Calcined Waste Storage at the Idaho Nuclear Technology and Engineering Center

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ABSTRACT

This comprehensive report provides definitive volume, mass, and composition (chemical and radioactivity) of calcined waste stored at the Idaho Nuclear Technology and Engineering Center. Calcine composition data are required for regulatory compliance (such as permitting and waste disposal), future treatment of the calcine, and shipping the calcine to an off-Site facility (such as a geologic repository).

This report also contains a description of the calcine storage bins. The Calcined Solids Storage Facilities (CSSFs) were designed by different architectural engineering firms and built at different times. Each CSSF has a unique design, reflecting varying design criteria and lessons learned from historical CSSF operation. The varying CSSF designs will affect future calcine retrieval processes and equipment.

Revision 4 of this report presents refinements and enhancements of calculations concerning the composition, volume, mass, chemical content, and radioactivity of calcined waste produced and stored within the CSSFs.

The historical calcine samples are insufficient in number and scope of analysis to fully characterize the entire inventory of calcine in the CSSFs. Sample data exist for all the liquid wastes that were calcined. This report provides calcine composition data based on liquid waste sample analyses, volume of liquid waste calcined, calciner operating data, and CSSF operating data using several large Microsoft Excel (Microsoft 2003) databases and spreadsheets that are collectively called the Historical Processing Model. The calcine composition determined by this method compares favorably with historical calcine sample data.

EXECUTIVE SUMMARY

This comprehensive report documents the volume, mass, and composition (both chemical and radioactivity) of calcined waste stored at the Idaho Nuclear Technology and Engineering Center (INTEC). This report also documents the chemical content and radioactivity of the calcine. In addition, this report provides a detailed description of the calcine storage bins in each Calcined Solids Storage Facility (CSSF).

Revision 4 of this report presents refinements and enhancements of the calculated composition, volume, mass, chemical content, and radioactivity of calcined waste produced and stored within the CSSFs. The refinements include changes in the concentrations of some trace calcine constituent metals regulated under the Resource Conservation and Recovery Act as hazardous wastes. The refinements also incorporate changes to the ORIGEN2-based waste models (used to calculate radioactivity when sample data are not available) resulting from a review and verification of those models.

Calcine composition data are required for regulatory compliance (such as permitting and waste disposal), future treatment of the calcine, and shipping the calcine to an off-Site facility (such as a geologic repository). The calcine composition is based on operating data from the two waste calcining facilities, volume of liquid waste calcined, liquid waste composition data (from sample analyses), operation of the CSSFs, and other INTEC fuel and waste processing information.

Spent nuclear fuel reprocessing at INTEC produced aqueous highly radioactive wastes. Between December 1963 and May 2000, the liquid wastes were converted into a solid, granular form called calcine in two calcining facilities. The Waste Calcining Facility operated from November 1963 to March 1981, and converted 4,091,000 gal of aqueous radioactive waste into 77,300 ft³ of calcined solids. The New Waste Calcining Facility operated from August 1982 through May 2000, and converted 3,642,000 gal of aqueous waste into 78,000 ft³ of calcined solids. The total volume of calcine stored in the CSSFs is about 155,300 ft³ (4,400 m³). Table E-1 provides a summary of the capacity of each CSSF and the volume of calcine stored in each CSSF.

Table E-1. Volume of calcine in solids storage facilities.

Calcined Solids Storage Facility	Total Storage Capacity (ft ³)	Usable Storage Volume (ft ³)	Calcine Volume ft ³ (m ³)	Percent Full
I	8,300	8,000	7,760 (220)	97
II	31,600	30,000	30,000 (850)	100
III	40,000	39,900	39,500 (1120)	99
IV	17,700	17,200	17,200 (486)	100
V	36,200	35,600	35,600 (1010)	100
VI	55,200	53,200	25,200 (713)	47

The calcined waste management strategy requires permitting the CSSFs for interim waste storage, retrieving the calcine, treating the calcine, and shipping the treated calcine to an off-Site disposal location. These activities require a quantitative calcine composition. The composition of calcine varies significantly among the CSSF storage bins. The historical calcine samples are insufficient in number and scope of analysis to fully characterize the entire inventory of calcine in the CSSFs. Obtaining and analyzing representative calcine samples from the CSSFs would be difficult and costly. Sample data exist

for all the liquid wastes that were calcined. This report uses historical liquid waste sample data, volume of liquid waste calcined, calciner operating data, and CSSF operating data to quantify the calcine inventory and composition, without further calcine sampling. These data are compiled and the calcine composition is calculated in several large Microsoft Excel databases and spreadsheets that are collectively called the Historical Processing Model. The calcine composition determined by the HPM compares favorably with historical calcine sample data.

A compact disc copy of this report is provided with the hard-copy version to facilitate additional data manipulations and analysis. The data on the compact disc also may be obtained through Idaho Cleanup Project Records Management.

CONTENTS

ABSTRACT.....	iii
ACRONYMS.....	xi
1. INTRODUCTION.....	1
1.1 Purpose.....	1
1.2 Scope.....	1
1.3 Calcine Background.....	3
1.4 Report Organization.....	4
1.4.1 Main Body.....	5
1.4.2 Appendix A Liquid Waste and Calcine Composition Summaries	5
1.4.3 Appendix B Calcination Campaign Data Plots	8
1.4.4 Appendix C Calcine Composition Data Plots	8
1.4.5 Appendix D Internal INTEC Documentation Referenced in Report	8
2. CALCINATION HISTORY AND DESCRIPTION.....	9
3. DESCRIPTION OF CALCINED SOLIDS STORAGE BINS	14
3.1 Calcined Solids Storage Facility I.....	14
3.2 Calcined Solids Storage Facility II	17
3.3 Calcined Solids Storage Facility III	19
3.4 Calcined Solids Storage Facility IV	21
3.5 Calcined Solids Storage Facility V	23
3.6 Calcined Solids Storage Facility VI.....	25
3.7 Calcined Solids Storage Facility VII.....	26
4. CALCINE COMPOSITION DETERMINATION.....	27
4.1 Calcine Composition Calculation Method	29
4.2 Comparison of HPM and Analytical Calcine Compositions	31
4.3 Liquid Waste Composition	35
4.3.1 Chemical Composition of Liquid Waste	36
4.3.2 Radionuclide Activity of Liquid Wastes	39
5. CALCINE COMPOSITION.....	41
5.1 Minor Chemical Constituents of Calcine.....	43
5.2 Detailed Discussion of Individual Chemical Constituents.....	45
5.2.1 Aluminum.....	46
5.2.2 Arsenic	46

5.2.3	Barium.....	47
5.2.4	Boron.....	48
5.2.5	Cadmium.....	48
5.2.6	Calcium.....	48
5.2.7	Carbonate.....	49
5.2.8	Cesium.....	50
5.2.9	Chloride.....	50
5.2.10	Chromium.....	51
5.2.11	Fluoride.....	51
5.2.12	Iron.....	51
5.2.13	Lead.....	52
5.2.14	Magnesium.....	52
5.2.15	Manganese.....	52
5.2.16	Mercury.....	53
5.2.17	Nickel.....	53
5.2.18	Nitrate.....	54
5.2.19	Oxygen.....	54
5.2.20	Phosphate.....	54
5.2.21	Potassium.....	55
5.2.22	Selenium.....	55
5.2.23	Silver.....	55
5.2.24	Sodium.....	57
5.2.25	Strontium.....	57
5.2.26	Sulfate.....	58
5.2.27	Tin.....	58
5.2.28	Uranium.....	58
5.2.29	Zirconium.....	59
5.3	Fission-Product Activity of Calcine.....	59
5.4	Activation-Product Activity of Calcine.....	60
5.5	Detailed Discussion of Individual Radionuclides.....	62
5.5.1	Cobalt-60.....	64
5.5.2	Nickel-63.....	64
5.5.3	Selenium-79.....	65
5.5.4	Strontium-90.....	65
5.5.5	Yttrium-90.....	65
5.5.6	Technitium-99.....	65
5.5.7	Tin-126.....	66
5.5.8	Iodine-129.....	66

5.5.9	Cesium-137	66
5.5.10	Barium-137m	66
5.5.11	Neptunium-237.....	67
5.5.12	Plutonium-238.....	67
5.5.13	Plutonium-239.....	68
5.5.14	Plutonium-240.....	68
5.5.15	Plutonium-241	68
5.5.16	Americium-241	68
5.5.17	Curium-242	69
5.6	RCRA and Organic Constituents	69
6.	CSSF inventory SUMMARIES.....	71
6.1.1	Calcined Solids Storage Facility I.....	71
6.1.2	Calcined Solids Storage Facility II.....	72
6.1.3	Calcined Solids Storage Facility III	73
6.1.4	Calcined Solids Storage Facility IV	74
6.1.5	Calcined Solids Storage Facility V	75
6.1.6	Calcined Solids Storage Facility VI	75
7.	CHANGES FROM PREVIOUS REPORT REVISION.....	77
7.1	Radionuclide Calculation Method.....	77
7.1.1	Calculation of Uranium and Transuranic Isotopes and Their Daughters	77
7.1.2	Changes to ORIGEN2-Based Models.....	78
7.2	Volume of Waste Calcined	80
7.3	Liquid Waste Composition	83
7.3.1	Erroneous Sample Data	83
7.3.2	Additional Sample Data	85
7.3.3	Minor and Trace Component Estimates	85
7.4	Bin-segment Fill Dates.....	86
7.5	Appendix Data Tables and Plots	87
7.6	HPM Electronic Files.....	87
8.	REFERENCES	90
	Appendix A—Liquid Waste and Calcine Composition Summaries.....	A-1
	Appendix B—Calcination Campaign Data Plots.....	B-1
	Appendix C—Calcine Composition Data Plots.....	C-1
	Appendix D—Internal INTEC Documentation Referenced in Report	D-1

FIGURES

1.	Map of the Idaho National Laboratory Site showing the location of the Idaho Nuclear Technology and Engineering Center and other major facilities.	2
2.	Former reprocessing of spent nuclear fuel at the Idaho Nuclear Technology and Engineering Center (ICP 2009).	9
3.	Historical photograph of calcine-related facilities.....	10
4.	Simplified schematic of the calcining process and CSSFs at INTEC.	11
5.	Artist’s depiction of the Calcined Solids Storage Facilities and their calcine volume.....	14
6.	Solids Storage Bin VES-WCS-115-2 in CSSF I.	15
7.	Solids Storage Bin VES-WCS-136-2 ready to be installed in CSSF II.....	17
8.	Center Bin VES-WCS-139 (or WCS-140-7) surrounded by six other bins in CSSF III.....	20
9.	Installation of solids storage Bin VES-WS4-142 in CSSF IV.	22
10.	Top of VES-WS5-147 in CSSF V.....	24
11.	Sloped bin fill piping, vertical retrieval piping, and annular bins in CSSF VI.....	26
12.	Simplified schematic of chemically different calcine layers in CSSF III.....	28
13.	Variation of calcine component concentrations within storage bins.	29
14.	Ratio of HPM-calculated calcine composition to the measured calcine composition.....	33
15.	Average concentrations of the major chemical constituents of calcine.....	43
16.	Average concentrations of the minor chemical constituents of calcine.....	44
17.	Major fission-product activity in calcine decayed to January 1, 2016.	60
18.	Activities of the major transuranic isotopes in calcine.....	62

TABLES

1.	Summary of liquid waste processed and calcine generated during calcination campaigns.....	12
2.	Approximate storage capacity and volume of calcine in the CSSFs	13
3.	Typical chemical compositions of six liquid wastes calcined at INTEC	38
4.	Typical chemical composition of four types of calcine.....	41
5.	Summary of CSSF filling	71
6.	Comparison of reported liquid waste volumes calcined.....	82
7.	Analytical data for Waste Stream Number 67 (from Tank VES-WM-187).....	84

ACRONYMS

CFR	<i>Code of Federal Regulations</i>
CSSF	Calcined Solids Storage Facility
DOE	U.S. Department of Energy
EDF	engineering design file
HPM	Historical Processing Model
ICPP	Idaho Chemical Processing Plant (now INTEC)
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
NRC	National Research Council
NWCF	New Waste Calcining Facility
RCRA	Resource Conservation and Recovery Act
SBW	sodium-bearing waste
TRU	transuranic
VRF	volume reduction factor
WCF	Waste Calcining Facility
WIR	waste incidental to reprocessing

Inventory of Calcined Waste Stored at the Idaho Nuclear Technology and Engineering Center

1. INTRODUCTION

1.1 Purpose

This comprehensive report documents the volume, mass, and composition of highly radioactive calcined waste stored at the Idaho Nuclear Technology and Engineering Center (INTEC). The calcine composition includes both chemical content and radioactivity based on operating data from the two INTEC waste calcining facilities, the volume of liquid waste calcined, liquid waste sample analyses, operational history of the Calcined Solids Storage Facilities (CSSFs) currently storing the calcine, and other INTEC fuel- and waste-processing information. The report also provides a detailed description of the calcine storage bins within each CSSF, emphasizing features that may be of concern to future calcine retrieval.

Revision 4 of this report presents refinements and enhancements of the methods used to calculate the composition, volume, mass, chemical content, and radioactivity of calcined waste produced and stored within the CSSFs. The refinements resulted in changes to the concentrations of some trace calcine constituents regulated under the Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et seq. 1976) as hazardous wastes (40 CFR 261). The refinements also incorporated changes to the ORIGEN2-based waste models (used to calculate radioactivity when sample data are not available) that resulted from a review and verification of those models.

The calcine volume, mass, and composition in this report were calculated using several large Microsoft Excel databases and spreadsheets that are collectively called the Historical Processing Model (HPM) and are incorporated within this report. The calcine composition determined by this analytical model compares favorably with historical calcine sample data.

1.2 Scope

A detailed description of the scope of this report about INTEC calcine, its composition, and constituents is provided in this section. This report provides a quantitative inventory and composition of the calcined solids stored within the INTEC CSSFs. This information is required for detailed evaluations of waste storage, treatment, and disposal options. Historical reports of the various calciner operating campaigns lack detailed information specific to the calcine inventory. A few reports on the CSSFs and calcine inventory (Kirkbride 1980; Berreth 1988; Penwell 1993) contain more specific information than the calciner operating reports, but do not provide quantitative information for all of the CSSFs or all the varieties of calcine that have been produced. Prior to the publication of this report historical information on calcine composition was available in disparate sources. This comprehensive report compiles information from these sources into one primary, definitive, authoritative source document. The uses of this report broadly range from environmental impact statements and permitting to safety analysis, waste management, and calcine treatment studies.

From December 1963 through May 2000, liquid radioactive wastes generated by spent nuclear fuel reprocessing were converted into a solid, granular form called calcine. Approximately 155,300 ft³(4,400 m³) of calcine is stored in six CSSFs at INTEC, which is located at the Idaho National Laboratory (INL) Site in southeastern Idaho, as shown in Figure 1. The CSSFs consist of stainless steel storage bins located within a concrete vault.

Figure 1. Map of the Idaho National Laboratory Site showing the location of the Idaho Nuclear Technology and Engineering Center and other major facilities.

Calcine composition data are required for regulatory compliance (such as permitting and waste disposal), future treatment of the calcine, and shipping the calcine to an off-Site facility (such as a geologic repository). The composition of calcine varies significantly among the CSSF storage bins. The historical calcine samples are too few to fully characterize the entire inventory of calcine in the CSSFs, and obtaining and analyzing representative calcine samples from the CSSFs would be onerous and costly. Sample data exist for all the liquid wastes that were calcined.

This report provides the chemical content and radioactivity of the entire inventory of INTEC calcine. The calcine composition is based on calciner and CSSF operating data, liquid waste sample analyses, volume of liquid waste calcined, and other INTEC waste processing and fuel-reprocessing information. Much of the data are provided in the appendices of this report. The calcine composition data include both major chemical components such as aluminum (Al), zirconium (Zr), fluoride (F), and calcium (Ca), and major radionuclides such as cesium (Cs) -137, strontium (Sr) -90, and plutonium (Pu) -238. It also includes several minor and trace constituents such as nickel (Ni), chromium (Cr), mercury (Hg), barium (Ba), neptunium (Np) -237, and americium (Am) -241 that may be of interest or regulatory concern. This information is required to support continued permitting of the CSSFs, designing, permitting, and operating of a future calcine retrieval and treatment facility, and shipping the calcine to a long-term storage or disposal facility.

This report also provides information on the design of the calcine storage bins, including their configuration, storage capacities, and bin access provisions. Emphasis is placed on those design characteristics that may hamper future calcine retrieval. This information is necessary for the future design of calcine retrieval equipment.

This report includes a detailed discussion of the composition of calcine and explains the sources of the various chemicals and radionuclides in the calcine, and the reasons for the large variations in the composition of the various types of calcine.

This report does not include any significant discussion of the physical properties of calcine, such as its bulk density, particle size and distribution, particle density, thermal conductivity, or flow properties. Those properties are detailed in *Physical Characteristics of Calcine Stored at the Idaho Nuclear Technology and Engineering Center (INTEC)* (Swenson 2010), which is a comprehensive report that compiled and provides citations to historical reports about the physical properties of calcine.

New information presented in this report revision includes refinements and enhancements of the method used to calculate the calcine composition that have improved the accuracy of the composition calculations. In addition, this revision documents corrections to data entry and typographic errors that were in the previous revision of this report. The changes from the previous revision do not significantly affect the reported amount of calcine or the concentrations of its major constituents. The total mass of the major calcine constituents, such as Al, Zr, Ca, and F, typically changed less than 1% from the previous revision of this report. Likewise, the changes to the major radionuclides such as Cs-137, Sr-90, and Pu-238 were small, typically less than 5% of the values from the previous revision of this report. The radioactivity changes were slightly larger than the chemical changes because of an effort to verify the radionuclide models used to determine radioactivity when sample data do not exist (Herbst 2011). The radionuclide verification effort used a newer version of ORIGEN, ORIGEN-ARP (Bowman and Gauld 2010), to perform radioactive decay calculations in place of the ORIGEN2 (Croff 1980) program that was used in previous revisions of this report. The newer ORIGEN version contained slightly different values for the half-lives of some of the radionuclides, which resulted in slightly different calcine radioactivity.

This report revision also presents changes to the concentrations of some of the trace calcine constituents, including arsenic (As) and silver (Ag), which are of interest because they are metals regulated under RCRA. Because the concentrations of these constituents in both liquid and calcined wastes were typically below the laboratory's detection level, their concentrations were estimated. This report revision presents a change in the method used to estimate those constituent concentrations. This change resulted in more conservative, or higher, calculated concentrations of those species.

1.3 Calcine Background

Originally named the Idaho Chemical Processing Plant (ICPP) when it was constructed in 1953, INTEC reprocessed spent nuclear fuel to recover highly enriched uranium and other nuclear-related products for the U.S. Department of Energy (DOE). Reprocessing spent nuclear fuel generated aqueous radioactive wastes. Calcination was a process developed at the INL Site to convert liquid waste into a solid, granular form. Calcine is currently stored in six CSSFs. The CSSFs are commonly referenced using either a Roman or Arabic numerical designator (e.g., CSSFs I, II, III, or CSSFs 1, 2, 3) and are often called "bin sets" because each CSSF consists of several stainless steel storage bins housed within a concrete vault. A seventh CSSF was constructed, but was never used for calcine storage. For consistency with previous revisions of this report, the Roman numeral naming convention is used in this report.

Beginning in 1953, the ICPP reprocessed spent nuclear fuel to recover highly enriched uranium and other nuclear-related products. With the end of the Cold War, DOE announced in April 1992 (WINCO

1992) that the ICPP would no longer reprocess spent nuclear fuel. The final fuel-reprocessing activities, comprising purification of uranium (U) that had already been recovered from spent nuclear fuel, were completed in 1994. In 1998, the name of the facility was changed from the ICPP to INTEC to reflect the change in the mission of the facility. For consistency, this report refers to the facility as INTEC, even though all of the fuel reprocessing and most of the calciner operations were completed when the facility was the ICPP.

Fuel reprocessing and associated support activities generated liquid radioactivity wastes that were stored in underground tanks in the INTEC Tank Farm Facility (hereafter referred to as “Tank Farm”). Calcination and conversion of the liquid radioactive waste into a granular, solid form began in December 1963. The solid waste form occupied much less space than the liquid form and thus required fewer and smaller storage facilities. The solid form was also an inherently safer form for waste storage because it was less likely to leak than the corrosive, acidic, liquid form. The calcination process sprayed liquid waste into a heated (400 to 600°C), fluidized bed. Calcination thermally decomposed the waste and converted it into solid metallic oxides and fluorides, water vapor, and nitrogen oxides. The resulting granular solid (calcine) was transported to the CSSFs for interim storage.

Seven CSSFs were constructed at INTEC. Five CSSFs were filled to, or near, capacity. The sixth CSSF is about half full, and the seventh was never used for radioactive calcine storage. The design of the CSSFs evolved over time to incorporate operational experience, changes in calcine composition, and future calcine retrieval plans. Although each CSSF has a unique design, with significant differences in design details, all CSSFs include some common features. These include stainless steel storage bins, reinforced concrete vaults, calcine cooling capability, and filtered off-gas venting of the storage bins. Calcine storage temperature control was a primary CSSF design consideration. Calcine temperature control was required to prevent volatile species from migrating from the calcine and to prevent calcine agglomeration, which would hinder future calcine retrieval. All of the CSSF designs included a convection cooling system with natural air circulation through the vault and around the bins to remove radiolytic decay heat from the calcine. Some of the CSSFs also had a forced (fan-driven) air-circulation cooling system. Another CSSF design consideration was bin access for future calcine retrieval. All CSSFs except CSSF I include bin access ports and piping through which calcine may be retrieved.

Aqueous radioactive waste was originally calcined in building CPP-633, known as the Waste Calcining Facility (WCF), and subsequently in building CPP-659, known as the New Waste Calcining Facility (NWCF). From December 1963 to March 1981, the WCF converted approximately 4,091,000 gal of liquid waste into 77,300 ft³ of calcined solids. The WCF calcine is stored in CSSFs I, II, and III. From September 1982 through May 2000, the NWCF converted approximately 3,642,000 gal of aqueous waste into 78,000 ft³ of calcined solids. The NWCF calcine is stored in CSSFs IV, V, and VI. Calcination in the NWCF ceased in May 2000, pending a decision by the DOE on whether to obtain an environmental permit and continue calcination, or to close the facility. The DOE decided to close the NWCF and treat the liquid waste remaining in the Tank Farm with a different process. Both the NWCF and WCF calcining processes have been closed, so calcine generation has ceased.

The CSSFs are interim waste storage facilities. In the future, the calcine will be retrieved, treated, and sent to an off-Site facility for storage or disposal. Quantitative calcine composition data will be required for any treatment, storage or disposal option. This report provides the composition of the calcine for future work.

1.4 Report Organization

The remaining portions of this report are organized as explained below. This organization has been preserved from previous revisions of this report.

1.4.1 Main Body

The main body of the report presents historical information about the calcination process at INTEC and characterization of the calcine as follows:

- Section 1 provides an introduction to this report.
- Section 2 provides a history of calcination conducted at INTEC.
- Section 3 describes the configuration of the calcine storage bins in the six CSSFs that contain calcine. A brief overview is given of the bins in the seventh CSSF, which does not contain calcine.
- Section 4 describes the method used to calculate the calcine composition.
- Section 5 provides a detailed description of the calcine composition, both chemical and radioactivity, and explains the variation in calcine composition among the bins.
- Section 6 describes the filling sequence of the CSSFs.
- Section 7 describes the changes in this report from the previous revision.
- Section 8 contains a list of references cited throughout the report.

In addition to the information in the main body of the report, extensive appendices contain information on the nearly 40 years of historical calciner operation. The information includes the volume of waste calcined, liquid waste sample results, calcine composition, and other related data. Much of the data used in the preparation of this report are not available in a convenient manner, particularly for those not familiar with the documentation recording and storage systems at INTEC. This report and its appendices make such data more readily available. The appendices are summarized below.

1.4.2 Appendix A Liquid Waste and Calcine Composition Summaries

Appendix A contains a compilation of data pertinent to the liquid waste that was calcined in 13 calciner operating periods called campaigns. It contains information on nearly 7,000 batches of material that were charged or fed to the calciners, converted to solids, and sent to the CSSFs. The material charged to the calciners includes nonradioactive “startup bed,” nonradioactive liquid feed material used to transition from the startup bed to radioactive waste, liquid radioactive waste, and chemicals added to the liquid waste to control the calcination chemistry. Appendix A contains composition data for the liquid wastes that were calcined. The composition data are based on historical analyses of liquid wastes and engineering estimates based on process knowledge of subject-matter experts. The liquid waste composition data and the volume of waste calcined were used to calculate the mass and composition of calcine produced from each batch of waste processed. Appendix A provides the composition of calcine within segments (sections) of each CSSF bin. It also summarizes the calcine composition for each bin, each CSSF, and all six CSSFs. Appendix A contains 19 tables. Their content is summarized below:

- Tables A1 through A6 contain the volume (or mass) of material in the nearly 7,000 batches of material that were fed to the calciner, converted into calcine, and sent to CSSFs I through VI respectively. Most of the material was liquid radioactive waste. The small amounts of startup bed and nonradioactive liquid feed used to transition from the startup bed to radioactive waste are included in the tables. The tables include information on the amount of material (waste, startup bed or nonradioactive feed solution) in each batch, the Tank Farm vessel from which the radioactive waste originated (such as Tank VES-WM-185 or VES-WM-189), the date the material was charged to the calciner, and the corresponding calcination campaign (WCF H1 through H9 and NWCF H1 through H4). The table header identifiers are self-explanatory with the possible exception of the term “stream”. The stream number is a sequential identification number assigned

to multiple batches of material having the same composition that were charged or fed to the calciners. For example, the first liquid waste calcined in the WCF came from Tank VES-WM-185 and was assigned the Waste Stream Number 1. Later, Tank VES-WM-185 was refilled and the new waste was calcined as Waste Stream Number 15 (waste from other Tank Farm vessels was calcined and assigned Waste Stream Numbers 2 through 14). Historically, many of the Tank Farm storage tanks were repeatedly filled and emptied as spent fuel was reprocessed (filling tanks) and calcined (emptying tanks). The waste in each tank had a unique, but uniform, composition and was assigned a waste stream number for tracking and calcine composition calculation purposes. Over time, INTEC reprocessed several different types of fuel, which generated chemically and radiologically different wastes. A total of 86 wastes, corresponding to Streams 1 through 87 (Waste Stream Number 48 was not used), were calcined. Four additional stream numbers (91 through 94) are used for the different types of material used as calciner startup bed.

- Tables A7 through A10 contain chemical composition and radioactivity data based on samples of the liquid wastes that were calcined. Typically, waste was transferred in small batches (1,000 to 2,000 gal) from a large (300,000-gal) Tank Farm vessel to the calcining facilities for treatment. The first several (typically four to eight) batches of waste from a given Tank Farm vessel were sampled and analyzed at the calcining facility. The sample data were averaged to determine the composition of waste in the Tank Farm vessel. Tables A7 and A9 contain the chemical and radionuclide analytical data, respectively, from the sampled wastes. Typically, the analytical data include the major waste components and the species that were important to calciner and CSSF operating parameters, such as heat generation, radiation shielding, corrosion, solids generation, and calcine process chemistry. Tables A7 and A9 also contain data for some species whose concentration or activity data did not come directly from waste analyses, but were calculated based on other analytes. For example, tin (Sn) was a component of the Zircaloy alloy used for Zr-clad fuel and thus was a component of all Zr waste. However, Sn was not an analyte for any waste sample. Its concentration was calculated based on the measured concentration of Zr and the Sn:Zr ratio in the Zircaloy alloy. Tables A8 and A10 contain the average chemical composition and radioactivity of the liquid waste streams whose sample data are in Tables A7 and A9, respectively. Table A10 contains radioactivity data for a few species for which there are no sample data in Table A9. For example, Table A10 contains the activities of selenium (Se) -79, Sn-126, and curium (Cm) -242 for which there are no sample data in Table A9. These species were included in Table A10 because they are potential regulatory species of concern (10 CFR 61.55; DOE G 435.1-1). Their activities were calculated based on the activity of Cs-137 measured in the waste and ORIGEN2-based radioactivity models. The calculation method is described in detail in Section 4.3.2.

This report uses the Tank Farm waste volume and composition as the basis for calculating calcine composition. Wastes that were transferred from the Tank Farm via steam jet and sampled at the calciners were diluted about 5 vol% with steam condensate. The average waste compositions in Tables A8 and A10 were adjusted to compensate for the steam condensate dilution. Waste samples obtained directly from the Tank Farm vessels, or from waste transferred from the Tank Farm to the calciners via an air lift were not diluted with steam condensate and do not include the steam condensate adjustment factor.

Tables A7 and A9 do not include all of the analytical data for the samples listed. Some of the sample data were determined to be in error. Sources of the errors included data transcription errors in the report from which the data were taken, sample dilution errors, and analytical equipment malfunctions. The erroneous data were not used in the average waste-composition calculations. Data were determined to be in error by comparing it with data from other samples of the same or similar wastes, and by process knowledge. This data screening and evaluation process is described further in Section 7.2 of this report. The sample data that were not used in the waste composition determination are included (as text) in the Excel spreadsheets on the compact disc provided with the hard copy of this report, with a note describing why the data was determined to be invalid. The information on the Excel spreadsheets on the compact disc is available through Idaho Cleanup Project Records Management.

- Tables A11 and A12 summarize the calculated masses of chemicals and activities of radionuclides, respectively, in the calcine. The tables show the calcine composition for several bin segments (sections), for each bin, and for each CSSF. For data reporting purposes, each calcine storage bin was divided into several segments based on the location of level-indicating thermocouples. The bin segments do not correspond to changes in calcine composition or chemically distinct layers of calcine. Instead, the segments correspond to the location of level-indicating thermocouples in each bin. A calcine segment may contain a single, uniform type of calcine, or it may contain multiple layers of chemically different calcine. Table A11 contains more chemical species than found on Tables A7 and A8. Table A11 contains calculated amounts of species of concern such as As and Se, for which sample data do not exist because they are present in concentrations below the analytical detection values. The concentrations and masses of these species are based on laboratory detection values and fission yields. The calculation methodology for these species is explained in Section 4.1 of this report. Likewise, the radionuclides listed in Table A12 are not the same as those in Tables A9 and A10. Tables A9 and A10 include several short-lived species such as ruthenium (Ru) -106 and cerium (Ce) -144 whose activities were significant when the waste was calcined, so their activities were measured and reported at that time. However, those species have decayed to insignificant levels, their activities are no longer needed, and they are not included on Table A12.
- Table A13 reports the chemical content of calcine and is similar to Table A11. However, Table A13 reports the wt% of each chemical constituent in the calcine instead of the mass of each chemical. Table A13 provides the wt% data for each bin segment, for each bin and for each CSSF. The wt% calculation is made by dividing the mass of each constituent in Table A11 by the total mass of calcine in each segment, bin, and CSSF and multiplying the result by 100.
- Table A14 presents the total radionuclide activity in all six CSSFs decayed to January 1 for selected years. The table shows the effect of radionuclide decay on the calcine activity over time.
- Table A15 shows the radionuclide activity in each of the six CSSFs decayed to January 1, 2016. This date was selected as the earliest date when a future project might retrieve calcine from the CSSFs. The data will be required for radiation shielding, waste heat generation, and other engineering calculations. The 2016 date provides a worst-case activity for such calculations.
- Table A16 summarizes the mass of chemical constituents in each of the six CSSFs.
- Table A17 summarizes the inventory of RCRA metals for each CSSF.
- Table A18 provides the volume, mass, and average bulk density of the calcine in each of the 43 calcine storage bins and for each CSSF.

- Table A19 is a summary of fuel-reprocessing campaigns at INTEC. Table A19 shows the amount of uranium reprocessed in each campaign, the types of fuels reprocessed, and the Tank Farm vessel in which the fuel-reprocessing wastes were initially stored. Table A19 is not a comprehensive history of either fuel reprocessing or the INTEC Tank Farm. The data in Table A19 has not received the amount of checking and review as other data in this report, and is provided for reference only. Other documents (e.g., Loos 2004) have a more detailed history of the Tank Farm, including the effect of the addition of decontamination wastes, waste evaporation, and blending of wastes. Details on fuel reprocessing can be found in various fuel-reprocessing campaign reports.

1.4.3 Appendix B Calcination Campaign Data Plots

Appendix B contains data plots depicting the history of calcination at INTEC and its effect on the volumes of both the liquid waste in the Tank Farm and the calcine in the CSSFs. Figures B1 through B13 identify the source (Tank Farm vessel), volume, and stream number of each of the wastes that were calcined during the 13 calcination campaigns. The stream numbers come from the waste composition tables in Appendix A. Figures B14 through B24 provide a graphical history of the waste volume and type of waste in the eleven 300,000-gal liquid waste storage tanks from 1953 through 2003. The eleven 300,000-gal tanks were constructed in the 1950s and early 1960s and provided temporary storage of the liquid waste prior to calcination. The tanks were filled with raffinates (liquid wastes) from first-, second-, and third-cycle fuel-reprocessing activities as well as wastes from support facilities and activities, such as laboratories, off-gas systems, and equipment decontamination. The tanks were emptied by calcining and occasionally evaporating the stored waste. Several of the tanks were repeatedly filled and emptied. The bulk of the calcined waste came from the 300,000-gal Tank Farm vessels. Small amounts came from three 18,000-gal tanks located in building CPP-604 and four 30,000-gal Tank Farm vessels. For simplicity, the histories of the 18,000 and 30,000-gal tanks are not included in Appendix B, although the detailed data tables in Appendix A include the waste calcined from those tanks. A 2004 letter report mentioned above (Loos 2004) contains a detailed history of the Tank Farm and additional information on the Tank Farm wastes, waste sources, and management of the facility. Figures B25 through B30 show the filling chronology of the calcine storage bins in each of the six CSSFs. The time spans of the 13 calcination campaigns are noted above each figure.

1.4.4 Appendix C Calcine Composition Data Plots

Appendix C contains calcine composition data plots (chemical and radioactivity) in units normally used by regulators for each component. These units include weight percent and parts per million for chemicals, curies per cubic meter for fission products, and nanocuries per gram for transuranic (TRU) radionuclides. The unit selection was intended to help minimize unit conversions and the potential errors by data users. The data plots show the variability in the composition of the calcine among the CSSFs and within individual bins.

1.4.5 Appendix D Internal INTEC Documentation Referenced in Report

Appendix D contains copies of the internal (INTEC) documents cited in footnotes throughout the report. They are attached as an aid to the reader of this report.

2. CALCINATION HISTORY AND DESCRIPTION

Reprocessing spent nuclear fuel and associated support activities generated liquid radioactive waste. Spent nuclear fuel reprocessing typically began by dissolving the fuel. This created an aqueous solution containing the fuel cladding, fission products, activation products, and U. The U was chemically separated from the dissolver solution in the first-cycle U extraction process. The raffinate from the first-cycle extraction process contained the bulk of the fuel cladding and fission products and was the principle source of the radioactive waste in the Tank Farm. Other waste sources included equipment decontamination, uranium purification (second- and third-cycle raffinates), and support operations such as ion-exchange systems, laboratory analyses of radioactive materials, and off-gas treatment systems.

INTEC reprocessed a variety of spent nuclear fuels from numerous reactors. A schematic of the reprocessing of spent nuclear fuel is provided in Figure 2. An aerial photograph of INTEC showing WCF, NWCF, and the CSSFs is provided in Figure 3.

Differences in the fuel configuration, especially the fuel-cladding material, dictated the use of different chemicals to reprocess the various types of fuel. Reprocessing varying types of fuels generated chemically different liquid wastes, and consequently, chemically different calcine. Liquid wastes and calcine were often named for the cladding of the fuel from which they were derived. Such names as “aluminum” and “zirconium” waste were applied to wastes generated by the dissolution of Al- and Zr-clad fuels, respectively. Aluminum is a major component of Al calcine and Zr is a major component of Zr calcine. Sodium-bearing waste (SBW) was a term applied to wastes that contained relatively high concentrations (1 to 2 molar) of sodium (Na). The high Na concentration came from processes that used alkali metal salts, such as sodium permanganate, sodium hydroxide, and sodium carbonate. Sodium-bearing wastes included most of the wastes generated by equipment decontamination and

Figure 2. Former reprocessing of spent nuclear fuel at the Idaho Nuclear Technology and Engineering Center (ICP 2009).

Figure 3. Historical photograph of calcine-related facilities. The now decommissioned and demolished Waste Calcining Facility calcined the waste sent to CSSFs I, II, and III; the New Waste Calcining Facility calcined the waste in CSSFs IV, V, and VI; and CSSF VII was never used for calcine storage.

support systems (e.g., ion exchangers, off-gas systems, scrubbers, and laboratory analyses). The May 1997 issue of *Radwaste Magazine* (Knecht et al. 1997) and Loos (2004) contain additional detail and explanation of fuel reprocessing, waste generation, and waste management at INTEC.

Fluidized-bed calcination was a unique process developed to treat liquid radioactive wastes at INTEC. Calcination converted liquid wastes into a solid form in a high-temperature (400 to 600°C) fluidized bed. During calcination, liquid radioactive wastes were atomized with air and sprayed into a heated bed of air-fluidized, granular solids. The principal calcination reactions were evaporation and thermal decomposition of the solutions to form metallic oxides and fluorides, water vapor, and nitrogen oxides. Solids dissolved in the liquid wastes built up in layers on the fluidized-bed particles. Gases and some of the smaller solids (less than 0.15 mm in diameter) were swept from the vessel with the fluidizing air. The average bed particle size was kept at the desired value (typically 0.3 to 0.7 mm in diameter) by controlled attrition of bed particles. This was achieved by varying the volume of air used to atomize the liquid waste as it was sprayed into the calciner. Parameters such as feed composition also affected the calcine particle size. Most of the solids formed in the calcination process were nonradioactive oxides of Al and Zr from the fuel cladding and calcium fluoride formed from the calcium nitrate added to fluoride-bearing wastes during the calcination process to prevent fluoride volatility. Only a small fraction (less than 1 wt%) of the calcine was composed of radioactive elements.

Two different methods were used to supply heat for the calcination process. Heat for the first three WCF operating campaigns (1963 through 1969) was supplied by circulating a liquid sodium-potassium eutectic metal alloy (NaK) through a heating coil located within the fluidized bed (Lakey 1963). Heat for the remaining six WCF campaigns and all four of the NWCF campaigns was supplied by the “in-bed” combustion of oxygen-atomized kerosene (Bendixsen 1970).

The calcination process included an extensive off-gas cleanup system that included a cyclone, wet-scrubbing system, adsorbers, and multiple stages of filtration that removed fine particulates from the calciner off-gas before exhausting the gases to the atmosphere. Details of the calcination process used in the WCF and the NWCF are discussed extensively in historical calcining facility safety analysis reports (Lakey and Bower 1963; LMITCO 1997). Figure 4 depicts the calcination process (without the off-gas cleanup system) and its interconnection with the CSSFs.

ICPP-A-16011
(3-94)

Figure 4. Simplified schematic of the calcining process and CSSFs at INTEC.

Figure 4 shows calcine was pneumatically transported from two sources within the calcining facilities to the CSSFs. Relatively large calcine particles (product) were removed from the fluidized-bed portion of the calciner vessel via lines connecting the calciner with the pneumatic transport system. Very small calcine particles were elutriated from the calciner and separated from the off-gas with a cyclone. The small particles were transferred from the cyclone to the pneumatic transport system where they joined the large particles from the calciner vessel. The combined stream of small and large particles was pneumatically transported from the calcination facilities to the CSSFs. In the CSSFs, a cyclone separated

the calcined solids from the transport air. The solids fell by gravity from the CSSF cyclone into the calcine storage bins. The pneumatic transport air returned to the calciner where it joined the calciner off-gas for cleanup prior to discharge to the atmosphere.

Table 1 contains a detailed summary of the volume of liquid waste calcined, the volume of calcine generated, and the liquid/solid volume ratio (also called the volume reduction factor or VRF) for each of the 13 calcination campaigns. The VRF is the volume reduction achieved by converting the liquid waste into a solid form. A VRF of 6 means 6 gal of liquid waste were converted into 1 gal of solid calcine. Aluminum waste (calcined in WCF Campaigns 1 and 2) had the highest VRF (9 to 11). Zirconium waste, which comprises most of the stored calcine, had a VRF of 6 to 8. The VRF for Zr waste was lower than that of Al waste because Zr waste contained more chemical additives and dissolved solids. A given volume of Zr waste made more calcine than Al waste and thus had a lower VRF. NWCF Campaign 4 had the lowest VRF (3.8) because of the calcination of large volumes of SBW that were blended with relatively large amounts of chemical additives (primarily aluminum nitrate). The VRF for NWCF Campaign 4 is low because it is based on the volume of liquid waste calcined and does not include the volume of the aluminum nitrate additive. All VRFs include solids from the calciner starting bed and nonradioactive transition feed material as part of the calcine formed.

Table 1. Summary of liquid waste processed and calcine generated during calcination campaigns.

Operating Campaign	Calciner Operating Date	Tank Farm Waste Calcined (gal)	Solid Calcine in Storage ^a ft ³ (m ³)	Liquid/Solid Volume Ratio ^b
WCF 1	Nov 1963 to Oct 1964	513,000	7,760 (220)	8.8
WCF 2	Mar 1966 to Mar 1968	986,000	13,000 (367)	10.1
WCF 3	Aug 1968 to Jun 1969	340,100	5,810 (165)	7.8
WCF 4	May 1970 to Jan 1971	229,500	5,120 (145)	6.0
WCF 5	Sept 1971 to May 1972	293,300	7,000 (198)	5.6
WCF 6	May 1973 to May 1974	401,900	9,060 (256)	5.9
WCF 7	May 1975 to Jan 1977	381,200	9,270 (263)	5.5
WCF 8	Sept 1977 to Sept 1978	469,000	10,700 (303)	5.9
WCF 9	Jun 1979 to Mar 1981	477,300	9,530 (270)	6.7
NWCF 1	Aug 1982 to Jun 1984	1,530,900	27,400 (777)	7.5
NWCF 2	Sept 1987 to Dec 1988	829,000	16,900 (480) ^c	6.6 ^c
NWCF 3	Dec 1990 to Nov 1993	776,700	16,000 (452)	6.5
NWCF 4	May 1997 to May 2000	505,200	17,600 (500) ^d	3.8
Total ^e		7,733,100	155,300 (4,400)	6.7
<p>a. Solids include startup bed and solids from both radioactive and nonradioactive feed material.</p> <p>b. Ratio of Tank Farm liquid to calcined solids. Solids include startup bed and nonradioactive feed associated with each operating campaign. Ratio of radioactive (Tank Farm) liquid to radioactive solids (excluding nonradioactive solids) is a higher number.</p> <p>c. Includes 330 ft³ of startup bed and nonradioactive feed material from attempted calciner operation in May/June 1989.</p> <p>d. Includes 40 ft³ of pilot plant calcine added to Bin WS6-154 in April 1986.</p> <p>e. Totals may differ slightly from the sum of the columns because of rounding.</p> <p>WCF Waste Calcining Facility</p> <p>NWCF New Waste Calcining Facility</p>				

The volume of calcine stored at INTEC has been reported in previous versions of this (and other) reports. This report previously reported calcine volumes ranging from 4,386 to 4,417 m³. The accuracy of the calcine volume estimates does not warrant four significant figures, because of assumptions regarding the angle of repose of the calcine and the volume of calcine in partially filled bins. This report makes every effort to provide an accurate value of the volume of calcine stored in the CSSFs. This revision calculates a calcine volume of 4,397 m³, which is unchanged from the previous revision. This value and each of the previously reported values rounds to 4,400 m³. No additional calcine has been generated or stored since May 2000. The small changes in the reported calcine volume from those of previous report revisions result from the correction of the bin volumes in CSSF I and refinements in the calculated amount of calcine in CSSF VI where the calcine level is between two level-indicating thermocouples and must be estimated. Table 2 shows the calculated volume of calcine in each of the six CSSFs as well as the total storage capacity of each CSSF.

Table 2. Approximate storage capacity and volume of calcine in the CSSFs.

Calcine Solids Storage Facility	Total Storage Volume (ft ³)	Usable Storage Volume (ft ³)	Calcine Volume ft ³ (m ³)	Percent Full
I	8,300	8,000	7,760 (220)	97
II	31,600	30,000	30,000 (850)	100
III	40,000	39,900	39,500 (1120)	99
IV	17,700	17,200	17,200 (486)	100
V	36,200	35,600	35,600 (1010)	100
VI	55,200	53,200	25,200 (713)	47

As indicated in Table 2, CSSFs II, IV, and V are completely full, CSSFs I and III are nearly full, and CSSF VI is about half full. WCF Campaign 1 ended just prior to filling CSSF I. This allowed sufficient room in CSSF I to receive the calciner bed after shutdown and avoided a bed dissolution and return of waste to the Tank Farm. WCF Campaign 1 stopped short of filling CSSF I because CSSF II did not yet exist, so there was no place to send additional calcine. Similarly, CSSF III is not quite full because WCF Campaign 9 ended just prior to filling the CSSF III bins, allowing enough room for CSSF III to receive the calciner bed after shutdown. WCF Campaign 9 ended the operation of the WCF, which was not connected to the next CSSF (IV). NWCF was not connected to CSSF III, so CSSF III could not be filled by NWCF. CSSFs II, IV, and V are filled to capacity because they were filled during calciner operating campaigns when the next CSSF was available to receive calcine. When those three CSSFs were filled, the next CSSF was placed in service without stopping operation of the calciner. CSSF VI is about half full because the DOE decided to stop calcining waste in May 2000, and to treat the waste remaining in the Tank Farm with an alternate method.

