0689	0.0203	0.052	0.0128	0.0451		0	0	0.008	0			0
Bi	0.0017	0.0032	0.0017	0.0031	3E-06	7E-06	0.0004	0.0017	0.0002	0.0009	0.0004	0.0014	0.0021	0.0054	0.0015	0.0055		0	0	0	0			0
La	0	0	0	0	0	0	0	0	8E-07	4E-06	5E-06	2E-05	1E-05	3E-05	4E-06	2E-05		0						
Hg	5E-06	8E-06	3E-06	6E-06	8E-07	2E-06	2E-06	1E-05	5E-06	2E-05	3E-06	1E-05	8E-06	2E-05	8E-06	3E-05		0	0	0	0.00023	0	0	0
ZrO(OH)2	0.0011	0.002	0.0013	0.0023	1E-06	3E-06	0.0003	0.0011	5E-05	0.0002	0.0002	0.0008	0.0014	0.0036	0.0014	0.0048		0	0	0	0.1			0
Pb	0	0	0	0	1E-07	2E-07	2E-06	9E-06	3E-05	0.0001	6E-06	2E-05	2E-05	5E-05	2E-05	8E-05		0	0	4.34E-05	0			0
Ni	0.0016	0.003	0.0016	0.0029	0.0018	0.0037	0.0024	0.0097	0.0028	0.0125	0.0026	0.0101	0.0018	0.0047	0.0018	0.0065		0	0	0.004	0			0
Sr	0	0	0	0	0	0	0	0	9E-07	4E-06	5E-06	2E-05	1E-05	3E-05	5E-06	2E-05		0						
Mn	0	0	0	0	0.0002	0.0005	0.0067	0.0269	0.0065	0.0291	0.0082	0.0316	0.0063	0.0161	0.0045	0.016		0	0	0.006	0			0
Ca	0.009	0.0164	0.009	0.0161	0.0092	0.0187	0.0121	0.0485	0.0138	0.0622	0.0129	0.0497	0.0093	0.0237	0.0095	0.0335		0	0.0183	0.01802	0.01802			0.018
K	0.012	0.0217	0.0113	0.0202	0.0142	0.029	0.0164	0.0658	0.0147	0.0663	0.0237	0.0912	0.0611	0.1563	0.0515	0.1818		0	0.011	0.00685	0.221			0.0002
balance		**-2E-15**		**-2E-15**		**1E-05**		**0.0006**		**0.0008**		**0.001**		**0.0016**		**0.001**		**0**	**-9E-16**	**1.11E-16**	**2.2E-16**			**3E-17**
density	1.1202		1.117		1.1797		1.1167		1.1113		1.1556		1.3121		1.1818									
vol%solids	50	17.683	50	11.446	50	13.82	50	55.385	50	48.966	50	55.173	50	99	50	45.523		90	3.9	2	10.5			0.6
void frac.	1	0.792	1	0.7772	1	0.8721	1	0.7865	1	0.7782	1	0.7183	1	0.5823	1	0.6239		0.5	0.789	0.888191	0.85031			0.7842
species														0.5865										
OH	0.1101	0.7234	0.1174	0.688	0.0641	6.3617	0.1897	5.3013	0.1929	7.8886	0.2398	8.142	0.3911	10.691	0.275	8.9553		0	3.3127	0.134772	0.60876			0.04
NO3	1.7805	3.2357	1.6811	3.0015	1.5385	3.1431	1.2865	5.1459	1.0272	4.6278	1.415	5.4422	1.9465	4.9755	1.2466	4.3998		0	0.6075	0.256891	0.38751			0.0662
NO2	0.2053	0.373	0.2125	0.3793	1.0186	2.0809	0.4066	1.6262	0.4015	1.8091	0.6982	2.6853	1.7136	4.3802	0.8138	2.8722		0	0.01	0.01	0.007			0
CO3	0.1102	0.2003	0.1213	0.2166	0.0118	0.024	0.1019	0.4076	0.0925	0.4166	0.1125	0.4327	0.2328	0.5952	0.1334	0.4709		0	0.0183	0.12	0.01802			0.009
PO4	0.1381	0.251	0.1403	0.2505	0.0003	0.0005	0.0352	0.1407	0.0173	0.0777	0.0331	0.1274	0.1304	0.3334	0.0795	0.2805		0	0	0.069517	0			0
SO4	0.1085	0.1971	0.1067	0.1905	0.0235	0.0481	0.0607	0.2426	0.0409	0.1841	0.0713	0.2744	0.2065	0.528	0.1035	0.3652		0	0.1348	0.004043	0			0
SiO3	0.0147	0.0267	0.0148	0.0264	0.0232	0.0475	0.0216	0.0865	0.0176	0.0794	0.0271	0.1044	0.0332	0.0849	0.0295	0.104		0	0.0921	0	0			0
F	0.1014	0.1842	0.1018	0.1817	0.0002	0.0004	0.0253	0.1012	0.0143	0.0643	0.0211	0.081	0.1246	0.3185	0.1172	0.4137		0	0.03	0	0.77			0
Cl	0.0677	0.1231	0.0644	0.1151	0.0642	0.1311	0.0489	0.1956	0.0313	0.1409	0.0578	0.2224	0.1108	0.2833	0.0632	0.2232		0	0.0506	0.00391	0.0046			0.0009
C6H5O7	0	0	0	0	0.0002	0.0005	0.0049	0.0196	0.0061	0.0276	0.0086	0.0331	0.0214	0.0546	0.0105	0.0372		0	0	0	0			0
EDTA	0	0	0	0	5E-06	1E-05	0.0029	0.0116	0.0013	0.0058	0.0043	0.0165	0.0126	0.0322	0.0098	0.0347		0	0	0	0			0
HEDTA	0	0	0	0	3E-07	6E-07	0.0056	0.0224	7E-06	3E-05	0.0081	0.0312	0.0236	0.0602	0.0174	0.0614		0	0	0	0			0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0						
glycolate	0	0	0	0	0.0003	0.0006	0.0172	0.069	0.0039	0.0174	0.0257	0.0988	0.0678	0.1734	0.0368	0.1299		0	0	0	0			0
acetate	0	0	0	0	3E-05	7E-05	0.0006	0.0022	0.0081	0.0367	0.0015	0.0059	0.0052	0.0133	0.0073	0.0259		0	0	0	0			0
oxalate	0	0	0	0	0	0	0	0	3E-06	1E-05	2E-05	7E-05	4E-05	1E-04	2E-05	6E-05		0	0	0	0			0
DBP	2E-05	3E-05	2E-05	3E-05	0.0002	0.0004	0.004	0.0159	0.0067	0.03	0.0061	0.0236	0.016	0.0408	0.0089	0.0315		0		0.003448				
butanol	2E-05	3E-05	2E-05	3E-05	0.0002	0.0004	0.004	0.0159	0.0067	0.03	0.0061	0.0236	0.016	0.0408	0.0089	0.0315		0		0.003448				
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0						
NH3	0.0006	0.0012	0.0007	0.0012	0.0192	0.0348	0.0064	0.0116	0.0055	0.01	0.0101	0.0184	0.0121	0.022	0.0841	0.1528		0	0	0	0.77			0.05
Fe(CN)6----	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0			0
Pu	6.4318	11.689	6.8506	12.231	23.044	47.078	23.654	94.617	27.403	123.46	27.334	105.13	25.286	64.634	23.461	82.806		0						
U	0.0026	0.0048	0.0036	0.0065	0.0041	0.0083	0.0036	0.0143	0.0039	0.0178	0.0041	0.0159	0.0031	0.008	0.0027	0.0097		0	0.0384	0.000462	0.00313			0
Cs	0.0071	0.0129	0.0081	0.0145	0.1448	0.2959	0.0618	0.2472	0.0423	0.1906	0.0832	0.32	0.2065	0.5278	0.1027	0.3623		0						
Sr	0.0135	0.0245	0.0137	0.0244	0.0321	0.0656	0.0249	0.0998	0.0171	0.077	0.0324	0.1245	0.0238	0.0607	0.0219	0.0773		0						

pred. sludge mol/L	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
Na	3.2819	4.0466	4.8458	3.542	4.0749	1.1961	3.6986	3.572	3.966089	3.8071521	3.4373	2.182193	2.3718	3.1868	3.5394	1.4008	1.8323	4.0314	0	2.82956	1.9919	1.2412	5.54806
Al	0	0	0.4759	0.8616	0	0	0	0	0	0	0.165	0.434425	4.1433	4.771	6.5382	5.8667	0	0		0	5.1582	5.8668	0
Fe(total)	0.1187	0.1188	0.3232	0.1787	0.5608	0.7924	0.3609	1.57339	0.893862	0.9550899	0.3571	0.106189	1.0131	2.6862	0.165	0.4571	2.6294	2.9608		2.91106	0.165	0.4571	0.12771
Cr	0.0023	0.002	0.0038	0.0043	0.0033	0.0051	0.0036	0.00293	0.002998	0.0029609	0	0.001876	0.8741	4.3989	0.0025	0.0024	0.0068	0.0065	0	0.00692	0.0026	0.0024	0.00265
Bi	0	0	0.077	0.0442	0.0923	0.0696	0.0604	0	0.247262	0.2852689	0	0.212265	0	0	0	0	0	0		0	0	0	0
La	0	0	0	0	0	0	0.2367	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Hg	0	0	9E-05	8E-05	0	0	0	0	0	0	0	0	0	0	0.0041	0.0108	0	0		0	0.0025	0.0059	0.002
ZrO(OH)2	0	0	0.0103	0.007	0	0	0	0	0	0	0	0.023782	0	0	0	0	0	0		0	0	0	0.9268
Pb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		5.2E-05	0	0	0
Ni	0.0012	0.001	0.0012	0.0013	0.0013	0.0015	0.0014	0.00147	0.136817	0.1298583	0.6517	0.19131	0.0507	0.1176	0.0013	0.0012	0.1018	0.0582		0.10177	0.0013	0.0012	0.00132
Sr	0	0	0	0	0	0	1.4593	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Mn	0	0	0	0	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Ca	0.0841	0.0845	0.0754	0.0455	0.1436	0.2766	0.2436	0.34504	0.263818	0.3035945	0.7943	0.238058	0.2145	0.507	0.1207	0.322	0.4213	0.2431		0.43391	0.1205	0.3211	0.09495
K	0.0005		0.0032	0.0028	0.0052	0.0035	0.2353	0.01581	0.016914	0.0166607	0.0105	0.003939	0.0085	0.0112	0.0018	0.0027	0.0027	0.0046		0.01272	0.0012	0.0019	0.19256
balance	**0**	**-0.0004**	**9E-16**	**-3E-15**	**0**	**-9E-16**	**-2E-15**	**-1.8E-15**	**0**	**1.776E-15**	**0**	**-8.9E-16**	**4E-15**	**7E-15**	**7E-15**	**7E-15**	**0**	**-2E-15**		**-1.8E-15**	**0**	**0**	**1.8E-15**
density	1.4112	1.4112	1.2893	1.2215	1.2468	1.133	1.3349	1.31537	1.370071	1.3746632	1.4655	1.224612	1.4832	2.2124	1.5503	1.5553	1.2761	1.4155		1.32511	1.3883	1.4678	1.26229
vol%solids	12	12	13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1	2.9	2.2	3.9		2.2	8.1	2.9	10.5
void frac.	0.7042	0.5801	0.6979	0.7922	0.7803	0.942	0.8634	0.91417	0.934508	0.9230049	0.8956	0.935004	0.7988	0.5737	0.8136	0.776	0.8413	0.8077		0.86177	0.8386	0.7762	0.85731
wt.% H2O	64.706	63.156	72.901	78.342	72.695	82.622	62.32	63.8366	61.98486	61.18974	65.242	78.43247	66.051	44.1	69.446	72.332	69.944	59.913		61.4155	77.182	75.518	69.1678
TOC wt.%C	0	0	0	0	0	0	0.3809	0.00031	0.710162	0.4091911	1.7547	0.612439	0	0	0	0	0	0		0	0	0	0
free OH-	0.1838	0.2278	0.0607	0.0228	0.0281	0.0586	0.0244	0.02376	0.031398	0.0217595	0.0444	0.123174	0.0093	0.0131	0.0282	0.0351	0.1742	0.1675		0.04545	0.0292	0.024	0.20615
OH-	6.5356	9.6111	2.6222	3.1772	1.7059	2.4309	4.7044	5.55494	2.919871	3.4617217	2.7787	1.844316	18.62	37.963	22.822	21.906	8.4259	10.191		8.97387	17.284	20.713	4.285
NO3-	0.1144	0.1129	0.3755	0.3892	0.9809	0.6524	1.373	2.19038	2.462992	2.4176952	0.0095	0.055821	0.0352	9E-09	0.702	0.6699	3E-11	2E-14		1.96816	0.5666	0.5293	0.27058
NO2-	0.0204	0	0.1798	0.2471	0.002	0.0015	0	0.3693	0.153631	0.1667184	2.2522	0.614048	1.9534	1.6065	1.1851	0.2407	0.3793	0.5875		0.45343	0.6769	0.2241	0.00823
CO3--	0.9011	1.3109	0.0754	0.0455	0.1436	0.2766	0.2436	0.51144	0.263818	0.3035945	0.7952	0.227745	0.2145	0.507	0.1207	0.322	0.4213	0.2431		0.43391	0.1205	0.3211	0.09495
PO4---	0.4005	0.4067	1.3204	0.8751	0.9767	0.1689	0.0977	0.11913	0.369043	0.4055559	0.1166	0.402289	0	0	0	0	0	0		0.08298	0	0	0
SO4--	0.1545	0.1293	0.0448	0.0515	0.0393	0.0253	0.0014	0.12976	0.17143	0.1693271	0.0144	0.018761	0.0153	0.0174	0.0013	0.0012	0.0368	0.1292		0.04846	0.0013	0.0012	0.00132
SiO3--	0.0029	0.0024	0.0631	0.05	0.0783	0.0184	0	0	0.061185	0.0654103	0	0.116751	0.0119	0.4775	0.0248	0	0.6221	1.5241		0	0.017	0	0
F-	0	0	0.166	0.1914	0.1743	0.1092	2.0334	0	0.196723	0.1943098	0	0.213848	0	0	0	0	0	0		0	0	0	5.28655
Cl-	0.0024	0.002	0.0149	0.0129	0.0238	0.016	0.0258	0.09382	0.077807	0.0766391	0.0483	0.018121	0.0391	0.0517	0.0083	0.0122	0.0122	0.0211		0.05851	0.0054	0.0086	0.00498
C6H5O7---	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
EDTA----	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
HEDTA---	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
glycolate-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oxalate--	0	0	0	0	0	0	0.2118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0	2.8E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0	2.8E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH3	3E-05	0	0.0002	0.0006	5E-08	6E-08	0	0.00087	0.000307	0.0003721	0.2464	0.03209	0.1316	0.3286	0.0004	7E-05	0.1336	0.2421		0.00174	0.0002	2E-05	0.66013
Fe(CN)6----									0.135135	0.078125	0.3571	0.104167											
Pu (µCi/g)	0.0069	0	0.006	0.0465	0.012	0.0105	0.0104	0.0032	0.001523	0.0015049	0	0.010538	0.0108	0.0137	1.6441	2.8861	0.2752	1.0361		4.27923	0.5909	1.2571	0.53949
U (M)	1.0292	1.5419	0.0006	0.0006	8E-05	5E-05	0	0.13974	0.106721	0.1227689	0.2752	0.00074	0.0216	0.2682	0.1835	0.4042	0.0314	0.1753	0.0031	0	0.0986	0.2069	0.00208
Cs (Ci/L)	0.0016	0	0.0122	0.0293	0.0002	0.0003	0	0.00134	0.013313	0.015393	1.7857	0.730612	0.0793	0.1865	0.0032	0.0035	0.2186	0.561		0.06317	0.0022	0.002	0.00123
Sr (Ci/L)	0.0138	0	0.0001	0.0003	8E-06	5E-05	0	0.02202	0.003227	0.003187	0	0.000294	1.0433	7.8275	0.0026	0.0029	8.061	13.687		0.02247	0.0018	0	0.00102