3. DESCRIPTION OF CALCINED SOLIDS STORAGE BINS

The solids produced by the waste calcining process are stored in CSSFs I through VI. Each CSSF consists of several stainless steel bins housed in a reinforced concrete vault. The CSSFs provide cooling for the calcine and isolate the calcine and its radioactive and hazardous components from the environment. This section describes the configuration and characteristics of the bins in each CSSF. The bulk of the detailed information regarding the bins comes from vendor and plant drawings. The descriptions emphasize the design aspects that may be important to calcine retrieval. The configuration of each of the CSSFs and their respective calcine volumes and capacity are represented in Figure 5.

Figure 5. Artist's depiction of the Calcined Solids Storage Facilities and their calcine volume.

3.1 Calcined Solids Storage Facility I

The Fluor Corporation of Los Angeles designed CSSF I, also known as Bin Set 1. Oscar Krenz of Berkeley, California, fabricated the bins in 1959 of Type 405 stainless steel. CSSF I contains four composite bins (sometimes referred to as groups), VES-WCS-115-1, -2, -3, and -4. Each composite bin consists of three concentric sub-bins, numbered from inside to outside, A, B, and C. The innermost sub-bin (A) in each group is cylindrical. Each cylindrical sub-bin is surrounded by an annular sub-bin (B), which is, in turn, surrounded by a second annular sub-bin (C). Small gaps between the sub-bins provide a path for airflow, which removes radiolytic decay heat from the calcine.

The innermost (cylindrical) sub-bin (A) has a dished head on top and a flat bottom. Each cylindrical sub-bin has a diameter of approximately 3 ft and is 25 ft tall except for VES-WCS-115-4A, which is about 28 ft tall. The bin wall thickness varies from 0.125 in. at the bottom to 0.25 in. at the top. The bottom of the bin is 0.3125 in. thick and the top of the bin is 0.25 in. thick. Each of the two annular sub-bins (B and C) surrounding the central cylindrical bin is approximately 20 ft tall and has a flat top and bottom. The inner annular bin has a 41-in. inside diameter and a 90-in. outside diameter. The inner annular bin has an inner wall thickness of 0.125 in., an outer wall thickness of 0.1875 in., a bottom thickness of 0.325 in., and a top thickness of 0.25 in. The outer annular bin has a 94-in. inside diameter and a 142-in. outside diameter. The outer annular bin has a wall thickness of 0.1875 in., a bottom thickness of 0.3125 in., and a top thickness of 0.1875 in. The usable calcine storage volume of CSSF I is approximately 8,000 ft³. The first WCF calcination campaign ended just before the CSSF I bins were filled, leaving room to remove and transport the bed material from the calciner to CSSF I. Figure 6 is a construction photo that shows the configuration of the three concentric bins associated with VES-WCS-115-2. Additional bin details are shown on the Oscar Krenz bin fabrication drawings (Drawings B-7062-4, B-7065-3, B-7066, C-7063-3, and C-7064-4).

Figure 6. Solids Storage Bin VES-WCS-115-2 in CSSF I.

The CSSF I bins contain internal obstructions such as thermowells, internally mounted wall stiffeners, bottom braces, and bin fill lines that could hinder future calcine retrieval operations. Each of the cylindrical (A) sub-bins has a centerline-mounted thermowell that extends from the top of the bin nearly to the bottom of the bin. The thermowell contains a series of thermocouples that were used to

determine the calcine level while the bin was being filled, and to monitor the calcine temperature thereafter. The thermowell is constructed of 1-1/4-in., Schedule 40 pipe. The thermowell is supported in three places by a collar, which is welded to two 2 × 1/4-in. flat plates (180 degrees apart), which are welded to the sidewall of the bin. Each of the annular (B and C) sub-bins contains two main thermowells and at least one secondary thermowell. The two main thermowells are located near the center of the annulus (midway between the inside and outside walls), on opposite sides of the bin, and extend from the top of the bin nearly to the bottom of the bin. The main thermowells in the annular sub-bins are similar to the thermowell in the A sub-bin. Each thermowell has a support collar and support legs that are welded to the outer and inner walls of the annular sub-bin. In addition to the main thermowells, the annular sub-bins contain at least one short secondary thermowell that penetrates the top of the bin and extends 30 in. into the bin (VES-WCS-115-2C and VES-WCS-115-4B each have two secondary thermowells). The secondary thermowells are fabricated of 1/2-in., Schedule 40 pipe and have no supports.

Each of the bins contains internal stiffening rings on the outer bin wall. The annular bins also contain internal stiffening rings on the inner bin wall as well as stiffeners on the flat bin floor. The bin wall and floor stiffeners are made of stainless-steel plate that varies in width from 2 to 3 in.

Each of the center (A) sub-bins was filled sequentially from a calcine distribution piping system connected to the solids outlet of the CSSF I cyclone. Each center sub-bin acted as the solids distributor for its two annular sub-bins. The center bin is equipped with two sets of calcine distribution piping, each at a different elevation, connected to the two outer annular bins. When calcine in the center bin reached the elevation of the lower of the two sets of distribution piping, it overflowed from the center bin, through the distribution piping, and into the first annular (B) sub-bin. When the B sub-bin (and its fill lines) filled with calcine, calcine again began filling the A sub-bin until it reached the second, upper, set of distribution piping. At that point, the calcine overflowed into the outer, annular (C) sub-bin. When the C sub-bin (and its fill lines) filled, calcine once again collected in the A sub-bin until it was filled. The network of calcine distribution piping extends from the A sub-bin, over the tops of the B and C sub-bins, and is a potential interference to access the tops of the B and C sub-bins. This calcine distribution piping is visible in Figure 6.

When CSSF I was nearly filled, the calcine level in VES-WCS-115-4C was measured using a bolt-weighted string as a plumb-bob. The “can disposal line” (4-in. PWA-3083) provided access to the bin for the level-monitoring activity. After its use, the weighted string was dropped into the bin to avoid handling the highly contaminated material. Operating records indicate that this type of level measurement was made at least three times. The external bin surfaces are encumbered with instrument junctions, electrical conduits, process piping, and structural members. None of the CSSF I bins has bin access nozzles or piping that was designed for calcine retrieval. Bin access ports and piping will have to be installed by a future project.

In April 1979, an estimated 250 to 750 gal of water entered the CSSF I vault.^a The source of the water was a nearby underground water line that froze and failed during construction of the NWCF. The water likely entered the CSSF vault through below-grade piping penetrations in the vault roof and through the joints between the vault’s roof and walls. The CSSF I vault is the only CSSF vault that was not waterproofed with an exterior, below-grade, bituminous coating to prevent in-leakage of water, and it is the only CSSF that has below-grade piping penetrations. The ruptured water line was repaired and the water level in the vault decreased over time without operational intervention. The water level did not raise high enough to touch the bins or interrupt convective cooling airflows. Samples taken of the water contained no radioactive contamination. In 1995, a remote video inspection of the vault (Griffith 1998)

a. Bodner, S. S., “Water Ingress to Bin Set Vaults,” Westinghouse Idaho Nuclear Company, Inc., Interdepartmental Correspondence to M. B. Heiser, Bod-06-92, May 22, 1992.

confirmed the undisturbed condition of the bins and the good condition of the concrete vault walls. No changes to the calcine or bins are expected from this event.

3.2 Calcined Solids Storage Facility II

Norman Engineering of Los Angeles designed CSSF II, also known as Bin Set 2. CSSF II contains seven bins, VES-WCS-136-1 through -7. Each bin is a right circular cylinder. Chicago Bridge and Iron Works Company, Western Operations, located in Salt Lake City, fabricated the bins in 1965 of Type 304 stainless steel.

Each CSSF II bin is about 42.3 ft tall and has a 12-ft diameter. The bin walls are 0.25 in. thick. The total usable calcine storage volume of CSSF II is approximately 30,000 ft³. Each bin has a 6-in., Schedule 40 nozzle on the top of the bin, which provides access to the bin for calcine retrieval. Each nozzle is attached to a 6-in., Schedule 40S, access pipe, or riser, that extends approximately 27 ft through the roof of the storage vault to the top of the CSSF, where it terminates beneath a removable concrete shielding block. Originally, five of the access risers terminated in a 6-in., welded cap and two terminated in a blinded, 150-lb, weld-neck flange. The two flanged access lines are embedded in the concrete vault roof and have an expansion bellows. The two flanged access lines contain corrosion coupons. In 1978, calcine was retrieved and analyzed from Bins VES-WCS-136-3 and -7 (Westra et al. 1979). At that time, the welded caps were cut from the ends of the access risers for those two bins to insert the sample device into the bins. The calcine sampling report did not indicate how the risers were sealed when the sampling work was finished. Figure 7 is a construction photo that shows VES-WCS-136-2 prior to installation. Additional bin details are shown on the Chicago Bridge and Iron bin construction drawings (Drawings 9-2698-1, -2, -3, and -4).

The CSSF II bins are arranged with six bins forming a circle around the seventh, central bin. The bin access lines from the six outer bins rise vertically from the calcine retrieval nozzle. The access line from the center bin (VES-WCS-136-1) rises at an angle of 6.5 degrees from vertical and goes through two 30-degree bends in a shielded structure on top of the CSSF vault. This arrangement was necessary to terminate the riser in an accessible location on top of the vault, instead of terminating it inside the concrete cell that houses the CSSF cyclone, which is located directly above the center bin.

Figure 7. Solids Storage Bin VES-WCS-136-2 ready to be installed in CSSF II.

The principal obstructions to future calcine retrieval are thermowells, thermowell supports, and corrosion coupons. Each bin has a centerline-mounted thermowell made of 1-1/2-in., Schedule 160 pipe that extends from the top of the bin nearly to the bottom of the bin. The thermowell contains a series of thermocouples that were used to determine the calcine level while the bins were being filled, and to monitor the calcine temperature thereafter. The thermowell is supported in two places by a collar, which is welded to three equally spaced (120 degrees apart) 1/2-in diameter rods that are welded to the bin wall. A third thermocouple support collar is located near the bottom of the thermowell. It is also supported by three equally spaced 1/2-in. rods, but the rods form a tripod that is welded to the bottom of the bin instead of the bin walls. In addition to the centerline thermowell, all bins have a wall-mounted thermowell that enters the vessel wall approximately 11 ft from the top of the vessel and extends down and attaches to the inside surface of the bin 4 ft below the entry point. Bins VES-WCS-136-1 and -4 have an additional wall mounted thermowell approximately 11 ft lower. Bins VES-WCS-136-1 and -4 also have two arrays of six thermocouples each, which were designed to monitor the temperature profile horizontally through the bin. The horizontal thermocouple arrays include a network of thermowells constructed of 1-in. pipe that are supported by a 3 × 3-in. angle. Each bin has four internal stiffening rings, approximately 5 in. wide, that are spaced roughly equidistant down the bin wall.

Two bins, VES-WCS-136-1 and -4, have corrosion coupons that are mounted on cables suspended from wall-mounted hangers and J-hooks within the calcine retrieval riser. One bin has four coupon cables, and the other has three. Prior to sampling the calcine stored in VES-WCS-136-3 and -7 in 1978, temporary bin ventilation equipment was installed on the riser connected to VES-WCS-136-1. At that time, a string of corrosion coupons in the VES-WCS-136-1 riser was inadvertently dropped into the bin.^b The cable and coupons were never recovered and they remain in the bin. The loose corrosion coupon cable and coupons could pose difficulties during future calcine retrieval operations.

Each bin is equipped with a 1-1/2-in. threaded test vent and drain at the tangent of the top head. The test vent nozzle is approximately 2 in. long. A detail of the nozzle closure is shown on the Chicago Bridge and Iron Works fabricator drawing but not on the plant drawings. The vendor drawing shows that the threaded plugs were back-welded. Construction photos (Figure 7) show the test vent fitting.

When CSSF II was nearly full, the calcine level was measured in two bins using a lead-weighted string. After its use, the weighted string was dropped into the bin to prevent the spread of radioactive contamination. Three such level measurements were made in Bin VES-WCS-136-2: the first on September 20, 1971, the second on October 21, 1971, and the last on November 24, 1971. At least two such measurements were made in Bin VES-WCS-136-6: one on September 20, 1971, and the second on October 21, 1971. The access risers on Bins VES-WCS-136-2 and 6 originally had a welded cap. Modifications were made to those risers to accommodate the level measurements in those bins. Access to Bin VES-WCS-136-2 was gained in 1972 for off-gas sampling through a 2-in. screw-cap nipple installed on the terminating weld cap of the retrieval line.^c Though not documented, the riser into Bin VES-WCS-136-6 was likely modified in a similar fashion.

The 1978 CSSF II calcine sampling activity (Westra et al. 1979) dropped a section of sample piping (an 18-in. length of 2-in. pipe) into Bin VES-WCS-136-3 that was never recovered. The calcine sampling operation also found the bin off-gas system was plugged or restricted.

b. Schofield, J. S., "Dropping of Corrosion Coupons into Bin Set #2," Allied Chemical Corporation Internal Correspondence to B. C. Musgrave, JSS-11-78, May 26, 1978.

c. Palmer, W. B., "Gas Sampling of Solids Storage Bins," Allied Chemical Corporation Internal Correspondence to G. E. Lohse, WBP-1-72, August 9, 1972.

An erosion failure in the transport system piping or cyclone in the CSSF II cyclone vault may have occurred.^d Calcine transport system parameter anomalies occurred about the time CSSF II was filled and CSSF III was placed in service^e. It was not clear whether the anomalies were the result of filling CSSF II or breaching the cyclone/transport piping system in a manner similar to that which occurred later in CSSF III (ACC 1976). A release of contamination from CSSF II occurred in December 1975 when the facility became slightly pressurized. Radioactive contamination was found around the sleeves for the extension rods that operate the CSSF cyclone inlet and outlet valves. It was supposed that the valve bellows inside the CSSF cyclone vault may have failed and released of contamination when the facility pressurized (ACC 1975). An inspection of the CSSF II cyclone vault to verify the integrity of the cyclone and associated piping and valves never occurred. Until otherwise verified, conservative planning might assume that the cyclone vault is contaminated with calcine.

3.3 Calcined Solids Storage Facility III

Idaho Nuclear Corporation of Idaho Falls, Idaho, designed CSSF III, also known as Bin Set 3. Capital Westward of Paramount, California, fabricated the bins in 1969 from Type 304 stainless steel. CSSF III contains seven bins: VES-WCS-140-1 through -6 and VES-WCS-139. Bin VES-WCS-139 has an equipment number that is not in sequence with the other CSSF III bins because it is physically different (longer) than the other six bins, which are identical in size and shape. However, Bin VES-WCS-139 has been renamed VES-WCS-140-7 in some plant documents for numbering consistency with the other bins, which has generated some confusion.

The bins in CSSF III are arranged and constructed similarly to those in CSSF II, except the center bin (VES-WCS-139) is taller than the other six as depicted in the photograph in Figure 8. Six of the 12-ft-diameter bins are approximately 53 ft tall. The seventh (center) bin (VES-WCS-139) is 61 ft tall. The bin wall thickness varies from 0.25 in. at the top to 0.4375 in. at the bottom. The total usable calcine storage volume of CSSF III is approximately 39,900 ft³. Each bin is fitted with a 6-in., Schedule 40S nozzle, located on the top of the tank, which provides access to the bin for calcine retrieval. An access line (riser) is attached to each nozzle and extends approximately 18 ft up through the vault roof, where it terminates beneath a removal concrete shield block. The access risers terminate with a blinded, 6-in., 150-lb, weld-neck flange. The access line for the center bin (VES-WCS-139) is angled 13.5 degrees from vertical, similar to that of CSSF II, to avoid having the access line terminate inside the cyclone vault, which is located directly above the center bin. Additional bin details are shown on the Capital Westward bin construction drawings (Drawings CW5463-1, -2, -3, -4, -5, and -6).

The principal obstructions to future calcine retrieval in CSSF III are thermowells, thermowell supports, and corrosion coupons. Each of the bins contains a centerline-mounted, 2-in., Schedule 80 thermowell that extends from the top of the bin nearly to the bottom of the bin. The thermowell contains a series of thermocouples that were used to determine the calcine level while the bins were being filled, and to monitor the calcine temperature thereafter. The thermowell is supported in two places (except in the center bin, VES-WCS-139, where it is supported in three places) by a collar, which is welded to three equally spaced (120 degrees apart) 1/2-in. diameter rods that are welded to the bin wall. A third thermocouple support collar is located near the bottom of the thermowell. It also is welded to three equally spaced 1/2-in. rods, but the rods form a tripod that is welded to the bottom of the bin instead of the bin walls. In addition to the centerline thermowell, VES-WCS-140-1 has four wall-mounted thermowells made of 1/2-in. Schedule 80 pipe, two on each side of the vessel that enter the vessel wall

d. Freeby, W. A., "Possibility of Additional Space in the Second Calcined Solids Storage Facility (CSSF)," Exxon Nuclear Idaho Company Internal Correspondence to G. L. Ritter, WAF-45-79, September 6, 1979.

e. Amberson, C. B., "ICP Operations Branch Monthly Report No. 143," Amb-26-72, March 3, 1972.

Figure 8. Center Bin VES-WCS-139 (or WCS-140-7) surrounded by six other bins in CSSF III.

near the middle of the bin and are attached to the inside surface of the bin wall about four feet above and below the point at which they enter the bin. Bin VES-WCS-140-1 also has an array of seven thermocouples, which were designed to monitor the calcine temperature profile horizontally through the bin, similar to those found in two of the CSSF II bins. The horizontal thermocouple arrays include a network of 1/2-in., Schedule 80 pipe (thermowells) supported by a 3 × 3-in. angle. Bins VES-WCS-140-1 through -6 have six internal stiffening rings that are spaced roughly equidistant down the bin wall. Bin VES-WCS-139 has seven internal stiffening rings. The stiffening rings are approximately 5 in. wide and fabricated of stainless steel.

Bin VES-WCS-140-1 has five sets of corrosion coupons. The corrosion coupons are installed on cables that are secured with 1/4-in. J-hooks welded to the inside of the bin access riser 4 to 5 in. from the top of the riser. Each CSSF III bin has a 2-in.-long, 2-in.-diameter, test vent nozzle at the tangent of the bottom head that is capped with a welded cap.

Bin VES-WCS-139 was equipped with nozzles for installing special level-monitoring equipment (Wright and Bendixsen 1968; de Boisblanc, Buckham, and Bower 1969). The design review packages for this bin refer to the design and installation of level-monitoring capacitance and ultrasonic probes. The construction photograph in Figure 8 shows that the 1-in. capacitance probe nozzle (about 1 ft from the outer wall of the bin and projecting about 1 ft above the top of the bin in the 7 o'clock position) is capped in the vault area immediately above the bin. The nozzle was capped in accordance with a

recommendation that the capacitance probe not be installed because of vault access misalignment.^f No documentation exists to show that the ultrasonic probe was ever installed. It is not shown on any as-built drawings or construction photographs. If installed, the presence of the ultrasonic probe is not expected to be a significant hindrance to calcine retrieval operations.

Frequent plugging of the calcine transport system and CSSF cyclone occurred while filling CSSF III (Childs, Donovan, and Swenson 1982). The piping was cleared with an auger-type device on several occasions. Although no documentary evidence was found, workers remember losing sections of wire auger cable on at least two different occasions. The wire cables may pose calcine retrieval problems.

Two erosion failures and releases of calcine occurred in the pneumatic transport line at the inlet to the CSSF III cyclone in the cyclone vault: one in October 1976 (ACC 1976) and the other in December 1977^g. The cyclone vault required extensive cleanup before the failed piping could be replaced. Erosion also caused a third failure, but no calcine was released because the second repair involved installation of a backup wear pad, which prevented the release of any contamination. For planning purposes, one should assume some residual contamination exists in the CSSF III cyclone vault.

3.4 Calcined Solids Storage Facility IV

Aerojet Nuclear Company of Idaho Falls, Idaho, designed CSSF IV, also known as Bin Set 4. Capital Westward of Paramount, California, fabricated the bins in 1976 of Type 304 stainless steel. CSSF IV contains three bins: VES-WS4-142, -143, and -144.

The CSSF IV bins are cylindrical, similar to those of CSSFs II and III, except that the stiffening rings are attached externally, which should make calcine retrieval easier. Each bin is approximately 55 ft tall and has a 12-ft diameter (Schindler 1975). The bin walls range in thickness from 0.375 in. at the top to 0.625 in. at the bottom. The total usable calcine storage volume of CSSF IV is approximately 17,200 ft³. Each bin is fitted with two 6-in., Schedule 80 nozzles located on the top of the bin, which provide access to the bin for calcine retrieval. The Capital Westward fabrication drawing shows that the nozzles are Schedule 80, but the plant drawings show the nozzles to be Schedule 40. The two nozzles are in close proximity to each other (1 ft apart) near the center of the bin. Attached to each nozzle is an 18-ft-long bin access line (riser), which penetrates the roof of the bin vault, where it is covered with a removable concrete shield block. The bin access line terminates in a blinded, 6-in., 150-lb, weld-neck flange. Figure 9 shows Bin VES-WS4-142 during placement in CSSF IV. Additional bin details are shown on the Capital Westward bin construction drawings (Drawings 45314-1 and -2).

Internal obstructions to calcine retrieval operations include thermowells, thermowell supports, and corrosion coupons. Each of the CSSF IV bins contains a centerline-mounted, 2-in., Schedule 80 thermowell that extends from the top of the bin nearly to the bottom of the bin. The thermowell contains a series of thermocouples that were used to determine the calcine level while the bins were being filled, and to monitor the calcine temperature thereafter. The thermowell is supported in two places by a collar, which is welded to three equally spaced (120 degrees apart) 1/2-in. diameter rods that are welded to the bin wall. A third thermocouple support collar is located near the bottom of the thermowell. It also is welded to three equally spaced 1/2-in. rods, but the rods form a tripod that is welded to the bottom of the bin instead of the bin walls.

f. Jobe, L. A., "Solids Storage Bin Solids Level Detector Connection," Idaho Nuclear Corporation Interoffice Correspondence, to G. V. Markham, Jobe-2-71, April 8, 1971.

g. McMillan, F. L., "ICPP Production Division Monthly Report No. 213," FMC-2-78, January 10, 1978.

Figure 9. Installation of solids storage Bin VES-WS4-142 in CSSF IV.

Corrosion coupons are installed in one of the two access nozzles in each bin. The coupons are secured to 1/4-in. J hooks that are welded to the inside of the riser 4 to 5 in. from its opening. Each bin is equipped with a 4-in. test vent at the tangent of the bottom head. The test nozzles are 4 in. long and have a welded cap. The vents are not shown on the plant drawings, but can be seen on construction photos. The 4-in. test vent is visible on the bottom left just above the ventilation skirt in Figure 9. Figure 9 also shows the bin stiffening rings on the outside of the bin.

The CSSF IV bin vent filters and associated pressure relief valves are highly contaminated. They were contaminated during a total loss of electrical power at NWCF in October 1982, during the first NWCF operating campaign. The NWCF off-gas blowers failed with the loss of electrical power, but the compressed air system continued to add air to the calciner process systems via sparges, instrument air

purges, jets, airlifts, and other equipment. As a result, the entire calciner process system pressurized and the pressure was relieved through the CSSF IV bin pressure relief valves and vent filters (F-WS4-101 and -102). The filter system contamination was discovered in January 1983, and the contact radiation reading on the filters was 125 R/hr.^h In 1986, consideration was given to changing the contaminated filters. A radiation survey found the vent filters had a contact radiation reading of up to 50 R/hr and a general body field of 12 R/hr at a distance of 1.5 ft from the filter. A decision was made not to change the contaminated equipment at that time because of the high radiation fields. Future design modifications to the bin vent system may need to contend with the contaminated relief valves and filters.

3.5 Calcined Solids Storage Facility V

EG&G Idaho of Idaho Falls, Idaho, designed CSSF V, also known as Bin Set 5. Capital Westward of Paramount, California, fabricated the bins in 1978 from Type 304L stainless steel. CSSF V contains seven annular bins: VES-WS5-146 through -152, arranged similarly to those in CSSFs II and III. Capital Westward identified the bins with the INTEC area identifier “WCS” instead of “WS5” that is used in INTEC documents.

The CSSF V bins are significantly different from those of CSSFs II, III, and IV. The CSSF V bins have an annular instead of cylindrical design. They are a cylinder with a hole running through the length of the bin, similar to an elongated donut. The annular bin design provided more bin surface area for heat dissipation and could accommodate waste with a higher heat generation than that of a cylindrical design. The annular bin design resulted in lower calcine temperatures and could more easily store calcine containing SBW, which had a lower allowable storage temperature (to prevent calcine agglomeration) than Zr or Al calcine.

Each CSSF V bin is approximately 55 ft tall with a 12-ft outer and a 4-ft inner diameter. The outer wall thickness varies from 0.625 in. at the bottom to 0.375 in. at the top, while the inner wall thickness is 0.375 in. throughout. The usable calcine storage volume of CSSF V is approximately 35,600 ft³. Each bin is fitted with four 8-in., Schedule 40 nozzles located approximately 90 degrees apart, which provide access to the bin for calcine retrieval. Each of the nozzles is connected to an 8-in., Schedule 40 pipe (riser) that extends vertically from the nozzle and is capped with a blinded, 8-in., 150-lb, weld-neck flange. Twenty-two of the risers are approximately 24 ft long (all of the risers from Bins VES-WS5-148 through -152 and two of the risers from VES-WS5-146) and terminate in the roof of the bin vault (the CSSF V instrument room floor), where they are covered by removable shield plugs. The four risers from Bin VES-WS5-147 are approximately 36 ft long and extend through the cyclone vault and terminate in the CSSF V roof, where they are covered with a removable shield plug. Two risers from Bin VES-WS5-146 are approximately 37 ft long and extend through the cyclone vault and terminate on the CSSF roof in the CSSF V equipment building, where they are equipped with a shielded plug. Additional bin details can be found on the Capital Westward bin construction drawings (Drawing CW-06358-1, -2, -3, -5, and -AB).

Figure 10 is a construction photograph that shows the top of VES-WS5-147 in CSSF V. It shows the four 8-in. bin access nozzles and associated bin access risers (vertical lines), a 3-in. vent line, two (sloping) bin fill lines (attached to the bin access risers just above the top of the bin), and two thermowells that penetrate the top of the bin. Construction plywood surrounds the outer portion of the bin and covers the annular hole through the center of the bin.

h. Wheeler, B. R., “Production Department Monthly Report,” Wlr-14-83, February 7, 1983.

Figure 10. Top of VES-WS5-147 in CSSF V.

Internal obstructions to calcine retrieval operations include thermowells, thermowell supports, and corrosion coupons. Each of the CSSF IV bins contains two 2-in., Schedule 80 thermowells that extend from the top of the bin nearly to the bottom of the bin. The thermowells are mounted on the centerline of the annular portion of the bin (midway between the outer and inner wall), with one thermowell on each side of the annular bin. The thermowells contain a series of thermocouples that were used to determine the calcine level while the bins were being filled, and to monitor the calcine temperature thereafter. The thermowells are supported in two places by a collar, which is welded to two 1/2-in. diameter rods (180 degrees apart) that extend radially to the inner and outer bin walls where they are welded in place. A third thermowell support collar is located near the bottom of the thermowell. It is welded to three equally spaced (120 degrees apart), 1/2-in. rods that form a tripod whose legs are welded to the bottom of the bin. Each bin also has several thermocouples that monitor the temperature of both the inner and outer bin wall. However, those thermocouples are mounted on the outside of the bin and should not pose a problem for calcine retrieval.

Two bins, VES-WS5-149 and -151, contain five sets of corrosion coupons similar to those of CSSFs II, III, and IV. However, unlike CSSFs II, III, and IV, where the corrosion coupons are in the bin access nozzles and risers designated for calcine retrieval, the corrosion coupons in CSSF V are in their own, dedicated, 6-in., Schedule 40 nozzles and risers, separate from the 8-in. calcine retrieval nozzles and risers.

The CSSF V bins have four stiffening rings on the inner wall and two on the outer wall. All of the stiffening rings are installed on the exterior surface of the bin, so they should not pose a problem for calcine retrieval. The Capital Westward drawings show that each bin is equipped with a 1-in. seal-welded, screwed, hydrostatic test vent at the tangent of the top head. The test vents are not shown on the plant drawings.

3.6 Calcined Solids Storage Facility VI

EG&G Idaho of Idaho Falls, Idaho, designed CSSF VI, also known as Bin Set 6. Mason Steel Fabricating Company of Decatur, Illinois, fabricated the bins from Type 304L stainless steel. CSSF VI contains seven annular bins: VES-WS6-154 through -160. With the exception of some dimension changes, the configuration of the CSSF VI bins is very similar to those of CSSF V.

Each CSSF VI bin is approximately 67.5 ft tall with a 13.5-ft outer and a 5-ft inner diameter. The outer wall thickness varies from 1 in. at the bottom to 0.375 in. at the top, while the inner wall thickness is 0.5625 in. throughout. The top of each bin is fitted with four 8-in., Schedule 80S bin access nozzles located approximately 90 degrees apart, which provide access to the bin for calcine retrieval. Each of the nozzles is attached to an 8-in., Schedule 40 pipe (access riser) that is capped and blinded with an 8-in., 150-lb, weld-neck flange. Four of the access risers (from Bin VES-WS6-154) are 39 ft long and extend to the roof of the CSSF where they terminate in a recess covered by a removable shield plug. The 24 access risers to the other six bins are 26 ft long and extend into the calcine storage vault roof (instrument room floor) where they terminate in a recess covered by a removable shield plug. The usable calcine storage volume of CSSF VI is approximately 53,200 ft³. Additional bin construction details can be found on the Mason Steel bin construction drawings (Drawings P-4790-81-1, through -6).

Figure 11 is a construction photograph of CSSF VI and shows the annular bins within the vault, the sloping, bin-fill piping, the vertical calcine retrieval risers, and the thermowells penetrating the tops of the bins. The annular bin design is typical of bins in CSSFs V and VI.

Obstructions to calcine retrieval in CSSF VI include thermowells, thermowell supports, and corrosion coupons. Each of the CSSF IV bins contains two 2-in., Schedule 80 thermowells that extend nearly to the bottom of the bin. The thermowells are mounted on the centerline of the annular bin (midway between the outer and inner wall), with one thermowell on each side of the annular bin. The thermowells contain a series of thermocouples that were used to determine the calcine level while the bins were being filled, and to monitor the calcine temperature thereafter. The thermowells are supported in two places by a collar, which is welded to two 1/2-in. diameter rods (180 degrees apart) that extend radially to the inner and outer bin walls where they are welded in place. A third thermowell support collar is located near the bottom of the thermowell. It is welded to three equally spaced (120 degrees apart), 1/2-in. rods that form a tripod whose legs are welded to the bottom of the bin. Each bin also has several thermocouples that monitor the temperature of both the inner and outer bin wall. However, those thermocouples are mounted on the outside of the bin and should not pose a problem for calcine retrieval.

Two of the CSSF VI bins, VES-WS6-156 and VES-WS6-159, contain five sets of corrosion coupons. As with CSSF V, the CSSF VI corrosion coupons are in their own, dedicated, 6-in., Schedule 40 risers, separate from the 8-in. calcine retrieval risers.

The CSSF VI bins have five stiffening rings on the inner wall and three on the outer wall. All of the stiffening rings are installed on the exterior surface of the bin, so they should not pose any problem for

Figure 11. Sloped bin fill piping, vertical retrieval piping, and annular bins in CSSF VI.

calcine retrieval. Each bin is equipped with two seal-welded, hydrostatic test vents at the tangent of the top head.

3.7 Calcined Solids Storage Facility VII

EG&G Idaho of Idaho Falls, Idaho, designed CSSF VII, also known as Bin Set 7. Mitternacht Boiler Works of Satsuma, Alabama, fabricated the bins fabricated from Type 304L stainless steel. CSSF VII contains of seven annular bins similar to CSSF VI. CSSF VII has never been used to store calcine; therefore, this report provides no details of that facility.

4. CALCINE COMPOSITION DETERMINATION

The composition of calcine is needed to perform facility safety analyses, ensure regulatory compliance, and develop future waste-treatment and disposal processes. There are relatively few historical calcine samples with extensive analyses to use as the basis for calcine composition. Obtaining additional calcine samples from the CSSFs is difficult because the CSSFs do not have installed sampling equipment. Sampling and analysis of the calcine in the CSSF bins has been done in the past (Staples, Pomiak, and Wade 1979). However, future similar calcine sampling and analysis efforts would be costly, generate additional mixed waste, and may not provide the desired detailed calcine composition data. Samples obtained from the CSSFs may not be representative of the stored calcine because they may include disproportionate amounts of startup bed or other calcine material. Analysis of the calcine sample may not provide accurate composition data.

If more calcine samples were obtained from the CSSF bins and analyzed, experience has shown many analyses will yield “nondetect” values or otherwise questionable results because of the difficulty in analyzing the highly radioactive samples. Some chemicals and radionuclides of interest cannot be detected in calcine because of their low concentration or activity. Some species, such as volatile and semivolatile components, may be lost during sample preparation processes such as high-temperature fusion, thus their analyses will not be accurate. Other species may not be analyzed correctly because they form insoluble solids that do not dissolve during sample preparation.

Obtaining calcine samples that are representative of the bulk calcine in a bin is a problem. Liquids can be mixed to provide a uniform composition prior to sampling and analysis. However, the calcine in the CSSF bins is not homogenous and cannot be mixed. Figure 12 shows that the bins contain multiple layers of chemically and radiologically different calcine. Obtaining representative samples from the multiple layers of chemically varying calcine would be difficult. Even individual calcine particles are not always homogeneous because of the method of “layering” in which calcine particles formed. Calcine particles formed from a seed particle that was coated with a thin layer of liquid waste. The liquid evaporated, leaving behind a thin layer of material formed by the solids dissolved in the waste. When the calciner feed composition changed, there was a transition period in which calcine particles had an interior composition corresponding to the first waste, and an exterior composition corresponding to the second waste. If a calcine sample were obtained from the bins, it would be uncertain which specific type of calcine or mixture of calcine was obtained. Figure 13 shows the concentrations of four calcine components (zirconium, aluminum, magnesium, and cadmium) in various CSSF bins. Figure 13 illustrates the significant variation in the concentrations of calcine components that exists in the calcine layers. Figure 13 presents a vertical profile (bottom to top in the bin corresponding to left to right on the data plot) of the concentration of these four components in the calcine.

This report provides an alternative to extensive calcine sampling and analysis to determine the composition of the calcine. It provides detailed calcine composition data based on calciner and CSSF operating data, liquid waste sample analyses, volumes of liquid waste calcined, and other INTEC fuel-reprocessing and waste-treatment information. This report divides each CSSF bin into several sections, or segments, and provides the composition of the calcine in each segment. There are six CSSFs, three to twelve bins in each CSSF (43 total bins), and six to twelve segments in each bin. Therefore, the calcine composition is summarized for several dozen bin segments. The locations of calcine level-indicating thermocouples in the bins were used as a convenient means to divide the bins into segments. If needed, additional calcine composition data are available for smaller portions of calcine. Although not presented in this report because of space limitations, the HPM calculates the composition of each of the nearly 7,000 batches of material (startup bed, nonradioactive material, and radioactive waste) charged to the calciners.

05-GA50178-03

Figure 12. Simplified schematic of chemically different calcine layers in CSSF III.

Figure 13. Variation of calcine component concentrations within storage bins.

The appendices to this report contain detailed information on the composition of calcine. The calcine composition data do not support the number of significant figures (up to three) presented in some of the graphs and tables in the appendices. A statistical reviewⁱ of the historical calcine sampling data determined that the relative error band for the calcine inventory is 14% at a 95% confidence level. This error applies to composition data based on liquid sample data and physical measurements (such as tank volumes). Errors associated with the ORIGEN2-based radionuclide calculations, which are used for trace species that cannot be detected in the waste, have been estimated at a factor of two (Wenzel 2005).

4.1 Calcine Composition Calculation Method

The calcine composition in this report was calculated by the HPM using several large Microsoft Excel databases and spreadsheets. The HPM began in the late 1990s as a part of the effort to close the Tank Farm. Closure of the Tank Farm required a waste incidental to reprocessing (WIR) determination. The WIR determination included a quantitative estimate of the amount of material that had been sent to and removed from the Tank Farm vessels, and the residual amount of material in the vessels at the time of closure, after the liquid waste in the final tank was calcined (Swenson 2003a). Transfer of waste to the calciner and subsequent calcination was the principle means of removing waste from the Tank Farm

i. Thomas, I. R., "Measurement Error Analysis for Calcine Verification Study," Bechtel BWXT Idaho, LLC Interoffice Memorandum, to K. F. Childs and M. D. Staiger, IRT-01-02, March 19, 2002.

vessels; therefore, a detailed database was developed to document the amount and composition of the waste that was calcined and thus removed from the Tank Farm.

During the late 1990s, the National Research Council (NRC) reviewed the various alternatives that were being considered to treat both the Tank Farm liquid waste and calcined solid waste at INTEC. The NRC's review included an evaluation of a calcine characterization report containing calcine characterization and composition data, published by an INL Site contractor in 1997. The NRC found that the 1997 report contained numerous errors to the point that its credibility and usefulness were questionable. In its evaluation report *Alternative High-Level Waste Treatments at the Idaho National Engineering and Environmental Laboratory* (NRC 1999), the NRC discussed the inadequacies of the 1997 report data and concluded that report data were not adequate for any type of calcine, for either process control or environmental considerations. Partly in response to the NRC findings on the inadequacy of the report's calcine characteristics, the calcine-related portion of the Tank Farm WIR determination work was issued as Revision 0 of this report in June 1999. Since that time, this report (and the HPM) has become the definitive source document on calcine composition. Since its initial publication in 1999, this report has been used as a source document in a variety of studies and other documents. They include environmental impact statements, safety analysis reports, calcine treatment studies, environmental permits, and other sources. Because of its extensive use, the HPM has undergone extensive review and verification (Wood et al. 2003).

The extensive use and review of the HPM has led to several revisions of the HPM databases and, consequently, this report. The revisions have improved both the accuracy and usefulness of the calcine composition data. The revisions have included database corrections, model refinements, and expansions of the report to include additional data such as trace RCRA constituents, additional radionuclide decay dates, and data plots and charts to supplement the original data tables. Nearly all of the HPM developers, report authors, and primary contributors (such as the ORIGEN2 model developers and HPM verifiers) have extensive experience (typically about 30 years) with the INTEC fuel-reprocessing and waste-treatment systems. Their process knowledge was used extensively in the development of the HPM, particularly in the INTEC process-specific aspects of the HPM, thus providing the most accurate determination of the calcine composition.

The HPM uses the compositions and volumes of the liquid wastes that were calcined, ORIGEN2- and ORIGEN-ARP-based radioactivity calculations, calciner and CSSF operating data, and process knowledge of INTEC fuel and waste-processing systems to calculate the calcine composition. The HPM determines the mass of dissolved constituents in the liquid wastes that were calcined, adds enough oxygen to balance species charges, and allocates the mass of dissolved solids and associated oxygen as calcine into the CSSF storage bins based on bin filling data from historical CSSF temperature data.

Most of the dissolved metals in the liquid waste (such as Al and Zr) formed solid metallic oxides (such as Al_2O_3 and ZrO_2) during the calcination process. A small amount of the metals formed metallic chlorides, phosphates, and sulfates, with the small quantities of those anions in the liquid waste. Calcium, in the form of calcium nitrate, was added to fluoride-bearing wastes as part of the calcination process. The Ca formed calcium fluoride (CaF_2) in the calciner and suppressed the volatility of F, which would have been highly corrosive to the calciner off-gas system. Typically, a small amount of extra Ca, above that required for the stoichiometric reaction with F, was added to the waste to account for small variations in the measured F content of the waste and ensure adequate F volatility control.

In general, the HPM does not identify specific compounds formed in the calcine, for example, whether the sulfate in the waste formed zirconium sulfate or calcium sulfate. Instead, the HPM calculates the mass of each chemical and the activity of each radionuclide without regard to specific molecular form. The HPM calculates the mass of each constituent as the product of its concentration in the liquid waste

and the volume of waste calcined. It performs this calculation for each constituent in each batch of liquid waste that was calcined. Further details on this calculation method and the compounds assumed to form in the calcine are provided in *Estimation of Alkali Metal Mole Percent and Weight of Calcined Solids for ICPP Calcine* (O'Brien 1995). A series of thermodynamic studies (e.g., Engineering Design File [EDF] -7856, "Thermodynamic Modeling of the Chemical Composition of Calcine in CSSF VI" [Nenni 2007]) has modeled the speciation of the calcine in each CSSF. See the reference list in EDF-7856 (Nenni 2007) for citation of the additional thermodynamic studies.

A portion of the alkali metals (Na and K) in the liquid waste formed nitrates in the calcine, based on thermodynamic studies and pilot plant data. This reaction was the source of most of the nitrates in the calcine. The HPM calculates the nitrate concentration in the calcine as 66 mole% of the combined Na and K concentration for all of the WCF operation and the 500°C NWCF operation (O'Brien 1995). The alkali metal nitrates melted at calcination temperatures that could cause calcine agglomeration and fluidization problems in the calciner, thus their concentrations in the calcine were administratively controlled and limited to manageable levels. In 1999 and 2000, a "high-temperature" calcination flowsheet (operation of the calciner at 600°C instead of the historical 500°C) was successfully tested. At 600°C, most (77 mole%) of the alkali metals formed aluminates (such as NaAlO_2) instead of nitrates.^j The aluminates did not melt at the calciner operating temperature and did not cause calcine agglomeration problems. The high-temperature calcination process reduced the SBW-caused calcine agglomeration problems. With fewer agglomeration problems, the amount of SBW in the calciner feed was increased and the amount of chemical additives was decreased, significantly increasing the net calcination rate of SBW. The HPM calculates the nitrate concentration as 23 mole% of the total alkali metals (Na and K) when the calciner operated at 600°C.

The HPM makes adjustments to the relative concentrations of semivolatile species such as iodine (I) and Hg in the calcine based on data from historical INTEC pilot plant studies and calcine sample analyses. The data from those studies and analyses show that 1% of the iodine in the liquid waste was retained in the calcine (McManus et al. 1982), 70% of the Hg in the liquid waste was retained in the calcine when the calciner operated with indirect heating (Lakey and Bower 1963), and 1% of the Hg in the liquid waste was retained in the calcine when the calciner operated with in-bed combustion of kerosene^k (Newby 1980a, 1980b).

4.2 Comparison of HPM and Analytical Calcine Compositions

The HPM, its databases, and calculation techniques were formally reviewed for accuracy and completeness (Wood et al. 2003; Swenson 2003b). To test the validity of the HPM's calcine composition calculations, comparisons of the HPM calcine composition with calcine sample analyses have been made (Wood et al 2003; Swenson and Thomas 2006). In general, agreement is excellent between the HPM-calculated compositions and those of the calcine samples, as discussed in detail below.

Figure 14 compares the HPM-calculated calcine composition with historical calcine sample data for four representative constituents. The constituents include a major chemical (Al), a minor chemical (Cr), a major radionuclide (Cs-137) and a minor radionuclide (Pu-238). Liquid-waste sample data exist for all wastes that were calcined and are used by the HPM to calculate the calcine composition. However, calcine sample analyses are not available for all wastes that were calcined. The data plots in Figure 14

j. Wood, R. A., "Updated Aluminum Nitrate/WM-189 Blend Calculations for 500°C and 600°C Operation During NWCF Run H4," Bechtel BWXT Idaho, LLC, Interoffice Memorandum, to K. B. Farmer, RAW-01-00, February 14, 2000.

k. Herbst, R. S., "Mercury and Chloride Analyses in Calcines Produced in NWCF Campaign H-4," Lockheed Martin Idaho Technologies Company Interdepartmental Communication, to M. D. Staiger, RSH-07-98, December 7, 1998.

have “stream numbers” on the x-axis for those wastes (or blends of wastes) for which historical calcine sample data exist. The stream number is a sequential number assigned to each large vessel of Tank Farm waste that was calcined. The stream numbers generally correspond with the waste calcination chronology, with Stream Number 1 being the first tank of waste that was calcined in 1963 and Stream Number 87 being the last tank of waste calcined in 2000. A few exceptions to the numerical waste stream numbers on Figure 14 include “Al” and “Zr”. These refer to the aluminum and zirconium calcine in CSSF II bins VES-WCS-136-3 and -7 that were sampled in 1978 (Staples, Pomiak, and Wade 1979). Those two bins contained calcine from several waste streams. Thus, the average calcine composition for the entire bin (instead of a single waste stream) was compared with the calcine sample data. The “Al” and “Zr” waste streams are between Streams 11/12 and 14 because that is the approximate time period in which that calcine was generated. Stream Numbers “16 low” and “17 low” refer to calcine from Waste Streams 16 and 17 that contained much less calcium nitrate than typical Zr waste. Stream “81HT” refers to calcine made from Waste Stream 81 with the high-temperature calcination flowsheet.

The y-axis on Figure 14 is the ratio of the HPM-calculated calcine composition divided by the calcine composition determined by sample analysis. A value of 1.0 means the two calcine compositions match exactly, which would be the ideal case. Figure 14 shows the composition ratio on a logarithmic scale. The logarithmic scale shows relative differences above and below the value of 1.0 with the same scale. For example, composition ratios of 2 and 1/2 have the same relative inconsistency (a factor of 2) and would be shown with the same difference from the value of 1.0 on a logarithmic scale. On a linear scale, the value of 2 would appear to be much further from the ideal value of 1.0 than the value of 1/2, despite their having the same relative inconsistency. Most of the data on Figure 14 are shown as solid shapes (diamonds, squares, or triangles, corresponding to Al, Zr, and SBW blend calcine, respectively). Some of the data points on the Pu-238 plot are outlines instead of solid shapes. The solid shapes represent data for which both liquid waste and corresponding calcine sample data are available for comparison. The outline shapes are used when calcine sample data are available, but liquid waste sample data are not available. The HPM calculates the radioactivity for such wastes with an ORIGEN2-based model. The calculation method is explained in detail in Section 7.4).

The historical calcine samples had varying numbers of analytes. Many samples were analyzed for major constituents such as Al, Zr, Ca, F, Cs-137, and Sr-90. Minor constituents such as Cr and Am-241 were determined for relatively few calcine samples because they were not major components, nor were they species of concern at the time of the analysis. Some of the minor constituents of current interest, such as selenium (Se) and I-129, are present in such small amounts that they cannot be detected in calcine samples; therefore, no calcine analytical data exist for those constituents.

Most of the composition ratios for the four constituents on Figure 14 are within 10 to 20% of the ideal value of 1.0, which shows excellent agreement between the HPM-calculated composition and the measured (analytical) composition. The Pu-238 data that used ORIGEN2-based data for the liquid waste (outline squares) also show excellent agreement with the analytical data. This shows that the calculated composition of the liquid waste is valid and provides accurate data for the calcine composition. Slight differences from the ideal value of 1.0 in some of the data in Figure 14 do not mean that either the HPM calculation or the sample analysis is in error. Small differences (up to 20%) in the two calcine compositions may exist because of sample analysis variability, variations in the composition of individual calciner feed batches (because of variations in the amounts of additives or off-gas scrub solution in the feed solution), and calciner bed turnover (the change in particle composition over time because of changes in feed composition). Large differences (of a factor of two or more) means one of the two compositions is likely incorrect.

Figure 14. Ratio of HPM-calculated calcine composition to the measured calcine composition.

The Pu-238 datum for Stream 86 on Figure 14 differs from the ideal value of 1.0 by a factor of 3.4 and is an exception to the otherwise excellent agreement between the HPM-calculated calcine composition and analytical data. The otherwise excellent agreement of the HPM-calculated compositions with calcine analytical data indicates that the HPM methodology is valid. The difference in the Pu-238 activity in Stream 86 is because either the liquid sample data used by the HPM to calculate the calcine composition is in error, or the calcine sample analysis is in error. A review of the data shows that the calcine analytical value, not the HPM, is likely in error.

The HPM averages data from five liquid waste samples of Stream 86 waste for its Pu-238 composition. The Pu-238 in the five samples averaged 1.37 mCi/L, and showed good agreement, with less than 15% difference between the high and low values.

Further validation of the Pu-238 activity in Waste Stream 86 comes from analyses of its components. Waste Stream 86 was generated when two dilute wastes (in Tanks VES-WM-183 and VES-WM-189) were combined and concentrated by evaporation. Neither of the two dilute wastes had its Pu-238 measured directly, but each of them had several “transuranic alpha” analyses performed on waste samples. The isotopes of Pu-238, Pu-239, Pu-240, and Am-241 comprise the bulk (more than 99%) of the TRU alpha activity in Stream 86, with Pu-238 accounting for about 90% of the total alpha activity. The waste in Tank VES-WM-183 had three TRU alpha analyses with an average value of 0.63 mCi/L. The waste in Tank VES-WM-185 had five TRU alpha analyses with an average value of 0.77 mCi/L. Waste Stream 86 was a 50:50 blend of those two wastes that was concentrated by a factor of 2. Assuming the Pu-238 activity was 90% of the TRU alpha activity, the calculated Pu-238 activity of Stream 86 should have had been approximately 1.26 mCi/L [$1.26 = (0.77 \times 0.5 + 0.63 \times 0.5) \times 2 \times 0.90$]. This calculated activity is the same (within analytical error) as the 1.37 mCi/L measured in Stream 86. These data provide additional evidence that the Pu-238 activity used by the HPM for Stream 86 was accurate, and thus the calcine activity determined by the HPM for Stream 86 is accurate.

On the other hand, the analytical value for the Pu-238 activity in Stream 86 calcine came from a single sample. It was not uncommon for a single waste sample to have results that differed from replicate samples of the same waste. This was especially true with calcine (solid) samples, which were more difficult to analyze than liquid samples, and whose results typically varied much more than those of liquid samples. Calcine analysis required extra sample preparation steps (such as sample dissolution or high-temperature fusion and dissolution) to get the sample into a liquid state that could be analyzed using wet-chemistry techniques. The extra sample preparation steps were an additional source of analytical error that did not exist with liquid analyses. The numerous, consistent, liquid waste analyses for Pu-238 in Stream 86 indicate that the HPM-calculated value for Pu-238 is more likely correct than the single calcine sample analysis.

A separate study comparing the calcine composition calculated by the HPM with that determined by sample analysis (Swenson and Thomas 2006) found when the HPM composition and sample data differed significantly, the calcine composition calculated by the HPM was more likely to be correct than the calcine sample data. This was attributed to the difficulties in analyzing the highly radioactive calcine samples and issues associated with sample preparation. These difficulties included the loss of semivolatile constituents (such as Hg) during high-temperature sample fusion, failure to dissolve the entire sample when converting a solid sample to a liquid form for wet-chemistry analytical techniques, and dilution errors made when highly radioactive solutions were diluted to allow hands-on analysis of the sample. Liquid-waste samples were easier to analyze than calcine samples because they did not require the extra sample preparation step (conversion of solid to liquid) required of calcine samples.

The liquid-waste sample data, which the HPM uses as a basis for calculating the calcine composition, typically included multiple samples of each waste stream. Data from the same waste stream

were compared to ensure that the results were consistent and reasonable. This data comparison eliminated obvious errors from the liquid-waste composition database. Several of the historical calcine sample data come from the analysis of a single sample. Without replicate analyses, it is difficult to ensure that the calcine analyses did not contain errors and that the results were consistent and repeatable. Nor is there any way to ensure that data transcription errors were not made in the reports from which the analytical data were obtained. As a result, waste compositions based on multiple historical samples, such as the liquid waste samples, are inherently more reliable than compositions based on a single sample of the calcine.

4.3 Liquid Waste Composition

The INTEC Tank Farm contained two general categories of liquid wastes, first-cycle raffinate and SBW. The dissolution of spent nuclear fuel and the subsequent extraction of uranium produced first-cycle raffinate. Typically, fuel reprocessing began by dissolving spent nuclear fuel (cladding, fission products, and uranium) in acid. Uranium was recovered from the acidic dissolver solution using a liquid solvent extraction system. The extraction process produced an aqueous, acidic waste called first-cycle raffinate that contained the dissolved fuel cladding and the bulk of the fission products originally in the spent fuel. Consequently, first-cycle raffinate had the highest radioactivity of any INTEC liquid waste. First-cycle raffinate had a variety of names. The names often referred to the cladding material (and hence a primary waste constituent) of the fuel from which the waste originated. The names included Al, Zr, stainless steel, and Rover wastes. “Rover” was the name given to a type of graphite matrix fuel developed by the Space Nuclear Propulsion Office Rover Project and did not relate to the cladding material or chemical composition of the waste. These liquid waste names also were used in reference to calcine, such as “Al calcine” or “Zr calcine.”

The second category of Tank Farm liquid waste was SBW. The name “sodium bearing” came from the waste’s relatively high concentration (1 to 2 molar) of Na ion. The Na came from processes and activities that used Na-containing chemicals such as sodium hydroxide, sodium permanganate, and sodium carbonate. Sources of SBW included equipment decontamination, analytical laboratories, off-gas scrubbers, and ion-exchange regeneration. Sodium-bearing waste also included some of the second- and third-cycle nuclear fuel-reprocessing raffinates. The second- and third-cycle processes purified the uranium recovered in the first-cycle process in a liquid solvent extraction system, similar to that of the first-cycle system. The second- and third-cycle raffinates contained much less radioactivity than first-cycle raffinate; therefore, they were often combined with the radiologically similar, low-activity SBW.

The calcination process included sampling and analyzing liquid wastes prior to calcination. Over time, hundreds of samples of liquid wastes were taken and analyzed for chemical content and radionuclide activity. These sample data form the liquid-waste composition database of the HPM from which the calcine composition is calculated. The effort to compile detailed composition data for the liquid wastes that were calcined was limited by the number and scope of the historical sample analyses and the ability to find the sample data. Although hundreds of liquid waste samples were analyzed, no central, organized data collection or storage system existed for the waste-sample data. Consequently, liquid sample data were retrieved from a variety of sources and compiled to form the HPM liquid sample database. The data sources included formal reports, internal office memoranda, facility operating log books, personal copies of laboratory data sheets, and archived laboratory analytical data.

Typically, historical liquid-waste analyses focused on major chemical species (such as Al, Zr, and F), and those species needed to control parameters such as corrosion, heat generation, and radiation exposure. Trace components that had no effect on historical waste management were typically not included as analytes in the historical samples. However, some of those trace components, such as

RCRA metals, subsequently became species of concern because of regulatory issues and knowing their concentration in calcine is now required, as discussed below.

The HPM calculates the concentrations of many calcine components, including RCRA constituents, for which historical sample data either do not exist, or exist for limited numbers of samples. A variety of methods was used to calculate the concentrations of such constituents. Some waste component concentrations were calculated based on fuel-reprocessing chemistry and metallurgy. For example, tin (Sn) was present in much of the waste because it was a component of the Zr alloy (Zircaloy) used for fuel cladding. The Sn concentration in Zr waste was calculated by multiplying the measured Zr concentration in the liquid waste by the Sn:Zr ratio in the Zircaloy fuel cladding. The concentrations of some waste species were determined based on the amounts and compositions of bulk chemicals used in INTEC processes. Calcium (in the form of calcium nitrate) was added to fluoride-bearing wastes as part of the calcination process to suppress F volatility. The Ca content of the calcine is based on the measured amounts of calcium nitrate added to the calciner feed batches. Chromium (in the form of chromic acid) was often added to the Zr fuel dissolver product to oxidize the Sn in the Zircaloy to a soluble state. In such cases, the amount of Cr in the waste was calculated based on the amount of Sn in the fuel cladding and the Cr:Sn ratio used in the fuel-dissolution process. Fission-yield calculations were used to determine the concentrations of some trace species, such as Ba and Se, which were not used as chemical additives in any of the INTEC processes, but were present as fission products in the spent nuclear fuel. Waste stream similarity also was used to determine chemical concentrations in some wastes. Many of the waste streams were generated by similar processes (dissolution of similar fuels using the same dissolution and uranium extraction processes) and had similar waste compositions. Waste samples of some waste streams were analyzed more extensively than other streams. Data from the more extensive sample analyses were used to estimate concentrations of components in similar wastes for which analytical data do not exist. For example, in the late 1980s and early 1990s, an extensive effort was made to analyze Al, Zr, and SBW for RCRA constituents as part of a RCRA waste characterization program. The results of those analyses were used to determine the RCRA concentrations of historical Al, Zr, and SBW wastes for which sample data do not exist. Some chemicals, such as As, were not part of any fuel cladding, were not used as a chemical additive in any fuel reprocessing or waste-treatment operation, and were not significant fission products. They also were not reliably detected in the late 1980s and early 1990s RCRA waste characterization effort, or in historical calcine samples that were analyzed for RCRA components (Patterson and Prather 2004). The concentration of such components in the liquid waste was conservatively set at the laboratory detection value.

The Excel workbooks of the HPM contain notes indicating which waste composition data are based on sample analyses and which are based on process knowledge and engineering calculations. They also contain information on the methods used to determine the concentrations of those species for which sample data do not exist.

4.3.1 Chemical Composition of Liquid Waste

The composition of calcine varies significantly because reprocessing different types of fuels generated chemically different liquid wastes and subsequently chemically different calcine. The original fuel-reprocessing flowsheet (see Section 4.1) was based on Al-clad fuel. With time, the fuel-reprocessing mission expanded to include Zr-clad, stainless steel-clad, and graphite matrix (Rover) fuels. As mentioned in Section 2, different chemical processes were used to reprocess different types of fuel, resulting in wastes of varying composition. In some cases, fuel-reprocessing methods for a given type of fuel evolved over time, resulting in differences between older and newer wastes of the same fuel type. For example, the original stainless-steel-clad fuel-dissolution system used sulfuric acid. Later, stainless-steel-clad fuel was dissolved in an electrolytic/nitric acid system. The original Zr-clad fuel-dissolution system added boron (B) to the fuel dissolver for criticality control. The original, aging, Zr-clad fuel dissolution facility

was replaced in the mid 1980s with a modified fuel dissolution process in a new facility. The new process was called the Fluorinel dissolution process. Like its predecessor, the new process used hydrofluoric acid to dissolve the Zr-clad fuel, and it was located at the INL (called the Idaho National Engineering Laboratory, or INEL, at the time). The term Fluorinel was coined by combining the word fluoride with the acronym INEL to get “Fluorinel.” The Fluorinel process differed from the original Zr-clad fuel dissolution process by using both cadmium (Cd) and B for criticality control. The use of Cd in the fuel dissolution process changed the composition of Zr waste, and, consequently the composition of Zr calcine

Historically, the bulk of the liquid waste that passed through the INTEC Tank Farm and was calcined was first-cycle raffinate. Table 3 gives the typical chemical compositions for five first-cycle raffinates (Al, Zr, Fluorinel, electrolytic stainless steel, and Rover), and SBW.

The chemical composition of the five first-cycle wastes in Table 3 reflects the type of fuel (cladding material) dissolved and the chemicals used during fuel reprocessing. Al-clad fuel was dissolved with nitric acid. Consequently, Al waste contained high concentrations of Al, nitrate, and hydrogen (acid) ions. Zr-clad fuel was dissolved with hydrofluoric acid. The Zr dissolver solution was then complexed with aluminum nitrate to reduce the corrosiveness of F on the downstream equipment. Consequently, Zr waste contained large amounts of Zr, F, Al, nitrate, and hydrogen (acid) ions. Al- and Zr-clad fuels were the most frequently reprocessed fuels and consequently produced the greatest volumes of liquid waste and calcine.

Smaller quantities of other fuels were reprocessed and generated smaller quantities of wastes. The original stainless-steel fuel-dissolution process used a sulfuric/nitric acid system and produced a relatively small amount of waste (not shown on Table 3). Sulfuric acid stainless-steel waste contained iron (Fe), chromium (Cr), nickel (Ni), sulfate, nitrate, and hydrogen (acid) ions. An electrolytic/nitric acid process replaced the original sulfuric acid system for the dissolution of stainless-steel fuel. Waste from the electrolytic process contained Fe, Cr, Ni, nitrate, Al (from the first-cycle extraction system), and hydrogen (acid) ions. Graphite matrix (Rover) fuels were reprocessed by burning the graphite and dissolving the uranium-bearing ash in hydrofluoric acid. The Rover waste contained F (from ash dissolution), Al (from F complexing), nitrate, and hydrogen (acid) ions.

In addition to the major chemical constituents, first-cycle waste contained a variety of minor components from the fuel cladding and the use of catalysts, oxidants, and neutron poisons in the fuel-dissolution and uranium-recovery processes. First-cycle Al raffinate contained a small amount of Hg from mercuric nitrate that was used as a catalyst to dissolve Al-clad fuel. First-cycle Zr waste contained boron (B) that was used as a soluble neutron poison. Zr waste also contained Fe, Cr, Ni, and Sn that were present in small quantities in the zirconium alloy used in fuel-cladding and in stainless-steel fuel components. Fluorinel waste was a “sub type” of Zr waste. It is listed in Table 3 to illustrate that given waste types (in this case Zr) generally had similar concentrations of major constituents (e.g., Al, Zr, and F), but often differed significantly in minor constituents. For example, Fluorinel waste contained Cd, which was used as a neutron poison for criticality control in the fuel-dissolution process. Other Zr waste did not contain Cd.

Although it was not a significant component of any liquid waste in the Tank Farm (and, therefore, not included in Table 3), Ca was added to fluoride-bearing wastes (Zr, Fluorinel, and Rover) during the calcination process. The Ca formed solid calcium fluoride during calcination, which prevented the volatilization of F and subsequent corrosion of the calciner off-gas system. Therefore, Ca is a major component of fluoride-bearing calcine, even though it was not in the original liquid waste.

Table 3. Typical chemical compositions of six liquid wastes calcined at INTEC.

Species	Units	First-Cycle Raffinates					Sodium-Bearing Waste
		Aluminum	Zirconium	Fluorine	Electrolytic Stainless Steel	Rover	
Acid (H ⁺)	molar	0.81	1.40	1.50	2.2	1.0	1.28
Aluminum	molar	1.51	0.68	0.43	0.2	0.50	0.57
Boron	molar	— ^a	0.19	0.15	—	0.15	0.017
Cadmium	molar	—	—	0.05	—	—	0.001
Chloride	mg/L	—	—	50	—	—	1,000
Chromium	molar	0.1	0.015	0.002	0.025	—	0.001
Fluoride	molar	—	3.2	2.10	—	0.68	0.04
Iron	molar	0.01	0.007	0.005	0.086	0.006	0.002
Mercury	molar	0.02	—	—	—	—	.0013
Nickel	molar	—	—	—	0.012	—	—
Nitrate	molar	5.4	2.3	1.90	3.2	1.9	4.5
Potassium	molar		0.003	0.005	—	0.001	0.17
Sodium	molar	0.06	0.017	0.02	—	0.007	1.5
Tin	molar	—	0.005	0.003	—	—	—
Zirconium	molar	—	0.41	0.31	—	—	0.03

a. A dash within a cell indicates an insignificant quantity.

Table 3 shows SBW contained significant quantities (1 to 2 molar) of the alkali metals Na and K. The Na and K came from processes that used chemicals such as sodium hydroxide, sodium permanganate, and sodium carbonate. Sodium-bearing wastes were usually concentrated in waste evaporators, resulting in the high Na and K concentrations. Because SBW included decontamination wastes, it had small amounts of chemicals (such as Al, Zr, F, Hg, and Cd) from all of the first-cycle wastes that were removed from process equipment during decontamination.

One important first-cycle waste not shown in Table 3 was called “coprocessing” waste. Coprocessing was the term given to an operating flowsheet that simultaneously reprocessed both Al- and Zr-clad fuels. Zr-clad fuels were dissolved in hydrofluoric acid. The resulting solution was extremely corrosive because of its high F concentration (up to 3 M). Aluminum nitrate was added to the Zr dissolver solution to complex the F. The addition of aluminum nitrate reduced the corrosiveness of the F and enhanced the extraction of U. Beginning in 1970, Al-clad and Zr-clad fuels were often dissolved simultaneously (in separate dissolvers). The Al fuel dissolver solution (essentially acidified aluminum nitrate) was used in place of aluminum nitrate to complex the F in the Zr fuel-dissolver solution. This substitution reduced the generation of fuel-reprocessing waste by eliminating the use of the chemical additive aluminum nitrate as a complexing reagent. Coprocessing waste was essentially a blend of the Al and Zr wastes shown in Table 3. It was chemically similar to Zr waste and many historical documents refer to coprocessing waste as Zr waste and make no distinction between the two types of waste.

4.3.2 Radionuclide Activity of Liquid Wastes

Historical liquid-waste analytes included radionuclides. Typical analyses included major fission products such as Sr-90, Cs-137, Ru-106, and Ce-144 that were important to heat generation or shielding calculations. The analyses also included the principle TRU components such as Pu-238 and Pu-239. However, as with the chemical constituents, few or no sample data exist for many radionuclides, typically those with very low activity. Most radionuclides were present in such small quantities that they had no impact on heat generation, shielding requirements, or other waste-management issues. The activity of most radionuclides was generally so low that it could not be detected by historical analytical methods. Today, there is interest in knowing the activity of some of those species, as discussed further in Section 5.1, particularly those that are long lived and may affect long-term waste management.

Several computer models (Wenzel 2005) were developed to calculate the activity of radionuclides for which no analytical data exist. The models use ORIGEN2 (Croff 1980) to generate data for fission and activation products present in spent nuclear fuel. Because different types of fuels were reprocessed, with different characteristics, ORIGEN2-based models were developed for three types of fuel (Zr, Al, and stainless steel) as well as a coprocessing model (a combination of the Zr and Al fuel models). The bulk of the fission products originally in the fuel went with the first-cycle raffinate. However, some of the actinides stayed with the U in the first-cycle extraction process. The actinides were separated from the U in the second- and third-cycle fuel-reprocessing steps. The radionuclide models account for this separation by normalizing both the fission and activation product activity calculated by the ORIGEN2 program to that found in samples of the various types of liquid wastes.

An ORIGEN2-based computer model also was developed for SBW by treating SBW as a pseudo fuel type. Sodium-bearing waste was assumed to be a blend of waste from Al, Zr, and stainless-steel fuels that had been reprocessed because that was the source of its activity. The SBW activity was calculated by applying adjustment factors to each of those three models to account for the amount of each type of fuel that had been reprocessed and the time when the fuel was reprocessed, and then summing the resulting activities of the three adjusted models. The activities of both the fission and activation products were then normalized to match that of SBW sample data.

The HPM calculates radionuclide activity for which analytical data are not available using one of the five waste models (Al, Zr, stainless steel, coprocessing, or SBW). The activity of a given nuclide is calculated by multiplying the Cs-137 activity in the waste of interest by the nuclide:Cs-137 activity ratio from the appropriate waste model. Cs-137 is used as the basis for the calculation because it was easily and accurately measured in all Tank Farm wastes and no processes partitioned cesium from the Tank Farm wastes. This method makes it possible to use Cs-137 as the basis to calculate radionuclide activities for all Tank Farm waste. The following relationship summarizes the HPM radioactivity calculation method (decayed to January 1, 2016):

$$\text{Calculated } Y_{2016} = (\text{Measured Cs-137}_{2016}) \times (\text{Model } Y_{2016} / \text{Model Cs-137}_{2016})$$

Where:

- Calculated Y_{2016} = Calculated activity of the nuclide Y of interest decayed to 2016.
- Measured Cs-137₂₀₁₆ = Measured activity of Cs-137 in the waste stream, decayed to 2016.
- Model Y_{2016} = Activity of nuclide Y from the applicable waste model, decayed to 2016.
- Model Cs-137₂₀₁₆ = Cs-137 activity in the applicable model (e.g., Zr and Al), decayed to 2016.

In most cases, the selection of the waste model (Zr, Al, coprocessing, or SBW) used to calculate radionuclide activity is straightforward, based on the source and composition of the waste. However,

some of the waste streams were mixtures of wastes and engineering judgment was used to categorize them. Table A8 (see Appendix A) indicates a waste type (Al, Zr, coprocessing, SBW, or stainless steel) for each waste stream. Table A8 identifies some waste streams as blends of two or more types of wastes. In such cases, engineering judgment was used in determining the waste model to use in calculating radioactivity. In some cases, a combination of waste models was used.

For example, Table A8 lists Waste Streams 61, 62, 63, and 70 as “coprocessing/SS/SBW.” Those waste streams came from Tank VES-WM-189 in the early 1980s and were mixtures of coprocessing, electrolytic stainless steel, and SBW. When the waste was calcined, the Na concentration in Tank VES-WM-189 waste was as high as 0.6 M. This concentration was about half that of the Na concentration of typical SBW, but it was an order of magnitude above any first-cycle waste. The Na concentration was high enough that the waste could not be calcined by itself. It had to be calcined as a blend with other wastes to comply with administrative limits on the Na concentration in the calcine. Thus, the waste in Tank VES-WM-189 was sometimes called SBW, based on its chemical composition. However, Waste Streams 61, 62, 63, and 70 contained a significant fraction (up to 45 vol%) of first-cycle raffinate. Because the fission-product activity of first-cycle waste is much higher than SBW, the bulk of the radioactivity in the Tank VES-WM-189 waste came from the first-cycle portion of the waste. Thus at other times the waste in Tank VES-WM-189 was classified as first-cycle raffinate. Tank VES-WM-189 contained two types of first-cycle raffinate; coprocessing and stainless steel. The fission-product activity in coprocessing waste was higher than that of stainless-steel waste. As a result, the HPM uses the coprocessing waste model to calculate the radioactivity of the fission products for which sample data do not exist in Waste Streams 61, 62, 63, and 70. The HPM uses a combination of both the electrolytic stainless steel and coprocessing models to determine the activity of activation products such as Ni-63 and the Pu isotopes for which the electrolytic waste was a significant factor.

Similarly, Waste Stream 86 was a mixture of wastes. Waste Stream 86 came from Tank VES-WM-188 in the late 1990s. After Stream 86 was calcined, the INTEC operating contractor noted that the Tank Farm had been emptied of all high-level (first-cycle) raffinate and only SBW remained in the Tank Farm (Hovinga 1998). This statement implied Stream 86 was a first-cycle raffinate. However, the Na concentration in Stream 86 (0.9M) was too high to calcine without blending it with other material (aluminum nitrate). Waste Stream 86 was SBW on a chemical basis, but it contained enough first-cycle raffinate (from Zr and stainless-steel raffinates) that some historical documents call it first-cycle waste. Table A8 lists Stream 86 as a blend of Zr, stainless steel, and SBW. The HPM calculates the radioactivity of Stream 86 as a nearly 50:50 mixture of SBW and Zr waste, with an adjustment for the elevated Ni-63 from electrolytic waste.

Table A8 identifies Waste Streams 28 and 36 as stainless-steel waste. These wastes were generated during the 1950s. The 2005 report *Relative Inventories of Reactor-Produced Species in INTEC Waste Types* (Wenzel 2005) presented a radionuclide model generated for stainless-steel waste produced from reprocessing Experimental Breeder Reactor II fuel in the 1970s and 1980s. The stainless-steel fuel reprocessed in the 1950s differed significantly from that reprocessed in the 1970s and 1980s. Due to those differences, the Zr waste model was deemed a better model and is used to calculate the fission-product radioactivity in the 1950s stainless-steel waste.

5. CALCINE COMPOSITION

The chemical content and radioactivity of the calcine are compiled in tabular form in Tables A11 through A13 and plotted on graphs in Appendix C. The data tables and plots were verified to ensure the data were accurately transcribed and manipulated (Millet 2004). This report section contains summary calcine composition data and discusses the sources of the various chemicals and radionuclides found in the calcine and the reasons for the variations in the calcine composition.

The calcine composition varies among the CSSFs and within individual bins because, as discussed previously (see Sections 2 and 4.3.1), calcination of different types of waste created chemically varying calcine. Table 4 shows the typical chemical content of four of the more common types of calcine.

Table 4. Typical chemical composition of four types of calcine.

Chemical Species	Units	Type of Calcine			
		Aluminum ^a	Zirconium ^a	Fluorinel/SBW Blend ^a	Aluminum Nitrate/SBW Blend ^a
Aluminum	wt%	47	8.1	7.5	38
Boron	wt%	0.1	1.0	1.0	0.1
Cadmium	wt%	— ^b	—	5.0	0.2
Calcium	wt%	—	28	27	3.2
Chloride	wt%	—		0.1	0.4
Chromium	wt%	0.1	0.3	0.1	0.1
Fluoride	wt%		25	17	1.7
Iron	wt%	0.8	0.1	0.3	0.6
Mercury	wt%	1.9	—	—	—
Nitrate	wt%	2.5	0.8	6.0	5.9 ^c
Oxygen	wt%	42	16	17	38
Potassium	wt%	0.2	0.1	0.7	1.8 ^c
Sodium	wt%	1.3	0.4	2.9	8.4 ^c
Sulfate	wt%	1.8	2.0	3.5	0.3
Tin	wt%	—	0.3	0.2	—
Zirconium	wt%	0.1	17	11	1.3
<p>a. Column totals are not 100% because of rounding values and the exclusion of trace components.</p> <p>b. A dash within a cell indicates an insignificant quantity.</p> <p>c. The aluminum nitrate/SBW blend nitrate value is a high-temperature (600°C) calcination value. Nitrate values were higher and alkali (sodium and potassium) values were lower when SBW was calcined at 500°C.</p> <p>SBW sodium-bearing waste</p>					

Table 4 shows that the calcine composition correlates with the composition of the corresponding liquid waste in Table 3. Calcine produced from liquid Al waste is primarily alumina (Al₂O₃). The Al calcine also contains small amounts of Hg, Na, and nitrate. Calcine produced from liquid Zr waste

contains large amounts of zirconia (ZrO_2) and calcium fluoride (CaF_2), with a moderate amount of alumina. Fluorinel calcine is similar to Zr calcine except that it contains Cd and sulfate from the cadmium sulfate and cadmium nitrate used as neutron poisons in the Fluorinel fuel-dissolution process. SBW was never calcined by itself, as discussed briefly in Section 4.3.2. It was calcined as a blend with Zr, Fluorinel, and Al wastes, and with nonradioactive aluminum nitrate. Consequently, SBW (blend) calcine contains chemicals found in Zr, Fluorinel, and Al calcine, as well as nitrates and oxides of Na and K.

Some of the liquid wastes shown on Table 3 are not included as calcine in Table 4. Liquid wastes from graphite matrix (Rover) and stainless-steel fuels were too dilute (dissolved solids content too low) to calcine by themselves. Instead, they were calcined as blends with Al, Zr, or coprocessing wastes. Consequently, there is no “pure” stainless-steel or Rover calcine. They are included as variations of Al and Zr calcine.

Figure 15 shows the average weight percent and standard deviation of four major chemical constituents (Al, Ca, Zr, and F) of the calcine in CSSFs 1 through 6. Figure 15 shows the average concentration of each component as a point, and the standard deviation as a bar above and below the average value. The values for the average and standard deviation in Figure 15 were determined by dividing the calcine in each bin into six to 12 portions, or segments, according to the location of calcine-level-indicating thermocouples in each bin, and calculating the average calcine composition in each segment. The segment values were used to determine the CSSF average composition and standard deviation.

Figure 15 shows the variability of the major chemical species in the calcine as well as trends in the concentrations of the major species. Additional discussion and information on these and other chemical species is found in Section 5.3 and in the composition data plots in Appendix C of this report. The Al content of the calcine varies from 47 wt% in CSSF I to only 10 wt% in CSSF IV. The F content varies from 0 wt% in CSSF I to 20 wt% in CSSF IV. The Ca content varies from 0 wt% in CSSF I to nearly 30 wt% in CSSF IV. The standard deviation of the calcine components also varies significantly among the CSSFs. CSSF I contains only Al calcine. It has a high Al content (47 wt%) and a small standard deviation (1 wt%) reflecting its uniform composition. On the other hand, CSSF II contains large amounts of both Al and Zr calcine. Two of the CSSF II bins contain primarily Al calcine, four bins contain primarily Zr calcine, and one bin contains large amounts of both Al and Zr calcine. The average Al concentration (22 wt%) in CSSF II has a large standard deviation (17 wt%) reflecting the large difference between the composition of Al and Zr calcine. Similarly, the Zr, F, and Ca concentrations in the Al and Zr calcine in CSSF II vary significantly. This results in moderate average concentrations and large standard deviations for these species in CSSF II.

Figure 15 shows the absolute concentrations of Zr, F, and Ca in the calcine vary significantly among the CSSFs, but their relative concentrations are generally the same. The primary constituents of Zr waste, Zr and F, track each other because the Zr fuel-dissolution flowsheet dictated the use of a nearly constant F:Zr ratio to dissolve Zr-clad fuel, resulting in a nearly constant F:Zr ratio in Zr waste. Calcium was added to all fluoride-bearing waste during the calcination process to prevent F volatility in the calciner. Thus, the concentrations of Zr, F, and Ca in the calcine generally track each other.

The Al concentration in the calcine varies among the CSSFs and does not track any of the other major constituents. This variation occurs because of the multiple sources of Al with varying concentrations in the calcine. The Al concentration in CSSF I is high because CSSF I contains only Al calcine. The Al concentration in CSSFs III through V is lower than in CSSF I because CSSFs III through V contain primarily Zr calcine. The Al concentration in CSSF VI is relatively high because CSSF VI contains a significant amount of calcine that was made from a blend of aluminum nitrate (a major source of the Al) and SBW.

Figure 15. Average concentrations of the major chemical constituents of calcine.

5.1 Minor Chemical Constituents of Calcine

The concentrations of minor calcine constituents vary depending on the type of liquid waste from which the calcine was formed and calciner operating conditions. The concentrations of minor constituents often differ among calcine of the same general type. Figure 16 shows the average concentrations of six minor calcine constituents (Hg, Cd, Cr, Ni, nitrate, and alkali metals [combined sodium plus potassium]) for CSSFs I through VI. Figure 16 shows that the concentrations of minor constituents have some distinct trends and vary considerably among the CSSFs. Additional discussion on these and other chemical species is found in Section 5.3.

Figure 16 shows that the average Hg concentration is relatively high (nearly 2 wt%) in CSSF I, moderate (0.7 wt%) in CSSF II (with a large standard deviation), and virtually zero in CSSFs III through VI. Two factors, waste type and calciner operating temperature, controlled the Hg concentration in calcine. Mercuric nitrate was used as a catalyst to dissolve Al-clad fuel, and provided Hg in Al and coprocessing wastes. Hg was not found in Zr wastes except as a contaminant if the tank had previously held Al waste. When calcined at 400°C (1963 through 1969) with the use of the NaK heating coil, the calcine retained about 70% of the Hg in the liquid waste (Lakey and Bower 1963). However, when calcined at 500 to 600°C (1970 through 2000) with in-bed combustion heating, the calcine retained only about 1% of the Hg in the liquid waste (Newby 1980a, 1980b). Consequently, the Al calcine in CSSF I (and some bins in CSSF II) contains about 2 wt% Hg. The rest of the calcine contains very little Hg because Zr waste contained no Hg, and the bulk of the Hg in the Al and coprocessing wastes volatilized in the higher-temperature calcining process used after 1969.

Figure 16. Average concentrations of the minor chemical constituents of calcine.

The concentration of Cd varies significantly among the CSSFs. Figure 16 shows that there is virtually no Cd in CSSFs I through IV, a relatively large amount (2.8 wt%) in CSSF V and a moderate amount (0.7 wt%) in CSSF VI. Fission product Cd is present in all calcine in trace concentrations (about 1 ppm). Calcine derived from Fluorinel waste contains about 5 wt% Cd. Fluorinel was a Zr-clad fuel-dissolution process constructed in the mid 1980s to replace the original, aging, Zr-clad fuel-dissolution facility. The Fluorinel process used Cd as a soluble neutron poison for criticality control. The original Zr-fuel-reprocessing facility did not use Cd. Thus, large Cd concentrations exist only in

Fluorinel waste (and as a minor contaminant in some SBW). The Fluorinel calcine is in the upper half of CSSF V and the bottom third of CSSF VI.

Figure 16 shows the concentration of Cr varies among the CSSFs. Aluminum calcine contains a small amount of Cr from some of the Al alloys (such as Alloy 6061) used as fuel cladding. Zirconium calcine contains Cr from chromic acid that was used as an oxidant in the dissolution of most of the Zr fuel. In addition, Cr was contained in some of the stainless-steel components of Zr fuel. Chromium was not used as an oxidant in the Fluorinel dissolution process, so Fluorinel waste has less Cr than other Zr wastes. Chromium also was a principal constituent of wastes from the dissolution of stainless-steel-clad fuel. Figure 16 shows that the concentration of Cr correlates with the type of waste in each CSSF. CSSF I contains Al calcine and has the least amount of Cr. CSSF IV contains both Zr and stainless-steel waste and has the highest Cr concentration. CSSF VI contains a moderate amount of Cr because it also contains calcine derived from both Zr and stainless-steel waste. CSSFs III and V contain Zr calcine, but the Cr concentration in CSSF V is about half that of CSSF III because CSSF V contains Fluorinel calcine, which had less Cr than other Zr wastes.

Figure 16 shows the concentration of Nickel (Ni) in the calcine. The Al calcine contains virtually no Ni. The Zr calcine contains Ni from two sources; the Zr fuel cladding (Zircaloy) contained a small amount of Ni, and there was Ni in the stainless-steel fuel components of the Zr fuel. The highest concentration of Ni was in stainless-steel waste, because Ni was a significant component of the fuel cladding. Figure 16 shows the Ni content of the calcine in each CSSF correlates to the type of liquid waste calcined. No Ni is contained in the Al calcine in CSSF I. CSSFs IV and VI have the most Ni because those CSSFs contain calcine derived from both Zr and stainless-steel waste. The calcine in CSSFs III and V have a moderate amount of Ni associated with Zr calcine. CSSF II has a small amount of Ni because it contains both Al and Zr calcine.

The alkali content (combined concentration of sodium and potassium, or Na + K) correlates with the amount of nitrate (NO_3) in each CSSF. The amount of NO_3 in the calcine was calculated as a percentage of the alkali metals, which form nitrates in the calcine. The concentration of Na, K, and nitrate are low in CSSFs I through III. They gradually increase in CSSFs IV through VI because of efforts in the late 1970s through the 1990s to calcine SBW. High concentrations of alkali nitrates in the calcine could cause agglomeration of the calcine. To avoid calcine agglomeration, SBW was calcined as a blend with other wastes (Zr, Fluorinel, and Al), and in some cases with nonradioactive aluminum nitrate. Blending SBW with other wastes reduced the alkali content and the calcine agglomeration potential to a manageable level.

The correlation between nitrates and the alkali metals in CSSF VI differs slightly from the other five CSSFs. Figure 16 shows the alkali concentration in CSSF VI increased faster than the corresponding increase in the nitrate content. This is the result of a high-temperature (600°C) calcination flowsheet that was tested in 1999 and 2000. At the higher calcination temperature, Na and K formed more aluminates and less nitrates. The aluminates did not cause bed agglomeration problems. Thus, the concentration of alkali metals in the calcine is relatively higher and the nitrate content is relatively lower in the calcine in the upper portion of CSSF VI.

5.2 Detailed Discussion of Individual Chemical Constituents

Appendix C contains data plots showing the concentrations (in weight percent or parts per million) of the 29 chemical constituents in the calcine that comprise the bulk of the calcine and constituents of concern, such as RCRA metals. The data plots are arranged in alphabetical order (by chemical name) from aluminum to zirconium. The data plots provide chemical concentration data by bin segment in each bin, based on the location of level-indicating thermocouples in the bins. The data plots also show the

average concentration for each constituent in each CSSF. For CSSF I, the data plots include only the four largest (outer) bins. The calcine in CSSF I is relatively uniform in chemical composition. Plotting composition data for only the four largest bins simplifies the graphs and eliminates virtually redundant plots. The data plots are arranged with the bin-segment numbers (low to high) corresponding with the bin elevation (bottom to top). Thus, the data plots read left to right as the bins were filled (bottom to top) over time.

The data plots in Appendix C include two values for the average concentration and a standard deviation for each component in each CSSF. The “segment average” is the unweighted average of the bin-segment concentrations. It does not include very small segments that exist in some of the bins. The standard deviation is based on the bin-segment concentrations (excluding the very small segments). The “bin average” concentration is the total mass of a constituent in the CSSF divided by the total mass of calcine in the CSSF. The two average values are generally very close (within a few percent of each other), with the largest deviation in those bins where the sizes of the bin segments differ substantially.

This report section discusses each chemical constituent for which a data plot is provided in Appendix C. The chemicals are discussed in the same (alphabetical) order in which the data plots are presented in Appendix C. The discussion includes the major source of each constituent, reasons for significant concentration variations among calcine types, and the basis (such as sample data, bulk chemical usage, or fission-product yield) for each component’s concentration calculation.

The discussion of the calcine composition is simplified by the following general statements about the distribution of calcine among the CSSFs. CSSF I contains only Al calcine, CSSF II contains significant amounts of both Al and Zr calcine, CSSFs III through V contain primarily Zr and Zr/SBW blend calcine. CSSF VI contains both Zr/SBW blend and aluminum nitrate/SBW blend calcine. Therefore, discussions pertinent to the Al calcine in CSSF I also apply to the Al calcine in CSSF II. Discussions pertinent to the Zr and Zr/SBW blend calcine in CSSFs III through V also apply to the Zr calcine in CSSF II and the Zr/SBW blend calcine in CSSF VI. Discussions about aluminum nitrate/SBW blend calcine apply to that calcine in the upper portion of CSSF VI.

5.2.1 Aluminum

Aluminum (Al) is a significant component of all calcine. The Al came from a variety of sources. These sources include the Al fuel cladding in Al calcine, the aluminum nitrate used to complex F in the Zr fuel dissolver solution in Zr calcine, and from both the SBW and the aluminum nitrate used as a chemical additive in aluminum nitrate/SBW blend calcine. A small amount also came from the aluminum nitrate commonly used during calciner startups to transition between the startup bed and radioactive waste. The Al concentration in Al calcine (CSSF I) is very high, between 45 and 50 wt%, because Al was virtually the only cation in Al waste. The Al concentration in Zr calcine (CSSFs III through V) is much lower, as low as 8 wt% in some Zr calcine because Zr calcine has significant quantities of other cations, such as Zr and Ca, that reduce the percentage of Al in the calcine. The Al concentration in aluminum nitrate/SBW blend calcine (CSSF VI) is a moderate value (35 wt%). It came from both the SBW and the aluminum nitrate that was added to the SBW during the calcination process. The HPM calculates the Al concentration based on analyses of liquid wastes and the amount of bulk aluminum nitrate used as startup transition feed and for SBW blending.

5.2.2 Arsenic

Arsenic (As) is a trace component of all calcine, but has never been reliably detected in calcine analyses. Arsenic was not a component of any fuel-cladding alloy, nor was it used in any uranium-recovery or waste-treatment process. Trace amounts of As are present in calcine because As was a minor

fission product in spent nuclear fuel and may have been a trace contaminant in some chemicals used in fuel-dissolution and calcining processes. Arsenic is included in this report because it is a regulated RCRA metal and thus is a constituent of concern. RCRA metals are discussed in detail in Section 5.6.

Because As was not a significant component of INTEC wastes, it was not an analyte for most historical waste samples. However, in an effort to characterize RCRA wastes from the late 1980s and early 1990s, As was an analyte of many waste samples of Al, Zr, and SBW. Those analyses generally did not detect As in the waste. The concentration of As in calcine derived from fission yield is very small, less than 0.05 ppm. Any As present as a contaminant in the bulk chemicals used at INTEC could be well above the fission-yield value, but still below the laboratory detection value. The HPM uses the liquid sample data as its basis to calculate the As concentration in calcine. The HPM conservatively sets the As concentration in each type of liquid waste (Al, Zr, and SBW) equal to the laboratory detection limit of the late 1980s and early 1990s samples that were analyzed for As. This results in the As concentration in the liquid waste ranging from 1 to 2 mg/L. The Appendix C data plot shows the resulting As concentration in calcine is about 16 ppm in Al calcine, 8 to 10 ppm in Zr calcine, and 2 to 4 ppm in aluminum nitrate/SBW calcine. These values are consistent with calcine analyses in which As was not detected in either Al or Zr calcine, with a laboratory detection limit of 40 to 50 ppm (Patterson and Prather 2004).

Use of the laboratory detection limit as the As concentration yields some spurious As concentration data in the Appendix C data plots. For example, Bin WCS-140-1 in CSSF III was the last bin filled by the WCF before it shut down in March 1981. At the time, the objective for the WCF was to empty the Tank Farm to the maximum extent possible, and provide the most liquid waste storage space for fuel reprocessing in case the upcoming operation of the NWCF was delayed. To do this, the WCF processed a dilute Zr waste, which had a low dissolved-solids content. This operating strategy provided the most waste reduction in the Tank Farm. Assigning the same As value to that dilute Zr waste as to the other more concentrated wastes yields a significantly higher calculated As concentration in the calcine formed from the dilute waste, nearly double that of the concentrated Zr wastes. This elevated As concentration is not real, but an artifact of the method used to assign As concentrations to the liquid waste streams.

5.2.3 Barium

Barium (Ba) is a trace component of all calcine. Barium was not a component of any fuel-cladding alloy, nor was it used in any uranium-recovery or waste-treatment process. However, trace amounts of Ba are present in all calcine because it is a principle fission product in spent nuclear fuel. Some Ba also was present as a contaminant in the calcium nitrate added to fluoride-bearing wastes during the calcination process. Barium is included in this report because it is a regulated RCRA metal (see Section 5.6) and thus is a constituent of concern.

The Ba concentration follows that of radioactive fission products in the calcine. The Ba concentration ranges from 100 to 400 ppm in Zr and Al calcine, respectively. The Ba concentration is highest in Al calcine (CSSF I) because liquid Al waste had the fewest dissolved solids, which resulted in the highest liquid-to-solid concentration factor. The Ba concentration in Zr calcine (CSSFs III through V) is lower than that of Al calcine because the Zr waste had a lower liquid-to-solid concentration factor. The SBW blend calcine in CSSF VI has the lowest Ba concentration (as low as 20 ppm) because SBW had the lowest fission-product concentration.

Samples of Al, Zr, and SBW were analyzed for Ba in the late 1980s and 1990s during the effort to characterize RCRA wastes. The analyses detected low concentrations of Ba that were near the levels expected from fission yield. Therefore, the HPM calculates the Ba concentration in calcine based primarily on fission yield, using ORIGEN2-based waste models. In addition to the fission-product Ba,

the HPM adds a small amount of Ba to fluoride-bearing waste to account for the Ba found as a contaminant in calcium nitrate (based on bulk chemical usage and samples of calcium nitrate).

5.2.4 Boron

Boron (B) is present in small quantities in all calcine because of its use as an additive in various uranium-recovery and waste-treatment processes. Small amounts of boric acid were added to every batch of Al waste and aluminum nitrate/SBW blend that was calcined. The presence of small amounts of B in the calciner feed solution promoted the formation of amorphous instead of crystalline alumina calcine. Small, amorphous alumina calcine particles removed by the calciner off-gas scrubbing system were dissolved in the nitric acid scrubbing solution and recycled back to the calciner with the feed solution. Crystalline alpha alumina formed if B were not present in the feed solution. Alpha alumina particles removed by the off-gas scrubbing system were not soluble in nitric acid and generated unacceptably high concentrations of undissolved solids in the calciner off-gas scrubbing system (Lakey and Bower 1963). Boron also was present in all Zr calcine because B was used during Zr fuel dissolution as a neutron poison for criticality control, as discussed briefly in Section 4.3.1.

The B concentration in calcine varies from very low concentrations (0.1 wt%) in Al and aluminum nitrate/SBW blend calcine (CSSFs I and VI), to higher, but still minor, concentrations (1 wt%) in Zr calcine (CSSFs III through V). The HPM calculates the B concentration based on liquid waste analyses for Zr calcine, and bulk chemical (boric acid) usage data for Al and aluminum nitrate/SBW blend calcine.