pred. sludge mol/L	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
Na	1.12675	1.1664	1.5756	2.0895	1.8258	3.384	3.384	3.8888	2.9631	6.6962	6.4431		3.7826	10.67	0	0.3	12.926	0.996	1.3109
Al	0	0	0	11.008	0	0.7071	0.7071	0	1.2273	6.065	0		0.2958	0.08	1.82	0	2.2875	0	0
Fe(total)	0.04	0.04	0.04	1.6846	5.6687	1.0882	1.0882	1.2278	1.0019	2.2078	1.502		0.0269	0.09	0.53	0	0	4.0014	4.0014
Cr	0.008	0.008	0.008	0.0052	0.0066	0.0075	0.0075	0.0071	0.0017	1E-07	0		0.0256	0	0	0	0	0.8057	0.8057
Bi	0	0	0	0	0	0	0	0	0	0	0		6E-05	0	0	0	0	0	0
La	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Hg	0	0	0	0	0	0	0	0	0	0	0		1E-06	0	0	0	0	0	0
ZrO(OH)2	0	0	0	0	0	0	0	0	0	0	0		3E-05	0	0	0	0	0	0
Pb	0	0	0	0	0.1516	0	0	0	8E-07	0	0		2E-06	0	0	0	0	0	0
Ni	0.004	0.004	0.004	0.0974	0.1851	0.0397	0.0397	0.0728	0.042	1.2076	0		0.0061	0	0	0	0	0.4013	0.4013
Sr	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Mn	0	0.0882	0.0009	0	0	0	0	0	0	0	0		0.0344	0	0	0.0013	0	0	0
Ca	0.01808	0.0181	0.0181	0.419	0.004	0.1698	0.1698	0.0017	0.222	0.2034	0.1368		0.0288	0.08	20.9	0	0	0.9101	0.9101
K	0.00329	0.0908	0.0055	0.0101	0.0731	0.0261	0.0261	0.0037	0.0023	0.0078	0.0116		0.0485	0	0	0.0013	0.0152	0.0005	0.0005
balance	**-2E-16**	**0**	**0**	**7E-15**	**0**	**0**	**-2E-15**	**0**	**0**	**0**	**0**		**0.001**	**0**	**-7E-15**	**-6E-17**	**7E-15**	**0**	**4E-15**
density	1.04021	1.0371	1.0571	1.7282	1.4473	1.2494	1.2879	1.2151	1.4319	1.9866	1.7469		1.1538	0.39	1.9	1.0188	1.6393	1.488	1.5
vol%solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6		1	100	100	13.6	80	1	1
void frac.	1	1	1	0.549	0.8226	0.9349	0.9349	0.8865	0.8459	0.5749	0.8505		1			1	0.8	0.7152	0.7152
wt.% H2O	90.6853	89.677	88.411	64.884	54.555	68.612	69.47	71.304	68.732	48.461	49.143		75.024	40	50	94.733	45.099	58.806	57.994
TOC wt.%C	0.84921	0.3273	0.2552	0	1.408	0.0205	0.0881	0	0.0426	0.1707	2.9914		0.3402			0	0	0	0
free OH-	0.174	0.482	0.1824	0.1633	0.0972	0.0358	0.0463	0.2149	0.1742	0.1119	0.1512		0.7102	0	0	-0.4935	0.5276	0.037	0.037
OH-	0.174	0.482	0.1824	38.57	17.766	5.7888	6.3627	4.0354	9.7453	30.989	10.651		1.8936	0	34.73	-0.4935	9.4851	15.237	15.237
NO3-	0.67545	0.6778	0.9429	1.5381	1E-17	2.5823	4E-07	1E-08	7E-24	0.0009	4E-06		1.4968	0	0	0.8	2.7909	0.1124	0.1124
NO2-	0.01	0.01	0.01	0.0078	0.8973	0.0119	2.5942	0.5586	0.2386	0.9932	0.5534		0.8102	0	0	0	4.2375	0.0172	0.01
CO3--	0.21781	0.3041	0.3041	0.5197	0.004	0.1698	0.1698	0.0017	0.222	0.3531	0.3397		0.1891	0	0	0	1.15	0.9051	0.9051
PO4---	0	0	0	8E-05	0	0.0845	0.0845	0.0178	0	0.0058	0		0.0126	0	0	0	0.0952	0	0.1073
SO4--	0.004	0.004	0.004	0.0038	0.0556	0.0507	0.0507	0.0214	0.0135	0.0254	0.0871		0.1133	0	0.69	0	0.0286	0.4309	0.4309
SiO3--	0	0	0	0	0	0	0	1.5179	1.2288	2.3862	1.8027		0.0646	5.67	6.37	0	0	0	0
F-	0	0	0	0	0	0.1126	0.1126	0	0	0	0		0.0033	0	0	0	0.0571	0	0
Cl-	0.01513	0.0121	0.0213	0.0635	0.0405	0.0595	0.0595	0.0169	0.0108	0.0357	0.0532		0.0658	0	0	0	0.59	0.0023	0.0023
C6H5O7---	0	0	0	0	0.033	0	0	0	0.0085	0.0086	0		0.0283	0	0	0	0	0	0
EDTA----	0	0	0	0	0.0659	0	0	0	0	0	0.1281		0	0	0	0	0	0	0
HEDTA---	0	0	0	0	0	0	0	0	0	0	0.2561		4E-05	0	0	0	0	0	0
											0		0	0					
glycolate-	0	0	0	0	0	0	0	0	0	0.1153	0.2561		0.0041	0	0	0	0	0	0
acetate-	0	0	0	0	0.4204	0	0	0	0	0	0		0	0	0	0	0	0	0
oxalate--	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
DBP	0.06134	0.0236	0.0187	0	0	0.0018	0.0079	0	0	0	3E-05		0.0186	0	0	0			
butanol	0.06134	0.0236	0.0187	0	0	0.0018	0.0079	0	0	0	3E-05			0	0	0	0	0	0
NH3	0	0	0	0	0.4455	1E-07	0.7179	0.1723	0.1428	0.0876	0.1147		0.0201	0	0	0	0.0682	0	0
Fe(CN)6----																			
Pu (µCi/g)	0	0	0	14.99	0	0	0	7.1971	14.277	2.6118	2.1827		0.0528			0	0		
U (M)	0	0	0	0	0	0.002	0.0977	0	0.4604	0.5604	1.0033		0.0079			0	0	0	0
Cs (Ci/L)	0	0	0	0	0	0.0001	0.591	0.0089	0.2709	0	0.0386		0.0452			0	0.5		
Sr (Ci/L)	0	0	0	0	18.034	0.0001	8.4474	11.967	30.552	4.6604	8.2565		0.0691			0	0.0063		

pred. sludge mol/L	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
Na		8.9838		9.0611		8.8804		11.962		12.08		14.561		16.612		15.807		0	5.1709	0.570127	5.50169	0	0	0.0463
Al		0.1075		0.0954		1.3828		1.013		1.9178		1.971		2.4308		2.4566		0	0.8618	0	0			0
Fe(total)		0.0112		0.0158		0.0217		0.0516		0.1074		0.0533		0.0069		0.0252		0	2.9608	1.901947	0.36391			1.3352
Cr		0.0062		0.0055		0.2276		0.057		0.0462		0.1005		0.0522		0.0629		0	0	0.007121	0	0	0	0
Bi		0.0026		0.0025		6E-06		0.0015		0.0008		0.0012		0.0054		0.0072		0	0	0	0			0
La		0		0		0		0		3E-06		2E-05		3E-05		1E-05		0	0	0	0			0
Hg		7E-06		5E-06		2E-06		9E-06		4E-05		1E-05		2E-05		5E-05		0	0	0	0.0021			0
ZrO(OH)2		0.0017		0.0018		3E-06		0.001		0.0002		0.0007		0.0036		0.0069		0	0	0	0.92681			0
Pb		0		0		2E-07		8E-06		0.0001		2E-05		5E-05		6E-05		0	0	3.87E-05	0			0
Ni		0.0084		0.0118		0.0157		0.016		0.0236		0.0168		0.0047		0.0121		0	0	0.111836	0			0
Sr		0		0		0		0		1E-05		5E-05		5E-05		5E-05		0	0	0	0			0
Mn		0		0		0.0004		0.0413		0.0501		0.0499		0.0162		0.0243		0	0	0.005341	0			0
Ca		0.0507		0.0709		0.0794		0.0804		0.1178		0.0827		0.0238		0.0628		0	0.2464	0.45976	0.0949			1.5089
K		0.0179		0.0161		0.0257		0.0586		0.0579		0.0775		0.1552		0.1369		0	0.0088	0.006098	0.19092			0.0002
balance		**-5E-15**		**-5E-15**		**1E-05**		**0.0005**		**0.0007**		**0.0009**		**0.0016**		**0.0008**		**0**	**0**	**8.88E-16**	**0**			**0**
density		1.4384		1.464		1.4939		1.5825		1.6129		1.7136		1.7752		1.7749		0.5	1.7786	1.182737	1.27627			1.2169
vol%solids		17.683		11.446		13.82		55.385		48.966		55.173		99		45.523		90	3.9	2	10.5			0.6
void frac.		0.792		0.7772		0.8721		0.7865		0.7782		0.7183		0.5823		0.6239		0.5	0.789	0.888191	0.85031			0.7842
wt.% H2O		53.192		55.379		49.572		39.774		39.697		32.117		29.863		31.708		100	53.761	79.09937	67.8831			78.495
TOC wt.%C		0.0003		0.0002		0.0065		0.5347		0.4493		0.6953		1.4191		0.9532		0	0	0.037373	0			0
free OH-		0.154		0.1482		0.0083		0.4134		0.4266		0.4408		0.7824		0.5927		0	1.1328	0.014557	0.0916			0.0126
OH-		0.6567		0.7376		6.4202		4.9983		8.875		9.0573		10.719		10.822		0	18.137	5.935539	4.87945			4.0133
NO3-		5.4181		4.6413		5.2992		7.0337		6.5358		7.5802		4.9966		6.2896		0	2E-14	0.217545	0.33355			0.052
NO2-		0.3067		0.3025		1.8474		1.4505		1.5794		2.364		4.3934		2.6065		0	0.4913	0.020036	0.00726			0
CO3--		0.2019		0.2308		0.0841		0.4381		0.4718		0.4767		0.5971		0.5606		0	0.2464	0.550541	0.0949			1.5019
PO4---		0.7173		1.0146		0.0005		0.1323		0.0679		0.1083		0.3352		0.4305		0	0	0.061883	0			0
SO4--		0.1621		0.1519		0.0427		0.2164		0.1607		0.2334		0.5297		0.3823		0	0.1072	0.003599	0			0
SiO3--		0.022		0.021		0.1318		0.1289		0.1267		0.1616		0.0854		0.1876		0	1.5246	0	0			0
F-		0.1515		0.1449		0.0004		0.0903		0.0561		0.0689		0.1409		0.15		0	0.0239	0	5.28775			0
Cl-		0.1012		0.0918		0.1164		0.1335		0.123		0.1223		0.101		0.1067		0	0.0403	0.003481	0.00397			0.0007
C6H5O7---		0		0		0.0004		0.0175		0.0241		0.0281		0.0542		0.028		0	0	0	0			0
EDTA----		0		0		9E-06		0.0103		0.005		0.014		0.0319		0.0261		0	0	0	0			0
HEDTA---		0		0		5E-07		0.02		3E-05		0.0265		0.0598		0.0462		0	0	0	0			0
glycolate-		0		0		0.0005		0.0615		0.0152		0.084		0.1721		0.0978		0	0	0	0			0
acetate-		0		0		6E-05		0.002		0.032		0.005		0.0132		0.0195		0	0	0	0			0
oxalate--		0		0		0		0		1E-05		6E-05		1E-04		4E-05		0	0	0	0			0
DBP		3E-05		2E-05		0.0004		0.0141		0.0262		0.02		0.0405		0.0237		0	0	0.00307	0			0
butanol		3E-05		2E-05		0.0004		0.0141		0.0262		0.02		0.0405		0.0237		0	0	0.00307	0			0
NH3		0.001		0.001		0.0309		0.0104		0.0087		0.0156		0.0219		0.1151		0	0.1972	1.26E-05	0.65474			0.0392
Fe(CN)6----																								
Pu (µCi/g)		0.008		0.0082		0.1016		0.0945		0.1388		0.0987		0.0379		0.0835		0	2.462	0.157767	0.6595			0
U (M)		0.0082		0.0271		0.0349		0.0226		0.0321		0.0255		0.0081		0.0163		0	0.8848	0.000411	0.0027			0
Cs (Ci/L)		0.0216		0.0224		0.2908		0.2317		0.211		0.3029		0.5245		0.2989		0	4.4532	0.026705	0.00191			0
Sr (Ci/L)		0.0201		0.0195		0.2624		0.1546		0.1225		0.2002		0.061		0.1345		0	58.413	0.023145	0.00163			0