5.2.5 Cadmium

Cadmium (Cd) is present as a trace fission product in all calcine, and as an important (because it is a regulated RCRA metal) minor component in the Zr calcine from the Fluorinel dissolution process. Cadmium was not a component of any fuel-cladding alloy, nor was it used in fuel reprocessing or waste-treatment processes except for the Fluorinel process. The Fluorinel process dissolved Zr fuel in the late 1980s and used Cd (cadmium nitrate and cadmium sulfate) as a soluble neutron poison for criticality control, as discussed briefly in Section 5. The Fluorinel process operated for two campaigns (about 2 years from late 1986 to late 1988) before fuel reprocessing ceased. Hence, Fluorinel calcine exists only in the upper half of CSSF V and the lower third of CSSF VI. Fluorinel calcine has a Cd concentration of about 5 wt% in CSSF V. Other calcine has (fission-product) Cd concentrations ranging from 3 ppm in Al calcine to 1 ppm in Zr calcine. The SBW calcine in CSSF VI contains 0.1 to 0.2 wt% Cd, which is more than the fission-product values of either Al or Zr calcine. The Cd in the SBW calcine in CSSF VI came from Fluorinel decontamination solutions. The HPM calculates the Cd concentration based on liquid-waste analyses for Fluorinel and SBW. The Cd concentration in the Al and Zr calcine is determined by ORIGEN2-based models and fission-product yield in a nuclear reactor.

5.2.6 Calcium

Calcium (Ca) is a major component of most calcine even though it was not a major component of any liquid waste. The primary source of Ca was the calcium nitrate added to fluoride-bearing waste during the calcination process. The Al calcine in CSSF I does not contain Ca because it does not contain F. The fluoride-bearing (Zr) calcine in CSSFs III through V contains significant quantities of Ca, up to 30 wt% in some calcine. The SBW calcine in CSSF VI contains small concentrations (3 to 5 wt%) of Ca because liquid SBW contained small amounts of F from decontamination waste.

Although the concentration of Ca is generally proportional to F, the Ca:F ratio varies between Zr waste and Zr/SBW blends. Generally, one of two Ca:F ratios was used as the basis for Ca addition to fluoride-bearing waste. When calcining Zr waste, Ca was usually added to achieve a Ca:F molar ratio

of 0.55, or 110% of the stoichiometric Ca requirement to form calcium fluoride. The extra 10% accommodated variations in laboratory results and volume measurements. When calcining Zr/SBW blends, a Ca:F molar ratio of 0.7 was generally used, resulting in the Zr/SBW blend calcine having relatively more Ca than Zr calcine. Table 4 shows both Zr and Fluorinel/SBW blend calcine compositions. The weight percent of both Zr and F in the SBW blend calcine is about two-thirds of the value in the Zr calcine because the solids from the SBW as well as the extra Ca “dilute” the solids from the Zr waste. The weight percent of Ca in the SBW blend calcine is about the same as that of the Zr calcine because of the higher Ca:F ratio used for the SBW blend.

A small amount of calcine contains Ca, but no Zr or F, because of the use of Ca-bearing material as calciner startup bed. The calciner required a startup bed of a granular material similar to calcine to begin the calcination process. Various materials were used as calciner startup beds. They included nonradioactive calcine from the calciner pilot plants and calcining facility test operations, dolomite ($\text{CaMg}(\text{CO}_3)_2$), and fluorapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$). Dolomite was the most often used startup bed material. Calcine containing dolomite or fluorapatite startup bed has an elevated Ca content relative to its Zr and F content. The calcine in CSSF I has no Ca, even from startup beds, because the WCF used nonradioactive alumina calcine from WCF testing as startup bed during WCF Campaign 1, when CSSF I was filled.

The HPM calculates the Ca concentration based on liquid-waste analyses, calcine-feed makeup datasheets, bulk-chemical (calcium nitrate, dolomite, and fluorapatite) usage records, and analyses of bulk calcium nitrate.

5.2.7 Carbonate

Carbonate (CO_3) is not a significant component of any calcine derived from radioactive waste because carbonate was not a significant constituent of the acidic waste. However, carbonate was a significant component of dolomite ($\text{CaMg}(\text{CO}_3)_2$), which was often used as calciner startup bed. The data plots in Appendix C show that the carbonate concentration in calcine was typically low (less than 2 wt%) with occasional large spikes, up to 43 wt% in the bottom segments of CSSF IV. The large carbonate concentration spikes correspond to calciner startups using dolomite and small bin segments that contain primarily dolomite. A typical NWCF calciner startup used 100 to 150 ft³ of startup bed. The calcine in CSSF IV includes two startup beds, one in the bottom of the bins and one where the bins are about two-thirds full. The bottom bin segments in CSSF IV contain only 42 ft³ of calcine, while other segments contain 560 ft³. The carbonate concentration in the bottom of CSSF IV is high because the segments are small and virtually filled with dolomite. The second calciner startup bed resulted in a much smaller increase in the carbonate concentration than the first startup, even though the amount of startup bed used was the same each time. The upper bin segments are much larger than the bottom bin segments and contain significant amounts of radioactive calcine, which has virtually no carbonate. This configuration reduces the average carbonate concentration in the upper segments that contain the second startup bed.

At times, the calciner generated large quantities of fines, which blew out of the calciner faster than bed material could be made. During such times, supplemental dolomite was added to the calciner to maintain the fluidized bed level at the proper level. This resulted in some dolomite-derived carbonate being in the calcine at times other than during a calciner startup.

When calculating the carbonate content of the calcine, only 50% of the carbonate in the dolomite charged to the calciners is assumed to be in the CSSFs. The dolomite was not screened prior to use and it contained a large fraction of very small particles. Dolomite was typically added to the calciner during startups, when the fluidizing air flow was much higher than normal to heat the startup bed. The high fluidizing airflow blew the very small dolomite particles out of the calciner and into the off-gas system. The high fluidizing airflow also provided a motive force for particle attrition, which resulted in more fines

and additional loss of bed material. As a result, a large fraction (assumed to be 50% based on historical operating experience) of the startup bed went into the acidic off-gas quench/scrub system, where the dolomite dissolved and the carbonate evolved as carbon dioxide gas and was released.

Trace amounts of carbonate may be in the calcine derived from the carbon dioxide generated by the in-bed combustion of kerosene and from carbon dioxide in the air. Estimates of the concentration of such carbonate in calcine are very low, less than 0.1 wt% for the calcine generated with the in-bed combustion process, which generated high concentrations of carbon dioxide (Christian 2004). The carbonate concentration in calcine generated by use of indirect heating is even lower. The amount of carbonate derived from carbon dioxide in the air is very small compared to the amount from the dolomite, so it was ignored in the calcine composition estimates. The HPM calculates the carbonate concentration based on the amount of dolomite startup bed charged to the calciner, which was documented on calciner operating datasheets, and bulk chemical usage data.

5.2.8 Cesium

Cesium (Cs) is not a significant chemical component of any calcine, other than radioactive Cs-137. This report estimates the Cs concentration because some historical waste treatment studies evaluated removing Cs-137 from dissolved calcine using an ion-exchange system (Raytheon 1994). Such a system also would remove stable Cs isotopes. Knowing the total amount of Cs in the calcine was important in sizing the ion-exchange units. Future calcine treatment processes may consider using similar technology, so the Cs concentration in the calcine is provided.

The primary source of Cs in the calcine was fission products in spent nuclear fuel. Smaller amounts came as contaminants in the dolomite and fluorapatite used as calciner startup beds. The concentration of Cs follows the fission products. It is about 400 ppm in Al calcine (CSSF I), 100 ppm in Zr calcine (CSSFs III through V), and 40 ppm in SBW blend calcine (CSSF VI). The Cs concentration is highest in Al calcine because liquid Al waste had the fewest dissolved solids, which resulted in the highest liquid-to-solid concentration factor. The calcine in CSSF VI has the lowest Cs concentration because much of the calcine in CSSF VI is derived from SBW, which had the lowest concentration of fission products and thus has the lowest Cs concentration. The HPM calculates the Cs (mass) concentration based on fission-yield calculations from ORIGEN2-based waste models and bulk chemical analyses.

5.2.9 Chloride

Chloride (Cl) is a minor component of calcine. Most of the liquid waste that was calcined (first-cycle raffinate) had low Cl concentrations (less than 100 ppm), consequently there is little Cl in most calcine. Most of the Cl in the waste came as a contaminant in bulk chemicals used at INTEC, especially decontamination chemicals. The fuel storage basin waste-treatment systems used Cl-containing chemicals to kill bacteria and algae. Decontamination and basin water treatment wastes were typically concentrated by evaporation. This resulted in high Cl concentrations in the evaporator concentrate, which was added to the SBW. As a result, the Cl concentration was significant in SBW, reaching concentrations of nearly 2,000 ppm in some SBW. Calcine that contains little or no SBW (CSSFs I and II) typically has a low Cl concentration, less than 400 ppm. Calcine containing moderate amounts of SBW (CSSFs III through V) has Cl concentrations of 0.1 to 0.2 wt% (1,000 to 2,000 ppm). The SBW-blend calcine in CSSF VI contains the most Cl, up to 0.35 wt% (3,500 ppm). The HPM makes no adjustment for Cl volatility in the calciner, so the HPM-calculated Cl concentration in calcine may be slightly high for some wastes because some Cl volatilized and went into the calciner off-gas scrubbing system. The HPM calculates Cl concentration based on representative liquid waste sample data and bulk chemical analyses.

5.2.10 Chromium

Chromium (Cr) is a minor constituent of nearly all calcine. The two main sources of Cr in the calcine are; a chemical additive used in fuel reprocessing, and a fuel-cladding alloy component. Chromic acid was used as an oxidizer in most of the Zr-clad fuel-dissolution campaigns to aid in the dissolution of Sn and other fuel components. Chromic acid was used in periodic dissolver “heel out” operations to remove a scale of uranium tetrafluoride that could collect on the dissolver vessel walls during fuel dissolution. Chromic acid also was used as an oxidizer in Al fuel-reprocessing campaigns during Np-237 recovery operations to oxidize Np-237 to an extractable oxidation state.

Chromium was a component of many of the alloys used for fuel cladding and other fuel components. Stainless steel (Types 304 and 316) fuel cladding and components contained about 20 wt% Cr. Some Al-cladding alloys also contained Cr (Alloy 6061 contained about 0.2 wt%). The Cr content of Al calcine (in CSSF I) varies from near zero in calcine derived from Cr-free Al alloys, to about 0.06 wt% in calcine derived from Cr-bearing alloys. The Cr concentration is higher in Zr calcine (CSSFs III through V), ranging from 0.15 to 0.35 wt%. The Cr concentration in the SBW calcine in CSSF VI varies from 0.05 to 0.1 wt%. The Cr concentration of the calcine increases noticeably in the upper portion of CSSF IV and lower portion of CSSF V. That calcine was derived from a blend of Zr and stainless-steel wastes (Streams 61, 62, 63, and 70) that contained relatively high concentrations of Cr from the stainless-steel component of the waste. A similar increase occurs in the middle of CSSF VI, when a second blend of stainless-steel fuel waste (Stream 86) was calcined. The lowest (first) segment of Bin WS6-154 in CSSF VI contains much more Cr than the first segments in the other bins. This is because that bin segment contains some pilot plant calcine that had a relatively high Cr content. The HPM calculates the Cr concentration based on fuel-cladding alloy metallurgy, historical fuel-reprocessing flowsheets, and liquid-waste sample data.

5.2.11 Fluoride

Fluoride (F) is a major constituent of most INTEC calcine. Hydrofluoric acid (HF) was used to dissolve Zr-clad fuel and is the source of the bulk of the F in the calcine. Thus, the F and Zr concentrations generally track each other. The lower portion of CSSF V contains calcine with a higher-than-normal F:Zr ratio because it includes Rover waste. As discussed in Section 4.3, Rover was a graphite matrix fuel. Reprocessing Rover fuel included burning the graphite matrix and dissolving the resulting ash with HF. Reprocessing Rover fuel created a fluoride-bearing waste that did not contain any Zr. Rover waste was processed as a blend with Zr and SBW, resulting in calcine with a reduced amount of Zr compared to the amount of F. Very small amounts of F came from fluorapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$) that was used briefly as a calciner startup bed. The fluorapatite startup bed is in CSSF III. The F concentration in calcine varies from virtually zero in Al calcine (CSSF I), to as high as 27 wt% in Zr calcine (CSSFs III through V). The SBW blend calcine in the upper portion of CSSF VI contains about 1 wt% F from the decontamination of equipment contaminated with fluoride-bearing waste. The bottom (first) segment in Bin WS6-154 in CSSF VI contains much more F than the other first segments of CSSF VI. This amount is because the bin contains pilot plant calcine with a higher F content than the calcine in the bottom of the other bins. The HPM calculates the F concentration in calcine based on liquid-waste analyses.

5.2.12 Iron

Iron (Fe) is a minor constituent of all INTEC calcine. The iron came from several sources including chemicals used in fuel reprocessing such as ferrous ammonium sulfate and ferrous sulfamate (reducing agents in the uranium extraction/purification process), stainless-steel fuel cladding, and stainless-steel components of Zr-clad fuel. The Fe concentration in Al calcine (CSSF I) varies from 0.3 to 1.3 wt%.

The Fe concentration in most Zr calcine (CSSFs III through V) varies from 0.3 to 0.5 wt%. The Fe concentration in the Zr calcine in the top of CSSF IV, bottom of CSSF V, and the middle of CSSF VI is higher (0.7 to 1.0 wt%) than other Zr calcine. The calcine with elevated Fe concentrations is derived from blends of stainless-steel wastes, which contained relatively high Fe concentrations. The HPM calculates the Fe concentration based on liquid-waste analyses, process knowledge, and stainless-steel metallurgy.

5.2.13 Lead

Lead (Pb) was not a component of any fuel alloy or routinely used bulk chemical in the fuel or waste-treatment processes and is not a significant component of any calcine. Lead is included in this report because it is a regulated RCRA metal (see Section 5.6) and thus is a constituent of concern. All calcine contains trace amounts of lead from the radioactive decay of uranium and the actinides. The largest source of lead was the corrosion of lead that was used as radiation shielding material. Lead was used as shielding, and it dissolved if it was unprotected and exposed to nitric acid-based decontamination solutions. Decontamination solutions were generally concentrated and added to the SBW. Consequently, calcine derived from SBW has the highest Pb concentration.

Because Pb is not a significant constituent of INTEC waste, it was seldom an analyte in historical samples. However, many samples of Al, Zr, and SBW were analyzed for Pb in the late 1980s and early 1990s during an effort to characterize all RCRA wastes. Lead was detected in very low concentrations in Al waste (6 mg/L), and in higher concentrations (250 mg/L) in SBW. These values were assigned to all historical Al and SBW. Lead was not detected in Zr waste, so the Pb concentration in Zr waste was set at the laboratory detection limit (0.7 mg/L).

The calculated Pb concentration in calcine varies from 60 to 4 ppm for the Al and Zr calcine located in CSSFs I and II. The lead concentration increases as the amount of SBW in the Zr/SBW blend calcine increases in CSSFs III through V, ranging between 100 and 300 ppm. Calcine in CSSF VI derived from SBW contains the highest concentration of Pb (about 900 ppm). The HPM calculates the Pb concentration based on representative liquid-waste analyses.

5.2.14 Magnesium

Magnesium (Mg) is found in small quantities in all calcine. The Mg in the calcine has several sources. Most Al calcine contains Mg because it was a minor component in some Al fuel cladding (Alloy 6061 had nearly 1 wt% Mg). Magnesium was a minor contaminant (0.13 wt%) in the bulk calcium nitrate added to fluoride-bearing wastes during the calcination process. The Mg concentration varies from about 0.1 to 0.3 wt% in the calcine derived from radioactive waste, where the Mg comes from the Al-cladding alloy and calcium nitrate additive. Magnesium was a significant component of dolomite ($\text{CaMg}(\text{CO}_3)_2$) that was often used as the calciner startup bed. The dolomite causes the large spikes in the Mg concentration in the Appendix C data plot, especially in the small bin segments. The Mg concentration spikes up to 17 wt% in the small bin segments containing dolomite in the bottom of CSSF IV. The HPM calculates the Mg concentration based on samples and amounts of bulk chemicals used in the waste-treatment processes, fuel-cladding metallurgy, and limited liquid-waste sample data.

5.2.15 Manganese

Manganese (Mn) is a minor constituent of all calcine. There are several sources of Mn in the calcine. The most significant source is the stainless steel used for fuel cladding and some Zr fuel components (Type 304 stainless steel contains up to 2 wt% Mn). Most Al calcine contains trace quantities of Mn from the Al alloys used for cladding (Alloy 6061 had about 0.1 wt% Mn). Some Mn was present as a contaminant (0.06 wt%) in the bulk calcium nitrate added to fluoride-bearing wastes. The Mn

concentration in Al calcine (CSSF I) is about 200 ppm. The Mn concentration in Zr calcine (CSSFs III through V) varies from 500 to 1,500 ppm. The Mn concentration is highest in the SBW blend calcine (CSSF VI) and varies from 2000 to 2400 ppm. The SBW blend calcine has the highest Mn concentration because permanganate was a component of some of the chemicals used in decontamination solutions. The spent decontamination solutions were concentrated and added to the SBW storage tanks. The HPM calculates the Mn concentration based on fuel cladding metallurgy, samples of bulk chemicals used in waste-treatment processes, and liquid waste sample data.

5.2.16 Mercury

Mercury (Hg) is a minor constituent in Al calcine generated prior to 1970, as discussed in Section 5.1, but is present in only trace quantities in the rest of the calcine. The source of the Hg was mercuric nitrate that was used as a catalyst in the dissolution of Al-clad fuel. Liquid Al waste contained approximately 3 g/L Hg. Coprocessing waste, which was a mixture of Al and Zr wastes, contained Hg from the portion of waste derived from Al fuel reprocessing. Although Hg was not used in the Zr fuel-reprocessing system, some of the Zr waste was contaminated with small amounts of Hg because of the reuse of Tank Farm storage tanks. Initially, most Tank Farm tanks stored Hg-bearing Al waste. Some of the tanks were emptied (waste was calcined) and refilled with Zr waste. However, the “emptied” tanks typically contained a “heel” of 5,000 to 15,000 gal of waste that could not be removed with the installed waste transfer equipment. The Al waste heel provided a small amount of Hg to the otherwise Hg-free Zr waste when the tanks were refilled with Zr waste.

Mercury volatilizes at elevated temperatures, and only a portion of the Hg in the liquid waste remained in the solids during calcination. Based on pilot plant studies and historical calcine samples, 70% of the Hg in the liquid waste remained in the calcine in the 1960s when the calciner operated with indirect (NaK) heating at 400°C (Lakey and Bower 1963). Both calciners (WCF and NWCF) used in-bed combustion of kerosene and operated at 500 to 600°C from 1970 through 2000, which increased the volatilization of Hg. Based on pilot plant data (Newby 1980a, 1980b) and calcine samples¹, an estimated 1% of the Hg remained in the calcine when the calciner used in-bed combustion of kerosene. Therefore, calcine produced after 1969 (CSSFs III through VI) contains much less Hg than the calcine produced in the 1960s.

The Hg data plot in Appendix C shows the effect of the calciner heating method on the Hg content of the calcine. Calcine generated from Al waste during the first three WCF campaigns with indirect heating (stored in CSSFs I and II) contains 1.8 to 2.5 wt% Hg. The rest of the calcine (CSSFs III through VI) contains only trace amounts of Hg, varying from 1 to 80 ppm, depending on the type of waste that was calcined. The HPM calculates the Hg concentration based on liquid-waste analyses and the calciner heating method, which dictates the percentage of Hg retained in the calcine.

5.2.17 Nickel

Nickel (Ni) is a minor component of calcine derived from Zr and stainless-steel wastes, but is virtually nonexistent in Al calcine. The Ni in the calcine had two primary sources. Ni was a minor constituent (0.05 wt%) of the Zircaloy used for Zr fuel cladding. Ni was a major component (10 wt%) of the stainless steel (Types 304 and 316) used for fuel cladding and some Zr fuel components. Al fuel cladding contained no Ni, so there is virtually no Ni in the Al calcine in CSSF I. The Ni concentration in most of the Zr calcine (CSSFs III through VI) is 400 to 600 ppm. The Ni concentration in the calcine in

1. Schindler, R. E., “Mercury Behavior During NWCF Run H-4 Operation”, Lockheed Martin Idaho Technologies Company Interdepartmental Communication, to B. H. O’Brien, SCHI-25-97, October 16, 1997.

the upper portion of CSSF IV, lower portion of CSSF V, and middle portion of CSSF VI is higher (1,100 ppm) than other Zr calcine. That calcine is derived from a blend of Zr and stainless-steel waste that contained higher concentrations of Ni than the typical Zr waste. The HPM calculates the Ni concentration based on fuel cladding and component metallurgy and representative samples of liquid wastes.

5.2.18 Nitrate

Nitrate is an important minor constituent of all calcine because of its capability to become gaseous and form nitrogen oxides (NO_x), during waste treatment operations. All liquid wastes contained high (2 to 5 molar) nitrate concentrations from the extensive use of nitric acid, aluminum nitrate, and calcium nitrate in the fuel-reprocessing and waste-treatment systems. During calcination, most of the nitrates were converted into oxides of nitrogen and evolved as gases from the calciner. As discussed in Section 4.1, pilot plant and thermodynamic studies indicate that a small portion of the nitrates remained in the calcine (O'Brien 1995). The bulk of the nitrates retained in the calcine were associated with the alkali metals Na and K. Pilot plant data indicate that about 66 atom percent of the alkali metals formed nitrates when the calciners operated in the 400 to 500°C range. That value fell to 23 atom percent during high-temperature (600°C) operation.

The calcine nitrate concentration varies from 1 to 13 wt%, depending on both the alkali metal concentration and the calciner operating temperature. The nitrate concentration of the newer calcine in CSSFs IV, V, and VI is generally higher than that of the older calcine in CSSFs I, II, and III because of the emphasis on calcining SBW from the late 1970s through the 1990s. Calcination of SBW generated calcine with a higher alkali metal concentration and corresponding higher nitrate concentration. An exception to this is the nitrate concentration in the upper portion of CSSF VI calcine is much lower (about half) than that in the middle portion, despite an increase in the alkali metal content in the calcine in the upper portion. The calcine in the upper portion of CSSF VI was generated with the high-temperature calcination flowsheet. The high-temperature flowsheet resulted in the alkali metals forming more aluminates and less nitrates, which reduced the nitrate content of the calcine.^j The HPM calculates the nitrate content based on pilot plant studies, calciner operating temperature, and liquid-waste analyses (for Na and K).

5.2.19 Oxygen

Most of the metals dissolved in the liquid waste formed oxides in the calcination process, making oxygen a significant constituent of all calcine. The oxide concentration in calcine was calculated by adding enough oxygen to the calcine composition to balance the charges of all the cations and anions. The oxide concentration is highest (45 wt%) in Al calcine (CSSF I) because no significant nonvolatile anions were in the waste. The oxide concentration is lowest (15 to 20 wt%) in Zr calcine (CSSFs III through V) because significant amounts of other anions (especially F) reduced the amount of oxygen necessary for a charge balance. The HPM calculates the oxide concentration based on a charge balance of the other calcine species, most of which are based on liquid-waste sample analyses.

5.2.20 Phosphate

Phosphate is a minor constituent of virtually all calcine. Most of the phosphate came from the tributyl phosphate (TBP) that was used to extract uranium from the fuel dissolver product during most of the operating history of the first-cycle extraction system. A small amount of phosphate also came as a contaminant in the calcium nitrate (0.015 wt%) that was added to fluoride-bearing waste during the calcination process. The phosphate concentration in most calcine is low, typically between 0.5 and 2.0 wt%. The exception is in Bin VES-WCS-140-2 in CSSF III, where the phosphate concentration is about 12 wt% in an upper bin segment. During late 1978 and early 1979, fluorapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$),

which contains 57 wt% phosphate, was tested as an alternative to dolomite as a calciner startup bed. Fluorapatite offered some advantages to dolomite as a startup bed, such as less erosion. Most of the fluorapatite used as startup bed went into the upper portion of Bin-VES-140-2, increasing the phosphate concentration of that bin well above the average value. The HPM calculates the phosphate concentration based on historical fuel-reprocessing flowsheets, bulk-chemical analyses, calciner startup bed records, and representative liquid-waste analyses.

5.2.21 Potassium

Potassium (K) is present in virtually all calcine. Potassium was present as a contaminant in many of the bulk chemicals used in both fuel and waste-processing activities. The highest K concentration was in SBW, where it often accompanied sodium as a primary component in the alkali salts (hydroxides, permanganates, and carbonates) used in equipment decontamination and scrubbers. Wastes from such operations provided much of the alkali content of SBW. The K concentration in calcine ranges from 0.2 to 2 wt%. The K concentration of the newer calcine in CSSFs IV, V, and VI is generally higher than that of the older calcine in CSSFs I, II, and III because of the emphasis on calcining SBW from the late 1970s through the 1990s. The K concentration is highest in CSSF VI (about 2 wt%) because CSSF VI contains the most calcine derived from SBW. The HPM calculates the K concentration based on liquid-waste analyses.

5.2.22 Selenium

Selenium (Se) is not a significant component of any calcine. It was not a component of any fuel-cladding alloy, nor was it used in any uranium-recovery or waste-treatment process. However, trace amounts of Se are present in all calcine because Se is a minor fission product in a nuclear reactor. Selenium is included in this report because it is a regulated RCRA metal and thus is a constituent of concern. Because Se was not a significant component of INTEC wastes, Se was not an analyte in most historical waste analyses. However, many Al, Zr, and SBW waste samples were analyzed for Se in the late 1980s and 1990s during the RCRA waste characterization effort. Most of those analyses did not detect any Se in the waste. However, some found Se concentrations very near the laboratory detection limit. A review of the Se sample data found the detected values of Se were very near the amount expected from fission yield in a nuclear reactor. Therefore, the HPM sets the Se concentration in the liquid waste at its fission-yield value.

The Se concentration in Zr and Al calcine ranges from 2 to 12 ppm, and follows the same trend as the major fission products. The Se concentration is highest (9 to 12 ppm) in Al calcine (CSSF I) because liquid Al waste had fewer dissolved solids, which resulted in the highest liquid-to-solid concentration factor. Zirconium calcine (CSSFs III through V) contains moderate concentrations of Se (2 to 5 ppm). The SBW calcine (CSSF VI) has the lowest Se concentration (0.5 ppm). Sodium-bearing waste has the lowest concentration of fission products and thus its calcine has the lowest Se concentration. The HPM calculates the Se concentration based on representative liquid waste sampling and fission product yield in a nuclear reactor using ORIGEN2-based waste models.

5.2.23 Silver

Silver (Ag) is not a significant component of any calcine. It was not a component of any fuel-cladding alloy, nor was it used in any uranium-recovery process. The only INTEC process to use silver was a small dissolver off-gas scrubbing system in the Rare Gas Plant that used silver nitrate to remove iodine for a short period in the 1950s. However, the amount of Ag used in the process was not significant enough to be detected in the Tank Farm liquid waste. Trace amounts of Ag are present in all

calcine because Ag is a minor fission product in a nuclear reactor. Silver is included in this report because it is a regulated RCRA metal (see Section 5.6) and thus is a constituent of concern.

Because Ag was not a significant component of INTEC wastes, Ag was not an analyte for most historical waste analyses. However, many Al, Zr, and SBW samples were analyzed for Ag in the late 1980s and 1990s as part of the RCRA waste characterization program. The results of the Ag analyses were extremely variable. Many of the analyses did not detect Ag in the waste, with detection values ranging from 1 to 8 ppm. However, some analyses found relatively high concentrations of Ag in the same wastes, with values approaching 300 ppm. For example, analyses of Zr waste from Tank VES-WM-187 ranged from no Ag detected (less than 2.6 mg/L) to as high as 260 mg/L, a difference of two orders of magnitude. Laboratory personnel who performed those analyses indicated species such as Fe and Al, which were present in the waste, interfered with the Ag analysis and likely resulted in false positive values for Ag.

Analyses of calcine produced from the Zr waste that had the high (presumed) false values for Ag confirmed that there was likely no detectable Ag in the liquid waste. The calcine analysis (Patterson and Prather 2004) found no detectable Ag, with a laboratory detection level of 15 ppm. This detection level in calcine corresponds to a detection level in the liquid waste of about 2.6 mg/L, the same value as many of the “less than detection” values in the liquid-waste analysis.

The Rare Gas Plant dissolver off-gas system that used silver nitrate for a short period of time in the 1950s was removed from service and flushed in 1958. Any residual silver from that system would have been sent to Tank VES-WM-184 as SBW. That waste stayed in VES-WM-184 until March 1981, when about half of it was transferred to Tank VES-WM-180. The waste in VES-WM-180 was sampled and analyzed for silver in 1993. Four of the six VES-WM-180 waste samples had no detectable Ag (detection level of about 2.5 mg/L). Two of the six samples had detectable Ag concentrations of about 0.5 mg/L. Based on process knowledge, this waste had the highest silver concentration of any Tank Farm waste because of the silver nitrate from the Rare Gas Plant scrubber solution. However, its measured concentration was very low.

The calcine analysis, VES-WM-180 waste analysis, and discussions with laboratory personnel all indicate that the elevated Ag concentrations from some of the waste analyses are incorrect and the “non-detects” are the more correct analytical values. Therefore, the Ag concentration in the liquid waste was set at values corresponding to laboratory detection levels in Zr and SBW (2.6 and 5 mg/L, respectively) and at the average of several potentially valid sample values (1.6 mg/L) in Al waste. The resulting Ag concentration in the calcine ranges from 10 to 20 ppm. This level is consistent with calcine sample analyses, which found no detectable Ag, with detection limits of 15 to 30 ppm.

Assigning Ag concentrations to wastes based on waste type as described above results in some spurious calcine composition data. For example, Bin VES-WCS-140-1 in CSSF III was the last bin filled by the WCF before it shut down in March 1981. At the time, the objective for WCF was to empty the Tank Farm to the maximum extent possible, and provide the most liquid waste storage space for fuel reprocessing in case operation of the NWCF was delayed. To do this, the WCF processed a dilute Zr waste, with a low dissolved solids content. This operating strategy provided the most waste reduction in the Tank Farm. Assigning the same Ag value to that dilute waste as to the more concentrated Zr wastes yields a significantly higher calculated Ag concentration in the calcine formed from the dilute waste, nearly double that of the concentrated Zr wastes. Similar to the elevated concentration of As (see Section 5.2.2), the elevated Ag concentration is not real, but an artifact of the method used to assign Ag concentrations to waste streams.

5.2.24 Sodium

Sodium (Na) is a minor (1 to 2 wt%) constituent of most calcine, but it is a significant component (9 wt%) in some of the SBW blend calcine in CSSF VI. Sodium was a primary component of many chemicals used in scrubbing systems, ion-exchange systems, and decontamination processes. These chemicals included sodium carbonate, sodium nitrate, sodium hydroxide, and sodium permanganate. These chemicals were used in processes that produced low activity wastes that were typically concentrated, then stored as SBW. Sodium also was a common contaminant in many of the bulk chemicals (such as calcium nitrate) used at INTEC. Tables A1 and A2 in Appendix A show sodium nitrate as a “cold chemical” that was added to the nonradioactive startup feed solutions. That sodium nitrate was a contaminant in the aluminum nitrate used during the first two calciner operating campaigns from 1963 to 1968.

Most of the Al and Zr calcine in CSSFs I through III contains 1 to 2 wt% Na. The Na in the Al and Zr calcine came from sodium carbonate that was used in the fuel-reprocessing system to scrub solvent decomposition products from the extraction system, and as a contaminant in some of the chemicals used in the process. The calcine in CSSFs IV through VI has a gradually increasing amount of Na because of a concerted effort to calcine SBW from the late 1970s through the 1990s. The calcine in the upper part of CSSF VI has the highest Na concentration (averaging 9 wt%). That calcine was made with the high-temperature calcination flowsheet in 1999 and 2000. The high-temperature calcination flowsheet was specifically designed to increase the amount of Na in the calcine and thus increase the SBW processing efficiency. The Na concentration in the calcine is based on liquid-waste sample analyses.

5.2.25 Strontium

Strontium (Sr) is not a significant chemical in calcine, other than radioactive Sr-90. This report includes the Sr concentration because some historical waste-treatment studies evaluated removing Sr-90 from dissolved calcine using either an ion-exchange or liquid-extraction system (Raytheon 1994). Such systems would also remove all stable Sr isotopes as well as Sr-90. Knowing the total amount of Sr in the calcine was important in sizing equipment such as ion-exchange units, because the radioactive Sr-90 constitutes a small portion (about 1%) of the total Sr in the calcine. A future calcine treatment process may use similar technology, so the total Sr concentration is provided in this report.

The primary source of Sr was the calcium nitrate (in which Sr was a contaminant) that was added to fluoride-bearing wastes during the calcination process. As a result, the Sr concentration generally tracks the Ca concentration. The bulk of the calcium nitrate used by the calciners was manufactured by Norsk from phosphate sources that were relatively rich in Sr (as high as 2,600-ppm Sr). The Sr concentration calculation assumes an average Sr concentration of 2,070-ppm Sr in the Norsk calcium nitrate. Calcium nitrate from Thatcher Chemical was used between June 1993 and March 1998. The Thatcher calcium nitrate had a much lower Sr concentration, averaging 143 ppm in the solids. Smaller amounts of Sr came as nuclear fission products and as contaminants in the dolomite and fluorapatite used as calciner startup beds.

The concentration of Sr is about 0.3 wt% in Zr calcine (CSSFs III through V), and 0.01 to 0.02 wt% in Al and SBW calcine (CSSFs I and VI, respectively). Zirconium calcine contains the most Sr because it contains calcium nitrate, which is the major source of Sr. The use of Thatcher calcium nitrate, with its low Sr content, in the mid 1990s accounts for the very low Sr concentration in Segments 3 and 4 of CSSF VI compared to the calcium concentration in those segments. The HPM calculates the Sr concentration based on bulk chemical usage, vendor data, and fission-product-yield calculations.

5.2.26 Sulfate

Sulfate is a minor component of all calcine. Sulfate came primarily from the bulk chemicals used in fuel and waste-treatment processes. These included ferrous ammonium sulfate, which was used as a reducing agent in the second- and third-cycle uranium purification processes, and cadmium sulfate, which was used in the Fluorinel dissolution process as a neutron poison for criticality control. Trace quantities of sulfate also were present in the calcium nitrate added to fluoride-bearing wastes during the calcination process.

The sulfate content in most of the calcine ranges from 1.5 to 2.5 wt%. The calcine in the upper half of CSSF V has a higher sulfate concentration (about 3.5 wt%). The high sulfate concentration in CSSF V comes from Fluorinel waste and its cadmium sulfate. The HPM calculates the sulfate concentration based on representative liquid-waste analyses, bulk-chemical analyses, and fuel-reprocessing knowledge.

5.2.27 Tin

Tin (Sn) is present in all calcine in varying amounts. The largest source of Sn was the Zircaloy used as Zr fuel cladding. Zircaloy contained about 1.5 wt% Sn as a minor alloy component. Tin also was present in trace quantities as a fission product from the spent nuclear fuel. These two sources account for a trace amount (5 ppm) of Sn in Al calcine (CSSF I) and a small amount (0.1 to 0.3 wt%) of Sn in Zr calcine (CSSFs III through V). The SBW calcine in CSSF VI contains about 0.01 wt% Sn, primarily from the portion of waste derived from the decontamination of equipment contaminated with Zr waste. The lower portion of CSSF V contains a noticeable dip in the Sn concentration. This decrease is the result of the calcination of a blend of Zr and Rover wastes. The Rover wastes contained Al, Ca, and F like other Zr wastes, but it had no Zr and consequently no Sn. The HPM calculates the Sn concentration based on fuel-cladding metallurgy, liquid-waste sample analyses (Zr concentration from which Sn is calculated), and fission-product-yield calculations.

5.2.28 Uranium

Uranium (U) is present in all calcine. The U in the calcined waste had two sources: highly enriched U from fuel reprocessing, and natural or depleted U from pilot plant testing. Highly enriched U from fuel reprocessing had about 60 wt% U-235. The concentration of enriched U in calcine is generally very low because the U extraction process was very efficient. The enriched U concentration is 80 to 100 ppm in Al calcine (CSSF I) and 10 to 30 ppm in most Zr calcine (CSSFs III through V). An exception is the calcine in the top of CSSF V and the bottom of CSSF VI, which contains 100 to 150 ppm enriched U. That calcine contains a blend of Zr and Al waste. The Al waste (Waste Stream 83) contained more enriched U than other wastes because it contained second- and third-cycle raffinates from several fuel-reprocessing campaigns. The SBW blend calcine (CSSF VI) contains about 60 ppm enriched U.

The second source of U was the INTEC pilot plants where natural or depleted U was used in fuel-dissolution and U-extraction studies. The U-bearing pilot plant waste solutions were sent to a waste evaporator for concentration with other low-activity wastes. The evaporator concentrate was sent to the Tank Farm as SBW. The total U concentration in SBW (primarily depleted and natural U) was typically an order of magnitude higher than the highly enriched U in the fuel-reprocessing raffinates. As a result, the total U in the calcine increases steadily in CSSFs IV through VI as progressively more SBW was calcined from the late 1970s through the 1990s. The total U concentration in Al calcine (CSSF I) is 80 to 100 ppm (all enriched U). The total U concentration in Zr calcine (CSSFs III through V) increases steadily from 10 to 170 ppm as the SBW (with its natural or depleted U) content of the calcine increases. The U data plot in Appendix C shows one significant exception to this general trend in the bottom of CSSF V where the total U spikes up to about 270 ppm. That U concentration spike is natural U that came

from testing of the Rover fuel-reprocessing system. Prior to the Rover fuel-reprocessing campaign, three batches of natural U were dissolved in the Rover equipment as part of preoperational system testing and operator training. The natural U was not recovered from the test solution by the uranium-extraction system. Instead, it was transferred to the Tank Farm and calcined, generating the high U concentration in the bottom of CSSF V. The total U in the SBW blend calcine (CSSF VI) varies from 200 to 400 ppm, the bulk of which is natural or depleted U. The HPM calculates the total U concentration based on liquid-waste analyses. The HPM calculates isotopic U concentrations by applying typical U isotopic values (from samples of representative wastes) to the total U concentrations measured in waste samples.

5.2.29 Zirconium

Zirconium (Zr) is a major constituent of most of the INTEC calcine. Zirconium-clad fuel was dissolved in hydrofluoric acid and was the source of the bulk of the Zr in the calcine. Zr is a major fission product in a nuclear reactor, so Al calcine contains a small amount of fission-product Zr. The Zr concentration in calcine varies from trace quantities (750 ppm) in Al calcine (CSSF I), to a range of 10 to 18 wt% in Zr calcine (CSSFs III through V). The Zr concentration in the SBW calcine (CSSF VI) is about 0.5 wt%. The Zr in SBW came from decontamination of process equipment contaminated with Zr waste. The HPM calculates the Zr concentration based on analyses of liquid wastes for Zr and SBW, and fission-product-yield calculations for Al waste.

5.3 Fission-Product Activity of Calcine

The radionuclide activity of the calcine varies among the CSSFs and within individual bins. The fission-product activity in the calcine is a function of uranium burnup in the reprocessed fuel, the age of the waste, and the dissolved solids content of the liquid waste from which the calcine was formed.

During fuel reprocessing, the bulk (more than 99.9%) of the fission products were separated from the uranium in the first-cycle extraction system and went with the first-cycle raffinate to the Tank Farm. The fission products produced in a reactor are largely independent of the fuel-cladding material or uranium enrichment. The fission-product activity of the first-cycle raffinate was primarily a function of uranium burnup and the age of the waste. Fuels with high uranium burnup had higher fission-product activity than fuels with low burnup. Radionuclides with short half-lives (such as Zr-95 and Ce-144) varied significantly among first-cycle raffinates depending on the fuel cooling time and age of the waste. However, even the “newest” calcine in the CSSFs came from fuel reprocessed more than 20 years ago. So the activity of short-lived fission products has decreased to insignificant levels in all calcine. As a result, the combined activity of Cs/Ba-137m and Sr/Y-90 account for more than 99% of the current fission-product activity in calcine. The fission-product activity in the calcine depends on the activity originally in the liquid waste, the dissolved-solids content of the liquid waste, and the age of the calcine.

Figure 17 shows the concentration of four fission products, Cs-137, Sr-90, technetium (Tc-99), and Se-79 in each of the six CSSFs. As with the average concentrations of chemical constituents depicted earlier in Figures 15 and 16, the average radionuclide activity of each CSSF in Figure 17 is shown as a point and the standard deviation is a line above and below the average point. The average and standard deviation values were determined by dividing the bins into several sections or segments, based on the location of level-indicating thermocouples, similar to the method used for the chemicals. The average activity is not weighted per the size of the segment; consequently, the average of the segment values differs slightly from the weighted average. Figure 17 shows that the activities of Cs-137, Sr-90, Se-79, and Tc-99 are highest in the Al calcine in CSSF I. The Zr calcine in CSSFs III through V has moderate activities of these radionuclides. A significant drop occurs in the fission-product activity of CSSF VI, which contains large amounts of calcine derived from blends of SBW that had low fission-product

Figure 17. Major fission-product activity in calcine decayed to January 1, 2016.

activity. Figure 17 shows that the activities of the fission products track each other because, with few exceptions, no process or operation separated fission products from each other.

5.4 Activation-Product Activity of Calcine

The light activation and TRU product activity of the calcine depends on the fuel type (cladding), uranium enrichment, irradiation history of the fuel, and INTEC fuel-reprocessing chemistry. Light activation products were a function of the cladding material of the nuclear fuel. For example, Ni-63 was formed in Zr-clad fuels from the Ni in the Zircaloy-cladding material. Virtually no Ni-63 was formed in Al-clad fuel because there was no Ni in the cladding. The light activation products generally went with the fission products in the first-cycle raffinate. The actinides (U and TRU components) have similar chemical properties. Therefore, some of the TRU components were extracted with the uranium in the first-cycle extraction system and separated from fission products that were in the first-cycle raffinate. The amounts of the TRU components extracted with the U depended on the type of fuel, concentrations of species that formed extractable complexes with TRU components, and the oxidation potential of the solutions. The TRU components were separated from the uranium product in the second- and third-cycle uranium purification steps. This enriched the second- and third-cycle raffinates in TRU components relative to fission products. Sometimes the second- and third-cycle raffinates were stored with the first-cycle raffinate, and sometimes they were mixed with SBW. Mixing the second- and third-cycle raffinate with SBW enriched the SBW with TRU components, relative to fission products.

The HPM uses ORIGEN2-based models to calculate radionuclide activity when waste-sample data are not available. The ORIGEN2 program calculates the activity of radionuclides formed in a reactor, but it cannot predict the path of the various species through the INTEC uranium extraction and waste-handling systems. In the first-cycle U-extraction process, virtually all of the U and some of the TRU activity were separated from the fuel cladding and fission products. The second- and third-cycle U purification processes separated the TRU activity from the U. Often, the TRU-enriched second- and third-cycle raffinates were sent to the SBW storage tanks in the Tank Farm. This practice resulted in the SBW being enriched in TRU activity compared to fission-product activity. To account for the partitioning effect of fuel reprocessing on the TRU activity, the ORIGEN2-predicted activities were adjusted and normalized based on waste-sample data for the various types of waste.

Figure 18 shows the activity of four TRU components (Pu-238, Pu-239, Np-237, and Am-241) in CSSFs I through VI. The TRU activity does not follow that of the fission-product activity shown in Figure 17. Nor do the activities of the various TRU components follow each other, like those of the fission products. The TRU activity of the calcine correlates with the type of liquid waste from which the calcine was derived and historical INTEC operations. The TRU activity is generally low in Al wastes and high in Zr wastes. The early first-cycle Al raffinate was stored and calcined separately from second- and third-cycle raffinates, which contained much of the TRU activity. This practice effectively reduced the TRU content of the CSSF I Al calcine. CSSFs III through V have the highest TRU activity because they contain primarily Zr calcine. Because of fuel-reprocessing chemistry, more TRU activity stayed in the first-cycle raffinate when processing Zr fuel than with Al fuel. CSSF VI contains a moderate amount of TRU activity, even though its fission-product activity is very low, because much of its calcine was derived from SBW, which contained relatively large amounts of second- and third-cycle raffinates that were high in TRU activity.

The activity of Np-237 does not follow that of the other TRU components in Figure 18 or the fission-product activity in Figure 17. Figure 18 shows that the activity of Pu-238 and Am-241 is higher in CSSF II than CSSF I, and higher still in CSSF III (because of the increasing amount of Zr calcine). However, the activity of Np-237 decreases dramatically from CSSF I to CSSF II, and increases only slightly from CSSFs II to III. Between 1965 and 1973, INTEC recovered Np-237 as a product for use as a source material for the production of Pu-238, a heat source for space power units (Johnson et al. 1973). CSSFs II and III contain calcine generated from liquid wastes produced during the Np-237 recovery period and consequently have low Np-237 activity. The Np-237 activity is significantly higher in CSSFs IV and V because the CSSFs IV and V calcine came from waste generated after 1973, when Np-237 recovery ceased.

The activities of Pu-238 and Pu-239 do not track each other because of differences in uranium enrichment and burnup among the various types of fuels. Zr waste had a high Pu-238:Pu-239 ratio (about 75), Al waste had a moderate ratio (about 10), and stainless-steel waste had a low ratio (about 0.02). Figure 18 shows that the Pu-238 activity steadily increases from CSSFs I through III, while the activity of Pu-239 remains about constant. This difference in activity is caused by the transition from Al calcine in CSSF I, with relatively low Pu-238 activity and high Pu-239 activity, to Zr calcine in CSSFs II and III with relatively high Pu-238 activity and low Pu-239 activity. The activity of Pu-239 is higher than expected for Zr calcine in CSSFs IV through VI, because those CSSFs contain calcine derived from a blend of stainless-steel waste, which had high Pu-239 activity and low Pu-238 activity.