pred. su mol/L	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
Na	2.1683	2.841	1.9293	1.708	2.1358	1.2697	1.7233	3.90735	3.891871	3.8817086	3.0405	1.769488	2.9693	3.9578	3.9839	1.8052	0.767	1.2854		3.28344	2.3752	1.5992	0.54515
Al(OH)4 -	0	0	0.1944	0.0246	0	0	0	0	0	0	0.0263	0.173895	0.4854	1.0595	1.6	0.6281	0	0		0	0.8511	0.6281	0
Fe	0.002	0.002	0.002	0.002	0.002	0.0017	0.002	0.002	0.002001	0.0020012	0	0.002	0.002	0.002	0.002	0.002	0.002	0.002		0.002	0.002	0.002	0.002
Cr	0.0033	0.0034	0.0054	0.0055	0.0043	0.0054	0.0041	0.00321	0.003208	0.0032079	0	0.002006	0.03	0.03	0.0031	0.0031	0.008	0.0081		0.00802	0.0031	0.0031	0.00309
Bi	0	0	0.004	0.004	0.004	0.003	0.004	0	0.003999	0.0039994	0	0.004003	0	0	0	0	0	0		0	0	0	0
La	0	0	0	0	0	0	0.006	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Hg	0	0	1E-05	4E-06	0	0	0	0	0	0	0	0	0	0	1E-05	2E-05	0	0		0	1E-05	1E-05	1E-05
Zr	0	0	0.003	0.003	0	0	0	0	0	0	0	0.003003	0	0	0	0	0	0		0	0	0	0.003
Pb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		6E-05	0	0	0
Ni	0.0017	0.0017	0.0017	0.0017	0.0016	0.0016	0.0016	0.0016	0.0018	0.0017998	0.0018	0.001802	0.0018	0.0018	0.0015	0.0015	0.0018	0.0018		0.0018	0.0015	0.0015	0.00154
Sr	0	0	0	0	0	0	0.0063	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Mn	0	0	0	0	0	0	0.0046	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Ca	0.009	0.0089	0.009	0.009	0.009	0.009	0.009	0.00901	0.009005	0.0090053	0.009	0.009006	0.009	0.009	0.009	0.009	0.009	0.009		0.00901	0.009	0.009	0.00901
K	0.0007	0.0007	0.0046	0.0035	0.0066	0.0037	0.2725	0.0173	0.0181	0.0180505	0.0117	0.004213	0.0106	0.0196	0.0022	0.0034	0.0032	0.0057		0.01476	0.0014	0.0024	0.22461
balance	1E-15	9E-16	-2E-16	-2E-16	4E-16	2E-16	4E-16	-8.9E-16	0	-4.44E-16	0	-2.2E-16	-9E-16	0	0	2E-16	0	-2E-16		-4.4E-16	0	0	0
density	1.0785	1.1021	1.0856	1.0662	1.0806	1.0473	1.0651	1.14809	1.147387	1.1471513	1.1166	1.077437	1.1466	1.2242	1.2629	1.1119	1.026	1.0457		1.12398	1.1493	1.1043	1.01711
vol%solids	12	12	13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1	2.9	2.2	3.9		2.2	8.1	2.9	10.5
void frac.	0.7042	0.5801	0.6979	0.7922	0.7803	0.942	0.8634	0.91417	0.934508	0.9230049	0.8956	0.935004	0.7988	0.5737	0.8136	0.776	0.8413	0.8077		0.86177	0.8386	0.7762	0.85731
wt.% H2O	86.789	83.247	87.714	88.955	85.46	91.223	84.5	73.5572	73.28673	73.307589	78.158	88.89935	78.528	73.832	75.29	86.47	94.864	91.551		76.3787	83.612	88.005	95.1018
TOC wt.%C	0	0	0	0	0	0	0.051	0.00039	0	0	0	0	0	0	0	0	0	0		0	0	0	0
species	excludes hydroxide bound to Al																						
OH-	0.2611	0.3927	0.087	0.0287	0.0361	0.0622	0.0282	0.02599	0.033599	0.0235747	0.0496	0.131736	0.0117	0.0229	0.0346	0.0452	0.207	0.2073		0.05274	0.0349	0.0309	0.24047
NO3-	0.1739	0.1945	0.5681	0.5443	1.2582	0.6934	1.5902	2.58276	2.770892	2.7708912	2.3551	0.545383	1.6225	1.5533	0.8785	0.8755	0.1976	0.1567		2.5848	0.6833	0.685	0.31676
NO2-	0.0176	0	0.2275	0.2588	0.0014	0.0008	0	0.21724	0.029108	0.0291088	0.1702	0.171052	0.8671	1.2467	1.4411	0.2979	0.2533	0.5707		0.22523	0.7996	0.2858	0.00845
CO3--	0.5512	0.8838	0.009	0.009	0.009	0.009	0.009	0.19103	0.009005	0.0090053	0.01	-0.00202	0.009	0.009	0.009	0.009	0.009	0.009		0.00901	0.009	0.009	0.00901
PO4---	0.1499	0.1491	0.1519	0.1518	0.153	0.1084	0.0472	0.13031	0.134315	0.1343205	0.1302	0.153935	0	0	0	0	0	0		0.09629	0	0	0
SO4--	0.2194	0.2228	0.0643	0.065	0.0504	0.0269	0.0016	0.14194	0.183445	0.183452	0.016	0.020065	0.0192	0.0302	0.0015	0.0015	0.0438	0.16		0.05623	0.0015	0.0015	0.00154
SiO3--	0.0041	0.0042	0.034	0.034	0.034	0.0195	0	0	0.033994	0.0339947	0	0.034029	0.0148	0.034	0.0305	0	0.034	0.034		0	0.0203	0	0
F-	0	0	0.2378	0.2401	0.2233	0.116	0.2401	0	0.21051	0.2105187	0	0.228714	0	0	0	0	0	0		0	0	0	0.24012
Cl-	0.0034	0.0034	0.0214	0.0163	0.0305	0.017	0.0299	0.10262	0.083259	0.0830322	0.0539	0.01938	0.049	0.0902	0.0102	0.0157	0.0145	0.0261		0.0679	0.0065	0.0111	0.00581
C6H5O7---	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
EDTA----	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
HEDTA---	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
glycolate-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
acetate-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
oxalate--	0	0	0	0	0	0	0.0226	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
DBP	0	0	0	0	0	0	0	3.1E-05	0	0	0	0	0	0	0	0	0	0		0	0	0	0
butanol	0	0	0	0	0	0	0	3.1E-05	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NH3	8.0E-05	0E+00	5.3E-04	1.1E-03	8.0E-08	4.7E-08	0E+00	8.1E-04	1.5E-05	1.5E-05	0E+00	3.9E-06	1.5E-02	2.7E-02	7.9E-04	1.4E-04	6.9E-03	2.5E-02		8.2E-04	2.6E-04	4.0E-05	7.8E-01
Fe(CN)6----	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Pu (µCi/L)	10.639	0	9.2604	11.331	16.565	11.625	12.776	4.02233	1.870272	1.8703485	0	11.32474	15.521	29.18	30.019	48.265	30.018	30.018		30.0121	30.018	30.018	30.0176
U (M)	0.0415	0.0634	0.0008	0.0008	0.0001	5E-05	0	0.004	0.003999	0.0039994	0.004	0.000792	0.004	0.004	0.004	0.0064	0.004	0.004	0.004	0	0.004	0.004	0.00243
Cs (Ci/L)	0.0022	0	0.0175	0.037	0.0002	0.0003	0	0.00105	0	0	0	0	0.0992	0.2231	0.004	0.0046	0.2599	0.6946		0.02925	0.0026	0.0026	0.00143
Sr (Ci/L)	0.0196	0	0.0002	0.0003	1E-05	6E-05	0	0.02409	0.003453	0.0034529	0	0.000315	0.034	0.034	0.0032	0.0037	0.034	0.034		0.02608	0.0021		0.00119

pred. su mol/L	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
Na	1.12675	1.1664	1.5756	3.8061	2.2197	3.6198	3.6198	1.0302	0.6658	3.4141	3.4046		3.7826			0.3	10.147	0.1957	0.636
Al(OH)4 -	0	0	0	0.2526	0	0.3174	0.3174	0	0.0772	0.5223	0		0.2958			0	1.85	0	0
Fe	0.04	0.04	0.04	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		0.0269			0	0	0.002	0.002
Cr	0.008	0.008	0.008	0.0095	0.008	0.008	0.008	0.008	0.002	2E-07	0		0.0256			0	0	0.008	0.008
Bi	0	0	0	0	0	0	0	0	0	0	0		6E-05			0	0	0	0
La	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Hg	0	0	0	0	0	0	0	0	0	0	0		1E-06			0	0	0	0
Zr	0	0	0	0	0	0	0	0	0	0	0		3E-05			0	0	0	0
Pb	0	0	0	0	0.0016	0	0	0	1E-06	0	0		2E-06			0	0	0	0
Ni	0.004	0.004	0.004	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0		0.0061			0	0	0.0018	0.0018
Sr	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Mn	0	0.0882	0.0009	0	0	0	0	0	0	0	0		0.0344			0.0013	0	0	0
Ca	0.01808	0.0181	0.0181	0.009	0.0049	0.009	0.009	0.0019	0.009	0.009	0.009		0.0288			0	0	0.009	0.009
K	0.00329	0.0908	0.0055	0.0183	0.0889	0.0279	0.0279	0.0042	0.0028	0.0135	0.0136		0.0485			0.0013	0.019	0.0007	0.0007
balance	-2E-16	0	0	1E-15	-1E-15	0	0	0	-1E-16	-4E-16	0		0.001			-6E-17	4E-15	0	0
density	1.04021	1.0371	1.0571	1.1579	1.0826	1.1592	1.159	1.0355	1.0276	1.1634	1.1267		1.1538			1.0188	1.5052	1.0067	1.0234
vol%solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6		1			13.6	80	1	1
void frac.	1	1	1	0.549	0.8226	0.9349	0.9349	0.8865	0.8459	0.5749	0.8505		1			1	0.8	0.7152	0.7152
wt.% H2O	90.6853	89.677	88.411	74.379	82.264	74.482	76.86	93.044	95.597	77.459	73.576		75.024			94.733	51.848	98.281	95.973
TOC wt.%C	0.84921	0.3273	0.2552	0	2.2883	0.0237	0.1047	0	0.0701	0.5069	5.4534		0.4176			0	0	0	0
species																			
OH-	0.174	0.482	0.1824	0.2974	0.1182	0.0383	0.0495	0.2424	0.2059	0.1947	0.1778		0.7102			-0.4935	0.6595	0.0517	0.0517
NO3-	0.67545	0.6778	0.9429	2.8016	1.005	2.7635	0.9408	0.5898	0.1511	1.6336	0.5287		1.4968			0.8	2.9166	0.1572	0.1572
NO2-	0.01	0.01	0.01	0.0141	0.0858	0.0114	1.8341	0.0404	0.131	0.0955	0.122		0.8102			0	3.3	0.0241	0.014
CO3--	0.21781	0.3041	0.3041	0.1925	0.0049	0.009	0.009	0.0019	0.009	0.2694	0.2476		0.1891			0	0.4	0.002	0.002
PO4---	0	0	0	0.0001	0	0.0903	0.0903	0.0201	0	0.01	0		0.0126			0	0.119	0	0.1501
SO4--	0.004	0.004	0.004	0.0069	0.0675	0.0542	0.0542	0.0241	0.016	0.0441	0.1024		0.1133			0	0.0357	0.004	0.004
SiO3--	0	0	0	0	0	0	0	0.034	0.034	0.034	0.034		0.0646			0	0	0	0
F-	0	0	0	0	0	0.1205	0.1205	0	0	0	0		0.0033			0	0.0714	0	0
Cl-	0.01513	0.0121	0.0213	0.1156	0.0493	0.0637	0.0637	0.0191	0.0127	0.0622	0.0626		0.0658			0	0.14	0.0032	0.0032
C6H5O7---	0	0	0	0	0.0401	0	0	0	0.01	0.015	0		0.0283			0	0	0	0
EDTA----	0	0	0	0	0.0802	0	0	0	0	0	0.1506		0			0	0	0	0
HEDTA---	0	0	0	0	0	0	0	0	0	0	0.3012		4E-05			0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
glycolate-	0	0	0	0	0	0	0	0	0	0.2006	0.3012		0.0041			0	0	0	0
acetate-	0	0	0	0	0.5111	0	0	0	0	0	0		0			0	0	0	0
oxalate--	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
DBP	0.06134	0.0236	0.0187	0	0	0.0019	0.0084	0	0	0	3E-05		0.0186			0	0	0	0
butanol	0.06134	0.0236	0.0187	0	0	0.0019	0.0084	0	0	0	3E-05		0.0186			0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
NH3	0E+00	0E+00	0E+00	0E+00	2.7E-04	2E-07	6E-02	1.2E-04	2.8E-03	2.2E-04	9.9E-04		0.0201			0	0.0853	0E+00	0E+00
Fe(CN)6----	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Pu (µCi/L)	0	0	0	30.018	0	0	0	29.979	29.986	30.005	29.996		60.933			0	0	0	0
U (M)	0	0	0	0	0	0.0021	0.004	0	0.004	0.004	0.004		0.0079			0	0	0	0
Cs (Ci/L)	0	0	0	0	0	0.0001	0.6322	0.01	0.3202	0	0.0454		0.0452			0	0.5	0	0
Sr (Ci/L)	0	0	0	0	0.034	0.0001	0.034	0.0345	0.0335	0.0343	0.0915		0.0691			0	0	0	0