Figure 18. Activities of the major transuranic isotopes in calcine.

5.5 Detailed Discussion of Individual Radionuclides

Of the hundreds of radionuclides that exist, only a few are considered species of interest, generally as a result of their high activity or long half-life. Table A10 in Appendix A presents the activity of the radionuclides of interest in the liquid wastes that were calcined. Tables 1 and 2 in 10 *Code of Federal Regulations* (CFR) 61.55, “Waste classification,” provide the basis for most of the radionuclides listed in Table A10. The radionuclides of interest include Tc-99, I-129, Pu-241, and Cm-242 (from the CFR Table 1), and Co-60, Ni-63, Sr-90, and Cs-137 (from the CFR Table 2). The CFR also indicates alpha-emitting TRU species with half-lives greater than 5 years are of interest. As a result, Table A10 includes Pu-238, Pu-239, Pu-240, and Am-241, which account for the bulk (more than 99%) of the alpha activity found in calcine. Some of the species listed in the two CFR tables are not included in Table A10. They include the species that were volatile or combustible in the calcination process (H-3 and C-14) and thus do not exist to any measureable degree in calcine. Also excluded from Table A10 were the activated metal species (Ni-59 and Nb-94) because activated metal is not stored with the calcine, nor was it processed with the spent nuclear fuel. The U.S. Department of Energy provides additional guidance on radionuclides of interest (DOE G 435.1-1). The DOE guidance adds three radionuclides, Se-79, Sn-126, and Np-237, to those found in the two CFR tables. The combined list of radionuclides in Table A10 derived from the CFR and DOE guidance includes the following 15 nuclides; Co-60, Ni-63, Se-79, Sr-90, Tc-99, Sn-126, I-129, Cs-137, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, and Cm-242.

The HPM has been used for various INTEC applications that required the activities of radionuclides beyond those derived from the CFR and DOE guidance. Therefore, the activities of Eu-154, Eu-155, Pu-242, and the principle uranium isotopes (U-234, U-235, U-236, and U-238) are included on Table A10, though they are not included in the data plots in Appendix C. The activities of Ba-137m and Y-90, the short-lived daughter products of Cs-137 and Sr-90, respectively, are listed in Table A10 in addition to those of Cs-137 and Sr-90. The activities of the daughter products are listed to avoid confusion that has occurred in the past when it was unclear whether the reported activity of Cs-137 and Sr-90 included the activity of their daughter products.

Appendix C contains data plots that show the radioactivity in the various types of calcine and CSSF bins for the 17 radionuclides of interest listed above, comprising the 15 radionuclides of interest derived from the CFR and DOE guide, and the two short-lived daughter products of Cs-137 and Sr-90; Ba-137m and Y-90, respectively. As with the previously discussed chemical concentration data plots (see Section 5.2), the activity from only the four largest, outer bins in CSSF I is plotted. The calcine in CSSF I has relatively uniform radioactivity, so including only the four largest bins simplifies the graphs and eliminates nearly redundant data plots. The data plots include all of the bins in CSSFs II through VI. The data plots are arranged with the bin-segment numbers (low to high) corresponding with elevation (bottom to top) in a bin. The data plots read left to right as the bins were filled (bottom to top). The data plots are arranged in order of atomic number, beginning with Co-60 and ending with Cm-242. The data plots include the “segment average” and standard deviation for the activity of each radionuclide. As with the chemical constituents, the segment average is the unweighted average of the radioactivity in the bin segments (excluding the very small segments). The data plots also have a “bin average” activity, which is the total activity in a bin divided by the total volume or mass of calcine in each bin. The bin average and segment average differ slightly because the bin segments are not the same size and the segment average is not weighted.

The data plots in Appendix C report radioactivity in one of two units: activity per unit mass (nanocuries per gram) for TRU components, and activity per unit volume (curies per cubic meter) for fission and light activation products. These units are used in the CFR. Many of the bins have very small segments at the top or bottom of the bins. Some segments are as small as a single cubic foot. The exact volume of calcine in those segments is uncertain because of their irregular shape from curved bin heads and an uncertain angle of repose of the calcine. The HPM can distribute calcine from a given calcine feed batch into multiple CSSF bins at a time. However, within a given bin, The HPM puts calcine from a given feed batch into a single bin segment. It does not partition calcine batches into more than one segment of a given bin. Most calciner feed batches generated more calcine than would fit in the very small (1-ft³) bin segments. The HPM overstates the radioactivity per unit volume in such cases. The activity data for the very small bin segments are not included in the detailed data plots nor are they included in the bin averages for those plots that have a volumetric basis (curies per cubic meter) because they would unreasonably skew the average values. This problem does not exist for the activities reported on a mass basis (nanocuries per gram). The HPM accurately calculates the mass of calcine and its constituents, regardless of the volume it occupies. The Appendix C data plots show the mass-based activity for all segments, even the very small segments, although the small segments are not used in the average value or standard deviation calculations.

The use of two different units and the exclusion of very small bin segments result in some data-plot anomalies that may be confusing. For example, the data plots for Pu-238 provide activity per unit mass and include all bin segments (data plots begin with Segment Number 1). In CSSF IV, the Pu-238 activity in Segment Number 1, which is located at the bottom of the bin, is 0 nCi/g, because the small segment at the bottom of the bin contains only nonradioactive startup material (dolomite and aluminum nitrate). In contrast, the data plot for Sr-90 in CSSF IV provides activity per unit volume and begins with Segment Number 2 with an activity of about 1,000 Ci/m³. The Sr-90 activity in Segment Number 1 is 0 Ci/m³, but

that value is not shown on the data plot. A superficial review of the Pu-238 and Sr-90 data plots may be confusing because of the differences in the activity in the “first” segments shown on the data plots, one having no activity and the other having high activity. The difference in the data plots is that the activity in the small, bottom segments is included for TRU components, but not for the fission products and light activation products. The reader must be cognizant of the data-plot methodology and take note of the segment numbers on the data plot to avoid confusion.

As with the chemical composition, the discussion of the calcine radioactivity is simplified by the following general statements about the distribution of calcine among the CSSFs. CSSF I contains only Al calcine. CSSF II contains significant amounts of both Al and Zr calcine. CSSFs III through V contain primarily Zr and Zr/SBW blend calcine. CSSF VI contains primarily SBW blend calcine. Therefore, discussions pertinent to the Al calcine in CSSF I also apply to the Al calcine in CSSF II. Discussions pertinent to the Zr calcine in CSSFs III through V also apply to the Zr calcine in CSSF II. The lower portion of CSSF VI contains Zr/SBW blend calcine. So, discussions pertinent to Zr calcine in CSSFs III through V apply to the calcine in the lower portion of CSSF VI, though the components derived from Zr waste are diluted by the SBW constituents.

The following sections discuss the activities of those species found in the Appendix C data plots. The order of the discussion of the nuclides is based on atomic number, beginning with cobalt-60 and continuing through curium-242.

5.5.1 Cobalt-60

Cobalt (Co) -60 is formed by the activation of stable Co-59 that is present as a contaminant in most nuclear fuel cladding. The activity of Co-60 varies among the bins and does not track either the fission products or the actinides. The Co-60 activity in the calcine is highest in the Zr calcine (up to 2 Ci/m³) and lowest in the Al and SBW calcine (0.002 to 0.02 Ci/m³, respectively). Because of its relatively short half-life (5.3 years), the Co-60 activity is higher in the newer calcine (CSSFs V and VI) and lower in the older calcine. The HPM calculates the Co-60 activity based on liquid-waste sample data.

5.5.2 Nickel-63

Nickel (Ni) -63 is an activation product formed from the activation of Ni in nuclear fuel cladding. The activity of Ni-63 in the Appendix C data plots varies among the bins and does not track either the fission products or the actinides. The activity of Ni-63 varied significantly with fuel type and was a function of the composition of the fuel cladding. Virtually no Ni was in Al fuel cladding; consequently, very little Ni-63 was formed in Al-clad fuel or is found in Al calcine. The Zircaloy fuel cladding contained a small amount (0.05 wt%) of Ni, so there is a small amount of Ni-63 in Zr calcine. The Ni-63 activity in Zr calcine (CSSFs III through V) varies from 2 to 4 Ci/m³. Stainless-steel-clad fuel had a significant amount of Ni in its cladding and, consequently, the most Ni-63 of any waste type. The amount of stainless-steel waste generated at INTEC was small compared to Al and Zr waste. A small amount of stainless-steel waste generated in the 1950s was mixed with Zr waste, processed as a blend in the WCF, and stored in CSSF III. The bulk of the stainless-steel waste was generated with an electrolytic dissolution process in the 1970s and early 1980s. That waste was blended with first-cycle Al, Zr, and SBW, calcined in the NWCF calciner, and is stored primarily in CSSFs IV and V, with a small amount in CSSF VI. The stainless-steel waste is responsible for the elevated Ni-63 activity (6 Ci/m³) in the top of CSSF IV and bottom of CSSF V. The HPM calculates the Ni-63 activity based on limited liquid-waste sample analyses, fuel-cladding metallurgy, and ORGIEN2-based activation product calculations.

5.5.3 Selenium-79

Selenium (Se) -79 is a long-lived fission product with a very low activity in the calcine. The Se-79 activity is highest in the Al calcine in CSSF I (0.010 to 0.016 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Se-79 activity in the Zr calcine in CSSFs III through V varies from 0.005 to 0.010 Ci/m³. The calcine in CSSF VI derived from SBW contains the lowest Se-79 activity (0.001 Ci/m³) because SBW contained much less fission-product activity than first-cycle raffinates. Because of its very low activity, no historical sample data exist for Se-79. The HPM calculates Se-79 activity using ORIGEN2-based fission-product calculations.

5.5.4 Strontium-90

Strontium (Sr) -90 is a fission product and is in equilibrium with its short-lived daughter product Yttrium (Y) -90. The data plots in Appendix C for the two radionuclides are identical. The combined activity of Sr/Y-90 accounts for nearly half of the total activity currently stored in the CSSFs. The Sr-90 activity follows that of the other fission products in the calcine. The Sr-90 activity is highest in the Al calcine in CSSF I (2,500 to 4,000 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has high Sr-90 activity (1,000 to 3,000 Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest Sr-90 activity (200 to 300 Ci/m³) because SBW contained much less fission-product activity than first-cycle raffinates. The HPM calculates the Sr-90 activity based on liquid waste sample data.

5.5.5 Yttrium-90

Short-lived yttrium (Y) -90 is in equilibrium with its relatively long-lived parent Sr-90. The Appendix C data plots for the two radionuclides are identical. The combined activity of Sr/Y-90 accounts for nearly half of the total activity currently stored in the CSSFs. The Y-90 activity is highest in the Al calcine in CSSF I (2,500 to 4,000 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has high Y-90 activity (1,000 to 3,000 Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest Y-90 activity (200 to 300 Ci/m³) because SBW contained much less fission-product activity than first-cycle raffinates. The HPM calculates the Y-90 activity based on liquid-waste sample data (for Sr-90).

5.5.6 Technetium-99

Technetium (Tc) -99 is a long-lived fission product whose activity in calcine is very low. The Tc-99 activity is highest in the Al calcine in CSSF I (1.5 to 2.5 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has relatively high Tc-99 activity (0.5 to 1.5 Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest Tc-99 activity (0.1 to 0.2 Ci/m³) because SBW contained much less fission-product activity than first-cycle raffinates. Tc-99 can be semivolatile under certain conditions. Few analytical data exist for Tc-99 in either liquid waste or calcine, thus the volatility of Tc-99 in the calciner cannot be reliably established. The few existing waste sample data suggest approximately half of the Tc-99 in the liquid waste may be retained in the calcine.

The HPM assumes all of the Tc-99 originally in the liquid is retained in the calcine. Thus, the HPM may conservatively overestimate the Tc-99 activity in the calcine. The HPM calculates the Tc-99 activity using ORIGEN2-based fission-yield calculations.

5.5.7 Tin-126

Tin (Sn) -126 is a long-lived fission product whose activity in calcine is very low. The Sn-126 activity is highest in the Al calcine in CSSF I (0.04 to 0.065 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has relatively high Sn-126 activity (0.015 to 0.040 Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest Sn-126 activity (0.003 to 0.005 Ci/m³) because SBW contained much less fission-product activity than typical first-cycle raffinates. Because of its very low activity, there are no historical sample data for Sn-126. The HPM calculates the Sn-126 activity using ORIGEN2-based on fission-yield calculations.

5.5.8 Iodine-129

Iodine (I) -129 is a long-lived fission product whose activity in calcine is very low. The I-129 activity is highest in the Al calcine in CSSF I (2.5 to 5×10^{-5} Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has a relatively high I-129 activity (0.5 to 2.5×10^{-5} Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest I-129 activity (2 to 6×10^{-6} Ci/m³) because SBW contained much less fission-product activity than typical first-cycle raffinates. INTEC studies (McManus et. al 1982) of the disposition of I-129 in the fuel-reprocessing cycle found that the bulk (99%) of the I-129 originally in the liquid waste volatilized in the calcination process and was exhausted with the off-gas. Accordingly, the HPM assumes 1% of the I-129 activity in the liquid waste was retained in the calcine. The HPM calculates the I-129 activity using ORIGEN2-based fission-yield calculations and INTEC studies of the disposition of I-129.

5.5.9 Cesium-137

Cesium (Cs) -137 is a major fission product that is in equilibrium with its short-lived daughter product barium (Ba) -137m. The combined activity of Cs/Ba-137m accounts for slightly more than half of the total radioactivity currently stored in the CSSFs. The Cs/Ba-137m activity follows that of the other fission products in the calcine. The Cs-137 activity is highest in the Al calcine in CSSF I (3,000 to 5,000 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has high Cs-137 activity (1,000 to 3,000 Ci/m³). The calcine in CSSF VI derived from SBW has the lowest Cs-137 activity (200 to 300 Ci/m³) because SBW contained much less fission-product activity than typical first-cycle raffinates. The HPM calculates the Cs-137 activity based on liquid-waste sample analyses.

5.5.10 Barium-137m

Metastable barium (Ba) -137m is the short-lived daughter product of Cs-137 and is in equilibrium with its parent Cs-137. The data plots for the two radionuclides are nearly identical, differing only by the Cs-137 branching ratio (0.946), which results in the Ba-137m activity being slightly less than the Cs-137 activity. The combined activity of Cs/Ba-137m accounts for slightly more than half of the total

radioactivity currently stored in the CSSFs. The Ba-137m activity follows that of the other fission products in the calcine. The Ba-137m activity is highest in the Al calcine in CSSF I (3,000 to 5,000 Ci/m³). The Al calcine contains the highest fission-product activity, even though it is the oldest calcine, because liquid Al waste contained the fewest dissolved solids and chemical additives, and thus had the highest concentration factor when converted into solid calcine. The Zr calcine in CSSFs III through V also has high Ba-137m activity (1,000 to 3,000 Ci/m³). The calcine in CSSF VI derived from SBW contains the lowest Ba-137m activity (200 to 300 Ci/m³) because SBW contained much less fission-product activity than typical first-cycle raffinates. The HPM calculates the Ba-137m activity based on liquid-waste sample analyses (for Cs-137).

5.5.11 Neptunium-237

Neptunium (Np) -237 is a long-lived TRU element. The activity of Np-237 does not follow that of either the fission products or other TRU species because of the recovery of Np-237 as a product during some fuel-reprocessing campaigns. From the mid 1960s through the early 1970s, Np-237 was recovered from fuel dissolver solution as a product. Liquid wastes generated during that period had much less Np-237 than other wastes. The HPM assumes the Np-237 recovery efficiency was 96%, based on limited sample data and historical operating reports. The Np-237-depleted wastes were calcined and are stored in CSSFs II and III. The data plots show that the Np-237 activity is about 6 nCi/g in Al calcine in CSSF I, and 30 to 40 nCi/g in the Zr calcine in CSSFs IV and V. The Np-237-depleted calcine in CSSFs II and III has much less Np-237 activity (less than 2 nCi/g) than other Zr calcine. The last bin filled in CSSF III (VES-WCS-140-1) contains Zr waste generated after Np-237 recovery operations ceased. It has much higher Np-237 activity than the other bins in CSSF III, about 30 nCi/g Np-237, which is typical of the Zr calcine in CSSFs IV and V. The HPM calculates the Np-237 activity based on representative liquid-waste analyses, ORIGEN2-based calculations, and historical reports for Np-237 recovery operations (Johnson et al. 1973).

5.5.12 Plutonium-238

Plutonium (Pu) -238 accounts for 85 to 90% of the TRU alpha activity in the calcine. The Pu-238 activity varies significantly among the different types of calcine. The activities of the Pu isotopes do not track each other because of variations in the amount of Pu produced in various types of fuel. The Pu-238 activity and the relative ratios of the Pu isotopes depend on U enrichment, U burnup, and other parameters of the spent fuel from which the calcine was derived. Higher U burnup produced more Pu than low burnup. Higher enriched fuel produced more Pu-238 than lower enrichments. The Pu activity also does not track the fission-product activity. Much of the Pu originally in Al fuel was extracted with the U in the first-cycle extraction process. The Pu was separated from the U in the second- and third-cycle uranium purification processes. The second- and third-cycle raffinates were often mixed with SBW. This separation process left the Al waste relatively depleted in Pu and the SBW relatively enriched. On the other hand, much of the Pu in Zr-clad fuel went with the first-cycle waste because the Pu was not extracted as efficiently with the U when processing Zr-clad fuel.

The Pu-238 activity is relatively low (1,000 to 2,000 nCi/g) in the Al calcine in CSSF I. The Pu-238 activity in the Zr calcine in CSSFs III through V is much higher (an order of magnitude) than in the Al calcine, ranging from 15,000 to 40,000 nCi/g. The Pu-238 activity in CSSF VI derived from SBW contains 3,000 to 7,000 nCi/g. Unlike the fission products in which the SBW calcine in CSSF VI contains an order of magnitude less activity than the calcine derived from first-cycle waste, SBW calcine contains slightly more Pu-238 activity than the Al calcine in CSSF I. The higher activity in SBW is because much of the Pu-238 in the Al fuel was sent to the SBW storage tanks with the second- and third-cycle raffinates. The HPM calculates the Pu-238 activity based on liquid waste analyses.

5.5.13 Plutonium-239

Plutonium (Pu) -239 is a long-lived TRU element and has the highest mass percentage of the Pu isotopes. However, because of differences in half-lives, the activity of Pu-239 is less than that of Pu-238 in most wastes. The Pu-239 activity varies among the CSSFs and does not track that of Pu-238. The Pu-239 activity in Al calcine in CSSF I is 200 to 250 nCi/g. Most of the Zr calcine in CSSFs III through V has 200 to 700 nCi/g of Pu-239 activity. The Pu-239 activity in the top of CSSF IV and the bottom of CSSF V is higher than other Zr calcine because it includes a significant amount of stainless-steel waste, which had relatively high Pu-239 activity. Though not as pronounced as the elevated Pu-239 activity in CSSFs IV and V, the middle segments of CSSF VI show a dip in Pu-238 activity and a corresponding increase in Pu-239 activity. This increase in activity also is caused by the calcination of a blend of stainless-steel waste. The Pu-239 activity in CSSF VI that is derived from SBW contains about the same Pu-239 activity as CSSF I, ranging from 150 to 300 nCi/g. Unlike fission products in which the SBW calcine has an order of magnitude less activity than the calcine derived from first-cycle waste, SBW calcine contains about the same Pu-239 activity as the Al calcine in CSSF I. This is because much of the Pu-239 in the Al fuel was sent to the SBW storage tanks with the second- and third-cycle raffinates. The HPM calculates the Pu-239 activity based on liquid-waste analyses.

5.5.14 Plutonium-240

Plutonium (Pu) -240 is a long-lived Pu isotope. As with Pu-238 and Pu-239, the activity of Pu-240 depends on the type of fuel from which the calcine was derived. The Pu-240 activity in the Al calcine in CSSF I is 75 to 100 nCi/g. The Zr calcine in CSSFs III through V has 150 to 650 nCi/g of Pu-240 activity. The Pu-240 activity in CSSF VI that is derived from SBW ranges from 60 to 130 nCi/g, which is about the same as its activity in the CSSF I Al calcine. Unlike the fission products in which the SBW calcine has an order of magnitude less activity than the calcine derived from first-cycle waste, SBW calcine contains about the same Pu-240 activity as the Al calcine in CSSF I. This is because much of the Pu-240 in the Al fuel was sent to the SBW storage tanks in the second- and third-cycle raffinates. The HPM calculates the Pu-240 activity based on liquid waste analyses.

5.5.15 Plutonium-241

Plutonium (Pu) -241 is a relatively short-lived (14.3-year half-life), beta-emitting, TRU element. The Pu-241 activity in the Al calcine in CSSF I is about 500 nCi/g. Most of the Zr calcine in CSSFs III through V has 5,000 to 12,000 nCi/g of Pu-241 activity. The calcine in the upper portion of CSSF V contains about 20,000 nCi/g of Pu-241, nearly double that of other Zr calcine. One of the reasons for the high Pu-241 activity in the top of CSSF V is the age of the waste. The calcine in the upper portion of CSSF V came from the most recently reprocessed fuel and has had the shortest decay period. Thus it has a higher activity than the older wastes. The Pu-241 activity in CSSF VI also is relatively high, at 2,500 to 3,500 nCi/g, compared to the activity of other Pu isotopes in CSSF VI. The SBW calcine in CSSF VI contains decontamination wastes from the equipment used in the most recent fuel-reprocessing campaign, and consequently has high activity Pu-241 activity because of its short decay period. The HPM calculates the Pu-241 activity based on representative liquid waste analyses.

5.5.16 Americium-241

Americium (Am) -241 is a TRU element with a moderately long half-life (433 years). The Am-241 activity in the Al calcine in CSSF I is 550 to 750 nCi/g. The Zr calcine in CSSFs III through V has 1,400 to 2,800 nCi/g of Am-241 activity. The Am-241 activity in CSSF VI derived from SBW ranges from 300 to 500 nCi/g, which is about the same as its activity in the CSSF I Al calcine. Unlike the fission products in which the SBW calcine has an order of magnitude less activity than the calcine derived from first-cycle

waste, SBW calcine contains about the same Am-241 activity as the Al calcine in CSSF I. This is because much of the Am-241 in the Al fuel was sent to the SBW storage tanks with the second- and third-cycle raffinates. The HPM calculates the Am-241 activity based on liquid waste analyses and ORIGEN2-based calculations.

5.5.17 Curium-242

Curium (Cm) -242 is a short-lived (0.45 year half-life) TRU element. Although the half-life of Cm-242 is only about one-half year, it is a daughter product of longer-lived parents Am-242m/Am-242, which have a 141-year half-life. Curium-242 is in equilibrium with its long-lived parents. The Cm-242 activity in the Al calcine in CSSF I is about 0.04 nCi/g. The Cm-242 activity in Zr calcine is much higher, ranging from 3 to 6 nCi/g in CSSFs III through V. The Cm-242 activity in SBW ranges from 0.4 to 1 nCi/g. Unlike the fission products in which the SBW calcine has an order of magnitude less activity than the calcine derived from first-cycle waste, SBW calcine contains more Cm-242 activity than the Al calcine in CSSF I. The higher activity in SBW is because much of the Am and Cm in the Al fuel was sent to the SBW storage tanks with the second- and third-cycle raffinates. Because of its low activity, Cm-242 was not routinely requested or detected in historical INTEC waste analyses. The HPM calculates the Am-242m/Am-242 and Cm-242 activity using ORIGEN2-based calculations.

5.6 RCRA and Organic Constituents

Calcine contains materials that are regulated as RCRA hazardous wastes cited in 40 CFR 261, “Identification and Listing of Hazardous Waste.” The RCRA Part B permit (DEQ 2006) for the CSSFs allows the calcine to contain 12 waste codes, including eight “D” codes (toxic metals) and four listed codes, three “F” codes and one “U” code. The RCRA waste numbers include D004 (As), D005 (Ba), D006 (Cd), D007 (Cr), D008 (Pb), D009 (Hg), D010 (Se), D011 (Ag), F001 (halogenated degreasing solvents), F002 (halogenated solvents), F005 (non-halogenated solvents), and U134 (hydrofluoric acid). The CSSF RCRA permit (DEQ 2006) contains additional details regarding the RCRA-related issues for the CSSFs.

The RCRA metals are found in calcine in varying concentrations. Some, such as As, were not a component of any fuel or used in any fuel or waste processing system. Such species did not exist in reliably detected concentrations in either liquid or calcined waste. Others, such as Cd and Hg, were used in the reprocessing of nuclear fuels. They were minor components of some liquid wastes and have concentrations of a few weight percent in some of the calcine. Section 5.3 discusses each of the eight RCRA metals cited in the RCRA permit, including the source of each metal and its concentration in the calcine.

Organic compounds in the calcined waste have two potential sources; the aqueous waste that was calcined, and products of incomplete combustion of kerosene in the calciner. The aqueous waste that was calcined had trace quantities of organics from the uranium extraction and purification processes, which used organic solvents and extractants. The aqueous waste may also have contained trace amounts of organics that had been used in various support activities (such as laboratory analyses and equipment decontamination). In addition, the calcine had the potential to adsorb organics, particularly products of incomplete combustion from the kerosene that was burned in the calciner to provide heat for the calcination process.

The 2004 report *Organic Compounds in Calcined Waste* (Swenson 2004) documents a review of the potential sources and concentrations of organic compounds in calcine as well as historical calcine analyses for organic compounds. The INTEC waste storage and treatment processes did not favor the retention of organic compounds in either the aqueous or calcined wastes. The acidic waste storage

conditions tended to destroy the organic compounds that may have existed in the liquid phase. Sample analyses show that the liquid waste generally contained less-than-detectable amounts of organics and was not a significant potential source of organics in the calcine. The elevated operating temperatures in the calcination process did not favor the retention of organics in the calcine. Calciner off-gas samples show concentrations of organics in the off-gas were too low to condense and be adsorbed by calcine. Calcine sample analyses found no detectable regulatory organic compounds of concern (Swenson 2004) (polychlorinated biphenyls, semivolatile, or volatile organic compounds). Some organics were detected in a few calcine samples. However, the detected organics were common laboratory contaminants (such as acetone), were found in trip blanks, and were not detected in repeated analyses of the same calcine samples. Thus, those organics were deemed not part of the calcine matrix.

The INTEC laboratory detection values for organic compounds of concern in the calcine varied from about 10 ppb for volatile compounds to a few hundred ppb for semivolatile compounds. Any organics in the calcine are below these values. The laboratory detection values are far below the RCRA treatment standards (40 CFR 268.40) for wastes having codes F001, F002, and F005. Because the organic concentrations in calcine are below laboratory detection values, this report does not include extensive tables of “non-detect” sample data. The evaluation of organics in calcine (Swenson 2004) contains detailed sample data from organic analyses of calcine samples.

6. CSSF INVENTORY SUMMARIES

Tables A1 through A6 (in Appendix A) document nearly 7,000 batches of material charged to the WCF and NWCF calciners, converted to calcine, and stored in CSSFs I through VI. The data in these tables, along with the waste-composition data (Tables A and A10), provide the basis for the calculated calcine composition. Individual calciner feed batch information for WCF Campaign 1 and most of WCF Campaign 2 could not be found. Feed batch information for those campaigns was derived by dividing the recorded amount of waste calcined each month into a reasonable number of batches, based on WCF operating history, equipment size, and process knowledge. The HPM uses calciner-feed batch information and waste-composition data to determine the calcine composition in Tables A11 through A13. Tables A11 through A13 divide each calcine storage bin into several segments, or sections, and present the calcine composition data for each segment. The bin segments vary in size and are defined by the location of calcine level-indicating thermocouples in each storage bin. The bin thermocouple data were used to determine when and how fast each bin was filled with calcine. This method determined the portion of each batch of calcine that went into each bin. Tables A14 through A17 provide simplified CSSF inventory summaries for principal chemical and radioactive constituents, based on the detailed inventories in Tables A11 through A13.

A filling chronology was prepared for each CSSF bin (Figures B25 through B30 in Appendix B) based on the level-indicating thermocouple data. The thermocouple data were not continuously recorded, so some data interpolation was necessary to determine the dates when each bin segment was filled with calcine. The thermocouple data were generally recorded at intervals ranging from once per week to once per month. The date when a thermocouple was covered with calcine was estimated based on the temperature increase between temperature recording dates. Calciner operation interruptions were taken into account where appropriate. The bin-filling chronology data were used to partition the calcine into the various bins. Table 5 provides a summary of the CSSF filling data, including the date when each CSSF began filling, the date when each CSSF was filled, and the volume of calcine stored in each CSSF.

Table 5. Summary of CSSF filling.

Calcine Solids Storage Facility	Date When Calcine Storage Began ^a	Date When CSSF Was Filled/Filling Stopped	Total Calcine Volume in Storage ft ³ (m ³)	Percent Full
I	November 1963	October 1964	7,760 (220)	97
II	March 1966	February 1972	30,000 (850)	100
III	February 1972	March 1981	39,500 (1,120)	99
IV	August 1982	July 1983	17,200 (486)	100
V	July 1983	January 1992	35,600 (1,010)	100
VI	January 1993 ^b	May 2000	25,200 (713)	47
<p>a. The initial service date is when the nonradioactive calciner startup began for CSSFs I, II, IV, and VI, and radioactive service began for CSSFs III and V.</p> <p>b. The initial service date does not include 40 ft³ of pilot plant calcine added to Bin VES-WS6-154 in April 1986.</p>				

6.1.1 Calcined Solids Storage Facility I

CSSF I collected calcine during nonradioactive testing of the WCF, which took place between February 1961 and November 1962. The calcine collected during the nonradioactive testing was removed prior to radioactive operation and later used as calciner startup bed. The CSSF I bins were filled with its

current calcine inventory between November 1963 and October 1964 during WCF Campaign 1 (Commander et al. 1966).

The first type of fuel to be reprocessed at INTEC had Al cladding. It was the primary type of fuel reprocessed from the early 1950s through the early 1960s. Consequently, the bulk of the liquid waste available to calcine in the early 1960s was Al waste. Aluminum waste was the only type of waste calcined during WCF Campaign 1. The CSSF I bins were filled with nonradioactive alumina startup bed and radioactive Al calcine. The calcine in CSSF I has the most uniform composition of all the CSSFs because it is entirely Al calcine, including the startup bed. Other CSSFs contain varying types of calcine and startup beds.

A heat-transfer test was conducted in CSSF I from September through November 1964 to help determine heat-transfer coefficients for use in the design of the later CSSFs. The test shut down the calcine cooling system (vault airflow), allowed the calcine temperature to increase to its equilibrium value, then restored the cooling system to operation. In general, the maximum CSSF I calcine temperatures were achieved during the 1964 heat transfer test. Table A12 shows the maximum calcine temperatures in the CSSF bins. Most of the CSSF I maximum temperatures in Table A12 come from a summary report of the 1964 heat transfer test.^m The heat-transfer test report provided temperature data for the hotter calcine segments, but not for every segment of every bin. The maximum temperatures of the CSSF I thermocouples not included in the 1964 heat-transfer test come from routine operator-recorded data from subsequent periods when the CSSF I cooling air system was shut down. These include the summer of 1971 and the summer of 1975.

Based on the information in Appendix A and summarized in Table 1, the approximate volumes and types of calcine sent to storage in CSSF I include 230 ft³ of nonradioactive alumina used for calciner startup material and 7,530 ft³ of radioactive Al calcine. CSSF I contains 2.9×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded calcine temperature in CSSF I was 435°F (224°C), in VES-WCS-115-3B, during November 1964. Tables A11 through A13 document the chemical content and radioactivity of the calcine in CSSF I.

6.1.2 Calcined Solids Storage Facility II

CSSF II began receiving calcine in March 1966 with the start of WCF Campaign 2. It was filled in February 1972, about midway through WCF Campaign 5. CSSF II stores the calcine produced during WCF Campaigns 2, 3, and 4 (Lohse and Hales 1970; Bendixsen, Lohse, and Hales 1971; Weiland, Lohse, and Hales 1972) and about half the calcine produced during WCF Campaign 5 (Weiland and Freeby 1973).

The calcine distribution system in CSSF II was designed to fill five of the seven bins in the following sequential order: VES-WCS-136-4, -3, -5, -7, and -6. Two of the bins (VES-WCS-136-1 and -2) were filled using an air-operated, calcine-diverter system (Petrie and Cooper 1966) that was manually activated. The diverter system had the effect of opening and closing a valve on the fill lines for those two bins. The diverter system was designed to selectively fill either of those two bins and segregate different types of calcine.

WCF Campaign 2 began filling CSSF II with Al calcine, similar to that contained in CSSF I. WCF Campaign 2 filled two of the bins (VES-WCS-136-3 and -4) and about half of a third (VES-WCS-136-5)

m. Garner, J. W., "Temperatures in Present Solids Storage Facilities," Phillips Petroleum Company Inter-Office Correspondence, to L. J. Weber, JWG-94-64A, December 22, 1964.

with Al calcine by mid-November 1967. At that point, the chemical composition of the calcine changed dramatically with the calcination of Zr waste.

By the mid-1960s, the primary type of fuel reprocessed at INTEC changed from Al to Zr clad, and the principle type of liquid waste became Zr waste. The initial calcination of Zr waste occurred at the end of WCF Campaign 2 (mid-November 1967 through March 1968). Because the Zr calcine composition differed significantly from Al calcine, operators initially attempted to use the CSSF II calcine diverter system and put the Zr calcine in VES-WCS-136-1 and -2. However, the calcine diverter system plugged and failed to operate as designed. As a result, most of the Zr calcine produced in WCF Campaign 2 went into Bin VES-136-5, which was already partially filled with Al calcine. This created the first bin of calcine that varied significantly in chemical composition. The diverter system was unplugged following WCF Campaign 2 and later used to fill Bins VES-136-1 and -2. However, calcination during WCF campaigns 3, 4, and 5 produced primarily Zr calcine, which was added to CSSF II without any further attempt to segregate calcine. As a result, CSSF II has two bins containing only Al calcine, four bins containing primarily Zr calcine, and one bin containing significant amounts of both Zr and Al calcine. These varying calcines produce the large variations in the CSSF II calcine chemical concentrations and radionuclide activity seen in the data plots in Appendix C.

After the 1960s, INTEC continued to reprocess both Al- and Zr-clad fuels. However, relatively small quantities of pure Al calcine exist outside of CSSFs I and II. In an effort to maximize fuel-reprocessing efficiency and minimize waste generation, a fuel-reprocessing method called coprocessing was implemented in 1970. Coprocessing used the dissolver solution from the Al fuel-dissolution system to complex the F in the Zr fuel-dissolver solution. This process minimized waste generation by reducing the amount of aluminum nitrate that would otherwise have been used to complex the F in the Zr fuel-dissolver solution. It also eliminated the generation of large amounts of Al calcine. From a calcination standpoint, calcination of coprocessing waste was virtually the same as processing Zr waste. Chemically, the two types of wastes were virtually the same. Consequently, many INTEC documents do not differentiate between the two types of waste. Zirconium (and coprocessing) waste constitute the bulk of the wastes calcined after WCF Campaign 2.

CSSF II was filled with Al and Zr calcines. Based on the information in Appendix A and summarized in Table 1, the approximate volumes and types of calcine sent to CSSF II include 2,770 ft³ of dolomite and nonradioactive alumina used for calciner startups, 12,060 ft³ of radioactive Al calcine, and 15,200 ft³ of radioactive Zr calcine. CSSF II contains 6.3×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded calcine temperature in CSSF II was 1,284°F (695°C), in VES-WCS-136-3, during August 1969. The high temperature was a consequence of the highly radioactive Al calcine contained in VES-WCS-136-3, the large-diameter, cylindrical configuration of the CSSF II bins, and the calcine cooling system being shut off during the summer of 1969. Tables A11 through A13 document the chemical content and radioactivity of the calcine in CSSF II.

The radioactive calcine in two of the CSSF II bins were sampled in 1978 (Staples, Pomiak, and Wade 1979). Samples of Al calcine stored in VES-WCS-136-3 and Zr calcine stored in VES-WCS-136-7 were obtained by inserting a long sample probe into the full bins. The probe retrieved calcine samples from multiple locations throughout the length of each bin. This sampling and analysis effort confirmed that the stored calcine had not agglomerated or consolidated into a large irretrievable mass.

6.1.3 Calcined Solids Storage Facility III

CSSF III began receiving calcine in February 1972, during the middle of WCF Campaign 5. It was filled in March 1981 with the completion of WCF Campaign 9 (Childs, Donovan, and Swenson 1982). The design of CSSF III included a calciner diverter system, similar to that of CSSF II, to selectively send

calcine to Bin VES-WCS-140-1. The other bins were designed to fill concurrently. However, data indicate some preferential bin filling occurred (see bin filling curves in Figure B27 of Appendix B). No attempts were made to use the diverter or segregate calcine in CSSF III.

From the mid-1960s through the late 1970s, first-cycle Zr (and coprocessing) comprised the bulk of the waste produced, calcined, and stored in CSSF III. However, CSSF III also contains small amounts of calcine derived from Al, stainless steel, and SBW. The stainless steel and SBW in CSSF III were calcined as blends with Zr waste. The stainless-steel waste was too dilute (too few dissolved solids) to calcine by itself, so it was blended with Zr waste. Calcination of SBW by itself generated alkali nitrate solids that could agglomerate in the calciner. Calcination of SBW as a blend with Zr waste reduced the agglomeration potential to a manageable level. Efforts to calcine SBW began in the late 1970s during WCF Campaigns 8 and 9, when CSSF III was nearly full. By that time, all of the tanks in the INTEC Tank Farm designed for SBW storage (those without cooling coils) were full or nearly full. As a result, INTEC began using tanks designed for first-cycle raffinate (those with cooling coils) to store SBW. Storing SBW in the first-cycle raffinate tanks affected fuel reprocessing by reducing first-cycle raffinate storage space and waste-segregation options. CSSF III was the first CSSF to contain SBW-blend calcine.

CSSF III contains calcine from various types of wastes and waste blends. They include radioactive Al, stainless steel, Zr (including coprocessing), and SBW calcine, along with nonradioactive dolomite, fluorapatite, and aluminum nitrate startup material produced during WCF Campaigns 6, 7, 8, 9, and the latter half of 5. Based on the information in Appendix A and summarized in Table 1, the approximate volumes and types of calcine sent to CSSF III include 5,200 ft³ of nonradioactive dolomite, alumina, and fluorapatite calciner startup material, 1,860 ft³ of radioactive Al calcine, and 32,400 ft³ of radioactive Zr (and coprocessing), Zr/SBW blend, and Zr/stainless-steel blend calcine. CSSF III contains 6.8×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded calcine temperature in CSSF III was 640°F (338°C), in VES-WCS-140-3, during June 1978. Tables A11 through A13 document the chemical content and radioactivity of the calcine in CSSF III.

6.1.4 Calcined Solids Storage Facility IV

CSSF IV received nonradioactive calcine between July 1981 and June 1982 during NWCF testing. A commercial contractor removed the nonradioactive calcine from CSSF IV prior to the radioactive startup of NWCF.ⁿ The CSSF IV bins were filled with its current calcine inventory between August 1982 and July 1983 during the first half of NWCF Campaign 1. The CSSF IV calcine distribution system was designed to fill all three bins simultaneously during normal operation. CSSF IV also included a calcine diverter system that could selectively direct calcine into Bin VES-WS4-143. While CSSF IV was being filled, VES-WS4-143 filled more slowly than the other two bins. The normal fill pipe leading from the distributor to the bin appeared to be restricted (see filling curves in Appendix B). In an effort to send more calcine into that bin, the CSSF IV diverter was used after May 30, 1983 (Penwell 1993). All the bins in CSSF IV were filled by July 15, 1983, when CSSF V was placed in operation.

CSSF IV contains primarily Zr (and coprocessing) and varying blends of Zr, stainless-steel, and SBW calcine. CSSF IV contains more SBW than previous CSSFs because of a concerted effort that began in the late 1970s and continued through the 1990s to reduce the amount of SBW stored in the INTEC Tank Farm.

n. Fawcett, C. L., retired, Westinghouse Idaho Nuclear Company employee, phone conversation with M. D. Staiger, December 10, 2002.

Based on the information in Appendix A and summarized in Table 1, the approximate volumes and types of calcine sent to CSSF IV include 730 ft³ of nonradioactive dolomite and alumina from calciner startups, 120 ft³ of aluminum nitrate/Zr blend, and 16,300 ft³ of radioactive Zr and Zr/stainless-steel/SBW blend calcines. The aluminum nitrate/Zr blend calcine came from four batches of calciner feed containing about 2,000 gal of nonradioactive aluminum nitrate that was spiked with 75 to 100 gal of radioactive Zr waste. Those four batches were used as a low-activity, radioactive test of the NWCF, just prior to full-scale radioactive operation. CSSF IV contains 4.1×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded calcine temperature in CSSF IV was 601°F (316°C), in VES-WS4-142, during October 1983. Tables A11 through A13 document the composition (chemical and radioactivity) of the calcine in CSSF IV.

6.1.5 Calcined Solids Storage Facility V

CSSF V began receiving calcine in July 1983, midway through NWCF Campaign 1. It was filled in January 1992, midway through NWCF Campaign 3 (see filling curves in Appendix B).

CSSF V contains primarily Zr/SBW blend calcine produced from a concerted effort to reduce the volume of SBW stored in the INTEC Tank Farm. It also contains various blends of Al, Zr, SBW, stainless-steel, Rover, and aluminum nitrate calcines. Based on the information in Appendix A and summarized in Table 1, the approximate volumes and types of calcine sent to CSSF V include 3,200 ft³ of nonradioactive alumina, dolomite, and pilot plant calcine used in calciner startups, 580 ft³ of Al calcine, and 31,820 ft³ of calcine formed from blends of radioactive Zr, SBW, Al, stainless-steel, and Rover wastes, and nonradioactive aluminum nitrate. The facility contains 8.8×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded calcine temperature in CSSF V was 239°F (115°C), in VES-WS5-146, during July 1988. The temperature of the calcine in CSSF V is considerably lower than that of similar calcine in CSSFs II, III, and IV due to the annular design of the CSSF V bins, which provides better heat removal from the bins. Tables A11 through A13 document the calcine chemical content and radioactivity in CSSF V.

6.1.6 Calcined Solids Storage Facility VI

CSSF VI began receiving calcine from the NWCF in January 1993, midway through NWCF Campaign 3. Prior to receiving calcine from the NWCF, 43 ft³ of pilot plant Zr calcine was placed in VES-WS6-154 on April 26, 1986.^o This amount was about half the volume of the bottom segment of that bin. The bottom segments of the other CSSF VI bins contain primarily startup bed and transition material (dolomite and alumina). As a result, the concentrations of Zr calcine components (Zr, F, B, Sn, Fe, and Cr) are higher and the concentrations of some dolomite constituents (Mg and CO₃) are lower in the bottom segment of VES-WS6-154 than in bottom segments of the other bins. The chemical data plots in Appendix C show these concentration differences. CSSF VI was filled to about 47% of its capacity when calcination ended in May 2000, at the end of NWCF Campaign 4 (see filling curves in Appendix B).

CSSF VI contains the highest percentage of alkali metals of any CSSF because of a concerted effort to increase the calcination of SBW in the late 1990s, including the use of a more aggressive “high-temperature” SBW calcination flowsheet during 1999 and 2000, as discussed briefly in Sections 5.1 and 5.1. Prior to 1999, the historical calciner operating temperature of both the WCF and NWCF calciners had been 400 to 500°C. At those operating temperatures, alkali metals formed low-melting nitrates that could cause calcine agglomeration. At 600°C, the alkali metals formed more aluminates (i.e. NaAlO₂) and

o. Dumas, M. M., “NWCF Campaign H-3 (1993 Portion) Feed Data,” Westinghouse Idaho Nuclear Company, Inc. Interdepartmental Correspondence, to M. D. Staiger, MMD-02-94, April 1, 1994.

less nitrates. The aluminates did not melt at calciner operating temperatures and did not cause calcine agglomeration problems. Thus the alkali content of the calciner feed could be increased.

In April and May 1999, the NWCF operated at 600°C for two 2-week periods. The 1999 high-temperature calcination test ended early because of problems with calciner off-gas line plugging. The plugging problems were resolved and the high-temperature flowsheet was successfully retested for approximately 9 weeks from March through May 2000. During that time, the alkali content of the calcine averaged 10 to 11 wt%, nearly triple the historical value. Even though the alkali content of the calcine went up dramatically during the high-temperature operation, the nitrate content actually decreased because of the formation of alkali aluminates instead of nitrates in the calcine. The drop in alkali nitrates reduced the calcine agglomeration potential.

CSSF VI contains a variety of calcines including Al, and various blends of Zr, Al, stainless steel, SBW, and nonradioactive aluminum nitrate produced during NWCF Campaigns 3 and 4. Based on the information in Appendix A and summarized in Table 1, CSSF VI contains approximately 2,070 ft³ of nonradioactive pilot plant calcine, alumina, and dolomite from calciner startups, 600 ft³ of Al calcine, and 22,500 ft³ of calcine blends formed from Al, Zr, stainless steel, SBW and aluminum nitrate. CSSF VI contains 2.3×10^6 Ci of radioactivity (decayed to January 1, 2016). The highest recorded temperature in CSSF VI was 153°F (67°C), in VES-WS6-154, during August 1994. The calcine in CSSF VI has the least activity and the lowest temperatures of any CSSF because it contains the most SBW, which had the lowest fission-product activity of any liquid waste. The annular bin design of CSSF VI also contributes to its low calcine temperature. Tables A11 through A13 document the composition (chemical and radioactivity) of the calcine in CSSF VI.