pred. su mol/L	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
Na		5.0045		5.0154		6.6696		8.5491		8.5657		10.403		12.031		11.164		0	2.7573	0.641897	0.49159	0	0	0.059
Al(OH)4 -		0.1358		0.1227		1.5857		1.288		1.5985		1.6005		1.6313		1.6113		0	0.3188	0	0			0
Fe		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0	0.002	0.002001	0.002			0.002
Cr		0.0078		0.0071		0.03		0.03		0.03		0.03		0.0306		0.0302		0	0	0.008018	0			0
Bi		0.0033		0.0032		7E-06		0.002		0.001		0.0016		0.004		0.004		0	0	0	0			0
La		0		0		0		0		4E-06		2E-05		4E-05		2E-05		0	0	0	0			0
Hg		9E-06		6E-06		2E-06		1E-05		1E-05		1E-05		9E-06		1E-05		0	0	0	1E-05			0
Zr		0.0021		0.0023		3E-06		0.0013		0.0003		0.001		0.003		0.003		0	0	0	0.003			0
Pb		0		0		3E-07		1E-05		0.0001		3E-05		8E-05		0.0001		0	0	4.35E-05	0			0
Ni		0.0018		0.0018		0.0018		0.0018		0.0018		0.0018		0.0018		0.0018		0	0	0.001799	0			0
Sr		0		0		0		0		4E-06		2E-05		5E-05		2E-05		0	0	0	0			0
Mn		0		0		0.0005		0.009		0.009		0.009		0.0092		0.0091		0	0	0.006013	0			0
Ca		0.009		0.009		0.009		0.009		0.009		0.009		0.009		0.009		0	0.009	0.009005	0.00901			0.009
K		0.0225		0.0207		0.0295		0.0746		0.0744		0.1079		0.2665		0.2194		0	0.0111	0.006865	0.22453			0.0002
balance		-3E-15		0		1E-05		0.0006		0.0009		0.0011		0.0027		0.0012		0	-4E-16	1.11E-16	-1E-16			-1E-17
density		1.1968		1.1963		1.3643		1.4071		1.4292		1.4981		1.5512		1.5228		1	1.1056	1.024146	1.01706			1.002
vol%solids		17.683		11.446		13.82		55.385		48.966		55.173		99		45.523		90	3.9	2	10.5			0.6
void frac.		0.792		0.7772		0.8721		0.7865		0.7782		0.7183		0.5823		0.6239		0.5	0.789	0.888191	0.85031			0.7842
wt.% H2O		68.785		68.742		60.769		54.638		54.966		48.201		42.095		45.318		100	87.097	95.38536	94.8655			99.394
TOC wt.%C		0.0004		0.0004		0.0082		0.7645		0.6515		1.1071		2.789		1.7806		0	0	0.048594	0			0
species		excludes hydroxide bound to Al																excludes hydroxide bound to Al						excludes hydroxide b
OH-		0.1945		0.1907		0.0095		0.5256		0.5482		0.6137		1.3437		0.9499		0	1.4358	0.016389	0.10773			0.016
NO3-		2.7669		2.7896		2.7973		2.8024		2.7971		2.8109		2.8909		2.8206		0	0.1735	0.25075	0.39292			0.0663
NO2-		0.3873		0.3893		2.1184		1.8443		2.0296		3.0809		3.0694		3.0943		0	0.4492	0.016739	0.00788			0
CO3--		0.2		0.2147		0.0144		0.3597		0.3476		0.3619		0.3911		0.3792		0	0.009	0.111213	0.00901			-1E-05
PO4---		0.1508		0.1518		0.0005		0.1511		0.0872		0.1508		0.1542		0.1526		0	0	0.069673	0			0
SO4--		0.2047		0.1955		0.0489		0.2751		0.2066		0.3249		0.3544		0.351		0	0.1359	0.004053	0			0
SiO3--		0.0278		0.0271		0.034		0.0339		0.0339		0.034		0.0346		0.0342		0	0.034	0	0			0
F-		0.1912		0.1864		0.0004		0.1148		0.0721		0.0959		0.2419		0.2403		0	0.0302	0	0.23998			0
Cl-		0.1278		0.1181		0.1334		0.1697		0.1581		0.1703		0.1735		0.171		0	0.051	0.003919	0.00467			0.0009
C6H5O7---		0		0		0.0005		0.0223		0.031		0.0392		0.0931		0.0448		0	0	0	0			0
EDTA----		0		0		1E-05		0.0131		0.0065		0.0195		0.0548		0.0419		0	0	0	0			0
HEDTA---		0		0		6E-07		0.0255		4E-05		0.0369		0.1027		0.074		0	0	0	0			0
		0		0		0		0		0		0		0		0		0	0	0	0			0
glycolate-		0		0		0.0006		0.0782		0.0195		0.117		0.2956		0.1567		0	0	0	0			0
acetate-		0		0		7E-05		0.0025		0.0411		0.007		0.0227		0.0312		0	0	0	0			0
oxalate--		0		0		0		0		2E-05		9E-05		0.0002		7E-05		0	0	0	0			0
DBP		3E-05		3E-05		0.0004		0.018		0.0336		0.0279		0.0696		0.038		0	0	0.003456	0			0
butanol		3E-05		3E-05		0.0004		0.018		0.0336		0.0279		0.0696		0.038		0	0	0.003456	0			0
		0		0		0		0		0		0		0		0		0	0	0	0			0
NH3		0.0012		0.0012		0.0355		0.0132		0.0112		0.0218		0.0375		0.1844		0	1.7E-02	1.5E-05	7.8E-01			5.0E-02
Fe(CN)6----		0		0		0		0		0		0		0		0		0	0	0	0			0
Pu (µCi/L)		12.135		12.552		30.687		30.147		30.028		30.268		26.045		30.767		0	42.52	0.930293	21.8264			0
U (M)		0.0041		0.0038		0.0041		0.0041		0.004		0.004		0.0037		0.0041		0	0.004	0.000463	0.00318			0
Cs (Ci/L)		0.011		0.0135		0.2967		0.2663		0.1711		0.341		0.8549		0.4153		0	2.6444	0.030067	0.00225			0
Sr (Ci/L)		0.0254		0.0251		0.034		0.0317		0.0333		0.0313		0.0313		0.0295		0	0.034	0.026058	0.00191			0

prec. solids mol/L	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
NaNO3																							
NaNO2																							
NaCl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaF	0	0	0	0.0011	0	0	1.8261	0	0	0	0	0	0	0	0	0	0	0		0	0	0	5.08069
Sr(OH)2							1.4538																
Na2CO3.7H2O	0.4352	0.7189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na3PO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3PO4.12H2O	0.2949	0.3203	1.1402	0.7139	0.7682	0	0		0	0	0	0.049838	0	0	0	0	0	0		0	0	0	0
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2SO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2SiO3	0	0	0.0393	0.0231	0.0518	0	0	0	0.029417	0.0340331	0	0.084934	0	0.458	0	0	0.5935	1.4966		0	0	0	0
(Al2O3.3H2O)/2	0	0	0.3401	0.8422	0	0	0	0	0	0	0.1414	0.271833	3.7556	4.1632	4.9383	5.3793	0	0		0	4.4444	5.3793	0
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2983	0	0	0		0	0	0	0
FeO(OH)	0.1173	0.1176	0.3218	0.1771	0.5592	0.7908	0.3592	1.57156	0.756856	0.8751178	0	0.000153	1.0115	2.6851	0.1633	0.4556	2.6277	2.9592		2.90933	0.1633	0.4556	0.12599
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	0	0	0.8501	4.3816	0	0	0	0		0	0	0	0
MnO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
BiPO4	0	0	0.0742	0.041	0.0891	0.0668	0.0569	0	0.243524	0.2815774	0	0.208522	0	0	0	0	0	0		0	0	0	0
Pb(OH)2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
(La2O3)/2	0	0	0	0	0	0	0.2316	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HgO	0	0	8E-05	7E-05	0	0	0	0	0	0	0	0	0	0	0.0041	0.0108	0	0	0	0	0.0025	0.0059	0.00199
Na3cit.5H2O																							
Na Acetate																							
Na 2 Oxalate	0	0	0	0	0	0	0.1923						0	0	0	0	0	0		0	0	0	0
Na3HEDTA																							
Na4EDTA																							
CaCO3.6H2O	0.0778	0.0793	0.0692	0.0383	0.1366	0.2681	0.2358	0.3368	0.255402	0.2952826	0.7863	0.229637	0.2073	0.5018	0.1134	0.315	0.4137	0.2358		0.42615	0.1129	0.3142	0.08723
Ni(OH)2	0	0	0	0	0	0	0	0	0	0.0500721	0.2929	0.085459	0.0492	0.1166	0	0	0.1002	0.0567		0.10022	0	0	0
ZrO2•2H2O	0	0	0.0082	0.0046	0	0	0	0	0	0	0	0.020975	0	0	0	0	0	0		0	0	0	0.92422
Na2NiFe(CN)6.6H2O									0.135135	0.078125	0.3571	0.104167											
UO2(OH)2*6H2O	1	1.5051	0	0	0	0	0	0.13608	0.102984	0.1190774	0.2717	0	0.0184	0.2659	0.1802	0.3992	0.028	0.1721		0	0.0953	0.2038	0

prec. solids mol/L	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
NaNO3						0	0	0			0	0	0				0.4576	0	0
NaNO2						0	0	0			0	0	0				1.5975	0	0
NaCl	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0.478	0	0
NaF	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Sr(OH)2																			
Na2CO3.7H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0.83	0	0
Na3PO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na3PO4.12H2O	0	0	0	0	0	0	0	0	0	0	0	0	0					0	0
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0.4	0.4
Na2SO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	1.0043	0			0	0	0.028	0.028
Na2SiO3	0	0	0	0	0	0	0	1.4878	1.2	2.3666	1.7738	3.2287	0			0	0	0	0
(Al2O3.3H2O)/2	0	0	0	10.87	0	0.4103	0.4103	0	1.162	5.7647	0	1.0355	0			0	0.1925	0	0
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0.615	0	0
FeO(OH)	0	0	0	1.6835	5.667	1.0863	1.0863	1.226	1.0003	2.2067	1.5003	0	0			0	0	4	4
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	0	1.2819	0			0	0	0.8	0.8
MnO2	0	0	0	0	0	0	0	0	0	0	0	1.7188	0			0	0	0	0
BiPO4	0	0	0	0	0	0	0	0	0	0	0	0.0032	0			0	0	0	0
Pb(OH)2	0	0	0	0	0.1503	0	0	0	0	0	0	0.0001	0			0	0	0	0
(La2O3)/2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
HgO	0	0	0	0	0	0	0	0	0	0	0	6E-05	0			0	0	0	0
Na3cit.5H2O																			
Na Acetate																			
Na 2 Oxalate	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na3HEDTA																			
Na4EDTA																			
CaCO3.6H2O	0	0	0	0.4141	0	0.1614	0.1614	0	0.2144	0.1982	0.1291	1.2931	0			0	0	0.9037	0.9037
Ni(OH)2	0	0	0	0.0964	0.1837	0.038	0.038	0.0712	0.0404	1.2066	0	0.3065	0			0	0	0.4	0.4
ZrO2•2H2O	0	0	0	0	0	0	0	0	0	0	0	0.0013	0			0	0	0	0
Na2NiFe(CN)6.6H2																			
UO2(OH)2*6H2O	0	0	0	0	0	0	0.0939	0	0.457	0.5581	0.9999	0.3061	0			0	0	0	0

prec. solids mol/L	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
NaNO3		3.2268		2.4733		2.8597		4.8296		4.3592		5.5611		3.3133		4.5297		0						
NaNO2		0		0		0		0		0		0.1509		2.6061		0.6758		0						
NaCl		0		0															0	0	0			0
NaF		0		0															0	0	5.08369			0
Sr(OH)2																								
Na2CO3.7H2O		0		0		0		0.0819		0.0905		0.1405		0.3509		0.2668		0	0	0	0			0
Na3PO4.10H2O		0.5978		0.8967		0		0.0135		0		0		0.2424		0.3306		0	0	0	0			0
Na3PO4.12H2O																			0	0	0			0
Na2SO4		0		0		0		0		0		0		0		0		0	0	0	0			0
Na2SO4.10H2O		0		0		0		0		0		0		0.3233		0.1633		0	0	0	0			0
Na2SiO3		0		0		0.1022		0.1023		0.1003		0.1372		0.0652		0.1663		0	1.4977	0	0			0
(Al2O3.3H2O)/2		0		0		0		0		0		0		0		0		0	0.6103	0	0			0
NaAlO2		0		0		0		0		0.6739		0.8214		1.4809		1.4513		0	0	0	0			0
FeO(OH)		0.0097		0.0142		0.02		0.05		0.1059		0.0519		0.0057		0.024		0	2.9592	1.900169	0.36221			1.3336
Cr(OH)3		0		0		0.2015		0.0334		0.0229		0.0789		0.0344		0.044		0	0	0	0			0
MnO2		0		0		0		0.0342		0.0431		0.0434		0.0109		0.0186		0	0	0	0			0
BiPO4		0		0		0		0		0		0		0.003		0.0047		0	0	0	0			0
Pb(OH)2		0		0		0		0		0		0		0		0		0	0	0	0			0
(La2O3)/2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0			0
HgO	0	0	0	0	0	0	0	7E-07	0	3E-05	0	2E-06	0	2E-05	0	4E-05		0	0	0	0.00209			0
Na3cit.5H2O																								
Na Acetate																								
Na 2 Oxalate		0		0		0		0		0		0		0		0		0	0	0	0			0
Na3HEDTA																								
Na4EDTA																								
CaCO3.6H2O		0.0436		0.0639		0.0715		0.0733		0.1108		0.0763		0.0185		0.0572		0	0.2393	0.451762	0.08724			1.5019
Ni(OH)2		0.007		0.0104		0.0141		0.0146		0.0222		0.0155		0.0036		0.011		0	0	0.110238	0			0
ZrO2•2H2O		0		0		0		0		0		0		0.0018		0.005		0	0	0	0.92426			0
Na2NiFe(CN)6.6H																								
UO2(OH)2*6H2O		0.0049		0.0241		0.0314		0.0194		0.029		0.0226		0.0059		0.0138		0	0.8816	0	0			0

vol. solids cc	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
NaNO3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaNO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaCl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaF	0	0	0	0.0184	0	0	29.976	0	0	0	0	0	0	0	0	0	0	0		0	0	0	83.4004
Sr(OH)2	0	0	0	0	0	0	48.781	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2CO3.7H2O	66.888	110.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2CO3.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3PO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3PO4.12H2O	69.197	75.145	267.54	167.51	180.26	0	0	0	0	0	0	11.69413	0	0	0	0	0	0		0	0	0	0
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2SO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2SiO3	0	0	1.9999	1.1723	2.6321	0	0	0	1.496098	1.730865	0	4.319583	0	23.295	0	0	30.184	76.116		0	0	0	0
Al2O3.3H2O	0	0	10.964	27.146	0	0	0	0	0	0	4.5575	8.762132	121.05	134.19	159.18	173.39	0	0		0	143.26	173.39	0
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.0557	0	0	0		0	0	0	0
FeO(OH)	3.4498	3.4598	9.4665	5.2109	16.453	23.265	10.568	46.2361	22.26712	25.74643	0	0.004488	29.759	78.997	4.8051	13.404	77.308	87.061		85.5941	4.8036	13.404	3.70669
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	0	0	24.8	127.82	0	0	0	0		0	0	0	0
MnO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
BiPO4	0	0	3.5661	1.9701	4.2847	3.2103	2.7367	0	11.70635	13.535578	0	10.02375	0	0	0	0	0	0		0	0	0	0
Pb(OH)2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
La2O3	0	0	0	0	0	0	5.7946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HgO	0	0	0.0016	0.0014	0	0	0	0	0	0	0	0	0	0	0.0795	0.2108	0	0	0	0	0.0491	0.1152	0.03887
Na3cit.5H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaAcetate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na2Oxalate	0	0	0	0	0	0	11.012	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na4EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
CaCO3.6H2O	9.1462	9.325	8.1289	4.5041	16.052	31.518	27.722	39.591	30.02236	34.710291	92.426	26.99373	24.37	58.986	13.327	37.027	48.631	27.722		50.0934	13.273	36.929	10.2542
Ni(OH)2	0	0	0	0	0	0	0	0	0	1.271968	7.4407	2.170893	1.2505	2.9615	0	0	2.5463	1.4411		2.54576	0	0	0
ZrO(OH)2	0	0	0.4014	0.227	0	0	0	0	0	0	0	1.027752	0	0	0	0	0	0		0	0	0	45.2869
Na2NiFe(CN)6.6H2O			0	0	0	0	0	0	31.87387	18.427083	84.238	24.56944	0	0	0	0	0	0		0	0	0	0
Pu																							
UO2(OH)2*6H2O	147.14	221.46	0	0	0	0	0	20.0238	15.15334	17.521392	39.972	0	2.7035	39.131	26.516	58.736	4.127	25.32	0	0	14.021	29.989	0
Cs																							
Sr																							

vol. solids cc	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
NaNO3	0	0	0	0	0	0	0	0	0	0	0	0	0			0	17.203	0	0
NaNO2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	50.843	0	0
NaCl	0	0	0	0	0	0	0	0	0	0	0	0	0			0	12.903	0	0
NaF	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Sr(OH)2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na2CO3.7H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	127.58	0	0
Na2CO3.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na3PO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na3PO4.12H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	21.2	21.2
Na2SO4.10H2O	0	0	0	0	0	0	0	0	0	0	0	221.02	0			0	0	6.1621	6.1621
Na2SiO3	0	0	0	0	0	0	0	75.667	61.03	120.36	90.213	164.21	0			0	0	0	0
Al2O3.3H2O	0	0	0	350.36	0	13.227	13.227	0	37.455	185.82	0	33.377	0			0	6.2049	0	0
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	18.671	0	0
FeO(OH)	0	0	0	49.528	166.73	31.96	31.96	36.071	29.428	64.922	44.14	0	0			0	0	117.68	117.68
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	0	37.396	0			0	0	23.338	23.338
MnO2	0	0	0	0	0	0	0	0	0	0	0	43.931	0			0	0	0	0
BiPO4	0	0	0	0	0	0	0	0	0	0	0	0.1524	0			0	0	0	0
Pb(OH)2	0	0	0	0	6.0417	0	0	0	0	0	0	0.0044	0			0	0	0	0
La2O3	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
HgO	0	0	0	0	0	0	0	0	0	0	0	0.0011	0			0	0	0	0
Na3cit.5H2O	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
NaAcetate	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na2Oxalate	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na3HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Na4EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
CaCO3.6H2O	0	0	0	48.673	0	18.969	18.969	0	25.205	23.302	15.176	152.01	0			0	0	106.23	106.23
Ni(OH)2	0	0	0	2.4493	4.6655	0.9662	0.9662	1.808	1.0273	30.651	0	7.7868	0			0	0	10.161	10.161
ZrO(OH)2	0	0	0	0	0	0	0	0	0	0	0	0.0616	0			0	0	0	0
Na2NiFe(CN)6.6H2	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
Pu																			
UO2(OH)2*6H2O	0	0	0	0	0	0	13.819	0	67.245	82.118	147.13	45.036	0			0	0	0	0
Cs																			
Sr																			

vol. solids cc	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
NaNO3		121.31		92.982		107.51		181.56		163.88		209.06		124.56		170.29		0	0	0	0			0
NaNO2		0		0		0		0		0		4.8026		82.945		21.509		0	0	0	0			0
NaCl		0		0		0		0		0		0		0		0		0	0	0	0	0	0	0
NaF		0		0		0		0		0		0		0		0		0	0	0	83.4497	0	0	0
Sr(OH)2		0		0		0		0		0		0		0		0		0	0	0	0			0
Na2CO3.7H2O		0		0		0		12.584		13.912		21.596		53.929		41.011		0	0	0	0			0
Na2CO3.10H2O		0		0		0		0		0		0		0		0		0	0	0	0			0
Na3PO4.10H2O		81.112		121.66		0		1.8304		0		0		32.883		44.853		0	0	0	0			0
Na3PO4.12H2O		0		0		0		0		0		0		0		0		0	0	0	0			0
Na2SO4		0		0		0		0		0		0		0		0		0	0	0	0			0
Na2SO4.10H2O		0		0		0		0		0		0		71.156		35.936		0	0	0	0			0
Na2SiO3		0		0		5.1965		5.2015		5.1017		6.9766		3.3179		8.4561		0	76.172	0	0			0
Al2O3.3H2O		0		0		0		0		0		0		0		0		0	19.671	0	0			0
NaAlO2		0		0		0		0		20.46		24.936		44.959		44.059		0	0	0	0			0
FeO(OH)		0.284		0.4177		0.587		1.4722		3.1147		1.5257		0.1687		0.7059		0	87.062	55.90399	10.6563			39.235
Cr(OH)3		0		0		5.8772		0.9743		0.6682		2.3022		1.004		1.2839		0	0	0	0			0
MnO2		0		0		0		0.8753		1.1018		1.1105		0.2774		0.4755		0	0	0	0			0
BiPO4		0		0		0		0		0		0		0.1457		0.2274		0	0	0	0			0
Pb(OH)2		0		0		0		0		0		0		0		0		0	0	0	0			0
La2O3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HgO	0	0	0	0	0	0	0	1E-05	0	0.0005	0	4E-05	0	0.0003	0	0.0008	0	0	0	0	0.04076	0	0	0
Na3cit.5H2O		0		0		0		0		0		0		0		0		0	0	0	0			0
NaAcetate		0		0		0		0		0		0		0		0		0	0	0	0			0
Na2Oxalate		0		0		0		0		0		0		0		0		0	0	0	0			0
Na3HEDTA		0		0		0		0		0		0		0		0		0	0	0	0			0
Na4EDTA		0		0		0		0		0		0		0		0		0	0	0	0			0
CaCO3.6H2O		5.1218		7.5116		8.41		8.6202		13.021		8.9655		2.1797		6.7267		0	28.13	53.10435	10.2551			176.54
Ni(OH)2		0.1776		0.2633		0.3584		0.3708		0.5647		0.3942		0.0919		0.2782		0	0	2.800335	0			0
ZrO(OH)2		0		0		0		0		0		0		0.0903		0.2463		0	0	0	45.2888			0
Na2NiFe(CN)6.6H2		0		0		0		0		0		0		0		0		0	0	0	0			0
Pu																								
UO2(OH)2*6H2O		0.725		3.5461		4.6138		2.8569		4.2632		3.3181		0.8651		2.025		0	129.73	0	0			0
Cs																								
Sr																								

frac. prec. solids	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
NaNO3	0	0	0	0	0	0	0	0.17895	0.179172	0.1791926	0	0	0	0.335	0	0	0	0	0	0.02784	0	0	0
NaNO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NaCl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
NaF	0	0	0	0.0012	0	0	0.2297		0	0		0											0.69282
Sr(OH)2							0.9																
Na2CO3	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3PO4	0.1966	0.2135	0.5207	0.5555	0.2612	0	0	0	0	0	0	0.015747	0	0	0	0	0.9	0.9		0	0.9	0.9	0.9
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na2SiO3	0	0	0.1418	0.151	0.0951	0	1	1	0.031098	0.0311159	1	0.107285	0	0.2051	0	1	0.2782	0.6335	0.6341	1	0	1	1
Al2O3.3H2O	0.6	0.6	0.2	0.9	0.3	0.6	0.8	0.07	0.07	0.07	0.07	0.07	0.26	0.07	0.2	0.2	0.07	0.07		0.3	0.3	0.2	0
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0121	0	0	0		0	0	0	0
FeO(OH)	0.8794	0.882	0.9583	0.9587	0.9507	0.9392	0.8756	0.9566	0.933456	0.933459	1	0.003659	0.9583	0.9626	0.8703	0.8692	0.9667	0.9831	0.9504	0.96978	0.8701	0.8692	0.87032
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	1	0	0.5626	0.7367	0	0	0	0		0	0	0	0
MnO2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1
BiPO4	1	1	0.7259	0.7289	0.6061	0.4316	0.3581	1	0.693108	0.6931136	1	0.714931	1	1	1	1	1	1		1	1	1	1
Pb(OH)2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		0	1	1	1
La2O3	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.602	0.60255	0.602547	0.6025474	0.6025	0.602547	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.60255	0.6025	0.6025	0.60255
HgO	1	1	0.492	0.8369	1	1	1	1	1	1	1	1	1	1	0.971	0.9515	1	1	1	1	0.9539	0.9452	0.95503
Na3cit.5H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na Acetate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na 2 Oxalate	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na3HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Na4EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
CaCO3.6H2O	0.5182	0.5284	0.5232	0.5277	0.5114	0.504	0.5066	0.51213	0.512651	0.5126393	0.5504	0.55113	0.5111	0.5163	0.5087	0.5052	0.5035	0.5072	0.2305	0.51083	0.5072	0.5045	0.50802
Ni(OH)2	0	0	0	0	0	0	0	0	0.640916	0.6409226	0.8201	0.820407	0.5538	0.5538	0	0	0.5513	0.5531		0.55119	0	0	0
ZrO(OH)2	1	1	0.2806	0.2884	1	1	1	1	1	1	1	0.251694	1	1	1	1	1	1		1	1	1	0.97043
Na2NiFe(CN)6.6H2O			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1
Pu	0	0.5	0	0.5188	0	0	0	0	0	0	0.5	0.003683	0	0	0.8734	0.7285	0.1904	0.6524		0.80571	0.6835	0.6382	0.69742
UO2(OH)2*6H2O	0.75	0.75	0	0	0	0	0	0.48851	0.488513	0.4885227	0.4876	0	0.1725	0.5602	0.7875	0.6442	0.134	0.6282	0.8928	0	0.6615	0.5978	0
Cs	0	0	0	0	0	0	0	0.01	1	1	1	1	0	0.005	0	0	0	0		0.02784	0	0	0
Sr	0	0.5	0	0	0	0	0.5	0	0	0	0.5	0	0.5756	0.8147	0	0	0.839	0.9404		0	0	0	0

frac. prec. solids	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
NaNO3	0	0	0	0.2456	0	0	0	0	0	0	0	0	0			0	0.13	0	0
NaNO2	0	0	0	0	0	0	0	0	0	0	0	0	0				0.3156	0	0
NaCl	0	0	0	0	0	0	0	0	0	0	0		0				0.7648	0	0
NaF	0	0	0			0	0						0				0	0	0
Sr(OH)2	0	0	0																
Na2CO3	0	0	0	0	0	0	0	0	0	0	0	0	0				0.664	0	0
	0	0	0																
	0	0	0																
Na3PO4	0	0	0	0	0	0	0	0	0.9	0	0	0	0				0	1	0.5843
	0	0	0																
Na2SO4	0	0	0	0	0	0	0	0	0	0	0	0.1773	0				0	0	0
Na2SiO3	0	0	0	1	1	1	1	0.5765	0.15	0.3219	0.5765	1	0				1	1	1
Al2O3.3H2O	0	0	0	0.5	0.1	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0				0.07	0.07	0.07
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0				0.2236	0.23	0.23
FeO(OH)	0	0	0	0.9513	0.9715	0.9693	0.9693	0.9502	0.7145	0.8827	0.9514	0	0				1	0.9501	0.9501
Cr(OH)3	0	0	0	0	0	0	0	0	0	0	1	1	0				1	0	0
MnO2	0	0	0	1	1	1	1	1	1	1	1	1	0			0	1	1	1
BiPO4	0	0	0	1	1	1	1	1	1	1	1	1	0				1	1	1
Pb(OH)2	0	0	0	1	0.5304	1	1	1	0	1	1	1	0				1	1	1
La2O3	0	0	0	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0.6025	0				0.6025	0.6025	0.6025
HgO	0	0	0	1	1	1	1	1	1	1	1	1	0				1	1	1
Na3cit.5H2O	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
Na Acetate	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
Na 2 Oxalate	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
Na3HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
Na4EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
CaCO3.6H2O	0	0	0	0.5166	0	0.5106	0.5106	0	0.1065	0.1306	0.2723	0.9	0				0.9	0.5016	0.5016
Ni(OH)2	0	0	0	0.5544	0.551	0.5515	0.5515	0.5516	0.1011	0.8205	1	1	0				1	0.551	0.551
ZrO(OH)2	0	0	0	1	1	1	1	1	1	1	1	1	0				1	1	1
Na2NiFe(CN)6.6H	0	0	0	1	1	1	1	1	1	1	1	1	0				1	1	1
Pu	0	0	0	0.9525	0.8	0.8	0.8	0.9004	0.773	0.5397	0.7665	0	0				0.8	0.8	0.8
UO2(OH)2*6H2O	0	0	0	0	0	0	0.5774	0	0.3637	0.4875	0.8671	0.7726	0				0	0	0
Cs	0	0	0	0.2456	0	0	0	0	0	0	0	0	0				0.16	0.16	0.16
Sr	0	0	0	1	0.8643	0	0.9351	0.915	0.82	0.48	0.7	0.0765	0				1	1	1