7. CHANGES FROM PREVIOUS REPORT REVISION

This report section documents the changes made to the HPM from the previous revision. The changes improve the accuracy of the calcine inventory and composition. The basic methodology of the HPM remains unchanged—that is the use of historical liquid waste sample analyses, the volume of liquid waste calcined, calciner operating data, and the CSSF filling history to calculate the amount of calcine, its chemical composition, and its radioactivity. Most of the changes to the HPM are refinements of the databases and assumptions used by the HPM to calculate the calcine composition. The changes to the HPM include minor modifications of the volumes of some of the wastes that were calcined, editing of the analytical data used to determine the composition of the liquid wastes calcined, adjustments to the dates used to determine when bin segments were filled with calcine, and adjustments to the radionuclide data in the ORIGEN2-based waste models. The changes also include revised concentrations of some trace calcine constituent metals regulated under RCRA and a change in the method used to calculate those constituent concentrations. This section describes these changes in more detail.

7.1 Radionuclide Calculation Method

This revision of the HPM incorporates changes to the ORIGEN2-based models used by the HPM to calculate radionuclide activity when sample data do not exist. The changes included improvements in the waste-model assumptions and corrections of the errors and inconsistencies in the ORIGEN2-based models that had been noted in the previous revision of this report.

7.1.1 Calculation of Uranium and Transuranic Isotopes and Their Daughters

When there are no sample data for a given radionuclide, the HPM calculates radioactivity based on a ratio of the radionuclide of interest and the Cs-137 activity from an ORIGEN2-based model, and the measured activity of Cs-137 in the waste, as described in Section 4.3.2. This method is valid for most fission products, because the relative activities of Cs-137 and most of the fission products in the liquid and calcined waste are the same as they were in the ORIGEN2-modeled spent fuel. However, the relative activities of Cs-137 and U (and its daughter products) are not the same as they were in the spent fuel. The bulk of the U originally in the fuel was recovered, leaving the waste depleted in U compared to Cs-137 and the fission products. The activity of the U remaining in the waste did not correlate with the Cs-137 activity of the waste. The ORIGEN2-based waste models in the previous version of the HPM accounted for the uranium recovery by adjusting the U in the waste model to match that measured in liquid waste samples. This adjustment yielded a fairly accurate estimate of the U in most wastes. However, the amount and activity of U in the waste was ultimately dependent on the U recovery efficiency and not the activity of Cs-137. Therefore, this HPM revision includes a change to the method used to calculate U activity.

Most of the historic waste samples did not include isotopic U data, hence the need for a method to calculate the isotopic activity. However, the total U concentration was measured in virtually every waste stream. The isotopic distribution of the U was known (from both the U product and waste-sample analyses) for the major waste types. Therefore, instead of calculating the isotopic U activity from the Cs-137 activity, the HPM was modified to use the total mass of uranium in each waste stream (from sample analyses) and the typical isotopic U distribution for each type of waste, to calculate the isotopic U in each waste stream. Use of the total mass of U instead of the Cs-137 activity to calculate the U activity incorporates the U recovery efficiency and gives a better estimate of the isotopic distribution and activity of U in the waste.

The U daughter products cannot be calculated by simple first-order methods (which the HPM can perform), so the HPM does not calculate the U daughter activity from the waste-sample data. Instead,

the HPM uses ORIGEN2-based models to calculate the activity of the U daughter products based on the Cs-137 and U activity in the waste models. As a result, the U daughter-product activity calculated by the HPM based on average waste compositions, does not match the U daughter activity that would be calculated from the measured U in the individual waste streams. This discrepancy results in data anomalies between the measured activities of the U isotopes and the calculated activities of their daughter products. However, the differences are relatively small, a factor of two or less for most waste streams. The total measured U activity is in good agreement with the total calculated activity of the U daughter products, but anomalies exist for individual waste streams. The U daughters have very low activities and are generally not constituents of concern. Therefore, the anomaly that exists between the measured activities of the U isotopes and the calculated activity of their daughters is not considered a significant concern.

Similar anomalies exist for TRU isotopes for which analytical data exist, primarily Pu and Np. Because of the U recovery chemistry and waste management, the activity of TRU components in individual waste streams varied from the average values in the ORIGEN2-based waste models. The HPM reports analytical values for the TRU components for which data are available, but does not calculate the activity of their daughter products from the measured activity of the parent nuclide. Instead, the activity of the daughter products is calculated using the ORIGEN2-based waste models. As with the U isotope activity and its daughters, this discrepancy is expected to be a factor of two or less for most waste streams, and affects species that are not considered species of concern.

The activity of Np-237 and its daughters requires a special note. INTEC recovered Np-237 from the fuel dissolver product for several years, resulting in several Np-237-depleted waste streams. The HPM adjusts the activity of protactinium (Pa) -233, the short-lived daughter of Np-237, to reflect the analyzed or calculated activity of Np-237, including its activity in Np-237-depleted wastes. The HPM does not adjust the activities of subsequent daughter products. Instead, the HPM calculates them using ORIGEN2-based waste models as previously explained. However, instead of being within a factor of two as explained with the U and Pu daughters, the ORIGEN2-based models overstate the activity of the Np-237 daughters in the Np-237-depleted wastes by a much larger value, likely a factor of 20 to 50 depending on the waste stream and the Np-237 recovery efficiency. This issue is considered a minor problem because it affects radionuclides that have very low activities and are not considered species of concern. The error also is a conservative error because the HPM overstates the activity of the Np-237 daughters in the Np-237 depleted waste streams.

7.1.2 Changes to ORIGEN2-Based Models

Several changes were made to the radionuclide data in the HPM resulting from a validation and verification of the five ORIGEN2-based models used to calculate radionuclide activity (Herbst 2011). The previous revision of this report documented a few errors in the five radionuclide models and made adjustments to the HPM to compensate for the errors. The errors were not with the ORIGEN2 program or its use. Instead, the errors were in the adjustment and compilation of the ORIGEN2 output data.

The ORIGEN2 program calculated the fission and activation products in spent nuclear fuel at the time it was reprocessed. The INTEC fuel-reprocessing system chemically separated some of the elements originally in the fuel, which altered their relative concentrations and activities. The chemical separations prevented the direct use of the ORIGEN2 data to determine radioactivity in INTEC wastes. For example, the fuel-reprocessing system recovered most of the U originally in the fuel. This removal resulted in much less U relative to other radionuclides in the waste than that determined by ORIGEN2 in the spent fuel. During fuel reprocessing, most of the fission and light activation products went into the first-cycle raffinate. However, much of the TRU activity went into the second- and third-cycle raffinates. Thus, there was a separation of the fission and light activation products from the TRU products. Because of these

chemical separations, the radionuclide activities determined by ORIGEN2 to be in the fuel were adjusted and normalized based on analyses of waste samples. The HPM uses the adjusted ORIGEN2 data in five waste models to calculate radioactivity in calcine when sample data do not exist. The adjustment, normalization, and compilation of the ORIGEN2 data used FORTRAN and Excel spreadsheets. The errors noted in the HPM radionuclide database were in the assumptions used to normalize the radionuclides to INTEC analytical data and in the FORTRAN and Excel spreadsheets used to compile the ORIGEN2 data.

Most of the radionuclide compilation errors were documented and resolved in the previous revision of this report and the HPM. The errors included a “cut and paste” spreadsheet error that affected curium, berkelium, californium, and einsteinium isotopes in the coprocessing model; a data entry (typo) error for U-234 in the analytical data portion of the Zr model; Ni-63, Ni-59, and Fe-55 adjustment errors in the Zr, coprocessing, and SBW models; an error in a decay date of the Al waste (waste was decayed to the year 3100 instead of 3110); and an incorrect assumption regarding the Pu-238:Pu-239 ratio in coprocessing waste. In addition, the 2005 Relative Inventories report (Wenzel 2005) indicated that newer values for half-lives were available than those used in the original ORIGEN2 program. The Relative Inventories report (Wenzel 2005) used the newer half-life values for some of radionuclides in some of the waste models, but did not use them consistently for all of the nuclides or in all of the models. This resulted in inconsistencies in radioactive decay calculations between models. These errors were identified and resolved in the prior revision of this report by adding adjustment factors to the HPM database, instead of revising the ORIGEN2-based models. As a result, the HPM radionuclide database was “cluttered” with various adjustment factors. In some cases, the errors were acknowledged but could not be easily fixed in the HPM. The HPM does not perform complex, multistep, radionuclide decay calculations, such as those of the uranium and thorium series. The activity of U-234 in the HPM could have easily been adjusted to account for the typo error in the analytical data adjustment for Zr waste, but the HPM could not easily be modified to calculate the resulting changes in the activity of the U-234 daughter products.

This report revision incorporates work that independently reviewed, verified, and modified (as needed) the analytical adjustments, radiolytic decay, and compilation of the ORIGEN2 data used in all five of the radionuclide models used by the HPM (Herbst 2011). The radionuclide inventory data from the independent review were compared to that of the original HPM database. The comparison looked for differences between the two databases and determined the reasons for any differences. Some of the differences were the result of errors in the original waste models, as noted above. Most were the result of differences in the half-lives between the original ORIGEN2 program and the SCALE/ORIGEN-ARP program used in the independent review. This review verified the data in the five radionuclide models have been decayed and compiled correctly.

During the independent review process, the previously identified errors were resolved and a few previously unidentified errors were found and corrected. They included typos in the analytical data entry for Sb-125 in the stainless-steel model, and misplaced data entries for Eu-154 and Eu-155 in the Zr waste model. Neither of these errors caused any problems with the use of data from the previous revisions of the HPM because they affected radionuclides that are relatively short-lived and are not considered species of concern. The independent review also noted that the original ORIGEN2 data manipulation increased the fuel cladding-to-U mass ratio to unreasonably high values in the Zr and the Zr portion of the coprocessing models. This caused the activity of light activation products in the fuel cladding, such as Ni-63, to be too high in those two waste models. This cladding adjustment was removed, resulting in more appropriate values for the light activation products. The independent review also found a 2-month discrepancy in the decay period for the SBW model. This discrepancy was removed from the SBW model.

ORIGEN2 is no longer available and has been replaced with SCALE/ORIGEN-ARP (Bowman and Gauld 2010). The independent review (Herbst 2011) of the Relative Inventories report (Wenzel 2005)

models used the ENDF-B-VI radionuclide database contained in ORIGEN-ARP to decay the original ORIGEN2 reactor model output. The independent review used consistent half-life values for all five HPM waste models. The values of several radionuclide half-lives in the ENDF-B-VI database differ from those in the ORIGEN2 database. In most cases, the differences are small and their effect on radioactivity calculations is insignificant over short periods of time. For example, the previous version of the HPM used a half-life of 30.07 years for Cs-137, based on the “updated” half-life given in Wenzel (2005). The half-life of Cs-137 in the ENDF-B-VI database used by SCALE/ORIGEN-ARP is 30.00 years, a difference of about 0.02%. In a few instances, such as Ce-142, ORIGEN2 treated the species as a long-lived radionuclide (half-life of 1.05×10^{11} years), whereas ENDF-B-VI treats it as a stable isotope. The differences in half-lives generally resulted in insignificant changes to the calculated radioactivity, especially for relatively short decay periods (a few hundred years).

One exception to the generally minor impact of the changes in half-lives is Se-79. The half-life of Se-79 in SCALE/ORIGEN-ARP ($2.947\text{E}+05$ years) is approximately four and one half times longer than that in ORIGEN2 ($6.496\text{E}+04$ years) that was used in previous revisions of the HPM. Hence, when converting the mass of Se-79 determined to be in the fuel at the time of reprocessing into radioactivity, SCALE/ORIGEN-ARP calculates the Se-79 activity to be about 22% of the activity previously calculated by ORIGEN2.

This report and HPM revision use the radionuclide data for the five waste models generated by the model verification and correction effort (Herbst 2011). As a result, the radionuclide adjustment factors used in previous versions of the HPM were removed because they are no longer necessary.

7.2 Volume of Waste Calcined

A few changes were made to the volume of liquid waste calcined. Tank Farm waste was typically transferred to the calciners via a steam jet. Condensation of the motive steam increased the volume of waste by about 5% and diluted the waste constituents by about 5%. For example, the transfer of 1,000 L of waste from the Tank Farm resulted in a waste volume of 1,050 L at the calciner because of condensation of the motive steam. If the Al concentration of that waste was 1.500 molar (M) in the Tank Farm, it would have been diluted to 1.429 M at the calciner. The mass of Al in that waste that was calcined and sent to the CSSFs is the product of the volume of waste and its Al concentration. There are two ways to make that Al mass calculation. The volume of waste and its Al concentration as measured at the Tank Farm (1000 L and 1.500 M) can be used (i.e. “Tank Farm basis”), or the volume of waste and its Al concentration as measured at the calciner (1050 L and 1.429 M) can be used (i.e. “calciner basis”). Both methods result in the same calculated mass of Al in the calcine; 1.500 g-moles, or 40.5 kg. Whether the Tank Farm or calciner values are used does not matter, as long as the waste volume and composition have the same basis.

The HPM uses the Tank Farm basis for all waste volumes and compositions. The volumes of the waste calcined in the HPM were previously validated (Wood et al 2003). However, the validation generally ensured that the historical data were correctly entered into the HPM database. The validation did not determine whether the data had a consistent basis (Tank Farm or calciner). A review of the waste volume data performed as part of this report revision found calciner waste volumes, instead of Tank Farm waste volumes, were used for two wastes (Streams 27 and 28) that were calcined in WCF Campaign 5. Use of the larger, dilute calciner volumes with the concentrated Tank Farm composition resulted in the HPM calculating slightly too much calcine mass and activity for those wastes. This inconsistency did not affect the mass-based concentrations of any chemical or radionuclide in the calcine because the relative concentrations of all species in the waste were unchanged. This HPM revision reduced the volume of liquid Waste Streams 27 and 28 by 5% to achieve a consistent Tank Farm basis. This change resulted in

a decrease of about 3,000 gal in the volume of waste calcined for those two waste streams. Overall, this was a very minor volume to the overall volume of nearly 8 million gal of waste that were calcined.

Similar changes were made to the volume of Waste Stream 31 that was calcined in WCF Campaign 6. During that campaign, some of the waste was transferred to the WCF and concentrated in an evaporator prior to being calcined. The volume of waste calcined in the previous revision of this report was generally the concentrated volume fed to the calciner, because that was the volume recorded on the calciner feed makeup sheets. However, the concentrated waste volume was not consistent with the Tank Farm basis of the HPM. This HPM revision includes a volume adjustment to each of those feed batches to achieve a consistent Tank Farm basis. The adjustment was made by multiplying the volume of concentrated waste fed to the calciner by the ratio of the volume of waste transferred from the Tank Farm to the volume of concentrated waste fed to the calciner. This change increased the volume of Waste Stream 31 that was calcined from 83,200 gal to 104,900 gal. This change increased the mass of calcine formed from Waste Stream 31, but did not change the mass-based concentrations of any chemical or radionuclide calculated in that calcine because the relative concentrations of the waste components were unchanged.

Table 6 contains a summary of the volume of liquid waste calcined during the 13 calcination campaigns (nine in the WCF and four in the NWCF) and the impact of the waste volume changes to the HPM. Table 6 contains three slightly differing columns of data for the volume of liquid waste calcined. The first column of data (historical) is the volume of waste calcined per historical calciner campaign reports (Commander 1966; Lohse and Hales 1970; Bendixsen, Lohse, and Hales 1971; Weiland, Lohse, and Hales 1972; Weiland and Freeby 1973; Childs, Donovan, and Swenson 1982). Formal calciner campaign reports were never written for some of the calciner campaigns, so information for those campaigns came from the INTEC operating contractor's monthly production reports.^p The second column of data (prior revision) is the volume of waste calcined in the previous revision of the HPM and this report (Revision 3). The third column of data is the volume of waste calcined in this revision of the HPM (Tables A1-A6 in Appendix A).

A comparison of the waste calcined data in Table 6 generally shows excellent agreement (within 1%) between the historical data and the data in this report for each calcining campaign. Most of the minor volume differences between the "historical" and "this revision" volumes in Table 6 are the result of number rounding, instrument calibrations, slight variations in the (5%) steam jet dilution value, and the designation of a few batches of waste as "calciner recycle" (wastes generated internal to the calcining facilities such as decontamination or off-gas scrubbing solutions) versus "Tank Farm" waste. The exceptions to the otherwise excellent volume agreement are WCF Campaigns 3 and 6 in which the volume of waste calcined in the HPM (this report) exceeds that in the historical campaign reports by about 4%. This relatively large difference indicated the possibility of the HPM having some incorrect waste volume data. Therefore, the waste volumes calcined in those two campaigns were reviewed in detail. The review found the volumes recorded in the HPM matched those recorded by calciner operating personnel on historical calciner feed makeup data sheets. However, several errors and data anomalies were found in the monthly production reports that were used as the basis of the "historical" data. For

p. Amberson, C. B., "ICPP Production Monthly Report No. 171," Amb-34-74, July 8, 1974. Amberson, C. B., "ICPP Production Monthly Report No. 189," Amb-2-76, January 6, 1976. Amberson, C. B., "ICPP Operations Division Monthly Report No. 202," Amb-17-77, February 3, 1977. McMillan, F. L., "ICPP Production Division Monthly Report No. 223," FMC-148-78, November 8, 1978. Mairson, R. C., "Production Department Monthly Report," Mair-135-84, July 6, 1984. Ermold, L. F., "Production Department Monthly Report," LFE-276-88, December 8, 1988. Halupa, S. M., "Operations Department Monthly Report," SMH-182-93, December 6, 1993. Clark, A., "Tank Farm and Process Equipment Waste (PEW) Monthly Report Tables," June 1997 through May 2000.

Table 6. Comparison of reported liquid waste volumes calcined.

Operating Campaign	Date	Tank Farm Waste Calcined (historical) (gal)	Tank Farm Waste Calcined (prior revision) (gal)	Tank Farm Waste Calcined (this revision) (gal)
WCF 1	Nov 1963 to Oct 1964	513,100	513,000	513,000
WCF 2	Mar 1966 to Mar 1968	989,000	986,000	986,000
WCF 3	Aug 1968 to Jun 1969	329,000	341,100	340,100
WCF 4	May 1970 to Jan 1971	224,700	229,500	229,500
WCF 5	Sept 1971 to May 1972	299,000	296,300	293,300
WCF 6	May 1973 to May 1974	386,300	387,400	401,900
WCF 7	May 1975 to Jan 1977	375,300	381,200	381,200
WCF 8	Sept 1977 to Sept 1978	456,900	468,900	469,000
WCF 9	Jun 1979 to Mar 1981	476,900	477,300	477,300
NWCF 1	Aug 1982 to Jun 1984	1,528,200	1,530,900	1,530,900
NWCF 2	Sept 1987 to Dec 1988	835,600	829,000	829,000
NWCF 3	Dec 1990 to Nov 1993	779,400	776,700	776,700
NWCF 4	May 1997 to May 2000	498,300	507,000	505,200
Total ^a		7,691,700	7,724,400	7,733,100
a. Totals may differ slightly from the sum of the columns because of rounding				

example, in the first month of WCF Campaign 3, the WCF section of the production monthly report^q indicates 17,425 gal of waste were transferred (by steam jet) from the Tank Farm, but the calciner received only 16,507 gal. The report appears to have reversed these two volumes because the volume received at the calciner should have been about 5% higher than the volume sent from the Tank Farm because of steam-jet condensate dilution. The Tank Farm section of that report gives a volume decrease of 16,400 gal because of calcination, which supports the view that the calcining section of the report is in error. The monthly report for the last month of WCF Campaign 3^r indicates 8,980 gal of waste were calcined during the month, but only 2,316 gal were added to the campaign total from the previous month to give a “corrected” campaign volume of 328,762 gal calcine. The monthly report gives no reason for the “correction” and resulting volume discrepancy. Similar data anomalies were found in the production monthly reports for WCF Campaign 6. Such anomalies raise questions about the accuracy of the reported historical data in both WCF Campaigns 3 and 6. The waste volume data in the HPM are in agreement with the WCF feed batch makeup data sheets for those campaigns. Based on the reviews of the WCF Campaigns 3 and 6 data, the HPM waste volumes are considered accurate for those campaigns.

The HPM had assumed waste transfers from liquid waste Tank VES-WM-189 used an airlift instead of a steam jet, so waste calcined from that tank generally had no steam dilution. However, a steam jet, instead of an air lift, was used to transfer waste from VES-WM-189 when its waste volume was less than approximately 50,000 gal. At that point, a loss of submergence caused the air lift to be too inefficient

q. Amberson, C. B., “CPP Production Monthly Report No 101,” Amb-196-68, August 29, 1968.

r. Amberson, C. B., “CPP Production Monthly Report No. 111,” Amb-136-69, July 2, 1969.

to use. This occurred in WCF Campaign 3 and NWCF Campaign 4, so the waste volumes received at the calciners from Tank VES-WM-189 when its volume was less than 50,000 gal were reduced by 5% to account for steam jet dilution. The waste volume in VES-WM-189 also went below 50,000 gal during NWCF Campaign 1. However, the calciner feed makeup data sheets for that campaign recorded the volume of Tank Farm waste that was transferred, not the volume received at the calciner, so no adjustment of those waste volumes was needed.

The changes to the volume of waste calcined resulted in a net increase of 8,692 gal in the total amount of waste calcined. This is just over 0.1% of the waste calcined during the nearly 40 years of calcination. The impact of these changes on the total amount of calcine, or composition of the calcine, is negligible.

7.3 Liquid Waste Composition

The analytical database used to determine the composition of the liquid waste calcined, and hence the composition of the calcine, was reviewed and edited. The 2003 report *Validation of Historical Tank Farm Composition Database* (Swenson 2003b) documents a review of the liquid waste composition database used in the HPM. That review generally ensured that the analytical data had been correctly transcribed from the source documents into the HPM database. Except for gross, order-of-magnitude errors, that review did not evaluate the analytical data to determine whether the data were consistent and reasonable for each waste stream. This HPM revision included a more detailed review of the analytical data for accuracy, based on consistency and process knowledge. In addition, changes were made to the assumed concentrations of some minor constituents for which analytical data do not exist.

7.3.1 Erroneous Sample Data

INTEC has not retained liquid waste analytical data as life-time records. Much of the analytical data in the HPM database came from secondary sources instead of the original laboratory reports, many of which are no longer available. The secondary sources included external reports, internal office memoranda, operations log books, personal logs, and other sources. These secondary sources may have had data transcription errors. In addition, some of the original analytical data may have been incorrect because of dilution errors, equipment malfunctions, or laboratory personnel errors. One way to identify such errors is to compare data from several samples of the same, or similar, wastes for consistency. The calciner feed characterization process typically analyzed multiple samples of each waste stream. The data from repeated sample analyses should have consistent results for each analyte. Significant variation in the concentration of an analyte indicates likely analytical, transcription, or other errors. The liquid waste data used by the HPM to calculate calcine composition were reviewed to ensure that data from multiple analyses of the same waste had consistent results. When errors were found, the erroneous data were noted in the HPM database and are no longer used by the HPM.

Table 7 contains analytical data from four samples of Waste Stream Number 67 (waste from Tank VES-WM-187 calcined in 1983). Table 7 contains data for Zr, F, the F:Zr ratio, Al, and Pu-238. Sample data that differ significantly from others is highlighted with a grey background. The erroneous data include Zr (and the corresponding F:Zr ratio) in Sample Log 83-090611 (Zr is a factor of 2 below the other values), Al in Log 83-09051 (Al is 25% below the other values), and Pu-238 in Log 83-09057 (Pu-238 is a factor of about 3.5 above the other values).

The data highlighted in grey in Table 7 are not consistent with the other sample data from Stream 67 (or with similar Zr wastes) and were deemed incorrect. Zr fuel dissolution was a precisely controlled chemical process in which zirconium fuel cladding was dissolved with hydrofluoric acid (HF)

Table 7. Analytical data for Waste Stream Number 67 (from Tank VES-WM-187).

Sample Date	Sample Log Number	Zr (Molar)	F (Molar)	F:Zr ratio	Al (Molar)	Pu-238 (d/s/mL)
Sept. 5, 1983	83-09051	0.40	2.59	6.48	0.45	2.27E+05
Sept. 5, 1983	83-09057	0.43	2.55	5.93	0.62	7.61E+05
Sept. 6, 1983	83-090611	0.174	2.53	14.4	0.60	1.73E+05
Sept. 7, 1983	83-09071	0.43	2.90	6.74	0.62	2.17E+05
Average of all four sample values		0.359	2.64	8.39	0.573	3.45E+05
Average of three values (excluding erroneous value)		0.420	2.64	6.38	0.613	2.40E+05

using a flowsheet that resulted in a consistent F:Zr ratio. Aluminum nitrate was added to the Zr fuel dissolver product to achieve a prescribed Al:F ratio to complex the HF and prevent corrosion of the uranium-extraction equipment. Too much aluminum nitrate could cause precipitation of AlF_3 , and too little would result in inadequate complexing and excessive corrosion. Thus the relative ratios of Al, Zr, and F are well known in Zr waste and can be used to determine the validity of historical sample data. The highlighted Zr and Al values in Table 7 are too low and not within historical fuel-reprocessing limits for the relative concentrations of Zr, F, and Al. The highlighted Pu-238 activity is too high compared with other sample data of the same waste. As a result of the data review, the highlighted data in Table 7 were not used by the HPM to determine the average waste composition for Stream Number 67. The changes shown in Table 7 illustrate the type of data comparison and changes made during the analytical data review.

In addition to the use of the relative ratios of Zr, Al, and F, other methods and data comparisons were used to edit the sample database and improve the accuracy of calcine composition calculations. Comparisons of the Cs-137:Sr-90 ratio (which should be approximately 1.1) were made on all waste samples. Charge balances were made and reviewed to ensure that the cation and anion charges balanced. A process knowledge-based review of the analytical data was done to ensure that the data were reasonable. For example, Zr and F were detected in trace amounts in some of the samples of Waste Stream Number 31. Waste Stream 31 was Al waste that had been stored in a Tank Farm vessel that had never contained Zr waste. Trace amounts of Zr and F were found in the first samples from that tank, but not in later samples. The trace Zr and F were deemed to have come from residual contamination in the calciner blend and hold tanks (from which the samples were taken) from the previously calcined Zr waste. Filling and emptying the calciner blend and hold tanks with Al waste flushed the residual Zr and F from the tanks and eliminated them from later waste samples. Based on this evaluation, the F and Zr data were deleted from Stream 31.

Most of the erroneous analytical data were changed from numbers to text in the HPM Excel database. The analytical data are thus still available for persons reviewing the data, but the Excel logic does not use the text values in its computations.

Of the thousands of analytical data, relatively few (a few dozen) were discarded as erroneous data. As a result, the composition of most waste streams, particularly the major waste components, and consequently most calcine did not change significantly from the previous revision of the HPM. Significant changes to major components (such as Stream 67 in Table 7) were few, and their effect on the overall calcine composition was generally masked by the wastes for which no composition changes

occurred. More significant changes to major calcine components were made in prior reviews and revisions of the HPM.

The total mass of the major chemical constituents in calcine typically changed 1% or less because of the combined changes to the volume of waste calcined and the liquid waste composition. For example, the total amount of Al in the calcine decreased from 960,640 kg in the previous version of this report to 960,043 kg, a change of less than 0.1%. The mass of Zr increased from 549,661 kg to 555,033 kg, an increase of 1.0%. Even the largest changes to the major calcine components were relatively small, especially compared to the total mass of calcine. They included a 3.5% decrease in the mass of K (from 29,892 kg to 28,842), and a 2.8% decrease in the mass of Na (from 122,805 kg to 119,312). Overall, the changes to the volume of waste calcined and the waste composition databases resulted in a small increase of 1.3% (5.54 million kg to 5.61 million kg) in the total mass of calcine. The changes to the major radionuclides were likewise small. The total activity of Cs-137 (decayed to January 1, 2016) decreased from 8.338 million Ci to 8.330 million Ci, a decrease of 0.1%. The total Sr-90 activity (decayed to January 1, 2016) decreased from 7.590 million Ci to 7.397 million Ci, a decrease of 2.5%. Most of the decrease of the Sr-90 activity (2.2 of the 2.5%) was caused by the change in the value of the half-life used to decay the Sr-90 activity (see Section 7.1.2).

7.3.2 Additional Sample Data

The HPM uses published reports as a source of liquid waste composition data when the original analytical reports are not available. Published reports often provide average waste compositions based on several sample analyses. However, the method used to delete erroneous data and determine the average waste composition in such reports is generally not known. Additionally, the published reports may contain data transcription errors. The previous revision of the HPM used the 1982 report *The Ninth Processing Campaign in the Waste Calcining Facility* (Childs, Donovan, and Swenson 1982), otherwise known as “ENICO-1100,” as its source of waste composition data for Waste Streams 52 through 57. Analytical reports for the composition of those wastes were found and entered into the HPM database in place of the ENICO-1100 composition data. This resulted in minor changes in the composition of those waste streams.

7.3.3 Minor and Trace Component Estimates

7.3.3.1. RCRA Metals (Silver, Arsenic, Barium, Lead, and Selenium). Several changes were made to the assumptions and calculations used to determine trace components in the liquid waste and calcine. These components were generally present in such small quantities that they either had no impact on the calcination process, or they were present in such small concentrations that they could not be detected by sample analyses. As a result, they were typically not included in historical waste analyses and little analytical data exist for them. These components included the RCRA metals Ag, As, Ba, Pb, and Se. Because little historical analytical data exist for these constituents, and because they were generally not used in fuel-reprocessing or waste-treatment processes, the prior version of the HPM estimated the concentrations of these elements in calcine based on nuclear-fission yield and decay of U and TRU components in the fuel that was reprocessed. In some cases, these calculations resulted in extremely low concentrations. The concentrations were likely lower than the amount actually present in calcine because of contaminants in fuel-cladding alloys and the various chemicals used to reprocess fuel and manage waste. Future waste-treatment processes may need a more realistic estimate of the concentrations of these constituents. This HPM revision revised the methods and assumptions used in calculating RCRA metal concentrations when no analytical data exist. This change resulted in more conservative estimates of the concentrations of those species.

In the late 1980s and early 1990s, numerous samples of Zr, Al, and SBW were analyzed specifically for RCRA metals as part of a plant-wide effort to characterize wastes and become compliant with applicable RCRA regulations (40 CFR 261). The data from those analyses were reviewed and used to estimate concentrations of the trace RCRA metals in the liquid wastes that were calcined. In general, if an analyte was detected in a given type of waste, its average value was determined and assigned to all similar, historic wastes (Al, Zr, and SBW) for which analytical data do not exist. Some species were not detected in the sampled wastes. In such cases, the laboratory detection value was put into the HPM database for that waste type as a conservative estimate of the concentration of that species. Detailed results of the RCRA sampling program (the species that were detected and their concentrations, and the species that were not detected and their laboratory detection values) are given for each species in Section 5.3. This change significantly increased the calculated masses and concentrations of As and Ag, whose previous estimates had been based solely on fission yield. Although their calculated concentrations increased dramatically, they are still very low (less than 20 ppm in calcine).

7.3.3.2. Dolomite and Calcium Nitrate. The previous revisions of the HPM included a database with the concentrations of trace elements and contaminants in the dolomite used as calciner startup bed. However, the database was not used when the HPM calculated the startup bed composition. The HPM was revised to use the startup bed trace element database to determine the composition of the calcine in the CSSFs. Likewise, analytical data existed for trace elements and contaminants found in the calcium nitrate that was added to fluoride-bearing wastes. The HPM was modified to include those calcium nitrate contaminants when calculating the calcine composition.

7.4 Bin-segment Fill Dates

The HPM calculates the mass of each element and the activity of each radionuclide in every batch of material charged to the calciners. The HPM uses historical bin thermocouple data to determine how fast each bin segment filled with calcine, and portions the calcine among the bins according to a calculated fill rate. A sudden increase in the temperature of a bin thermocouple indicated when one bin segment was filled and the next segment began filling. An error in the bin-segment fill date causes the HPM to assign too much calcine to one bin segment and too little calcine to the adjoining segment. An error in the bin fill date does not affect mass-based calcine composition calculations (weight percent or activity per unit mass). However, a bin fill date error affects volumetric calculations (activity per unit volume) because it places too much or too little calcine in a bin segment with a fixed volume. The historical bin thermocouple data were recorded by operations personnel at varying intervals, generally ranging from once per week to once per month during calciner operation. Determining the exact day that a bin segment was filled based on thermocouple temperatures is complicated by the infrequent data recording. The bin-segment fill dates were extrapolated from the thermocouple data, the rate of temperature increase, and engineering judgment. They are subject to a few days of uncertainty.

This HPM revision includes modifications to some of the bin-segment fill dates to resolve some data anomalies. The same type of calcine in different bin segments should have similar densities (mass per unit volume) and specific activity (activity per unit volume). A review of the calcine density data from the previous HPM revision showed a few anomalies caused by the estimated segment fill dates. The segment fill dates were reviewed and adjusted to provide more realistic density data. Generally, a change of 1 or 2 days in a fill date was sufficient to resolve the density anomaly. Such changes are within the uncertainty of the interpolation of the historical thermocouple data.

There are still anomalies in the values of volume-based calculations such as calcine density in a few bin segments because of the methodology used by the HPM to fill bins and the size of some bin segments. A typical batch of WCF feed solution generated 10 to 15 ft³ of calcine, an NWCF batch was about twice that amount. The volume of most of the bin segments in CSSFs II through VI are 500 to

1,000 ft³. If the HPM puts an extra batch, or fraction of a batch, of calcine into such segments the impact on any calculated calcine parameter is insignificant, especially in CSSFs III through VI where multiple bins filled simultaneously and calcine batches were split among multiple bins. However, some of the bins in CSSF 1 and some of the bottom segments in the bins of other CSSFs have very small volumes, ranging from 1 ft³ to 35 ft³. In such small bin segments, a single batch of calcine can exceed the total segment volume. Placing entire calcine batches in such small bin segments significantly affects volume-based calcine composition calculations, such as the fission-product concentrations (curies per cubic meter) and calcine density. As a result, the very small bin segments are not included in the volume-based data plots and calculations in Appendix C. This small-segment data anomaly affects only a few of the bin segments that contain a very small fraction (less than 0.1%) of the total calcined waste. Its overall effect on the calcine composition calculations is insignificant.

7.5 Appendix Data Tables and Plots

The data tables and plots in Appendixes A through D have a few changes from the previous version of this report. The data tables and plots in the appendixes present only a portion of the data included in the electronic version of the HPM. Because of space limitations, only the more significant chemicals and radionuclides are included in the printed version of the HPM (this report). The radionuclides of concern in this report revision were modified to include Se-79 and Sn-126 to conform with DOE guidance (DOE G 435.1-1), as discussed in Section 5.5. These two radionuclides were in the electronic database of the prior revision of the HPM, but were not included in the tables and data plots of the previous version of this report. They are now included in the radionuclide data tables (Tables A10, A12, A14, and A15) and the Appendix C data plots.

The radionuclide data in Table A14 was modified to include an additional decay date, January 1, 3110. The prior version of the HPM included this date in the electronic database, but not in the printed version (this report). This report includes January 1, 3110 because the Yucca Mountain waste acceptance criteria (DOE-2008), which may apply to the future disposal of calcine, requires radionuclide estimates for the waste decayed to the year 3110.

7.6 HPM Electronic Files

The compact disc provided with the hard-copy version of this report contains the files necessary to run the HPM and perform operations such as decaying radioactivity to various dates, or finding the activity of radionuclides or quantities of trace elements not listed in the summary tables of this report. The files may be used as the basis of future calculations or HPM revisions. Instructions for use of the HPM are in the Word document entitled “Read Me”. The files described below are used by the HPM or this report and are included on the disc.

- Microsoft Word files
 - 98-00455 Report Text rev 4 Final R7.doc—This file is the text portion of this report.
 - Read Me.doc—This file explains how to operate the HPM including performing functions such as generating radionuclide activity at various decay dates, and modifying HPM data files, report tables, and other information.
- Microsoft Excel files (all dated September 21, 2011, unless noted otherwise)

- All Batch Data R7.xls—This file collects data from the individual calcine feed batches in the file “CSSF Inventory Summary R7.xls”, calculates the total volume of each waste stream calcined, and tabulates the total volume according to calciner campaign number.
- ANAL R7.xls—This file contains the liquid waste sample data and liquid waste-stream compositions from which the calcine composition is determined. It imports data from “WEN R7.xls” when liquid waste sample data are not available.
- Attach A Tables 1 to 19 R7.xls—This file compiles data from several HPM workbooks and generates the tables in Appendix A of this report.
- Calcination Campaign Charts R7.xls—This file contains the data plots in Appendix B that show the volumes of Tank Farm waste and their waste stream number that were calcined during the 13 calciner operating campaigns.
- Chem Data R7.xls—This file retrieves calcine chemical composition data from file “Tables 11 and 12 R7.xls” and calculates average and standard deviation values. It is the source of the chemical composition data plots in the “Chemicals” folder and in Appendix C.
- CSSF I R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF I was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF II R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF II was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF III R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF III was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF IV R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF IV was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF V R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF V was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF VI R7.xls—This file imports the chemical mass and radioactivity in each batch of waste processed while CSSF VI was being filled, distributes the calcine among the bins based on bin-segment filling data, and calculates the calcine composition in each bin segment.
- CSSF Inventory Summary R7.xls—This file contains the volume of each batch of startup bed material, nonradioactive feed, and liquid waste fed to the calciners. The file uses the waste composition data in the “ANAL R7.xls” workbook to calculate the mass of chemicals and radioactivity in each feed batch and provides the information to the individual “CSSF XX R7.xls” files.

- FilingDataRev7.xls—This file contains the date when each bin segment was filled with calcine. It calculates the calcine distribution fractions used to partition the calcine among the bins. The file also generates the data plots in Appendix B that show how the individual bins in the CSSFs filled over time.
 - ICPP Tank Farm Charts R7.xls—This file contains the data plots showing the Tank Farm waste volume over time that are presented in Appendix B.
 - Radio Data R7.xls—This file obtains radioactivity data from file “Tables 11 and 12 R7.xls,” calculates average and standard deviation values, and provides data for the radioactivity plots in the “Radiochem” folder and presented in Appendix C.
 - Tables 11 and 12 R7.xls—This file gets calcine composition (chemical and radioactivity) data from the file “Attach A Tables 1 to 19 R7”. It is the source of data for the “Chem Data R7” and “Radio Data R7” files from which the Appendix C calcine composition data plots are made.
 - Wen R7.xls—This file contains data from the five ORIGEN2-based models used to calculate radionuclide activity and fission/activation products for species not determined by sample analyses. The data for the five models comes from the “Parsed Data R7.xls” and Wen Data R7.xls” files (both in the “Supplementary Files” folder).
- Microsoft File Folders (file dates as noted)
 - Appendix D Internal References—This folder contains portable document format (PDF) files of several INTEC internal documents that are referenced as footnotes and included in Appendix D of this report.
 - Chemicals—This folder contains the data plots for the nonradioactive calcine constituents presented in Appendix C. The data plots are derived from data in the “Chem Data R7.xls” workbook. The files are dated September 21, 2011.
 - Radiochem—This folder contains the data plots for the radioactive calcine constituents presented in Appendix C. The data plots are derived from data in the “Radio Data R7.xls” workbook. The files are dated September 21, 2011.
 - Supplementary Files—This folder has two workbooks “Parsed Data R7.xls” and “Wen Data R7.xls” (both dated June 27, 2011) that contain the ORIGEN2-based radionuclide data for the five waste models. The waste model data are accessed and used by the “Wen R7.xls” workbook. The folder also contains the workbook “TC Sheets Rev 7.xls”, which contains the historical calcine thermocouple data used to determine the filling of bin segments and the highest recorded calcine temperatures. The folder also contains some files that are not actively used by the HPM, but which contain technical backup.
 - Molecular Weight—This folder contains a program from Chemicalogic Corporation of Burlington, Massachusetts, that determines molecular weight from a chemical formula. The program is used to determine the molecular weight of calcine chemical constituents. The “MWCALC.XLL” file within the folder is dated January 31, 1996, and the “mxcalc7.exe” file is dated September 22, 1999. If this program is not used, modification of the “ANAL R7.xls” workbook will be needed to convert various species from mass to molar quantities.

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Appendix A

Liquid Waste and Calcine Composition Summaries

Appendix A

Liquid Waste and Calcine Composition Summaries

Tables

A1.	Calcined material to Calcined Solids Storage Facility I.....	A-5
A2.	Calcined material to Calcined Solids Storage Facility II.....	A-13
A3.	Calcined material to Calcined Solids Storage Facility III	A-41
A4.	Calcined material to Calcined Solids Storage Facility IV	A-71
A5.	Calcined material to Calcined Solids Storage Facility V	A-79
A6.	Calcined material to Calcined Solids Storage Facility VI.....	A-97
A7.	Chemical analyses of liquid waste samples.....	A-111
A8.	Average liquid waste stream chemical content	A-119
A9.	Radiochemical analyses of liquid waste samples	A-123
A10.	Average liquid waste stream radioactivity decayed to January 2016.....	A-131
A11.	Calcine chemical content by bin segment (mass basis).	
	CSSF I	A-135
	CSSF II	A-139
	CSSF III.....	A-143
	CSSF IV	A-147
	CSSF V	A-149
	CSSF VI	A-153
A12.	Calcine radioactivity by bin segment decayed to January 2016.	
	CSSF I	A-159
	CSSF II	A-163
	CSSF III.....	A-167
	CSSF IV	A-171
	CSSF V	A-173
	CSSF VI	A-177
A13.	Calcine chemical content by bin segment (weight percent)	
	CSSF I	A-183
	CSSF II	A-187
	CSSF III.....	A-191
	CSSF IV	A-195

CSSF V	A-197
CSSF VI	A-201
A14. Total calcine radionuclide activity decayed to January 1 for selected years	A-207
A15. Calcine radioactivity in each of the six CSSFs decayed to January 1, 2016	A-209
A16. Chemical inventory in each of the six CSSFs	A-211
A17 RCRA metal mass and concentration in each of the six CSSFs.....	A-213
A18 Calcine mass, volume, and calculated bulk density in each CSSF bin.....	A-215
A19. Historical fuel reprocessing and waste disposition summary	A-217

Table A1. Calcined material to Calcined Solids Storage Facility I.

					Feed Stream									Cold Chemicals							
WCF		Date			Batch			1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	m	yr	No.	Tank	gal	Stream ¹	Tank	gal	Stream ¹	Tank	gal	Stream ¹	gal	M	M	kg	lb			
H-1	30	11	63	CC	Cold Calcine (approx. 77 cubic feet)																
H-1	30	11	63	1C	Cold									1222	1.7	0.039	2.9				
H-1	1	12	63	2C	Cold									1222	1.7	0.039	2.9				
H-1	2	12	63	3C	Cold									1222	1.7	0.039	2.9				
H-1	3	12	63	4C	Cold									1222	1.7	0.039	2.9				
H-1	4	12	63	5C	Cold									1222	1.7	0.039	2.9				
H-1	5	12	63	6C	Cold									1222	1.7	0.039	2.9				
H-1	6	12	63	7C	Cold									1222	1.7	0.039	2.9				
H-1	7	12	63	8C	Cold									1222	1.7	0.039	2.9				
H-1	8	12	63	9C	Cold									1222	1.7	0.039	2.9				
H-1	8	12	63	1	WM-185	1106	1													2.7	
H-1	9	12	63	2	WM-185	1106	1													2.7	
H-1	10	12	63	3	WM-185	1106	1													2.7	
H-1	10	12	63	4	WM-185	1106	1													2.7	
H-1	11	12	63	5	WM-185	1106	1													2.7	
H-1	12	12	63	6	WM-185	1106	1													2.7	
H-1	13	12	63	7	WM-185	1106	1													2.7	
H-1	13	12	63	8	WM-185	1106	1													2.7	
H-1	14	12	63	9	WM-185	1106	1													2.7	
H-1	15	12	63	10	WM-185	1106	1													2.7	
H-1	16	12	63	11	WM-185	1106	1													2.7	
H-1	16	12	63	12	WM-185	1106	1													2.7	
H-1	17	12	63	13	WM-185	1106	1													2.7	
H-1	18	12	63	14	WM-185	1106	1													2.7	
H-1	19	12	63	15	WM-185	1106	1													2.7	
H-1	19	12	63	16	WM-185	1106	1													2.7	
H-1	20	12	63	17	WM-185	1106	1													2.7	
H-1	21	12	63	18	WM-185	1106	1													2.7	
H-1	22	12	63	19	WM-185	1106	1													2.7	
H-1	22	12	63	20	WM-185	1106	1													2.7	
H-1	23	12	63	21	WM-185	1106	1													2.7	
H-1	24	12	63	22	WM-185	1106	1													2.7	
H-1	25	12	63	23	WM-185	1106	1													2.7	
H-1	25	12	63	24	WM-185	1106	1													2.7	
H-1	26	12	63	25	WM-185	1106	1													2.7	
H-1	27	12	63	26	WM-185	1106	1													2.7	
H-1	28	12	63	27	WM-185	1106	1													2.7	
H-1	28	12	63	28	WM-185	1106	1													2.7	
H-1	29	12	63	29	WM-185	1106	1													2.7	
H-1	30	12	63	30	WM-185	1106	1													2.7	
H-1	31	12	63	31	WM-185	1106	1													2.7	
H-1	31	12	63	32	WM-185	1106	1													2.7	
H-1	1	1	64	33	WM-185	1106	1													2.7	
H-1	2	1	64	34	WM-185	1106	1													2.7	
H-1	3	1	64	35	WM-185	1106	1													2.7	
H-1	3	1	64	36	WM-185	1106	1													2.7	
H-1	4	1	64	37	WM-185	1106	1													2.7	
H-1	5	1	64	38	WM-185	1106	1													2.7	
H-1	6	1	64	39	WM-185	1106	1													2.7	
H-1	6	1	64	40	WM-185	1106	1													2.7	
H-1	7	1	64	41	WM-185	1106	1													2.7	
H-1	8	1	64	42	WM-185	1106	1													2.7	
H-1	9	1	64	43	WM-185	1106	1													2.7	
H-1	9	1	64	44	WM-185	1106	1													2.7	
H-1	10	1	64	45	WM-185	1106	1													2.7	
H-1	11	1	64	46	WM-185	1106	1													2.7	
H-1	12	1	64	47	WM-185	1106	1													2.7	
H-1	12	1	64	48	WM-185	1106	1													2.7	
H-1	13	1	64	49	WM-185	1106	1													2.7	
H-1	14	1	64	50	WM-185	1106	1													2.7	
H-1	15	1	64	51	WM-185	1106	1													2.7	
H-1	15	1	64	52	WM-185	1106	1													2.7	
H-1	16	1	64	53	WM-185	1106	1													2.7	
H-1	17	1	64	54	WM-185	1106	1													2.7	
H-1	18	1	64	55	WM-185	1106	1													2.7	
H-1	18	1	64	56	WM-185	1106	1													2.7	
H-1	19	1	64	57	WM-185	1106	1													2.7	

The CC (Cold Calcine) addition is shown in the unit of gallons. The value represents the volume of Stream 91 that when calcined would produce the volume (cubic feet) of solids that were added to the calciner.