frac. prec. solids	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
NaNO3		0.1763		0.0943		0.1257		0.5198		0.4612		0.5638		0.6593		0.4687		0	0	0	0			0
NaNO2		0		0		0		0		0		0.031		0.589		0.1071		0.3694	0	0	0			0
NaCl		0		0		0		0.2349		0		0.3532		0.6409		0.365		0.2237	0	0	0			0
NaF		0		0		0		0		0		0		0.5545		0.5184		0	0		0.69323			0.6932
Sr(OH)2																								
Na2CO3		0		0		0		0.1356		0.1449		0.2175		0.6023		0.2936		0.1935	0	0	0			0
Na3PO4		0.4212		0.4097		0		0.0531		0		0	0	0.7263		0.5457		0	0.9	0	0.9			0.9
Na2SO4		0		0		0		0		0		0		0.6063		0.2035		0.0263	0	0	0			0
Na2SiO3		0		0		0.2974		0.6545		0.6189		0.7249		0.761		0.7278		0.4794	0.634	1	1			1
Al2O3.3H2O		0		0		0		0		0		0		0		0		0	0.07	0.3	0			0
NaAlO2		0		0		0		0		0.188		0.2511		0.6051		0.331		0.0942	0	0	0			0
FeO(OH)		0.4708		0.4549		0.5842		0.9402		0.9668		0.9442		0.8265		0.8678		0.702	0.9831	0.950085	0.95079			0.8002
Cr(OH)3		0		0		0.486		0.4118		0.2957		0.6318		0.655		0.4445		0.4295	1	0	1			1
MnO2		1		1		0		0.7052		0.7248		0.759		0.6663		0.53		0.3269	1	0	1			1
BiPO4		0		0		0		0		0		0		0.5599		0.3939		0	1	1	1			1
Pb(OH)2		1		1		0		0		0		0		0		0		0	1	0	1			1
La2O3		0.6025		0.6025		0.6025		0.6025		0		0		0		0		0	0.6025	0.602547	0.60255	0.6025	0.6025	0.6025
HgO		0		0		0		0.0375		0.6041		0.1189		0.7378		0.6597		0.3106	1	1	0.95702			1
Na3cit.5H2O		0		0		0		0		0		0		0		0		0	0	0	0			0
Na Acetate		0		0		0		0		0		0		0		0		0	0	0	0			0
Na 2 Oxalate		0		0		0		0		0		0		0		0		0	0	0	0			0
Na3HEDTA		0		0		0		0		0		0		0		0		0	0	0	0			0
Na4EDTA		0		0		0		0		0		0		0		0		0	0	0	0			0
CaCO3.6H2O		0.4708		0.4549		0.5282		0.8367		0.8713		0.847		0.7761		0.7771		0.6466	0.511	0.501389	0.50823			0.5005
Ni(OH)2		0.4165		0.4036		0.5247		0.836		0.8716		0.8491		0.7693		0.7688		0.6572	1	0.551188	1			1
ZrO(OH)2		0		0		0		0		0		0		0.5058		0.4783		0	1	1	0.97047			0.9705
Na2NiFe(CN)6.6H2		1		1		1		1		1		1		1		1		1	1	1	1			1
Pu		0		0		0.3597		0.7191		0.7832		0.7568		0.7637		0.692		0.528	0.8	0.8	0.8			0.8
UO2(OH)2*6H2O		0.1814		0.4263		0.5203		0.7498		0.7992		0.7845		0.7258		0.6487		0.5064	0.8965	0	0			0
Cs		0.1763		0.0943		0.015		0.05		0.2		0.1		0.05		0.05		0.08	0.034	0	0			0
Sr		0		0		0.4908		0.7198		0.6147		0.7877		0.6973		0.6834		0.5403	0.9854	0	0			1

pred. sludge ppm	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
Na	53468		86408	66664	75138	24271	63699	62431.4	66551.57	63671.177	53924	40966.95	36763	33115	52487		33010	65479		49091.5	32984	19441	101047
Al	0		9957.9	19031	0	0	0	0	0	0	3037.3	9571.028	75367	58182	113785		0	0		0	100241	107837	0
Fe	4696.3		13998	8170.2	25120	39060	15101	66801.9	36435.7	38801.434	13610	4842.64	38145	67807	5942		115068	116819		122687	6635.3	17393	5650.03
Cr	86.091		152.69	184.94	138.76	234.35	138.64	115.926	113.775	112.00369	0	79.65355	30644	103389	84.227		275.22	239.16		271.365	96.752	84.135	108.997
Bi	0		12477	7553.8	15463	12839	9453.4	0	37715.39	43367.339	0	36222.99	0	0	0		0	0		0	0	0	0
La	0		0	0	0	0	24634	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Hg	0		14.241	12.604	0	0	0	0	0	0	0	0	0	0	527.9		0	0		0	365.03	808.05	317.92
ZrO(OH)2	0		727.88	523.53	0	0	0	0	0	0	0	1771.493	0	0	0		0	0		0	0	0	66975.5
Pb	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		8.10925	0	0	0
Ni	48.6		53.046	64.247	59.683	78.258	61.083	65.4422	5862.856	5546.0726	26107	9171.737	2005.5	3121.1	47.548		4681.3	2413.4		4508.9	54.618	47.496	61.5308
Sr	0		0	0	0	0	95786	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Mn	0		0	0	0	0	164.34	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Ca	2389.9		2345.1	1491.3	4615.7	9784.8	7314.4	10513.4	7717.708	8851.6714	21725	7791.321	5796.7	9184.2	3120.4		13231	6883.9		13124.2	3477.7	8769.1	3014.95
K	14.282		98.255	89.747	162.25	120.26	6891.6	470.049	482.7163	473.88507	279.98	125.776	224.18	198.73	45.691		81.227	126.78		375.316	33.341	49.803	5964.63
balance																							
density	1.4112		1.2893	1.2215	1.2468	1.133	1.3349	1.31537	1.370071	1.3746632	1.4655	1.224612	1.4832	2.2124	1.5503		1.2761	1.4155		1.32511	1.3883	1.4678	1.26229
vol%solids	12		13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1		2.2	3.9		2.2	8.1	2.9	10.5
void frac.	0.7042		0.6979	0.7922	0.7803	0.942	0.8634	0.91417	0.934508	0.9230049	0.8956	0.935004	0.7988	0.5737	0.8136		0.8413	0.8077		0.86177	0.8386	0.7762	0.85731
wt.% H2O	64.706		72.901	78.342	72.695	82.622	62.32	63.8366	61.98486	61.18974	65.242	78.43247	66.051	44.1	69.446		69.944	59.913		61.4155	77.182	75.518	69.1678
TOC wt.%C	0		0	0	0	0	0.3809	0.00031	0.710162	0.4091911	1.7547	0.612439	0	0	0		0	0		0	0	0	0
free OH-	2214.5		800.36	316.64	383.81	878.83	310.41	307.062	389.594	269.09303	515.61	1709.893	106.71	100.74	308.71		2320.2	2011.3		583.023	358.08	277.58	2776.4
OH-	78734		34575	44217	23260	36475	59910	71792.8	36230.1	42809.953	32234	25602.7	213418	291704	250258		112247	122396		115127	211643	239895	57708.7
NO3-	5028.3		18058	19753	48780	35704	63771	103244	111458.1	109042.78	401.2	2826.13	1470.7	0.0003	28075		1E-06	7E-10		92087.3	25305	22359	13290.1
NO2-	666.01		6414.8	9304.4	73.769	61.146	0	12915	5158.146	5578.8556	70695	23065.44	60583	33402	35164		13673	19092		15740.5	22429	7024.3	299.93
CO3--	38319		3511.3	2232.9	6911	14650	10951	23332.9	11555.38	13253.214	32565	11160.27	8679.1	13751	4672		19811	10307		19650.3	5207	13130	4514.15
PO4---	26952		97262	68038	74400	14159	6951.5	8601.14	25581.16	28018.237	7556	31197.97	0	0	0		0	0		5947.28	0	0	0
SO4--	10516		3341.5	4047.1	3027.2	2148.8	99.942	9476.15	12019.53	11832.396	940.65	1471.618	991.88	753.43	77.797		2771.3	8769.3		3512.82	89.365	77.712	100.675
SiO3--	58.132		1374.1	1149.9	1763.6	455.5	0	0	1254.442	1336.6011	0	2678.025	224.58	6063.1	449		13694	30246		0	343.85	0	0
F-	0		2446.3	2976.7	2655.8	1831.9	28942	0	2728.139	2685.6655	0	3317.877	0	0	0		0	0		0	0	0	79573.5
Cl-	59.53		409.55	374.09	676.28	501.25	684.19	2526.98	2012.075	1975.2645	1167	524.2641	934.43	828.34	190.45		338.57	528.46		1564.41	138.97	207.59	139.703
C6H5O7---	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
EDTA----	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
HEDTA---	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
glycolate-	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
acetate-	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
oxalate--	0		0	0	0	0	13968	0	0	0	0	0	0	0	0		0	0		0	0	0	0
DBP	0		0	0	0	0	0	4.49418	0	0	0	0	0	0	0		0	0		0	0	0	0
butanol	0		0	0	0	0	0	1.58646	0	0	0	0	0	0	0		0	0		0	0	0	0
	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
NH3	0.3858		2.3964	7.7312	0.0007	0.0008	0	11.2186	3.813142	4.6018054	2858.3	445.47	1508.8	2524.8	4.6034		1780.3	2908		22.3849	1.8927	0.2166	8890.4
NiFe(CN)6--	0		0	0	0	0	0	0	26692.24	15379.903	65952	23019.2	0	0	0		0	0		0	0	0	0
Pu (µCi/g)	0.0069	0	0.006	0.0465	0.012	0.0105	0.0104	0.0032	0.001523	0.0015049	0	0.010538	0.0108	0.0137	1.6441	2.8861	0.2752	1.0361	0	4.27923	0.5909	1.2571	0.53949
U (µg/g)	173603		105.94	121.85	15.65	10.796	0	25287.5	18541.27	21258.059	44706	143.8892	3461.6	28858	28168	61858	5859.7	29481	#DIV/0!	0	16913	33555	392.287
Cs (µCi/g)	1.1213	0	9.4937	23.986	0.1558	0.2361	0	1.0183	9.7169	11.197633	1218.5	596.6067	53.444	84.293	2.0734	2.2764	171.32	396.34	#DIV/0!	47.6728	1.5698	1.3796	0.97256
Sr (µCi/g)	9.8013	0	0.084	0.2145	0.0067	0.0482	0	16.7397	2.355082	2.3184161	0	0.240243	703.38	3538	1.6777	1.8674	6316.8	9669.9	#DIV/0!	16.9603	1.2745	0	0.80607

pred. sludge ppm	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
Na	24902.7	25856	34264	27796	29003	62271	60408	73580	47576	77493	84795		75370	628983	0	6769.7	181276	15388	20091
Al	0	0	0	171852	0	15269	14812	0	23126	82370	0		6918	5534.4	25844	0	37649	0	0
Fe	2147.54	2154	2113.1	54435	218740	48643	47187	56433	39079	62068	48019		1304.5	12888	15578	0	0	150176	148978
Cr	399.921	401.12	393.52	156.9	236.94	312.47	303.12	304.57	61.484	0.003	0		1155.5	0	0	0	0	28157	27932
Bi	0	0	0	0	0	0	0	0	0	0	0		11.485	0	0	0	0	0	0
La	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Hg	0	0	0	0	0	0	0	0	0	0	0		0.1972	0	0	0	0	0	0
ZrO(OH)2	0	0	0	0	0	0	0	0	0	0	0		1.9865	0	0	0	0	0	0
Pb	0	0	0	0	21704	0	0	0	0.1225	0	0		0.3907	0	0	0	0	0	0
Ni	225.763	226.44	222.15	3309	7510.4	1866.5	1810.6	3516.2	1720.6	35690	0		311.95	0	0	0	0	15833	15706
Sr	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Mn	0	4672.4	45.848	0	0	0	0	0	0	0	0		1636.9	0	0	70.104	0	0	0
Ca	696.597	698.09	686.67	9717.3	111.86	5447	5284.1	55.734	6214.9	4103.8	3137.9		999.06	8221.5	440880	0	0	24514	24319
K	123.667	3424.8	204.25	227.67	1975.1	816.16	791.74	118.51	63.845	152.89	259.06		1644.1	0	0	49.892	363.46	13.005	12.901
balance																			
density	1.04021	1.0371	1.0571	1.7282	1.4473	1.2494	1.2879	1.2151	1.4319	1.9866	1.7469		1.1538	0.39	1.9	1.0188	1.6393	1.488	1.5
vol%solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6		1	100	100	13.6	80	1	1
void frac.	1	1	1	0.549	0.8226	0.9349	0.9349	0.8865	0.8459	0.5749	0.8505		1	0	0	1	0.8	0.7152	0.7152
wt.% H2O	90.6853	89.677	88.411	64.884	54.555	68.612	69.47	71.304	68.732	48.461	49.143		75.024	40	50	94.733	45.099	58.806	57.994
TOC wt.%C	0.84921	0.3273	0.2552	0	1.408	0.0205	0.0881	0	0.0426	0.1707	2.9914		0.3402	0	0	0	0	0	0
free OH-	2843.67	7900.9	2933.4	1606	1142.3	487.35	610.52	3006.6	2068.2	957.8	1471.4		10464	0	0	-8234.7	5471.6	422.65	419.28
OH-	2843.67	7900.9	2933.4	379396	208685	78768	83987	56459	115701	265188	103656		27900	0	310742	-8234.7	98364	174074	172685
NO3-	40259.1	40519	55298	55177	6E-13	128150	0.0189	0.0005	3E-19	28.574	0.1404		80430	0	0	48685	105554	4683.7	4646.4
NO2-	442.22	443.55	435.14	206.71	28518	437.67	92659	21148	7666	22999	14573		32301	0	0	0	118909	532.15	307.95
CO3--	12565.5	17597	17263	18047	167.48	8155.6	7911.6	83.449	9305.3	10668	11669		9837.4	0	0	0	42099	36501	36210
PO4---	0	0	0	4.2678	0	6420.1	6228	1390.6	0	275.66	0		1039.8	0	0	0	5517.5	0	6796.5
SO4--	369.388	370.5	363.47	209.67	3687.6	3896.3	3779.7	1687.9	908.69	1226.8	4788.9		9430.8	0	34885	0	1674.2	27815	27593
SiO3--	0	0	0	0	0	0	0	35092	24106	33741	28988		1572.1	408385	94175	0	0	0	0
F-	0	0	0	0	0	1712.6	1661.3	0	0	0	0		54.568	0	0	0	662.31	0	0
Cl-	515.472	414.87	715.35	1301.5	992.31	1688.1	1637.6	493.99	266.12	637.3	1079.8		2020	0	0	0	12752	54.206	53.773
C6H5O7---	0	0	0	0	4307.3	0	0	0	1117.7	823.14	0		4632.3	0	0	0	0	0	0
EDTA----	0	0	0	0	13127	0	0	0	0	0	21121		0	0	0	0	0	0	0
HEDTA---	0	0	0	0	0	0	0	0	0	0	40190		9.5026	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0	0	0	4355	11000		265.11	0	0	0	0	0	0
acetate-	0	0	0	0	17144	0	0	0	0	0	0		0	0	0	0	0	0	0
oxalate--	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
DBP	12382.5	4772.7	3720.4	0	0	299.51	1284.9	0	0	0	3.1529		3387.2	0	0	0	0	0	0
butanol	4371.05	1684.8	1313.3	0	0	105.73	453.59	0	0	0	1.113		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
NH3	0	0	0	0	5232.9	0.0019	9476.3	2410.4	1695.9	749.79	1116.5		296.82	0	0	0	707.75	0	0
NiFe(CN)6--	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Pu (µCi/g)	0	0	0	14.99	0	0	0	7.1971	14.277	2.6118	2.1827		0.0528	0	0	0	0	0	0
U (µg/g)	0	0	0	0	0	381.37	18049	0	76534	67145	136708		1634.4	0	0	0	0	0	0
Cs (µCi/g)	0	0	0	0	0	0.1033	458.91	7.3213	189.18	0	22.115		39.216	0	0	0	305.01	0	0
Sr (µCi/g)	0	0	0	0	12461	0.085	6559.1	9848.8	21337	2346	4726.4		59.861	0	0	0	3.8126	0	0

pred. sludge ppm	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
Na		143590		142289		136662		173785		172189		195353		215141		204743		0	66836	11082.12	99104.5			874.05
Al		2017.3		1757.6		24974		17271		32080		31032		36944		37342		0	13073	0	0			0
Fe		436.03		600.87		811.05		1821.4		3719.5		1737		217.68		794.37		0	92966	89806.97	15923.8			61272
Cr		222.8		195.53		7922.4		1871.8		1490.2		3049.6		1530.1		1841.6		0	0	313.1006	0			0
Bi		379.27		350.45		0.8588		203.01		104.52		144.17		632.28		850.66		0	0	0	0			0
La		0		0		0		0		0.2777		1.3485		2.0204		0.8882		0	0	0	0			0
Hg		0.9447		0.6727		0.202		1.169		4.4511		1.1743		2.2999		5.2292		0	0	0	329.621			0
ZrO(OH)2		105.29		112.97		0.1539		57.586		11.405		37.61		185.69		354.88		0	0	0	66243			0
Pb		0		0		0.0304		1.0291		13.214		2.2288		5.4338		7.4426		0	0	6.775354	0			0
Ni		343.47		471.64		616.11		593.95		860.09		576.07		154.96		399.6		0	0	5551.42	0			0
Sr		0		0		0		0		0.6173		2.8108		2.7132		2.3167		0	0	0	0			0
Mn		0		0		16.376		1434.5		1706.7		1600.5		501.25		750.81		0	0	248.1022	0			0
Ca		1412.5		1940.8		2129.8		2036.4		2926.3		1935.1		537.41		1419.2		0	5552.6	15580.13	2980.18			49697
K		485.44		429.32		673.92		1449.1		1402.8		1768.9		3417.7		3015.4		0	192.37	201.5849	5849.03			5.0459
balance																								
density		1.4384		1.464		1.4939		1.5825		1.6129		1.7136		1.7752		1.7749		0.5	1.7786	1.182737	1.27627			1.2169
vol%solids		17.683		11.446		13.82		55.385		48.966		55.173		99		45.523		90	3.9	2	10.5			0.6
void frac.		0.792		0.7772		0.8721		0.7865		0.7782		0.7183		0.5823		0.6239		0.5	0.789	0.888191	0.85031			0.7842
wt.% H2O		53.192		55.379		49.572		39.774		39.697		32.117		29.863		31.708		100	53.761	79.09937	67.8831			78.495
TOC wt.%C		0.0003		0.0002		0.0065		0.5347		0.4493		0.6953		1.4191		0.9532		0	0	0.037373	0			0
free OH-		1820.6		1720.7		94.141		4440.5		4496.3		4373		7492.9		5676.6		0	10827	209.2279	1220.14			175.46
OH-		7761.9		8564.8		73059		53694		93541		89853		102654		103654		0	173353	85314.13	64994.6			56064
NO3-		233543		196554		219926		275572		251233		274256		174513		219700		0	7E-10	11403.89	16203.6			2648.8
NO2-		9808.6		9505.3		56884		42165		45043		63458		113847		67550		0	12705	779.2609	261.642			0
CO3--		8425		9460		3378.1		16615		17552		16694		20186		18954		0	8313.6	27933.47	4462.09			74060
PO4---		47358		65818		30.213		7940.2		3995.8		6004.3		17931		23035		0	0	4969.007	0			0
SO4--		10826		9967		2743		13136		9572.6		13082		28664		20689		0	5791	292.3379	0			0
SiO3--		429.25		403.44		2478.2		2288.9		2206.9		2649.1		1351		2968.6		0	24077	0	0			0
F-		2000.6		1880.4		4.8817		1084.3		661.14		764.14		1507.6		1605.3		0	254.94	0	78719.6			0
Cl-		2493.2		2220.5		2759.6		2988.5		2702		2529.6		2016		2129.9		0	801.83	104.265	110.317			21.033
C6H5O7---		0		0		51.232		2093		2829.3		3103.4		5773.4		2979.3		0	0	0	0			0
EDTA----		0		0		1.7812		1876.8		897.14		2359.2		5182.6		4242.2		0	0	0	0			0
HEDTA---		0		0		0.0939		3467.1		4.857		4241.3		9231.2		7133.1		0	0	0	0			0
		0		0		0		0		0		0		0		0		0	0	0	0			0
glycolate-		0		0		26.987		2916.1		706.97		3678		7274.4		4132.5		0	0	0	0			0
acetate-		0		0		2.3262		73.852		1171.6		173.67		439.22		647.58		0	0	0	0			0
oxalate--		0		0		0		0		0.6633		3.2207		4.8253		2.1214		0	0	0	0			0
DBP		3.719		3.4117		51.738		1877.1		3406.8		2454.3		4790.5		2801.7		0	0	544.95	0			0
butanol		1.3128		1.2043		18.264		662.61		1202.6		866.38		1691.1		989.02		0	0	192.3689	0			0
		0		0		0		0		0		0		0		0		0	0	0	0			0
NH3		11.374		11.161		351.94		111.54		91.698		155.19		209.36		1102.1		0	1884.3	0.180406	8721.17			547.76
NiFe(CN)6--		0		0		0		0		0		0		0		0		0	0	0	0			0
Pu (µCi/g)		0.008		0.0082		0.1016		0.0945		0.1388		0.0987		0.0379		0.0835		0	2.462	0.157767	0.6595	0	0	0
U (µg/g)		1350.5		4399.5		5561.3		3401.8		4735		3536		1081		2188.1		0	118408	82.76835	503.695			0
Cs (µCi/g)		14.998		15.31		194.68		146.45		130.82		176.78		295.44		168.41		0	2503.7	22.57937	1.49794			0
Sr (µCi/g)		14.008		13.31		175.67		97.697		75.966		116.85		34.377		75.778		0	32841	19.56879	1.27497			0

pred. su. ppm	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
Na	46222		40857	36829	45439	27872	37198	78243.1	77980.75	77793.122	62600	37756.76	59535	74325	72525		17186	28259		67159.9	47512	33294	12322.3
Al	0		4832.4	621.77	0	0	0	0	0	0	636.35	4354.476	11421	23349	34183		0	0		0	19980	15345	0
Fe	103.56		102.95	104.82	103.42	92.947	104.93	97.343	97.40287	97.422896	0	103.6709	97.466	91.212	88.49		108.92	106.87		99.4138	97.234	101.2	109.872
Cr	159.97		259.83	267.45	205.17	269.11	201.25	145.286	145.3774	145.41325	0	96.82744	1361.3	1273.9	127.09		406.86	400.81		371.242	139.36	144.09	157.785
Bi	0		770.46	784.49	773.29	597.79	785.05	0	728.4125	728.57842	0	776.5109	0	0	0		0	0		0	0	0	0
La	0		0	0	0	0	782.74	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Hg	0		2.263	0.71	0	0	0	0	0	0	0	0	0	0	1.588		0	0		0	1.7449	1.8161	1.97173
Zr	0		252.23	256.82	0	0	0	0	0	0	0	254.2109	0	0	0		0	0		0	0	0	269.197
Pb	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		11.0939	0	0	0
Ni	90.306		90.263	92.911	88.246	89.869	88.67	82.0165	92.09193	92.112969	94.703	98.16743	92.216	86.299	71.747		103.06	101.11		94.0592	78.674	81.341	89.0726
Sr	0		0	0	0	0	521.06	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Mn	0		0	0	0	0	238.56	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Ca	334.45		332.47	338.53	334.01	344.05	338.88	314.376	314.5686	314.6333	323.23	334.9992	314.77	294.83	285.81		351.77	345.15		321.12	314.04	326.85	354.861
K	26.538		167.19	129.79	239.89	138.1	10004	589.096	616.7966	615.24013	410.28	152.8943	363.04	625.96	68.945		120.08	212.47		513.454	48.025	85.292	8634.46
balance																							
density	1.0785		1.0856	1.0662	1.0806	1.0473	1.0651	1.14809	1.147387	1.1471513	1.1166	1.077437	1.1466	1.2242	1.2629		1.026	1.0457		1.12398	1.1493	1.1043	1.01711
vol%solids	12		13.7	24.9	6.8	3.4	3.9	2.8	3.7	3.2	1.4	4.8	4.5	1.9	8.1		2.2	3.9		2.2	8.1	2.9	10.5
void frac.	0.7042		0.6979	0.7922	0.7803	0.942	0.8634	0.91417	0.934508	0.9230049	0.8956	0.935004	0.7988	0.5737	0.8136		0.8413	0.8077		0.86177	0.8386	0.7762	0.85731
wt.% H2O	86.789		87.714	88.955	85.46	91.223	84.5	73.5572	73.28673	73.307589	78.158	88.89935	78.528	73.832	75.29		94.864	91.551		76.3787	83.612	88.005	95.1018
TOC wt.%C	0		0	0	0	0	0.051	0.00039	0	0	0	0	0	0	0		0	0		0	0	0	0
species																							
OH	4115		1361.9	457.91	567.5	1009.2	450.6	384.83	497.8085	349.36072	755.58	2078.558	172.81	317.31	465.82		3429.9	3370.7		797.608	515.8	475.37	4019.14
NO3	9999.5		32444	31653	72190	41048	92572	139476	149727.4	149758.15	130766	31383.53	87732	78669	43131		11940	9289.6		142581	36862	38461	19308.9
NO2	750.7		9641.4	11165	61.294	36.177	0	8704.22	1166.955	1167.2422	7013.4	7302.864	34785	46843	52491		11355	25103		9217.67	32001	11903	382.233
CO3	30668		497.8	506.87	500.1	515.12	507.4	9984.96	470.9896	471.08643	537.78	-112.699	471.3	441.43	427.93		526.69	516.77		480.798	470.2	489.38	531.317
PO4	13203		13290	13520	13442	9831.1	4211.5	10779.5	11117.35	11120.08	11073	13568.47	0	0	0		0	0		8136.21	0	0	0
SO4	19541		5685.9	5852.7	4476	2467.6	145.08	11876.1	15358.1	15361.878	1378.4	1788.91	1606.3	2373.2	117.39		4096.8	14696		4805.74	128.72	133.09	145.739
Si	108.02		880.27	896.31	883.51	523.08	0	0	832.23	832.41949	0	887.1835	363.69	780.04	677.52		930.7	913.8		0	495.29	0	0
F	0		4162.6	4279.5	3926.8	2103.7	4282.5	0	3485.913	3486.772	0	4033.235	0	0	0		0	0		0	0	0	4485.63
Cl	110.62		696.89	540.98	999.94	575.62	993.2	3166.98	2570.954	2564.4656	1710.2	637.2992	1513.2	2609.1	287.38		500.51	885.64		2140.2	200.18	355.52	202.236
C6H5O7	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
EDTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
HEDTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
NTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
glycolate	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
acetate	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
oxalate	0		0	0	0	0	1869.4	0	0	0	0	0	0	0	0		0	0		0	0	0	0
DBP	0		0	0	0	0	0	5.6324	0	0	0	0	0	0	0		0	0		0	0	0	0
butanol	0		0	0	0	0	0	1.98825	0	0	0	0	0	0	0		0	0		0	0	0	0
	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
NH3	1.2682		8.2432	16.959	0.0013	0.0008	0	12.0036	0.215694	0.2157645	0	0.062065	219.05	381.02	10.57		114.9	407.03		12.3306	3.8985	0.6151	13065.6
NiFe(CN)6--	0		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0
Pu (µCi/L)																							
U (M)																							
Cs (Ci/L)																							
Sr (Ci/L)																							

pred. su. ppm	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
Na	24902.7	25856	34264	75573	47138	71790	71800	22873	14894	67467	69469		75370			6769.7	154984	4470.1	14287
Al	0	0	0	5886.5	0	7387.4	7388.5	0	2028.2	12113	0		6918			0	33160	0	0
Fe	2147.54	2154	2113.1	96.523	103.17	96.394	96.408	107.86	108.71	96.023	99.102		1304.5			0	0	111.02	109.21
Cr	399.921	401.12	393.52	426.59	385.09	360.23	360.28	403.15	101.28	0.009	0		1155.5			0	0	414.43	407.65
Bi	0	0	0	0	0	0	0	0	0	0	0		11.485			0	0	0	0
La	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Hg	0	0	0	0	0	0	0	0	0	0	0		0.1972			0	0	0	0
Zr	0	0	0	0	0	0	0	0	0	0	0		1.9865			0	0	0	0
Pb	0	0	0	0	306.2	0	0	0	0.2018	0	0		0.3907			0	0	0	0
Ni	225.763	226.44	222.15	91.324	97.612	91.202	91.215	102.05	102.79	90.851	0		311.95			0	0	105.04	103.32
Sr	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Mn	0	4672.4	45.848	0	0	0	0	0	0	0	0		1636.9			70.104	0	0	0
Ca	696.597	698.09	686.67	311.72	181.8	311.36	311.41	73.775	351.07	310.11	320.28		999.06			0	0	358.54	352.68
K	123.667	3424.8	204.25	619	3210.1	940.92	941.06	156.87	105.17	454.09	472.27		1644.1			49.892	494.79	26.877	26.438
balance																			
density	1.04021	1.0371	1.0571	1.1579	1.0826	1.1592	1.159	1.0355	1.0276	1.1634	1.1267		1.1538			1.0188	1.5052	1.0067	1.0234
vol%solids	0.6	1.1	0.6	2.3	1.2	5.8	5.8	3.1	0.5	0.68	2.6		1			13.6	80	1	1
void frac.	1	1	1	0.549	0.8226	0.9349	0.9349	0.8865	0.8459	0.5749	0.8505		1			1	0.8	0.7152	0.7152
wt.% H2O	90.6853	89.677	88.411	74.379	82.264	74.482	76.86	93.044	95.597	77.459	73.576		75.024			94.733	51.848	98.281	95.973
TOC wt.%C	0.84921	0.3273	0.2552	0	2.2883	0.0237	0.1047	0	0.0701	0.5069	5.4534		0.4176			0	0	0	0
species																			
OH	2843.67	7900.9	2933.4	4366.4	1856.5	561.84	725.65	3979.8	3407	2844.7	2682.4		10464			-8234.7	7448.8	873.52	859.24
NO3	40259.1	40519	55298	150021	57558	147808	50329	35311	9117.1	87060	29093		80430			48685	120136	9680.1	9521.9
NO2	442.22	443.55	435.14	562.03	3645.6	453.25	72792	1794.4	5864.1	3776.7	4982.3		32301			0	100851	1099.8	631.08
CO3	12565.5	17597	17263	9975.6	272.2	466.19	466.26	110.46	525.64	13898	13188		9837.4			0	15947	117.36	115.44
PO4	0	0	0	11.603	0	7401.4	7402.5	1840.7	0	818.7	0		1039.8			0	7511.3	0	13928
SO4	369.388	370.5	363.47	570.07	5993.4	4491.8	4492.5	2234.2	1496.9	3643.6	8730.2		9430.8			0	2279.2	382.79	376.53
Si	0	0	0	0	0	0	0	922.26	930.11	821.06	847.99		1572.1			0	0	0	0
F	0	0	0	0	0	1974.3	1974.6	0	0	0	0		54.568			0	901.64	0	0
Cl	515.472	414.87	715.35	3538.7	1612.8	1946.2	1946.4	653.89	438.39	1892.8	1968.5		2020			0	3295.4	112.03	110.2
C6H5O7	0	0	0	0	7000.5	0	0	0	1841.2	2444.7	0		4632.3			0	0	0	0
EDTA	0	0	0	0	21335	0	0	0	0	0	38505		0			0	0	0	0
HEDTA	0	0	0	0	0	0	0	0	0	0	73267		9.5026			0	0	0	0
NTA	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
glycolate	0	0	0	0	0	0	0	0	0	12934	20053		265.11			0	0	0	0
acetate	0	0	0	0	27864	0	0	0	0	0	0		0			0	0	0	0
oxalate	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
DBP	12382.5	4772.7	3720.4	0	0	345.29	1527.3	0	0	0	5.7478		3387.2			0	0	0	0
butanol	4371.05	1684.8	1313.3	0	0	121.89	539.13	0	0	0	2.029		1195.7			0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
NH3	0	0	0	0	4.2863	0.0023	923.06	2.0467	45.994	3.169	14.944		296.82			0	963.51	0	0
NiFe(CN)6--	0	0	0	0	0	0	0	0	0	0	0		0			0	0	0	0
Pu (µCi/L)																			
U (M)																			
Cs (Ci/L)																			
Sr (Ci/L)																			