¹"Stream" refers to the liquid waste stream number in Tables A8 and A10

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	20	1	64	58	WM-185	1106	1										2.7	
H-1	21	1	64	59	WM-185	1106	1										2.7	
H-1	21	1	64	60	WM-185	1106	1										2.7	
H-1	22	1	64	61	WM-185	1106	1										2.7	
H-1	23	1	64	62	WM-185	1106	1										2.7	
H-1	24	1	64	63	WM-185	1106	1										2.7	
H-1	24	1	64	64	WM-185	1106	1										2.7	
H-1	25	1	64	65	WM-185	1106	1										2.7	
H-1	26	1	64	66	WM-185	1106	1										2.7	
H-1	27	1	64	67	WM-185	1106	1										2.7	
H-1	28	1	64	68	WM-185	1106	1										2.7	
H-1	29	1	64	69	WM-185	1106	1										2.7	
H-1	29	1	64	70	WM-185	1106	1										2.7	
H-1	30	1	64	71	WM-185	1106	1										2.7	
H-1	31	1	64	72	WM-185	1106	1										2.7	
H-1	31	1	64	73	WM-185	1106	1										2.7	
H-1	1	2	64	74	WM-185	1106	1										2.7	
H-1	2	2	64	75	WM-185	1106	1										2.7	
H-1	3	2	64	76	WM-185	1106	1										2.7	
H-1	3	2	64	77	WM-185	1106	1										2.7	
H-1	4	2	64	78	WM-185	1106	1										2.7	
H-1	5	2	64	79	WM-185	1106	1										2.7	
H-1	5	2	64	80	WM-185	1106	1										2.7	
H-1	6	2	64	81	WM-185	1106	1										2.7	
H-1	7	2	64	82	WM-185	1106	1										2.7	
H-1	8	2	64	83	WM-185	1106	1										2.7	
H-1	8	2	64	84	WM-185	1106	1										2.7	
H-1	9	2	64	85	WM-185	1106	1										2.7	
H-1	10	2	64	86	WM-185	1106	1										2.7	
H-1	10	2	64	87	WM-185	1106	1										2.7	
H-1	11	2	64	88	WM-185	1106	1										2.7	
H-1	12	2	64	89	WM-185	1106	1										2.7	
H-1	12	2	64	90	WM-185	1106	1										2.7	
H-1	13	2	64	91	WM-185	1106	1										2.7	
H-1	14	2	64	92	WM-185	1106	1										2.7	
H-1	15	2	64	93	WM-185	1106	1										2.7	
H-1	15	2	64	94	WM-185	1106	1										2.7	
H-1	16	2	64	95	WM-185	1106	1										2.7	
H-1	17	2	64	96	WM-185	1106	1										2.7	
H-1	17	2	64	97	WM-185	1106	1										2.7	
H-1	18	2	64	98	WM-185	1106	1										2.7	
H-1	19	2	64	99	WM-185	1106	1										2.7	
H-1	19	2	64	100	WM-185	1106	1										2.7	
H-1	20	2	64	101	WM-185	1106	1										2.7	
H-1	21	2	64	102	WM-185	1106	1										2.7	
H-1	22	2	64	103	WM-185	1106	1										2.7	
H-1	22	2	64	104	WM-185	1106	1										2.7	
H-1	23	2	64	105	WM-185	1106	1										2.7	
H-1	24	2	64	106	WM-185	1106	1										2.7	
H-1	24	2	64	107	WM-185	1106	1										2.7	
H-1	25	2	64	108	WM-185	1106	1										2.7	
H-1	26	2	64	109	WM-185	1106	1										2.7	
H-1	26	2	64	110	WM-185	1106	1										2.7	
H-1	27	2	64	111	WM-185	1106	1										2.7	
H-1	28	2	64	112	WM-185	1106	1										2.7	
H-1	28	2	64	113	WM-185	1106	1										2.7	
H-1	29	2	64	114	WM-185	1106	1										2.7	
H-1	1	3	64	115	WM-185	1106	1										2.7	
H-1	1	3	64	116	WM-185	1106	1										2.7	
H-1	2	3	64	117	WM-185	1106	1										2.7	
H-1	3	3	64	118	WM-185	1106	1										2.7	
H-1	3	3	64	119	WM-185	1106	1										2.7	
H-1	4	3	64	120	WM-185	1106	1										2.7	
H-1	5	3	64	121	WM-185	1106	1										2.7	
H-1	5	3	64	122	WM-185	1106	1										2.7	
H-1	6	3	64	123	WM-185	1106	1										2.7	
H-1	8	3	64	124	WM-185	1106	1										2.7	
H-1	8	3	64	125	WM-185	1106	1										2.7	

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	9	3	64	126	WM-185	1106	1										2.7	
H-1	10	3	64	127	WM-185	1106	1										2.7	
H-1	10	3	64	128	WM-185	1106	1										2.7	
H-1	11	3	64	129	WM-185	1106	1										2.7	
H-1	12	3	64	130	WM-185	1106	1										2.7	
H-1	12	3	64	131	WM-185	1106	1										2.7	
H-1	13	3	64	132	WM-185	1106	1										2.7	
H-1	14	3	64	133	WM-185	1106	1										2.7	
H-1	14	3	64	134	WM-185	1106	1										2.7	
H-1	15	3	64	135	WM-185	1106	1										2.7	
H-1	16	3	64	136	WM-185	1106	1										2.7	
H-1	16	3	64	137	WM-185	1106	1										2.7	
H-1	17	3	64	138	WM-185	1106	1										2.7	
H-1	17	3	64	139	WM-185	1106	1										2.7	
H-1	19	3	64	140	WM-185	1106	1										2.7	
H-1	19	3	64	141	WM-185	1106	1										2.7	
H-1	20	3	64	142	WM-185	1106	1										2.7	
H-1	21	3	64	143	WM-185	1106	1										2.7	
H-1	22	3	64	144	WM-185	1106	1										2.7	
H-1	22	3	64	145	WM-185	1106	1										2.7	
H-1	23	3	64	146	WM-185	1106	1										2.7	
H-1	24	3	64	147	WM-185	1106	1										2.7	
H-1	24	3	64	148	WM-185	1106	1										2.7	
H-1	25	3	64	149	WM-185	1106	1										2.7	
H-1	26	3	64	150	WM-185	1106	1										2.7	
H-1	26	3	64	151	WM-185	1106	1										2.7	
H-1	27	3	64	152	WM-185	1106	1										2.7	
H-1	28	3	64	153	WM-185	1106	1										2.7	
H-1	28	3	64	154	WM-185	1106	1										2.7	
H-1	29	3	64	155	WM-187	1144	2										2.8	
H-1	30	3	64	156	WM-187	1144	2										2.8	
H-1	30	3	64	157	WM-187	1144	2										2.8	
H-1	31	3	64	158	WM-187	1144	2										2.8	
H-1	1	4	64	159	WM-187	1144	2										2.8	
H-1	1	4	64	160	WM-187	1144	2										2.8	
H-1	2	4	64	161	WM-187	1144	2										2.8	
H-1	3	4	64	162	WM-187	1144	2										2.8	
H-1	3	4	64	163	WM-187	1144	2										2.8	
H-1	4	4	64	164	WM-187	1144	2										2.8	
H-1	5	4	64	165	WM-187	1144	2										2.8	
H-1	5	4	64	166	WM-187	1144	2										2.8	
H-1	6	4	64	167	WM-187	1144	2										2.8	
H-1	7	4	64	168	WM-187	1144	2										2.8	
H-1	7	4	64	169	WM-187	1144	2										2.8	
H-1	8	4	64	170	WM-187	1144	2										2.8	
H-1	9	4	64	171	WM-187	1144	2										2.8	
H-1	9	4	64	172	WM-187	1144	2										2.8	
H-1	10	4	64	173	WM-187	1144	2										2.8	
H-1	11	4	64	174	WM-187	1144	2										2.8	
H-1	11	4	64	175	WM-187	1144	2										2.8	
H-1	12	4	64	176	WM-187	1144	2										2.8	
H-1	13	4	64	177	WM-187	1144	2										2.8	
H-1	13	4	64	178	WM-187	1144	2										2.8	
H-1	14	4	64	179	WM-187	1144	2										2.8	
H-1	15	4	64	180	WM-187	1144	2										2.8	
H-1	15	4	64	181	WM-187	1144	2										2.8	
H-1	16	4	64	182	WM-187	1144	2										2.8	
H-1	17	4	64	183	WM-187	1144	2										2.8	
H-1	17	4	64	184	WM-187	1144	2										2.8	
H-1	18	4	64	185	WM-187	1144	2										2.8	
H-1	19	4	64	186	WM-187	1144	2										2.8	
H-1	19	4	64	187	WM-187	1144	2										2.8	
H-1	20	4	64	188	WM-187	1144	2										2.8	
H-1	21	4	64	189	WM-187	1144	2										2.8	
H-1	21	4	64	190	WM-187	1144	2										2.8	
H-1	22	4	64	191	WM-187	1144	2										2.8	
H-1	23	4	64	192	WM-187	1144	2										2.8	
H-1	23	4	64	193	WM-187	1144	2										2.8	

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	24	4	64	194	WM-187	1144	2										2.8	
H-1	25	4	64	195	WM-187	1144	2										2.8	
H-1	25	4	64	196	WM-187	1144	2										2.8	
H-1	26	4	64	197	WM-187	1144	2										2.8	
H-1	26	4	64	198	WM-187	1144	2										2.8	
H-1	27	4	64	199	WM-187	1144	2										2.8	
H-1	28	4	64	200	WM-187	1144	2										2.8	
H-1	28	4	64	201	WM-187	1144	2										2.8	
H-1	29	4	64	202	WM-187	1144	2										2.8	
H-1	30	4	64	203	WM-187	1144	2										2.8	
H-1	30	4	64	204	WM-187	1144	2										2.8	
H-1	1	5	64	205	WM-187	1144	2										2.8	
H-1	2	5	64	206	WM-187	1144	2										2.8	
H-1	2	5	64	207	WM-187	1144	2										2.8	
H-1	3	5	64	208	WM-187	1144	2										2.8	
H-1	4	5	64	209	WM-187	1144	2										2.8	
H-1	4	5	64	210	WM-187	1144	2										2.8	
H-1	5	5	64	211	WM-187	1144	2										2.8	
H-1	5	5	64	212	WM-187	1144	2										2.8	
H-1	6	5	64	213	WM-187	1144	2										2.8	
H-1	7	5	64	214	WM-187	1144	2										2.8	
H-1	7	5	64	215	WM-187	1144	2										2.8	
H-1	8	5	64	216	WM-187	1144	2										2.8	
H-1	9	5	64	217	WM-187	1144	2										2.8	
H-1	9	5	64	218	WM-187	1144	2										2.8	
H-1	10	5	64	219	WM-187	1144	2										2.8	
H-1	11	5	64	220	WM-187	1144	2										2.8	
H-1	11	5	64	221	WM-187	1144	2										2.8	
H-1	12	5	64	222	WM-187	1144	2										2.8	
H-1	13	5	64	223	WM-187	1144	2										2.8	
H-1	13	5	64	224	WM-187	1144	2										2.8	
H-1	14	5	64	225	WM-187	1144	2										2.8	
H-1	14	5	64	226	WM-187	1144	2										2.8	
H-1	15	5	64	227	WM-187	1144	2										2.8	
H-1	16	5	64	228	WM-187	1144	2										2.8	
H-1	16	5	64	229	WM-187	1144	2										2.8	
H-1	17	5	64	230	WM-187	1144	2										2.8	
H-1	18	5	64	231	WM-187	1144	2										2.8	
H-1	18	5	64	232	WM-187	1144	2										2.8	
H-1	19	5	64	233	WM-187	1144	2										2.8	
H-1	20	5	64	234	WM-187	1144	2										2.8	
H-1	20	5	64	235	WM-187	1144	2										2.8	
H-1	21	5	64	236	WM-187	1144	2										2.8	
H-1	21	5	64	237	WM-187	1144	2										2.8	
H-1	22	5	64	238	WM-187	1144	2										2.8	
H-1	23	5	64	239	WM-187	1144	2										2.8	
H-1	23	5	64	240	WM-187	1144	2										2.8	
H-1	24	5	64	241	WM-187	1144	2										2.8	
H-1	25	5	64	242	WM-187	1144	2										2.8	
H-1	25	5	64	243	WM-187	1144	2										2.8	
H-1	26	5	64	244	WM-187	1144	2										2.8	
H-1	26	5	64	245	WM-187	1144	2										2.8	
H-1	27	5	64	246	WM-187	1144	2										2.8	
H-1	28	5	64	247	WM-187	1144	2										2.8	
H-1	28	5	64	248	WM-187	1144	2										2.8	
H-1	29	5	64	249	WM-187	1144	2										2.8	
H-1	30	5	64	250	WM-187	1144	2										2.8	
H-1	30	5	64	251	WM-187	1144	2										2.8	
H-1	31	5	64	252	WM-187	1144	2										2.8	
H-1	1	6	64	253	WM-187	1144	2										2.8	
H-1	1	6	64	254	WM-187	1144	2										2.8	
H-1	2	6	64	255	WM-187	1144	2										2.8	
H-1	2	6	64	256	WM-187	1144	2										2.8	
H-1	3	6	64	257	WM-187	1144	2										2.8	
H-1	4	6	64	258	WM-187	1144	2										2.8	
H-1	4	6	64	259	WM-187	1144	2										2.8	
H-1	5	6	64	260	WM-187	1144	2										2.8	
H-1	6	6	64	261	WM-187	1144	2										2.8	

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	6	6	64	262	WM-187	1144	2										2.8	
H-1	7	6	64	263	WM-187	1144	2										2.8	
H-1	8	6	64	264	WM-187	1144	2										2.8	
H-1	8	6	64	265	WM-187	1144	2										2.8	
H-1	9	6	64	266	WM-187	1144	2										2.8	
H-1	10	6	64	267	WM-187	1144	2										2.8	
H-1	10	6	64	268	WM-187	1144	2										2.8	
H-1	11	6	64	269	WM-187	1144	2										2.8	
H-1	11	6	64	270	WM-187	1144	2										2.8	
H-1	12	6	64	271	WM-187	1144	2										2.8	
H-1	13	6	64	272	WM-187	1144	2										2.8	
H-1	13	6	64	273	WM-187	1144	2										2.8	
H-1	14	6	64	274	WM-187	1144	2										2.8	
H-1	14	6	64	275	WM-187	1144	2										2.8	
H-1	15	6	64	276	WM-187	1144	2										2.8	
H-1	16	6	64	277	WM-187	1144	2										2.8	
H-1	16	6	64	278	WM-187	1144	2										2.8	
H-1	17	6	64	279	WM-187	1144	2										2.8	
H-1	18	6	64	280	WM-187	1144	2										2.8	
H-1	18	6	64	281	WM-187	1144	2										2.8	
H-1	19	6	64	282	WM-187	1144	2										2.8	
H-1	19	6	64	283	WM-187	1144	2										2.8	
H-1	20	6	64	284	WM-187	1144	2										2.8	
H-1	21	6	64	285	WM-187	1144	2										2.8	
H-1	21	6	64	286	WM-187	1144	2										2.8	
H-1	22	6	64	287	WM-187	1144	2										2.8	
H-1	23	6	64	288	WM-187	1144	2										2.8	
H-1	23	6	64	289	WM-187	1144	2										2.8	
H-1	24	6	64	290	WM-187	1144	2										2.8	
H-1	25	6	64	291	WM-187	1144	2										2.8	
H-1	25	6	64	292	WM-187	1144	2										2.8	
H-1	26	6	64	293	WM-187	1144	2										2.8	
H-1	26	6	64	294	WM-187	1144	2										2.8	
H-1	27	6	64	295	WM-187	1144	2										2.8	
H-1	28	6	64	296	WM-187	1144	2										2.8	
H-1	28	6	64	297	WM-187	1144	2										2.8	
H-1	29	6	64	298	WM-187	1144	2										2.8	
H-1	30	6	64	299	WM-187	1144	2										2.8	
H-1	30	6	64	300	WM-187	1144	2										2.8	
H-1	1	7	64	301	WM-187	1144	2										2.8	
H-1	2	7	64	302	WM-187	1144	2										2.8	
H-1	2	7	64	303	WM-187	1144	2										2.8	
H-1	3	7	64	304	WM-187	1144	2										2.8	
H-1	3	7	64	305	WM-187	1144	2										2.8	
H-1	4	7	64	306	WM-187	1144	2										2.8	
H-1	5	7	64	307	WM-187	1144	2										2.8	
H-1	5	7	64	308	WM-187	1144	2										2.8	
H-1	6	7	64	309	WM-187	1144	2										2.8	
H-1	7	7	64	310	WM-187	1144	2										2.8	
H-1	7	7	64	311	WM-187	1144	2										2.8	
H-1	8	7	64	312	WM-187	1144	2										2.8	
H-1	8	7	64	313	WM-187	1144	2										2.8	
H-1	9	7	64	314	WM-187	1144	2										2.8	
H-1	10	7	64	315	WM-187	1144	2										2.8	
H-1	10	7	64	316	WM-187	1144	2										2.8	
H-1	11	7	64	317	WM-187	1144	2										2.8	
H-1	12	7	64	318	WM-187	1144	2										2.8	
H-1	12	7	64	319	WM-187	1144	2										2.8	
H-1	13	7	64	320	WM-187	1144	2										2.8	
H-1	13	7	64	321	WM-187	1144	2										2.8	
H-1	14	7	64	322	WM-187	1144	2										2.8	
H-1	15	7	64	323	WM-187	1144	2										2.8	
H-1	15	7	64	324	WM-187	1144	2										2.8	
H-1	16	7	64	325	WM-187	1144	2										2.8	
H-1	17	7	64	326	WM-187	1144	2										2.8	
H-1	17	7	64	327	WM-187	1144	2										2.8	
H-1	18	7	64	328	WM-187	1144	2										2.8	
H-1	18	7	64	329	WM-187	1144	2										2.8	

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	19	7	64	330	WM-187	1144	2										2.8	
H-1	20	7	64	331	WM-187	1144	2										2.8	
H-1	20	7	64	332	WM-187	1144	2										2.8	
H-1	21	7	64	333	WM-187	1144	2										2.8	
H-1	22	7	64	334	WM-187	1144	2										2.8	
H-1	22	7	64	335	WM-187	1144	2										2.8	
H-1	23	7	64	336	WM-187	1144	2										2.8	
H-1	23	7	64	337	WM-188	600	3										1.5	
H-1	24	7	64	338	WM-183	1102	4										2.7	
H-1	25	7	64	339	WM-183	1102	4										2.7	
H-1	25	7	64	340	WM-183	1102	4										2.7	
H-1	26	7	64	341	WM-183	1102	4										2.7	
H-1	26	7	64	342	WM-183	1102	4										2.7	
H-1	27	7	64	343	WM-183	1102	4										2.7	
H-1	28	7	64	344	WM-183	1102	4										2.7	
H-1	29	7	64	345	WM-183	1102	4										2.7	
H-1	29	7	64	346	WM-183	1102	4										2.7	
H-1	30	7	64	347	WM-183	1102	4										2.7	
H-1	31	7	64	348	WM-183	1102	4										2.7	
H-1	1	8	64	349	WM-183	1102	4										2.7	
H-1	1	8	64	350	WM-183	1102	4										2.7	
H-1	2	8	64	351	WM-183	1102	4										2.7	
H-1	3	8	64	352	WM-183	1102	4										2.7	
H-1	4	8	64	353	WM-183	1102	4										2.7	
H-1	4	8	64	354	WM-183	1102	4										2.7	
H-1	5	8	64	355	WM-183	1102	4										2.7	
H-1	6	8	64	356	WM-183	1102	4										2.7	
H-1	7	8	64	357	WM-183	1102	4										2.7	
H-1	7	8	64	358	WM-183	1102	4										2.7	
H-1	8	8	64	359	WM-183	1102	4										2.7	
H-1	9	8	64	360	WM-183	1102	4										2.7	
H-1	10	8	64	361	WM-183	1102	4										2.7	
H-1	10	8	64	362	WM-183	1102	4										2.7	
H-1	11	8	64	363	WM-183	1102	4										2.7	
H-1	12	8	64	364	WM-183	1102	4										2.7	
H-1	13	8	64	365	WM-183	1102	4										2.7	
H-1	13	8	64	366	WM-183	1102	4										2.7	
H-1	14	8	64	367	WM-183	1102	4										2.7	
H-1	15	8	64	368	WM-183	1102	4										2.7	
H-1	15	8	64	369	WM-183	1102	4										2.7	
H-1	16	8	64	370	WM-183	1102	4										2.7	
H-1	17	8	64	371	WM-183	1102	4										2.7	
H-1	18	8	64	372	WM-183	1102	4										2.7	
H-1	18	8	64	373	WM-183	1102	4										2.7	
H-1	19	8	64	374	WM-183	1102	4										2.7	
H-1	20	8	64	375	WM-183	1102	4										2.7	
H-1	21	8	64	376	WM-183	1102	4										2.7	
H-1	21	8	64	377	WM-183	1102	4										2.7	
H-1	22	8	64	378	WM-183	1102	4										2.7	
H-1	23	8	64	379	WM-183	1102	4										2.7	
H-1	24	8	64	380	WM-183	1102	4										2.7	
H-1	24	8	64	381	WM-183	1102	4										2.7	
H-1	25	8	64	382	WM-183	1102	4										2.7	
H-1	26	8	64	383	WM-183	1102	4										2.7	
H-1	26	8	64	384	WM-183	1102	4										2.7	
H-1	27	8	64	385	WM-180	986	5										2.7	
H-1	28	8	64	386	WM-180	986	5										2.7	
H-1	28	8	64	387	WM-180	986	5										2.7	
H-1	29	8	64	388	WM-180	986	5										2.7	
H-1	30	8	64	389	WM-180	986	5										2.7	
H-1	31	8	64	390	WM-183	1102	4										2.7	
H-1	31	8	64	391	WM-183	1102	4										2.7	
H-1	1	9	64	392	WM-183	1102	4										2.7	
H-1	1	9	64	393	WM-183	1102	4										2.7	
H-1	2	9	64	394	WM-183	1102	4										2.7	
H-1	3	9	64	395	WM-183	1102	4										2.7	
H-1	3	9	64	396	WM-183	1102	4										2.7	
H-1	4	9	64	397	WM-183	1102	4										2.7	

Table A1. Calcined material to Calcined Solids Storage Facility I (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	5	9	64	398	WM-183	1102	4										2.7	
H-1	5	9	64	399	WM-183	1102	4										2.7	
H-1	6	9	64	400	WM-183	1102	4										2.7	
H-1	7	9	64	401	WM-183	1102	4										2.7	
H-1	7	9	64	402	WM-183	1102	4										2.7	
H-1	8	9	64	403	WM-183	1102	4										2.7	
H-1	9	9	64	404	WM-183	1102	4										2.7	
H-1	9	9	64	405	WM-183	1102	4										2.7	
H-1	10	9	64	406	WM-183	1102	4										2.7	
H-1	11	9	64	407	WM-183	1102	4										2.7	
H-1	11	9	64	408	WM-183	1102	4										2.7	
H-1	12	9	64	409	WM-183	1102	4										2.7	
H-1	13	9	64	410	WM-183	1102	4										2.7	
H-1	13	9	64	411	WM-183	1102	4										2.7	
H-1	14	9	64	412	WM-183	1102	4										2.7	
H-1	15	9	64	413	WM-183	1102	4										2.7	
H-1	15	9	64	414	WM-183	1102	4										2.7	
H-1	16	9	64	415	WM-183	1102	4										2.7	
H-1	17	9	64	416	WM-183	1102	4										2.7	
H-1	17	9	64	417	WM-183	1102	4										2.7	
H-1	18	9	64	418	WM-183	1102	4										2.7	
H-1	19	9	64	419	WM-183	1102	4										2.7	
H-1	19	9	64	420	WM-183	1102	4										2.7	
H-1	20	9	64	421	WM-183	1102	4										2.7	
H-1	21	9	64	422	WM-183	1102	4										2.7	
H-1	21	9	64	423	WM-183	1102	4										2.7	
H-1	22	9	64	424	WM-183	1102	4										2.7	
H-1	23	9	64	425	WM-183	1102	4										2.7	
H-1	23	9	64	426	WM-183	1102	4										2.7	
H-1	24	9	64	427	WM-183	1102	4										2.7	
H-1	25	9	64	428	WM-183	1102	4										2.7	
H-1	25	9	64	429	WM-183	1102	4										2.7	
H-1	26	9	64	430	WM-183	1102	4										2.7	
H-1	26	9	64	431	WM-183	1102	4										2.7	
H-1	27	9	64	432	WM-183	1102	4										2.7	
H-1	28	9	64	433	WM-183	1102	4										2.7	
H-1	28	9	64	434	WM-183	1102	4										2.7	
H-1	29	9	64	435	WM-183	1102	4										2.7	
H-1	30	9	64	436	WM-183	1102	4										2.7	
H-1	30	9	64	437	WM-183	1102	4										2.7	
H-1	1	10	64	438	WM-183	1102	4										2.7	
H-1	2	10	64	439	WM-183	1102	4										2.7	
H-1	2	10	64	440	WM-183	1102	4										2.7	
H-1	3	10	64	441	WM-183	1102	4										2.7	
H-1	4	10	64	442	WM-183	1102	4										2.7	
H-1	4	10	64	443	WM-183	1102	4										2.7	
H-1	5	10	64	444	WM-183	1102	4										2.7	
H-1	6	10	64	445	WM-183	1102	4										2.7	
H-1	6	10	64	446	WM-183	1102	4										2.7	
H-1	7	10	64	447	WM-183	1102	4										2.7	
H-1	7	10	64	448	WM-183	1102	4										2.7	
H-1	8	10	64	449	WM-183	1102	4										2.7	
H-1	9	10	64	450	WM-183	1102	4										2.7	
H-1	9	10	64	451	WM-183	1102	4										2.7	
H-1	10	10	64	452	WM-183	1102	4										2.7	
H-1	11	10	64	453	WM-183	1102	4										2.7	
H-1	11	10	64	454	WM-183	1102	4										2.7	
H-1	12	10	64	455	WM-183	1102	4										2.7	
H-1	13	10	64	456	WM-183	1102	4										2.7	
H-1	13	10	64	457	WM-183	1102	4										2.7	
H-1	14	10	64	458	WM-183	1102	4										2.7	
H-1	14	10	64	459	WM-183	1102	4										2.7	

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Table A2. Calcined material to Calcined Solids Storage Facility II.

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	m	yr	No.	Tank	gal	Stream ¹	Tank	gal	Stream ¹	Tank	gal	Stream ¹	gal	M	M	kg	lb
H-2	14	3	66	CC	Cold Calcine (approx. 77 cubic feet)							5420	91					
H-2	15	3	66	1	Cold									1440	1.6	0.04	4.0	
H-2	15	3	66	CC	Cold Calcine (approx. 17 cubic feet)							1162	91					
H-2	15	3	66	CC	Cold Calcine (approx. 17 cubic feet)							1162	91					
H-2	16	3	66	CC	Cold Calcine (approx. 17 cubic feet)							1162	91					
H-2	16	3	66	2	Cold									1440	1.6	0.04	4.0	
H-2	16	3	66	3	Cold									1440	1.6	0.04	4.0	
H-2	17	3	66	4	Cold									1149	1.6	0.04	3.2	
H-2	18	3	66	5	Cold									1086	1.6	0.04	3.1	
H-2	18	3	66	6	Cold									1065	1.6	0.04	3.0	
H-2	19	3	66	7	Cold									1202	1.6	0.04	3.4	
H-2	20	3	66	8	Cold									1080	1.6	0.04	3.0	
H-2	21	3	66	9	Cold									238	1.6	0.04	0.7	
H-2	28	3	66	CC	Cold Calcine (approx. 31 cubic feet)							2170	91					
H-2	28	3	66	11	Cold									1364	1.6	0.04	3.8	
H-2	29	3	66	12	Cold									1456	1.6	0.04	4.1	
H-2	30	3	66	13	Cold									1433	1.6	0.04	4.0	
H-2	31	3	66	14	Cold									1462	1.6	0.04	4.1	
H-2	1	4	66	15	Cold									1448	1.6	0.04	4.1	
H-2	1	4	66	1	WM-183	1152.8	6										3.2	
H-2	2	4	66	2	WM-183	1152.8	6										3.2	
H-2	3	4	66	3	WM-183	1152.8	6										3.2	
H-2	3	4	66	4	WM-183	1152.8	6										3.2	
H-2	4	4	66	5	WM-183	1152.8	6										3.2	
H-2	5	4	66	6	WM-183	1152.8	6										3.2	
H-2	6	4	66	7	WM-183	1152.8	6										3.2	
H-2	7	4	66	8	WM-183	1152.8	6										3.2	
H-2	7	4	66	9	WM-183	1152.8	6										3.2	
H-2	7	4	66	CC	Cold Calcine (approx. 3 cubic feet)							230	91					
H-2	8	4	66	11	WM-183	1152.8	6										3.2	
H-2	9	4	66	12	WM-183	1152.8	6										3.2	
H-2	9	4	66	13	WM-183	1152.8	6										3.2	
H-2	10	4	66	14	WM-183	1152.8	6										3.2	
H-2	11	4	66	15	WM-183	1152.8	6										3.2	
H-2	11	4	66	16	WM-183	1152.8	6										3.2	
H-2	12	4	66	17	WM-183	1152.8	6										3.2	
H-2	13	4	66	18	WM-183	1152.8	6										3.2	
H-2	14	4	66	19	WM-183	1152.8	6										3.2	
H-2	14	4	66	20	WM-183	1152.8	6										3.2	
H-2	15	4	66	21	WM-183	1152.8	6										3.2	
H-2	16	4	66	22	WM-183	1152.8	6										3.2	
H-2	16	4	66	23	WM-183	1152.8	6										3.2	
H-2	17	4	66	24	WM-183	1152.8	6										3.2	
H-2	18	4	66	25	WM-183	1152.8	6										3.2	
H-2	19	4	66	26	WM-183	1152.8	6										3.2	
H-2	19	4	66	27	WM-183	1152.8	6										3.2	
H-2	20	4	66	28	WM-183	1152.8	6										3.2	
H-2	21	4	66	29	WM-183	1152.8	6										3.2	
H-2	22	4	66	30	WM-183	1152.8	6										3.2	
H-2	22	4	66	31	WM-183	1152.8	6										3.2	
H-2	23	4	66	32	WM-183	1152.8	6										3.2	
H-2	24	4	66	33	WM-183	1152.8	6										3.2	
H-2	24	4	66	34	WM-183	1152.8	6										3.2	
H-2	25	4	66	35	WM-183	1152.8	6										3.2	
H-2	26	4	66	36	WM-183	1152.8	6										3.2	
H-2	26	4	66	37	WM-183	1152.8	6										3.2	
H-2	27	4	66	38	WM-183	1048.1	6										2.9	
H-2	28	4	66	39	WM-183	1048.1	6										2.9	
H-2	29	4	66	40	WM-183	1048.1	6										2.9	
H-2	30	4	66	41	WM-183	1048.1	6										2.9	
H-2	30	4	66	42	WM-183	1048.1	6										2.9	
H-2	1	5	66	43	WM-183	1048.1	6										2.9	
H-2	2	5	66	44	WM-183	1048.1	6										2.9	
H-2	2	5	66	45	WM-183	1048.1	6										2.9	
H-2	3	5	66	46	WM-183	1048.1	6										2.9	
H-2	4	5	66	47	WM-183	1048.1	6										2.9	
H-2	4	5	66	48	WM-183	1048.1	6										2.9	