pred. su. ppm	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
Na		96138		96382		112390		139676		137791		159637		178312		168552		0	57337	14409.28	11112			1353.6
Al		3061.3		2767.6		31358		24695		30176		28823		28372		28549		0	7780.6	0	0			0
Fe		92.952		93.302		81.796		79.285		78.077		74.603		73.185		73.65		0	101.03	109.12	109.807			111.53
Cr		338.11		307.9		1142.4		1107.2		1090.3		1042.9		1025.8		1031.6		0	0	407.1023	0			0
Bi		575.56		551.85		1.0783		290.28		151.59		229.58		541.56		548.62		0	0	0	0			0
La		0		0		0		0		0.4028		2.1474		3.9706		1.6593		0	0	0	0			0
Hg		1.4336		1.0593		0.2537		1.5494		1.4127		1.4522		1.1703		1.4673		0	0	0	1.9734			0
Zr		159.79		177.89		0.1933		82.341		16.541		59.89		178.76		180.36		0	0	0	269.037			0
Pb		0		0		0.0382		1.4715		19.164		3.5491		10.679		13.903		0	0	8.809507	0			0
Ni		88.218		88.277		77.391		75.036		73.877		70.621		69.331		69.738		0	0	103.1448	0			0
Sr		0		0		0		0		0.2681		1.4295		2.6432		1.1046		0	0	0	0			0
Mn		0		0		20.562		351.03		345.65		330.47		324.95		326.89		0	0	322.5895	0			0
Ca		301.11		301.32		264.16		256.12		251.99		240.82		233.37		237.24		0	326.47	352.4227	354.876			360.21
K		736.68		676.04		846.2		2072		2034.5		2816.8		6716.7		5633		0	392.26	262.1064	8631.79			7.8145
balance																								
density		1.1968		1.1963		1.3643		1.4071		1.4292		1.4981		1.5512		1.5228		1	1.1056	1.024146	1.01706			1.002
vol%solids		17.683		11.446		13.82		55.385		48.966		55.173		99		45.523		90	3.9	2	10.5			0.6
void frac.		0.792		0.7772		0.8721		0.7865		0.7782		0.7183		0.5823		0.6239		0.5	0.789	0.888191	0.85031			0.7842
wt.% H2O		68.785		68.742		60.769		54.638		54.966		48.201		42.095		45.318		100	87.097	95.38536	94.8655			99.394
TOC wt.%C		0.0004		0.0004		0.0082		0.7645		0.6515		1.1071		2.789		1.7806		0	0	0.048594	0			0
species																								
OH		2762.9		2709.5		118.21		6349.3		6521		6963.5		14726		10604		0	22078	272.044	1800.63			271.73
NO3		143343		144574		127123		123476		121344		116327		115543		114841		0	9729.5	15179.93	23952.5			4102.1
NO2		14885		14968		71426		60290		65326		94598		91020		93470		0	18689	751.8586	356.524			0
CO3		10027		10772		633.02		15342		14595		14495		15131		14943		0	488.81	6516.569	531.34			-0.6697
PO4		11970		12048		37.936		10196		5795		9561.1		9439.7		9516.8		0	0	6460.844	0			0
SO4		16429		15695		3444.2		18783		13883		20831		21948		22140		0	11809	380.106	0			0
Si		651.41		635.28		699.4		676.99		667.03		637.62		626.24		630.06		0	863.87	0	0			0
F		3036.1		2961		6.1296		1550.4		958.84		1216.8		2962.7		2998.8		0	519.86	0	4483.2			0
Cl		3783.6		3496.5		3465.1		4273.1		3918.6		4028		3962.1		3978.9		0	1635	135.5683	162.802			32.573
C6H5O7		0		0		64.329		2992.7		4103.3		4941.7		11346		5565.7		0	0	0	0			0
EDTA		0		0		2.2365		2683.6		1301.1		3756.7		10185		7924.7		0	0	0	0			0
HEDTA		0		0		0.1178		4957.5		7.044		6753.8		18142		13325		0	0	0	0			0
NTA		0		0		0		0		0		0		0		0		0	0	0	0			0
glycolate		0		0		33.885		4169.6		1025.3		5856.7		14296		7719.8		0	0	0	0			0
acetate		0		0		2.9208		105.6		1699.2		276.55		863.19		1209.7		0	0	0	0			0
oxalate		0		0		0		0		0.9619		5.1286		9.483		3.9629		0	0	0	0			0
DBP		5.6437		5.3723		64.964		2684		4940.8		3908.2		9414.6		5233.9		0	0	708.5594	0			0
butanol		1.9923		1.8964		22.932		947.45		1744.1		1379.6		3323.4		1847.6		0	0	250.1235	0			0
		0		0		0		0		0		0		0		0		0	0	0	0			0
NH3		17.26		17.575		441.9		159.5		132.99		247.11		411.45		2058.8		0	265.19	0.245652	13075.9			849.4
NiFe(CN)6--		0		0		0		0		0		0		0		0		0	0	0	0			0
Pu (µCi/L)																								
U (M)																								
Cs (Ci/L)																								
Sr (Ci/L)																								

	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CWZr1
B	7		2990		219	194		4472	172														
B'																							
BY	1		110	1	3	13	5	501	285	819	470	2	23	7	15	17	553	700		159	3,723	13,203	
BY'																							
A1			4673	66	2	9	5	66		18	20	5	479	25	511	22	326	139		20	19		1650
A1'																							
T1	319		3059	962	79			6465				1034											
T1'																							
R				1					3	2	2		7,796	6,697	457	465	2	1		1	9	75	
R'																							
T2			1098	884	63	176		4420	245	105	49	318	4,361	869	1,082	1,859	2110	1239		110	312	2606	
T2'																							
S1			538	172	14	146	37	1091	142	134	107	115	10452	643	1352	750	941	495		133	436	2071	
S1'																							
S2			113	2319		2	1	22	10	8	3	1			7	129	70	36		7	11	46	
S2'																							
A2																							
A2'																							
CC																							
CC'																							
			12581	4405	380	540	48	17037	857	1086	651	1475	23111	8241	3424	3242	4002	2610		430	4510	18001	1650
pass thru			-954	12,084	8,531	22,038	8,252	5,356	12,322	19,451	10,951	2,343	-2,469	584	-449	-1,490	2,015	1,224		216	1,223	2,549	0
													-2,469	584	-449	-1,490					1,223	2,549	0
frac NO3- left in su	0.9081	1	0.925	0.8785	0.9989	0.9988	1	0.92241	0.989604	0.989604	1	0.999048	0.6517	0.5548	0.9782	0.982	0.4482	0.2184	1	0.92314	0.9867	0.9943	0.99577
frac. NO2 to NH3 i	0.0023	0	0.0019	0.0031	3E-05	3E-05	0	0.00194	0.000251	0.0002508	0	2.29E-05	0.0102	0.014	0.0005	0.0004	0.0191	0.0359	0	0.00192	0.0003	0.0001	0.0001
frac NO3- left in sl	0.9344	1	0.9471	0.9025	0.9991	0.9989	1	0.9277	0.951175	0.9453183	0.0045	0.109467	0.0271	1E-08	0.9822	0.986	2E-10	1E-13	1	0.88357	0.9888	0.9956	0.99637
frac. NO2 to NH3 i	0.0016	0	0.0013	0.0025	2E-05	3E-05	0	0.0018	0.001201	0.0013487	0.1216	0.051706	0.0829	0.3565	0.0004	0.0003	0.4188	0.5103	0	0.00297	0.0003	0.0001	8.7E-05
0.05	mol NO2/mol NO3/Ci/yr.																						
2.52	gal TBP lost per ton fuel																						
1.20E-03	mol NH3/mol NO2/Ci/yr.																						
su ionic strength	4.5065	2.4032	4.0558	4.3981	5.2508	4.3744	4.6307	3.29621	2.731209	2.7293644	1.8935	4.39555	5.1564	6.9381	7.0108	8.6262	6.7952	6.8578	0.2683	6.98555	6.8951	6.8391	6.7763
complexability	1.0704	1.4048	0.3771	0.3775	0.3653	0.2527	0.1051	0.59363	0.46108	0.4610982	0.2864	0.325911	0.0282	0.0393	0.0105	0.0105	0.0528	0.169	0	0.25782	0.0105	0.0105	0.01055

	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	CSR in	CSR	DE	CEM	NIT	Salt Slurry	DW	N
B																		24	
B'																			
BY	382	43	4,771		583	304	634	21	470	570			6649					575	325
BY'																			
A1	79	181	55	18	38	4		777	751	608	713		556					125	65
A1'																			
T1																			
T1'																			
R	1		56		1	1	2		2	21			111					6	
R'																			
T2	320	938	900	1,637	47	100	27	429	403	2389	806		6,038					4598	355
T2'																			
S1	233	380	676	164	107	61	18	710	337	2574	828		8345					2,634	1,444
S1'																			
S2	16	37	16		5	3	1	167	127	134	143		146					33	14
S2'																			
A2																			
A2'																			
CC																			
CC'																			
	1031	1579	6474	1819	781	473	682	2104	2090	6296	2490		21845			0	0	7995	2203
pass thru	380	516	929	-163	222	454	-254	170	2,039	8,107	1,364		3,476					810	-46
	380	516	929		222	454	-254	170	2,039	8,107	1,364		3,476					810	-46
frac NO3- left in su	1	1	1	1	0.9299	0.9995	0.3403	0.9359	0.5553	0.9503	0.8252	1	0.8436	1	1	1	0.4753	1	1
frac. NO2 to NH3 i	0	0	0	0	0.0017	1E-05	0.0255	0.0016	0.014	0.0012	0.0046	0	0.0041	0	0	0	0.0177	0	0
frac NO3- left in sl	1	1	1	1	2E-17	0.9995	4E-07	2E-08	6E-23	0.001	9E-06	1	0.8436	1	1	1	0.4709	1	1
frac. NO2 to NH3 i	0	0	0	0	0.6036	1E-05	0.296	0.3479	0.7077	0.1533	0.2437	0	0.0041	0	0	0	0.0179	0	0
0.05																			
2.52																			
1.20E-03																			
su ionic strength	1.30566	1.4559	1.491	7.0082	1.7616	2.022	2.1248	6.796	6.7857	7.0002	7.1331	0	9.8165	0	0	0.5519	3.348	0.5127	1.074
complexability	0.28315	0.3317	0.3268	0.1996	0.9844	0.2458	0.2523	0.0661	0.045	0.5643	2.1571	0	0.407	0	0	0	0.6738	0.006	0.3062

	B in	B-SltCk	T1 in	T1-SltCk	R in	RSltCk	T2 in	T2-SltCk	BY in	BY-SltCk	S1 in	S1-SltCk	S2 in	S2-SltSlr	A1 in	A1-SltCk	A2 in	A2-SltSlr	P3	PL2	CWZr2	BP /Cplx	BP /NCplx	PASF
B																								
B'		4,445																						
BY		637		15		13																		
BY'										8,124														
A1		48		20				850		2,180		1353												
A1'																4,668								
T1																								
T1'				6,675																				
R		1		6		24																		
R'						7,706																		
T2		56		2,123		239																		
T2'								10,828																
S1		152		514		597		4,110		56														
S1'												11,364												
S2		11		10				1407		377		3,673												
S2'														3,562										
A2																								
A2'																		0						
CC																								
CC'																								
pass thru																								
	18115																							
frac NO3- left in su	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.2832	0.973911	0.99804	1	1	1
frac. NO2 to NH3 i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0298	0.000634	4.7E-05	0	0	0
frac NO3- left in sl	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1E-13	0.976794	0.99833	1	1	1
frac. NO2 to NH3 i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5087	0.000563	4E-05	0	0	0
0.05																								
2.52																								
1.20E-03																								
su ionic strength	0	4.9295	0	4.9936	0	7.293	0	7.4545	0	7.4162	0	7.606	0	7.3645	0	7.7359	0	0	8.2577	1.588304	5.79508	0	0	0.3134
complexability	0	0.7063	0	0.7138	0	0.0665	0	1.2091	0	0.9108	0	1.4074	0	2.1553	0	1.7405	0	0	0.1449	0.258068	0.00901	0	0	-1E-05