¹ "Stream" refers to the liquid waste stream number in Tables A8 and A10

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	5	5	66	49	WM-183	1048	6										2.9	
H-2	6	5	66	50	WM-183	1048	6										2.9	
H-2	7	5	66	51	WM-183	1048	6										2.9	
H-2	7	5	66	53	WM-183	1048	6										2.9	
H-2	7	5	66	54	WM-183	1048	6										2.9	
H-2	8	5	66	55	WM-183	1048	6										2.9	
H-2	9	5	66	56	WM-183	1048	6										2.9	
H-2	10	5	66	57	WM-183	1048	6										2.9	
H-2	11	5	66	58	WM-183	1048	6										2.9	
H-2	11	5	66	59	WM-183	1048	6										2.9	
H-2	11	5	66	60	WM-183	1048	6										2.9	
H-2	12	5	66	61	WM-183	1048	6										2.9	
H-2	13	5	66	62	WM-183	1048	6										2.9	
H-2	13	5	66	63	WM-183	1048	6										2.9	
H-2	14	5	66	64	WM-183	1048	6										2.9	
H-2	14	5	66	65	WM-183	1048	6										2.9	
H-2	15	5	66	66	WM-183	1048	6										2.9	
H-2	16	5	66	67	WM-183	1048	6										2.9	
H-2	16	5	66	68	WM-183	1048	6										2.9	
H-2	17	5	66	69	WM-183	1048	6										2.9	
H-2	18	5	66	70	WM-183	1048	6										2.9	
H-2	18	5	66	71	WM-183	1048	6										2.9	
H-2	19	5	66	72	WM-183	1048	6										2.9	
H-2	20	5	66	73	WM-183	1048	6										2.9	
H-2	21	5	66	74	WM-183	1048	6										2.9	
H-2	21	5	66	75	WM-183	1048	6										2.9	
H-2	22	5	66	76	WM-183	1048	6										2.9	
H-2	22	5	66	77	WM-183	1048	6										2.9	
H-2	23	5	66	78				WM-182	932	7							2.6	
H-2	24	5	66	79				WM-182	932	7							2.6	
H-2	25	5	66	80				WM-182	932	7							2.6	
H-2	25	5	66	81				WM-182	932	7							2.6	
H-2	26	5	66	82	WM-183	1048	6										2.9	
H-2	26	5	66	83	WM-183	1048	6										2.9	
H-2	27	5	66	84				WM-182	1040	7							2.9	
H-2	28	5	66	85				WM-182	1040	7							2.9	
H-2	29	5	66	86				WM-182	1040	7							2.9	
H-2	30	5	66	87				WM-182	1040	7							2.9	
H-2	30	5	66	88				WM-182	1040	7							2.9	
H-2	30	5	66	89				WM-182	1040	7							2.9	
H-2	31	5	66	90				WM-182	1040	7							2.9	
H-2	31	5	66	91				WM-182	1040	7							2.9	
H-2	1	6	66	92				WM-182	1040	7							2.9	
H-2	2	6	66	93				WM-182	1040	7							2.9	
H-2	2	6	66	94				WM-182	1040	7							2.9	
H-2	3	6	66	95				WM-182	1040	7							2.9	
H-2	4	6	66	96				WM-182	1040	7							2.9	
H-2	4	6	66	97				WM-182	1040	7							2.9	
H-2	5	6	66	98				WM-182	1040	7							2.9	
H-2	6	6	66	99				WM-182	1040	7							2.9	
H-2	6	6	66	100				WM-182	1040	7							2.9	
H-2	7	6	66	101				WM-182	1040	7							2.9	
H-2	8	6	66	102				WM-182	1040	7							2.9	
H-2	8	6	66	103				WM-182	1040	7							2.9	
H-2	9	6	66	104	WM-180	941	8										2.6	
H-2	10	6	66	105	WM-180	941	8										2.6	
H-2	10	6	66	106	WM-180	941	8										2.6	
H-2	11	6	66	107	WM-180	941	8										2.6	
H-2	12	6	66	108	WM-180	941	8										2.6	
H-2	12	6	66	109	WM-180	941	8										2.6	
H-2	13	6	66	110	WM-180	941	8										2.6	
H-2	14	6	66	111	WM-180	941	8										2.6	
H-2	14	6	66	112	WM-180	941	8										2.6	
H-2	15	6	66	113	WM-180	941	8										2.6	
H-2	15	6	66	114	WM-180	941	8										2.6	
H-2	16	6	66	115	WM-180	941	8										2.6	
H-2	17	6	66	116	WM-180	941	8										2.6	
H-2	17	6	66	117	WM-180	941	8										2.6	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	18	6	66	118	WM-180	941	8										2.6	
H-2	19	6	66	119	WM-180	941	8										2.6	
H-2	20	6	66	120	WM-180	941	8										2.6	
H-2	20	6	66	121	WM-180	941	8										2.6	
H-2	21	6	66	122	WM-180	941	8										2.6	
H-2	22	6	66	123	WM-180	941	8										2.6	
H-2	22	6	66	124	WM-180	941	8										2.6	
H-2	23	6	66	125	WM-180	941	8										2.6	
H-2	23	6	66	126	WM-180	941	8										2.6	
H-2	24	6	66	127	WM-180	941	8										2.6	
H-2	25	6	66	128	WM-180	941	8										2.6	
H-2	25	6	66	129	WM-180	941	8										2.6	
H-2	26	6	66	130	WM-180	941	8										2.6	
H-2	27	6	66	131	WM-180	720	8										2.0	
H-2	27	6	66	132	WM-180	720	8										2.0	
H-2	28	6	66	133	WM-180	720	8										2.0	
H-2	29	6	66	134	WM-180	720	8										2.0	
H-2	29	6	66	135	WM-180	720	8	WM-182	1184	7							5.3	
H-2	30	6	66	136	WM-180	720	8	WM-182	1184	7							5.3	
H-2	30	6	66	137	WM-180	720	8										2.0	
H-2	1	7	66	138	WM-180	720	8										2.0	
H-2	2	7	66	139	WM-180	720	8										2.0	
H-2	2	7	66	140	WM-180	720	8										2.0	
H-2	3	7	66	141	WM-180	720	8										2.0	
H-2	4	7	66	142	WM-180	720	8										2.0	
H-2	4	7	66	143	WM-180	720	8										2.0	
H-2	5	7	66	144	WM-180	720	8										2.0	
H-2	6	7	66	145	WM-180	720	8										2.0	
H-2	6	7	66	146	WM-180	720	8										2.0	
H-2	7	7	66	147	WM-180	720	8										2.0	
H-2	7	7	66	148				WM-182	1184	7							3.3	
H-2	8	7	66	149				WM-182	1184	7							3.3	
H-2	9	7	66	150				WM-182	1184	7							3.3	
H-2	9	7	66	151				WM-182	1184	7							3.3	
H-2	10	7	66	152				WM-182	1184	7							3.3	
H-2	10	7	66	153				WM-182	1184	7							3.3	
H-2	11	7	66	154				WM-182	1184	7							3.3	
H-2	12	7	66	155				WM-182	1184	7							3.3	
H-2	12	7	66	156				WM-182	1184	7							3.3	
H-2	13	7	66	157				WM-182	1184	7							3.3	
H-2	14	7	66	158				WM-182	1184	7							3.3	
H-2	15	7	66	159				WM-182	1184	7							3.3	
H-2	16	7	66	160				WM-182	1184	7							3.3	
H-2	17	7	66	161				WM-182	1184	7							3.3	
H-2	18	7	66	162				WM-182	1184	7							3.3	
H-2	18	7	66	163				WM-182	1184	7							3.3	
H-2	19	7	66	164				WM-182	1184	7							3.3	
H-2	20	7	66	165				WM-182	1184	7							3.3	
H-2	21	7	66	166				WM-182	1184	7							3.3	
H-2	22	7	66	167				WM-182	1184	7							3.3	
H-2	23	7	66	168				WM-182	1184	7							3.3	
H-2	23	7	66	169				WM-182	1184	7							3.3	
H-2	24	7	66	170				WM-182	1184	7							3.3	
H-2	25	7	66	171				WM-182	1184	7							3.3	
H-2	25	7	66	172				WM-182	1184	7							3.3	
H-2	26	7	66	173				WM-182	1184	7							3.3	
H-2	27	7	66	174				WM-182	1005	7							2.8	
H-2	27	7	66	175				WM-182	1005	7							2.8	
H-2	28	7	66	176				WM-182	1005	7							2.8	
H-2	29	7	66	177				WM-182	1005	7							2.8	
H-2	29	7	66	178				WM-182	1005	7							2.8	
H-2	30	7	66	179				WM-182	1005	7							2.8	
H-2	31	7	66	180				WM-182	1005	7							2.8	
H-2	31	7	66	181				WM-182	1005	7							2.8	
H-2	1	8	66	182				WM-182	1005	7							2.8	
H-2	2	8	66	183				WM-182	1005	7							2.8	
H-2	2	8	66	184				WM-182	1005	7							2.8	
H-2	3	8	66	185				WM-182	1005	7							2.8	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	4	8	66	186				WM-182	1005	7							2.8	
H-2	4	8	66	187				WM-182	1005	7							2.8	
H-2	5	8	66	188				WM-182	1005	7							2.8	
H-2	6	8	66	189				WM-182	1005	7							2.8	
H-2	7	8	66	190				WM-182	1005	7							2.8	
H-2	7	8	66	191				WM-182	1005	7							2.8	
H-2	8	8	66	192				WM-182	1005	7							2.8	
H-2	8	8	66	193				WM-182	1005	7							2.8	
H-2	10	8	66	CC	Cold Calcine (approx. 8 cubic feet)							540	91					
H-2	13	8	66	194				WM-182	1005	7							2.8	
H-2	14	8	66	195				WM-182	1005	7							2.8	
H-2	14	8	66	196				WM-182	1005	7							2.8	
H-2	15	8	66	197				WM-182	1005	7							2.8	
H-2	16	8	66	198				WM-182	1005	7							2.8	
H-2	16	8	66	199				WM-182	1005	7							2.8	
H-2	17	8	66	200				WM-182	1005	7							2.8	
H-2	18	8	66	201	WM-180	1489	8										4.2	
H-2	18	8	66	202				WM-182	1005	7							2.8	
H-2	19	8	66	203	WM-180	1489	8										4.2	
H-2	20	8	66	204				WM-182	1005	7							2.8	
H-2	20	8	66	205	WM-180	1489	8										4.2	
H-2	21	8	66	206				WM-182	1005	7							2.8	
H-2	22	8	66	207	WM-180	1489	8										4.2	
H-2	22	8	66	208				WM-182	1005	7							2.8	
H-2	23	8	66	209	WM-180	1489	8										4.2	
H-2	24	8	66	210				WM-182	1005	7							2.8	
H-2	24	8	66	211	WM-180	1489	8										4.2	
H-2	25	8	66	212				WM-182	1005	7							2.8	
H-2	26	8	66	213	WM-180	1489	8										4.2	
H-2	27	8	66	214				WM-182	1109	7							3.1	
H-2	27	8	66	215	WM-180	808	8										2.3	
H-2	28	8	66	216				WM-182	1109	7							3.1	
H-2	29	8	66	217	WM-180	808	8										2.3	
H-2	30	8	66	218				WM-182	1109	7							3.1	
H-2	30	8	66	219	WM-180	808	8										2.3	
H-2	31	8	66	220				WM-182	1109	7							3.1	
H-2	1	9	66	221	WM-180	808	8										2.3	
H-2	1	9	66	222				WM-182	1109	7							3.1	
H-2	2	9	66	223	WM-180	808	8										2.3	
H-2	3	9	66	224				WM-182	1109	7							3.1	
H-2	3	9	66	225	WM-180	808	8										2.3	
H-2	4	9	66	226				WM-182	1109	7							3.1	
H-2	5	9	66	227	WM-180	808	8										2.3	
H-2	5	9	66	228				WM-182	1109	7							3.1	
H-2	6	9	66	229	WM-180	808	8										2.3	
H-2	7	9	66	230				WM-182	1109	7							3.1	
H-2	7	9	66	231	WM-180	808	8										2.3	
H-2	8	9	66	232				WM-182	1109	7							3.1	
H-2	9	9	66	233	WM-180	808	8										2.3	
H-2	9	9	66	234	WM-180	808	8										2.3	
H-2	10	9	66	235				WM-182	1109	7							3.1	
H-2	11	9	66	236	WM-180	808	8										2.3	
H-2	12	9	66	CC	Cold Calcine (approx. 2 cubic feet)							150	91					
H-2	8	11	66	CC	Cold Calcine (approx. 77 cubic feet)							5420	91					
H-2	9	11	66	Cold	Cold									1805	1.6	0.04	5.1	
H-2	10	11	66	Cold	Cold									1805	1.6	0.04	5.1	
H-2	11	11	66	Cold	Cold									1805	1.6	0.04	5.1	
H-2	12	11	66	Cold	Cold									1805	1.6	0.04	5.1	
H-2	13	11	66	Cold	Cold									1805	1.6	0.04	5.1	
H-2	14	11	66	238				WM-182	1101	7							3.1	
H-2	15	11	66	239				WM-182	1101	7							3.1	
H-2	16	11	66	240	WM-180	936	8										2.6	
H-2	17	11	66	241				WM-182	1101	7							3.1	
H-2	17	11	66	242	WM-180	936	8										2.6	
H-2	18	11	66	243	WM-180	936	8										2.6	
H-2	19	11	66	244				WM-182	1101	7							3.1	
H-2	19	11	66	245	WM-180	936	8										2.6	
H-2	20	11	66	246				WM-182	1101	7							3.1	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	20	11	66	247	WM-180	936	8										2.6	
H-2	21	11	66	248	WM-180	936	8										2.6	
H-2	22	11	66	249				WM-182	1101	7							3.1	
H-2	22	11	66	250	WM-180	936	8										2.6	
H-2	23	11	66	251				WM-182	1101	7							3.1	
H-2	24	11	66	252	WM-180	936	8										2.6	
H-2	24	11	66	253	WM-180	936	8										2.6	
H-2	25	11	66	254				WM-182	1101	7							3.1	
H-2	26	11	66	255	WM-180	936	8										2.6	
H-2	26	11	66	256				WM-182	1101	7							3.1	
H-2	27	11	66	257	WM-180	1075	8										3.0	
H-2	28	11	66	258	WM-180	1075	8										3.0	
H-2	29	11	66	259				WM-182	1098	7							3.1	
H-2	29	11	66	260	WM-180	1075	8										3.0	
H-2	30	11	66	261				WM-182	1098	7							3.1	
H-2	1	12	66	262	WM-180	1075	8										3.0	
H-2	1	12	66	263				WM-182	1098	7							3.1	
H-2	2	12	66	264				WM-182	1098	7							3.1	
H-2	3	12	66	265	WM-180	1075	8										3.0	
H-2	3	12	66	266				WM-182	1098	7							3.1	
H-2	4	12	66	267	WM-180	1075	8										3.0	
H-2	5	12	66	268	WM-180	1075	8										3.0	
H-2	5	12	66	269				WM-182	1098	7							3.1	
H-2	6	12	66	270	WM-180	1075	8										3.0	
H-2	7	12	66	271				WM-182	1098	7							3.1	
H-2	7	12	66	272	WM-180	1075	8										3.0	
H-2	8	12	66	273	WM-180	1075	8										3.0	
H-2	9	12	66	274				WM-182	1098	7							3.1	
H-2	9	12	66	275	WM-180	1075	8										3.0	
H-2	10	12	66	276				WM-182	1098	7							3.1	
H-2	11	12	66	277	WM-180	1075	8										3.0	
H-2	11	12	66	278	WM-180	1075	8										3.0	
H-2	12	12	66	279				WM-182	1098	7							3.1	
H-2	13	12	66	280	WM-180	1075	8										3.0	
H-2	14	12	66	281				WM-182	1098	7							3.1	
H-2	14	12	66	282	WM-180	1075	8										3.0	
H-2	15	12	66	283	WM-180	1075	8										3.0	
H-2	16	12	66	284				WM-182	1098	7							3.1	
H-2	16	12	66	285	WM-180	1075	8										3.0	
H-2	17	12	66	286				WM-182	1098	7							3.1	
H-2	18	12	66	287	WM-180	1075	8										3.0	
H-2	18	12	66	288	WM-180	1075	8										3.0	
H-2	19	12	66	289				WM-182	1098	7							3.1	
H-2	20	12	66	290	WM-180	1075	8										3.0	
H-2	20	12	66	291				WM-182	1098	7							3.1	
H-2	21	12	66	292	WM-180	1075	8										3.0	
H-2	22	12	66	293	WM-180	1075	8										3.0	
H-2	22	12	66	294				WM-182	1098	7							3.1	
H-2	23	12	66	295	WM-180	1075	8										3.0	
H-2	24	12	66	296				WM-182	1098	7							3.1	
H-2	24	12	66	297	WM-180	1075	8										3.0	
H-2	25	12	66	298	WM-180	1075	8										3.0	
H-2	26	12	66	299	WM-180	1075	8										3.0	
H-2	27	12	66	300				WM-182	842	7							2.4	
H-2	27	12	66	301				WM-182	842	7							2.4	
H-2	28	12	66	302	WM-180	1239	8										3.5	
H-2	28	12	66	303	WM-180	1239	8										3.5	
H-2	29	12	66	304				WM-182	842	7							2.4	
H-2	30	12	66	305	WM-180	1239	8										3.5	
H-2	31	12	66	306				WM-182	842	7							2.4	
H-2	31	12	66	307	WM-180	1239	8										3.5	
H-2	1	1	67	308	WM-180	1239	8										3.5	
H-2	2	1	67	309				WM-182	842	7							2.4	
H-2	2	1	67	310	WM-180	1239	8										3.5	
H-2	3	1	67	311				WM-182	842	7							2.4	
H-2	4	1	67	312	WM-180	1239	8										3.5	
H-2	4	1	67	313	WM-180	1239	8										3.5	
H-2	5	1	67	314				WM-182	842	7							2.4	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	6	1	67	315	WM-180	1239	8										3.5	
H-2	6	1	67	316				WM-182	842	7							2.4	
H-2	7	1	67	317	WM-180	1239	8										3.5	
H-2	7	1	67	318	WM-180	1239	8										3.5	
H-2	8	1	67	319				WM-182	842	7							2.4	
H-2	9	1	67	320				WM-182	842	7							2.4	
H-2	10	1	67	321	WM-180	1239	8										3.5	
H-2	10	1	67	322				WM-182	842	7							2.4	
H-2	11	1	67	323	WM-180	1239	8										3.5	
H-2	12	1	67	324				WM-182	842	7							2.4	
H-2	13	1	67	325	WM-180	1239	8										3.5	
H-2	13	1	67	326				WM-182	842	7							2.4	
H-2	14	1	67	327	WM-180	1239	8										3.5	
H-2	14	1	67	328	WM-180	1239	8										3.5	
H-2	15	1	67	329				WM-182	842	7							2.4	
H-2	15	1	67	330	WM-180	1239	8										3.5	
H-2	16	1	67	331				WM-182	842	7							2.4	
H-2	17	1	67	332	WM-180	1239	8										3.5	
H-2	17	1	67	333	WM-180	1239	8										3.5	
H-2	18	1	67	334				WM-182	842	7							2.4	
H-2	19	1	67	335	WM-180	1239	8										3.5	
H-2	19	1	67	336				WM-182	842	7							2.4	
H-2	20	1	67	337	WM-180	1239	8										3.5	
H-2	21	1	67	338	WM-180	1239	8										3.5	
H-2	21	1	67	339				WM-182	842	7							2.4	
H-2	22	1	67	340	WM-180	1239	8										3.5	
H-2	23	1	67	341				WM-182	842	7							2.4	
H-2	23	1	67	342	WM-180	1239	8										3.5	
H-2	24	1	67	343	WM-180	1239	8										3.5	
H-2	25	1	67	344				WM-182	842	7							2.4	
H-2	25	1	67	345	WM-180	1239	8										3.5	
H-2	26	1	67	346				WM-182	842	7							2.4	
H-2	27	1	67	347	WM-180	1043	8										2.9	
H-2	27	1	67	348	WM-180	1043	8										2.9	
H-2	28	1	67	349				WM-182	1038	7							2.9	
H-2	29	1	67	350	WM-180	1043	8										2.9	
H-2	29	1	67	351				WM-182	1038	7							2.9	
H-2	30	1	67	352	WM-180	1043	8										2.9	
H-2	31	1	67	353	WM-180	1043	8										2.9	
H-2	31	1	67	354				WM-182	1038	7							2.9	
H-2	1	2	67	355	WM-180	1043	8										2.9	
H-2	2	2	67	356				WM-182	1038	7							2.9	
H-2	2	2	67	357	WM-180	1043	8										2.9	
H-2	3	2	67	358	WM-180	1043	8										2.9	
H-2	4	2	67	359				WM-182	1038	7							2.9	
H-2	4	2	67	360	WM-180	1043	8										2.9	
H-2	5	2	67	361				WM-182	1038	7							2.9	
H-2	6	2	67	362	WM-180	1043	8										2.9	
H-2	6	2	67	363	WM-180	1043	8										2.9	
H-2	7	2	67	364				WM-182	1038	7							2.9	
H-2	8	2	67	365	WM-180	1043	8										2.9	
H-2	8	2	67	366				WM-182	1038	7							2.9	
H-2	9	2	67	367	WM-180	1043	8										2.9	
H-2	10	2	67	368	WM-180	1043	8										2.9	
H-2	10	2	67	369				WM-182	1038	7							2.9	
H-2	11	2	67	370	WM-180	1043	8										2.9	
H-2	12	2	67	371				WM-182	1038	7							2.9	
H-2	12	2	67	372	WM-180	1043	8										2.9	
H-2	13	2	67	373	WM-180	1043	8										2.9	
H-2	14	2	67	374				WM-182	1038	7							2.9	
H-2	14	2	67	375	WM-180	1043	8										2.9	
H-2	15	2	67	376				WM-182	1038	7							2.9	
H-2	16	2	67	377	WM-180	1043	8										2.9	
H-2	17	2	67	378	WM-180	1043	8										2.9	
H-2	17	2	67	379				WM-182	1038	7							2.9	
H-2	18	2	67	380	WM-180	1043	8										2.9	
H-2	19	2	67	381				WM-182	1038	7							2.9	
H-2	19	2	67	382	WM-180	1043	8										2.9	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	20	2	67	383	WM-180	1043	8										2.9	
H-2	21	2	67	384				WM-182	1038	7							2.9	
H-2	21	2	67	385	WM-180	1043	8										2.9	
H-2	22	2	67	386				WM-182	1038	7							2.9	
H-2	22	2	67	387	WM-180	1043	8										2.9	
H-2	23	2	67	388	WM-180	1043	8										2.9	
H-2	23	2	67	389				WM-182	1038	7							2.9	
H-2	24	2	67	390	WM-180	1043	8										2.9	
H-2	25	2	67	391				WM-182	1038	7							2.9	
H-2	26	2	67	392	WM-180	1043	8										2.9	
H-2	26	2	67	393	WM-180	1043	8										2.9	
H-2	27	2	67	394				WM-182	642	7							1.8	
H-2	27	2	67	395	WM-180	591	8										1.7	
H-2	28	2	67	396	WM-180	591	8	WM-182	642	7							3.5	
H-2	1	3	67	397	WM-180	591	8	WM-182	642	7							3.5	
H-2	1	3	67	398	WM-180	591	8	WM-182	642	7							3.5	
H-2	2	3	67	399	WM-180	591	8	WM-182	642	7							3.5	
H-2	3	3	67	400	WM-180	591	8	WM-182	642	7							3.5	
H-2	3	3	67	401	WM-180	591	8	WM-182	642	7							3.5	
H-2	4	3	67	402	WM-180	591	8	WM-182	642	7							3.5	
H-2	5	3	67	403	WM-180	591	8	WM-182	642	7							3.5	
H-2	5	3	67	404	WM-180	591	8	WM-182	642	7							3.5	
H-2	6	3	67	405	WM-180	591	8	WM-182	642	7							3.5	
H-2	7	3	67	406	WM-180	591	8	WM-182	642	7							3.5	
H-2	7	3	67	407	WM-180	591	8	WM-182	642	7							3.5	
H-2	18	3	67	DB	Dolomite Bed (approx. 77 cubic feet)							5420	92					
H-2	18	3	67	16	Cold									1440	1.6	0.04	4.0	
H-2	18	3	67	DB	Dolomite Bed (approx. 33 cubic feet)							2320	92					
H-2	18	3	67	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-2	19	3	67	17	Cold									1440	1.6	0.04	4.0	
H-2	20	3	67	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-2	20	3	67	18	Cold									1440	1.6	0.04	4.0	
H-2	21	3	67	19	Cold									1440	1.6	0.04	4.0	
H-2	22	3	67	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-2	23	3	67	20	Cold									700	1.6	0.04	2.0	
H-2	24	3	67	409				WM-182	642	7							1.8	
H-2	25	3	67	410				WM-182	642	7							1.8	
H-2	25	3	67	411				WM-182	642	7							1.8	
H-2	26	3	67	412	WM-180	591	8	WM-182	642	7							3.5	
H-2	27	3	67	413	WM-180	739	8	WM-182	561	7							3.6	
H-2	27	3	67	414	WM-180	739	8	WM-182	561	7							3.6	
H-2	28	3	67	415	WM-180	739	8	WM-182	561	7							3.6	
H-2	29	3	67	416	WM-180	739	8	WM-182	561	7							3.6	
H-2	30	3	67	417	WM-180	739	8	WM-182	561	7							3.6	
H-2	6	4	67	418	WM-180	739	8	WM-182	561	7							3.6	
H-2	7	4	67	419	WM-180	739	8	WM-182	561	7							3.6	
H-2	7	4	67	420	WM-180	739	8	WM-182	561	7							3.6	
H-2	8	4	67	421	WM-180	739	8	WM-182	561	7							3.6	
H-2	9	4	67	422	WM-180	739	8	WM-182	561	7							3.6	
H-2	9	4	67	423	WM-180	739	8	WM-182	561	7							3.6	
H-2	10	4	67	424	WM-180	739	8	WM-182	561	7							3.6	
H-2	11	4	67	425	WM-180	739	8	WM-182	561	7							3.6	
H-2	12	4	67	426	WM-180	739	8	WM-182	561	7							3.6	
H-2	12	4	67	427	WM-180	739	8	WM-182	561	7							3.6	
H-2	13	4	67	428	WM-180	739	8	WM-182	561	7							3.6	
H-2	14	4	67	429	WM-180	739	8	WM-182	561	7							3.6	
H-2	14	4	67	430				WM-182	1450	9							4.1	
H-2	15	4	67	431				WM-182	1450	9							4.1	
H-2	16	4	67	432				WM-182	1450	9							4.1	
H-2	17	4	67	433				WM-182	1450	9							4.1	
H-2	18	4	67	434				WM-182	1450	9							4.1	
H-2	18	4	67	435				WM-182	1450	9							4.1	
H-2	19	4	67	436				WM-182	1450	9							4.1	
H-2	19	4	67	437				WM-182	1450	9							4.1	
H-2	20	4	67	438				WM-182	1450	9							4.1	
H-2	20	4	67	439				WM-182	1450	9							4.1	
H-2	21	4	67	440				WM-182	1450	9							4.1	
H-2	22	4	67	441				WM-182	1450	9							4.1	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	23	4	67	442				WM-182	1450	9							4.1	
H-2	24	4	67	443				WM-182	1450	9							4.1	
H-2	24	4	67	444				WM-182	1450	9							4.1	
H-2	25	4	67	445				WM-182	1450	9							4.1	
H-2	25	4	67	446				WM-182	1450	9							4.1	
H-2	26	4	67	447				WM-182	1450	9							4.1	
H-2	27	4	67	448				WM-182	1413	9							4.0	
H-2	28	4	67	449				WM-182	1413	9							4.0	
H-2	29	4	67	450				WM-182	1413	9							4.0	
H-2	29	4	67	451				WM-182	1413	9							4.0	
H-2	30	4	67	452				WM-182	1413	9							4.0	
H-2	1	5	67	453				WM-182	1413	9							4.0	
H-2	2	5	67	454				WM-182	1413	9							4.0	
H-2	2	5	67	455				WM-182	1413	9							4.0	
H-2	3	5	67	456				WM-182	1413	9							4.0	
H-2	4	5	67	457				WM-182	1413	9							4.0	
H-2	5	5	67	458				WM-182	1413	9							4.0	
H-2	6	5	67	459				WM-182	1413	9							4.0	
H-2	7	5	67	460				WM-182	1413	9							4.0	
H-2	8	5	67	461				WM-182	1413	9							4.0	
H-2	8	5	67	462				WM-182	1413	9							4.0	
H-2	9	5	67	463				WM-182	1413	9							4.0	
H-2	10	5	67	464				WM-182	1413	9							4.0	
H-2	10	5	67	465				WM-182	1413	9							4.0	
H-2	11	5	67	466				WM-182	1413	9							4.0	
H-2	12	5	67	467				WM-182	1413	9							4.0	
H-2	13	5	67	468				WM-182	1413	9							4.0	
H-2	14	5	67	469				WM-182	1413	9							4.0	
H-2	14	5	67	470				WM-182	1413	9							4.0	
H-2	15	5	67	471				WM-182	1413	9							4.0	
H-2	16	5	67	472				WM-182	1413	9							4.0	
H-2	16	5	67	473				WM-182	1413	9							4.0	
H-2	17	5	67	474				WM-182	1413	9							4.0	
H-2	23	5	67	475				WM-182	1413	9							4.0	
H-2	24	5	67	476				WM-182	1413	9							4.0	
H-2	25	5	67	477				WM-182	1413	9							4.0	
H-2	25	5	67	478				WM-182	1413	9							4.0	
H-2	26	5	67	479				WM-182	1413	9							4.0	
H-2	27	5	67	480				WM-182	1344	9							3.8	
H-2	28	5	67	481				WM-182	1344	9							3.8	
H-2	29	5	67	482				WM-182	1344	9							3.8	
H-2	29	5	67	483				WM-182	1344	9							3.8	
H-2	30	5	67	484				WM-182	1344	9							3.8	
H-2	31	5	67	485				WM-182	1344	9							3.8	
H-2	1	6	67	486				WM-182	1344	9							3.8	
H-2	2	6	67	487				WM-182	1344	9							3.8	
H-2	2	6	67	488				WM-182	1344	9							3.8	
H-2	3	6	67	489				WM-182	1344	9							3.8	
H-2	4	6	67	490				WM-182	1344	9							3.8	
H-2	4	6	67	491				WM-182	1344	9							3.8	
H-2	5	6	67	492				WM-182	1344	9							3.8	
H-2	6	6	67	493				WM-182	1344	9							3.8	
H-2	7	6	67	494				WM-182	1344	9							3.8	
H-2	8	6	67	495				WM-182	1344	9							3.8	
H-2	8	6	67	496				WM-182	1344	9							3.8	
H-2	9	6	67	497				WM-182	1344	9							3.8	
H-2	10	6	67	498				WM-182	1344	9							3.8	
H-2	10	6	67	499				WM-182	1344	9							3.8	
H-2	11	6	67	500				WM-182	1344	9							3.8	
H-2	12	6	67	501				WM-182	1344	9							3.8	
H-2	13	6	67	502				WM-182	1344	9							3.8	
H-2	14	6	67	503				WM-182	1344	9							3.8	
H-2	14	6	67	504				WM-182	1344	9							3.8	
H-2	15	6	67	505				WM-182	1344	9							3.8	
H-2	16	6	67	506				WM-182	1344	9							3.8	
H-2	16	6	67	507				WM-182	1344	9							3.8	
H-2	17	6	67	508				WM-182	1344	9							3.8	
H-2	18	6	67	509				WM-182	1344	9							3.8	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	19	6	67	510				WM-182	1344	9							3.8	
H-2	20	6	67	511				WM-182	1344	9							3.8	
H-2	20	6	67	512				WM-182	1344	9							3.8	
H-2	21	6	67	513				WM-182	1344	9							3.8	
H-2	21	6	67	514				WM-182	1344	9							3.8	
H-2	22	6	67	515				WM-182	1344	9							3.8	
H-2	22	6	67	516				WM-182	1344	9							3.8	
H-2	23	6	67	517				WM-182	1344	9							3.8	
H-2	24	6	67	518				WM-182	1344	9							3.8	
H-2	24	6	67	519				WM-182	1344	9							3.8	
H-2	25	6	67	520				WM-182	1344	9							3.8	
H-2	25	6	67	521				WM-182	1344	9							3.8	
H-2	26	6	67	522				WM-182	1344	9							3.8	
H-2	27	6	67	523				WM-182	1202	9							3.4	
H-2	27	6	67	524				WM-182	1202	9							3.4	
H-2	28	6	67	525				WM-182	1202	9							3.4	
H-2	29	6	67	526				WM-182	1202	9							3.4	
H-2	29	6	67	527				WM-182	1202	9							3.4	
H-2	30	6	67	528				WM-182	1202	9							3.4	
H-2	30	6	67	529				WM-182	1202	9							3.4	
H-2	1	7	67	530				WM-182	1202	9							3.4	
H-2	2	7	67	531				WM-182	1202	9							3.4	
H-2	2	7	67	532				WM-182	1202	9							3.4	
H-2	3	7	67	533				WM-182	1202	9							3.4	
H-2	4	7	67	534				WM-182	1202	9							3.4	
H-2	4	7	67	535				WM-182	1202	9							3.4	
H-2	5	7	67	536				WM-182	1202	9							3.4	
H-2	5	7	67	537				WM-182	1202	9							3.4	
H-2	6	7	67	538				WM-182	1202	9							3.4	
H-2	7	7	67	539				WM-182	1202	9							3.4	
H-2	7	7	67	540				WM-182	1202	9							3.4	
H-2	8	7	67	541				WM-182	1202	10							3.4	
H-2	9	7	67	542				WM-182	1202	10							3.4	
H-2	10	7	67	543				WM-182	1202	10							3.4	
H-2	10	7	67	544				WM-182	1202	10							3.4	
H-2	11	7	67	545				WM-182	1202	10							3.4	
H-2	11	7	67	546				WM-182	1202	10							3.4	
H-2	12	7	67	547				WM-182	1202	10							3.4	
H-2	13	7	67	548				WM-182	1202	10							3.4	
H-2	13	7	67	549				WM-182	1202	10							3.4	
H-2	14	7	67	550				WM-182	1202	10							3.4	
H-2	16	7	67	551				WM-182	1202	10							3.4	
H-2	15	7	67	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-2	15	7	67	552				WM-182	1202	10							3.4	
H-2	16	7	67	553				WM-182	1202	10							3.4	
H-2	17	7	67	554				WM-182	1202	10							3.4	
H-2	18	7	67	555				WM-182	1202	10							3.4	
H-2	19	7	67	556				WM-182	1202	10							3.4	
H-2	19	7	67	557				WM-182	1202	10							3.4	
H-2	20	7	67	558				WM-182	1202	10							3.4	
H-2	20	7	67	559				WM-182	1202	10							3.4	
H-2	21	7	67	560				WM-182	1202	10							3.4	
H-2	22	7	67	561				WM-182	1202	10							3.4	
H-2	22	7	67	562				WM-182	1202	10							3.4	
H-2	23	7	67	563				WM-182	1202	10							3.4	
H-2	24	7	67	564				WM-182	1202	10							3.4	
H-2	24	7	67	565				WM-182	1202	10							3.4	
H-2	25	7	67	566				WM-182	1202	10							3.4	
H-2	25	7	67	567				WM-182	1202	10							3.4	
H-2	26	7	67	568				WM-182	1202	10							3.4	
H-2	26	7	67	569				WM-182	1202	10							3.4	
H-2	27	7	67	570				WM-182	1155	10							3.2	
H-2	28	7	67	571				WM-182	1155	10							3.2	
H-2	29	7	67	572				WM-182	1155	10							3.2	
H-2	29	7	67	573				WM-182	1155	10							3.2	
H-2	30	7	67	574				WM-182	1155	10							3.2	
H-2	30	7	67	575				WM-182	1155	10							3.2	
H-2	31	7	67	576				WM-182	1155	10							3.2	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	1	8	67	577				WM-182	1155	10							3.2	
H-2	1	8	67	578				WM-182	1155	10							3.2	
H-2	2	8	67	579				WM-182	1155	10							3.2	
H-2	3	8	67	580				WM-182	1155	10							3.2	
H-2	3	8	67	581				WM-182	1155	10							3.2	
H-2	4	8	67	582				WM-182	1155	10							3.2	
H-2	4	8	67	583				WM-182	1155	10							3.2	
H-2	5	8	67	584				WM-182	1155	10							3.2	
H-2	6	8	67	585				WM-182	1155	10							3.2	
H-2	6	8	67	586				WM-182	1155	10							3.2	
H-2	7	8	67	587				WM-182	1155	10							3.2	
H-2	8	8	67	588				WM-182	1155	10							3.2	
H-2	8	8	67	589				WM-182	1155	10							3.2	
H-2	9	8	67	590				WM-182	1155	10							3.2	
H-2	9	8	67	591				WM-182	1155	10							3.2	
H-2	10	8	67	592				WM-182	1155	10							3.2	
H-2	11	8	67	593				WM-182	1155	10							3.2	
H-2	11	8	67	594				WM-182	1155	10							3.2	
H-2	12	8	67	595				WM-182	1155	10							3.2	
H-2	12	8	67	596				WM-182	1155	10							3.2	
H-2	13	8	67	597				WM-182	1155	10							3.2	
H-2	14	8	67	598				WM-182	1155	10							3.2	
H-2	14	8	67	599				WM-182	1155	10							3.2	
H-2	15	8	67	600				WM-182	1155	10							3.2	
H-2	15	8	67	601				WM-182	1155	10							3.2	
H-2	16	8	67	602				WM-182	1155	10							3.2	
H-2	17	8	67	603				WM-182	1155	10							3.2	
H-2	17	8	67	604				WM-182	1155	10							3.2	
H-2	18	8	67	605				WM-182	1155	10							3.2	
H-2	18	8	67	606				WM-182	1155	10							3.2	
H-2	19	8	67	607				WM-182	1155	10							3.2	
H-2	19	8	67	608				WM-182	1155	10							3.2	
H-2	20	8	67	609				WM-182	1155	10							3.2	
H-2	21	8	67	610				WM-182	1155	10							3.2	
H-2	21	8	67	611				WM-182	1155	10							3.2	
H-2	22	8	67	612				WM-182	1155	10							3.2	
H-2	23	8	67	613				WM-182	1155	10							3.2	
H-2	23	8	67	614				WM-182	1155	10							3.2	
H-2	24	8	67	615				WM-182	1155	10							3.2	
H-2	24	8	67	616				WM-182	1155	10							3.2	
H-2	25	8	67	617				WM-182	1155	10							3.2	
H-2	25	8	67	618				WM-182	1155	10							3.2	
H-2	26	8	67	619				WM-182	1155	10							3.2	
H-2	26	8	67	620				WM-182	1155	10							3.2	
H-2	27	8	67	621				WM-182	1230	10							3.5	
H-2	28	8	67	622				WM-182	1230	10							3.5	
H-2	28	8	67	623				WM-182	1230	10							3.5	
H-2	29	8	67	624				WM-182	1230	10							3.5	
H-2	30	8	67	625				WM-182	1230	10							3.5	
H-2	30	8	67	626				WM-182	1230	10							3.5	
H-2	31	8	67	627				WM-182	1230	10							3.5	
H-2	31	8	67	628				WM-182	1230	10							3.5	
H-2	1	9	67	629				WM-182	1230	10							3.5	
H-2	2	9	67	630				WM-182	1230	10							3.5	
H-2	2	9	67	631				WM-182	1230	10							3.5	
H-2	3	9	67	632				WM-182	1230	10							3.5	
H-2	3	9	67	633				WM-182	1230	10							3.5	
H-2	4	9	67	634				WM-182	1230	10							3.5	
H-2	5	9	67	635				WM-182	1230	10							3.5	
H-2	5	9	67	636				WM-182	1230	10							3.5	
H-2	6	9	67	637				WM-182	1230	10							3.5	
H-2	6	9	67	638				WM-182	1230	10							3.5	
H-2	7	9	67	639				WM-182	1230	11							3.5	
H-2	8	9	67	640				WM-182	1230	11							3.5	
H-2	8	9	67	641				WM-182	1230	11							3.5	
H-2	9	9	67	642				WM-182	1230	11							3.5	
H-2	9	9	67	643				WM-182	1230	11							3.5	
H-2	10	9	67	644				WM-182	1230	11							3.5	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	10	9	67	645				WM-182	1230	11							3.5	
H-2	11	9	67	646				WM-182	1230	11							3.5	
H-2	12	9	67	647				WM-182	1230	11							3.5	
H-2	13	9	67	648				WM-182	1230	11							3.5	
H-2	13	9	67	649				WM-182	1230	11							3.5	
H-2	14	9	67	650				WM-182	1230	11							3.5	
H-2	14	9	67	651				WM-182	1230	11							3.5	
H-2	15	9	67	652				WM-182	1230	11							3.5	
H-2	16	9	67	653				WM-182	1230	11							3.5	
H-2	16	9	67	654				WM-182	1230	11							3.5	
H-2	17	9	67	655				WM-182	1230	11							3.5	
H-2	17	9	67	656				WM-182	1230	11							3.5	
H-2	18	9	67	657				WM-182	1230	11							3.5	
H-2	19	9	67	658				WM-182	1230	11							3.5	
H-2	19	9	67	659				WM-182	1230	11							3.5	
H-2	20	9	67	660				WM-182	1230	11							3.5	
H-2	21	9	67	661				WM-182	1230	11							3.5	
H-2	21	9	67	662				WM-182	1230	11							3.5	
H-2	22	9	67	663				WM-182	1230	12							3.5	
H-2	23	9	67	664				WM-182	1230	12							3.5	
H-2	23	9	67	665				WM-182	1230	12							3.5	
H-2	24	9	67	666				WM-182	1230	12							3.5	
H-2	24	9	67	667				WM-182	1230	12							3.5	
H-2	25	9	67	668				WM-182	1230	12							3.5	
H-2	25	9	67	669				WM-182	1230	12							3.5	
H-2	26	9	67	670				WM-182	1230	12							3.5	
H-2	27	9	67	671				WM-182	1153	12							3.2	
H-2	27	9	67	672				WM-182	1153	12							3.2	
H-2	28	9	67	673				WM-182	1153	12							3.2	
H-2	28	9	67	674				WM-182	1153	12							3.2	
H-2	29	9	67	675				WM-182	1153	12							3.2	
H-2	30	9	67	676				WM-182	1153	12							3.2	
H-2	30	9	67	677				WM-182	1153	12							3.2	
H-2	1	10	67	678				WM-182	1153	12							3.2	
H-2	2	10	67	679				WM-182	1153	12							3.2	
H-2	2	10	67	680				WM-182	1153	12							3.2	
H-2	3	10	67	681				WM-182	1153	12							3.2	
H-2	4	10	67	682				WM-182	1153	12							3.2	
H-2	4	10	67	683				WM-182	1153	12							3.2	
H-2	5	10	67	684				WM-182	1153	12							3.2	
H-2	5	10	67	685				WM-182	1153	12							3.2	
H-2	6	10	67	686				WM-182	1153	12							3.2	
H-2	6	10	67	687				WM-182	1153	12							3.2	
H-2	7	10	67	688				WM-182	1153	12							3.2	
H-2	8	10	67	689				WM-182	1153	12							3.2	
H-2	8	10	67	690				WM-182	1153	12							3.2	
H-2	9	10	67	691				WM-182	1153	12							3.2	
H-2	9	10	67	692				WM-182	1153	12							3.2	
H-2	10	10	67	693				WM-182	1153	12							3.2	
H-2	10	10	67	694				WM-182	1153	12							3.2	
H-2	11	10	67	695				WM-182	1153	12							3.2	
H-2	13	10	67	696				WM-182	1153	12							3.2	
H-2	14	10	67	697				WM-182	1153	12							3.2	
H-2	14	10	67	698				WM-182	1153	12							3.2	
H-2	15	10	67	699				WM-182	1153	12							3.2	
H-2	15	10	67	700				WM-182	1153	12							3.2	
H-2	16	10	67	701				WM-182	1153	12							3.2	
H-2	16	10	67	702				WM-182	1153	12							3.2	
H-2	17	10	67	703				WM-182	1153	12							3.2	
H-2	18	10	67	704				WM-182	1153	12							3.2	
H-2	18	10	67	705				WM-182	1153	12							3.2	
H-2	19	10	67	706				WM-182	1153	12							3.2	
H-2	20	10	67	707				WM-182	1153	12							3.2	
H-2	20	10	67	708				WM-182	1153	12							3.2	
H-2	21	10	67	709				WM-182	1153	12							3.2	
H-2	21	10	67	710				WM-182	1153	12							3.2	
H-2	22	10	67	711				WM-182	1153	12							3.2	
H-2	23	10	67	712				WM-182	1153	12							3.2	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	24	10	67	713				WM-182	1153	12							3.2	
H-2	24	10	67	714				WM-182	1153	12							3.2	
H-2	25	10	67	715				WM-182	1153	12							3.2	
H-2	25	10	67	716				WM-182	1153	12							3.2	
H-2	26	10	67	717				WM-182	1153	12							3.2	
H-2	27	10	67	718				WM-182	1594	12							4.5	
H-2	27	10	67	719				WM-182	1594	12							4.5	
H-2	28	10	67	720				WM-182	1594	12							4.5	
H-2	28	10	67	721				WM-182	1594	12							4.5	
H-2	29	10	67	722				WM-182	1594	12							4.5	
H-2	30	10	67	723				WM-182	1594	12							4.5	
H-2	30	10	67	724				WM-182	1594	12							4.5	
H-2	31	10	67	725				WM-182	1594	12							4.5	
H-2	1	11	67	726				WM-182	1594	12							4.5	
H-2	1	11	67	727				WM-182	1594	12							4.5	
H-2	2	11	67	728				WM-182	1594	12							4.5	
H-2	3	11	67	729				WM-182	1594	13							4.5	
H-2	3	11	67	730				WM-182	1594	13							4.5	
H-2	4	11	67	731				WM-182	1594	13							4.5	
H-2	4	11	67	732				WM-182	1594	13							4.5	
H-2	5	11	67	733				WM-182	1594	13							4.5	
H-2	6	11	67	734				WM-182	1594	13							4.5	
H-2	7	11	67	735				WM-182	1594	13							4.5	
H-2	7	11	67	736				WM-182	1594	13							4.5	
H-2	8	11	67	737				WM-182	1594	13							4.5	
H-2	9	11	67	738				WM-182	1594	13							4.5	
H-2	9	11	67	739				WM-182	1594	13							4.5	
H-2	10	11	67	740				WM-182	1594	13							4.5	
H-2	11	11	67	741				WM-182	1594	13							4.5	
H-2	12	11	67	742				WM-182	1594	13							4.5	
H-2	13	11	67	1	WM-188	861	14											2077
H-2	13	11	67	2	WM-188	861	14											2077
H-2	14	11	67	3	WM-188	861	14											2077
H-2	15	11	67	4	WM-188	861	14											2077
H-2	16	11	67	5	WM-188	861	14											2077
H-2	17	11	67	6	WM-188	861	14											2077
H-2	18	11	67	7	WM-188	861	14											2077
H-2	18	11	67	8	WM-188	861	14											2077
H-2	19	11	67	9	WM-188	861	14											2077
H-2	20	11	67	10	WM-188	861	14											2077
H-2	21	11	67	11	WM-188	861	14											2077
H-2	21	11	67	12	WM-188	861	14											2077
H-2	22	11	67	13	WM-188	861	14											2077
H-2	23	11	67	14	WM-188	861	14											2077
H-2	24	11	67	15	WM-188	861	14											2077
H-2	25	11	67	16	WM-188	861	14											2077
H-2	26	11	67	17	WM-188	861	14											2077
H-2	9	12	67	DB	Dolomite Bed (approx. 77 cubic feet)							5420	92					
H-2	9	12	67	21	Cold									1440	1.6	0.04	4.0	
H-2	9	12	67	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-2	10	12	67	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-2	10	12	67	22	Cold									1440	1.6	0.04	4.0	
H-2	10	12	67	23	Cold									850	1.6	0.04	2.4	
H-2	11	12	67	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-2	11	12	67	24	Cold									1300	1.6	0.04	3.7	
H-2	11	12	67	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-2	11	12	67	25	Cold									780	1.6	0.04	2.2	
H-2	11	12	67	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-2	13	12	67	26	Cold									850	1.6	0.04	2.4	
H-2	13	12	67	18	WM-188	861	14											2077
H-2	14	12	67	19	WM-188	861	14											2077
H-2	15	12	67	20	WM-188	861	14											2077
H-2	15	12	67	21	WM-188	861	14											2077
H-2	16	12	67	22	WM-188	861	14											2077
H-2	17	12	67	23	WM-188	861	14											2077
H-2	18	12	67	24	WM-188	861	14											2077
H-2	18	12	67	25	WM-188	861	14											2077
H-2	19	12	67	26	WM-188	861	14											2077

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	20	12	67	27	WM-188	861	14											2077
H-2	21	12	67	28	WM-188	861	14											2077
H-2	22	12	67	29	WM-188	861	14											2077
H-2	23	12	67	30	WM-188	861	14											2077
H-2	24	12	67	31	WM-188	861	14											2077
H-2	24	12	67	32	WM-188	861	14											2077
H-2	25	12	67	33	WM-188	861	14											2077
H-2	26	12	67	34	WM-188	861	14											2077
H-2	26	12	67	35	WM-188	861	14											2077
H-2	27	12	67	36	WM-188	861	14											2077
H-2	28	12	67	37	WM-188	861	14											2077
H-2	29	12	67	38	WM-188	861	14											2077
H-2	29	12	67	39	WM-188	861	14											2077
H-2	30	12	67	40	WM-188	861	14											2077
H-2	31	12	67	41	WM-188	861	14											2077
H-2	1	1	68	42	WM-188	861	14											2077
H-2	2	1	68	43	WM-188	861	14											2077
H-2	3	1	68	44	WM-188	861	14											2077
H-2	4	1	68	45	WM-188	861	14											2077
H-2	5	1	68	46	WM-188	861	14											2077
H-2	6	1	68	47	WM-188	861	14											2077
H-2	7	1	68	48	WM-188	861	14											2077
H-2	7	1	68	49	WM-188	861	14											2077
H-2	8	1	68	50	WM-188	861	14											2077
H-2	9	1	68	51	WM-188	861	14											2077
H-2	10	1	68	52	WM-188	861	14											2077
H-2	10	1	68	53	WM-188	861	14											2077
H-2	11	1	68	54	WM-188	861	14											2077
H-2	12	1	68	55	WM-188	861	14											2077
H-2	13	1	68	56	WM-188	861	14											2077
H-2	13	1	68	57	WM-188	861	14											2077
H-2	14	1	68	58	WM-188	861	14											2077
H-2	15	1	68	59	WM-188	861	14											2077
H-2	16	1	68	60	WM-188	861	14											2077
H-2	17	1	68	61	WM-188	861	14											2077
H-2	18	1	68	62	WM-188	861	14											2077
H-2	19	1	68	63	WM-188	861	14											2077
H-2	19	1	68	64	WM-188	861	14											2077
H-2	20	1	68	65	WM-188	861	14											2077
H-2	21	1	68	66	WM-188	861	14											2077
H-2	21	1	68	67	WM-188	861	14											2077
H-2	22	1	68	68	WM-188	861	14											2077
H-2	23	1	68	69	WM-188	861	14											2077
H-2	24	1	68	70	WM-188	861	14											2077
H-2	24	1	68	71	WM-188	861	14											2077
H-2	25	1	68	72	WM-188	861	14											2077
H-2	26	1	68	73	WM-188	861	14											2077
H-2	26	1	68	74	WM-188	861	14											2077
H-2	27	1	68	75	WM-188	861	14											2077
H-2	28	1	68	76	WM-188	861	14											2077
H-2	29	1	68	77	WM-188	861	14											2077
H-2	29	1	68	78	WM-188	861	14											2077
H-2	30	1	68	79	WM-188	861	14											2077
H-2	31	1	68	80	WM-188	861	14											2077
H-2	1	2	68	81	WM-188	861	14											2077
H-2	2	2	68	82	WM-188	861	14											2077
H-2	2	2	68	83	WM-188	861	14											2077
H-2	3	2	68	84	WM-188	861	14											2077
H-2	3	2	68	85	WM-188	861	14											2077
H-2	4	2	68	86	WM-188	861	14											2077
H-2	5	2	68	87	WM-188	861	14											2077
H-2	6	2	68	88	WM-188	861	14											2077
H-2	6	2	68	89	WM-188	861	14											2077
H-2	7	2	68	90	WM-188	861	14											2077
H-2	8	2	68	91	WM-188	861	14											2077
H-2	9	2	68	92	WM-188	861	14											2077
H-2	10	2	68	93	WM-188	861	14											2077
H-2	10	2	68	94	WM-188	861	14											2077

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	11	2	68	95	WM-188	861	14											2077
H-2	11	2	68	96	WM-188	861	14											2077
H-2	12	2	68	97	WM-188	861	14											2077
H-2	13	2	68	98	WM-188	861	14											2077
H-2	14	2	68	99	WM-188	861	14											2077
H-2	14	2	68	100	WM-188	861	14											2077
H-2	15	2	68	101	WM-188	861	14											2077
H-2	16	2	68	102	WM-188	861	14											2077
H-2	17	2	68	103	WM-188	861	14											2077
H-2	17	2	68	104	WM-188	861	14											2077
H-2	18	2	68	105	WM-188	861	14											2077
H-2	19	2	68	106	WM-188	861	14											2077
H-2	20	2	68	107	WM-188	861	14											2077
H-2	21	2	68	108	WM-188	861	14											2077
H-2	22	2	68	109	WM-188	861	14											2077
H-2	22	2	68	110	WM-188	861	14											2077
H-2	23	2	68	111	WM-188	861	14											2077
H-2	24	2	68	112	WM-188	861	14											2077
H-2	25	2	68	113	WM-188	861	14											2077
H-2	25	2	68	114	WM-188	861	14											2077
H-2	26	2	68	115	WM-188	861	14											2077
H-2	27	2	68	116	WM-188	861	14											2077
H-2	28	2	68	117	WM-188	861	14											2077
H-2	28	2	68	118	WM-188	861	14											2077
H-2	29	2	68	119	WM-188	861	14											2077
H-2	1	3	68	120	WM-188	861	14											2077
H-2	2	3	68	121	WM-188	861	14											2077
H-2	3	3	68	122	WM-188	861	14											2077
H-2	3	3	68	123	WM-188	861	14											2077
H-2	4	3	68	124	WM-188	861	14											2077
H-2	5	3	68	125	WM-188	861	14											2077
H-2	5	3	68	126	WM-188	861	14											2077
H-2	6	3	68	127	WM-188	861	14											2077
H-2	7	3	68	744				WM-185	1099	15							3.1	
H-2	7	3	68	745				WM-185	1099	15							3.1	
H-2	8	3	68	746				WM-185	1099	15							3.1	
H-2	9	3	68	747				WM-185	1099	15							3.1	
H-2	10	3	68	748				WM-185	1099	15							3.1	
H-2	10	3	68	749				WM-185	1099	15							3.1	
H-2	11	3	68	750				WM-185	1099	15							3.1	
H-2	12	3	68	751				WM-185	1099	15							3.1	
H-2	12	3	68	752				WM-185	1099	15							3.1	
H-2	13	3	68	753				WM-185	1099	15							3.1	
H-2	14	3	68	754				WM-185	1099	15							3.1	
H-2	15	3	68	755				WM-185	1099	15							3.1	
H-2	15	3	68	756				WM-185	1099	15							3.1	
H-2	16	3	68	757				WM-185	1099	15							3.1	
H-2	17	3	68	758				WM-185	1099	15							3.1	
H-2	18	3	68	759				WM-185	1099	15							3.1	
H-2	19	3	68	760				WM-185	1099	15							3.1	
H-2	19	3	68	761				WM-185	1099	15							3.1	
H-2	20	3	68	762				WM-185	1099	15							3.1	
H-2	21	3	68	763				WM-185	1099	15							3.1	
H-2	22	3	68	764				WM-185	1099	15							3.1	
H-2	22	3	68	765				WM-185	1099	15							3.1	
H-2	23	3	68	766				WM-185	1099	15							3.1	
H-3	8	8	68	DB	Dolomite Bed (approx. 83 cubic feet)							5810	92					
H-3	8	8	68	1C	Cold									1166	1.6		3.3	
H-3	9	8	68	2C	Cold									1220	1.6		3.4	
H-3	10	8	68	3C	Cold									1160	1.6		3.3	
H-3	10	8	68	4C	Cold									712	1.6		2.0	
H-3	11	8	68	5C	Cold									1207	1.6		3.4	
H-3	11	8	68	6C	Cold									1241	1.6		3.5	
H-3	12	8	68	7C	Cold									744	1.6		2.1	
H-3	12	8	68	8C	Cold									1430	1.6		4.0	
H-3	13	8	68	9C	Cold									890	1.6		2.5	
H-3	14	8	68	10C	Cold									1063	1.6		3.0	
H-3	14	8	68	11	WM-188	763	16											1630

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	15	8	68	12	WM-188	858	16											1780
H-3	16	8	68	13	WM-188	871	16											1950
H-3	16	8	68	14	WM-188	891	16											2080
H-3	17	8	68	15	WM-188	874	16											2340
H-3	18	8	68	16	WM-188	900	16											2180
H-3	19	8	68	17	WM-188	859	16											2300
H-3	19	8	68	18	WM-188	868	16											2290
H-3	20	8	68	19	WM-188	856	16											1950
H-3	21	8	68	20	WM-188	1047	16											2380
H-3	21	8	68	21	WM-188	961	16											2320
H-3	22	8	68	22	WM-188	975	16											2280
H-3	23	8	68	23	WM-188	950	16											2060
H-3	24	8	68	24	WM-188	854	16											1880
H-3	24	8	68	25	WM-188	1049	16											2190
H-3	25	8	68	26	WM-188	1053	16											2310
H-3	26	8	68	27	WM-188	1053	16											2020
H-3	27	8	68	28	WM-188	950	16											1620
H-3	27	8	68	29	WM-188	1045	16											2300
H-3	28	8	68	30	WM-188	1044	16											2050
H-3	29	8	68	31	WM-188	1063	16											2080
H-3	30	8	68	32	WM-188	1059	16											1960
H-3	31	8	68	33	WM-188	1042	16											1920
H-3	1	9	68	34	WM-188	1044	16											2020
H-3	2	9	68	35	WM-188	1044	16											1980
H-3	3	9	68	36	WM-188	950	16											2000
H-3	3	9	68	37	WM-188	929	16											1860
H-3	4	9	68	38	WM-188	1044	16											1950
H-3	5	9	68	39	WM-188	1042	16											1710
H-3	6	9	68	40	WM-188	972	16											1650
H-3	6	9	68	41	WM-188	1041	16											1780
H-3	7	9	68	42	WM-188	1054	16											1730
H-3	8	9	68	43	WM-188	1054	16											1800
H-3	8	9	68	44	WM-188	1050	16											1800
H-3	9	9	68	45	WM-188	1036	16											1560
H-3	10	9	68	46	WM-188	1036	16											1850
H-3	11	9	68	47	WM-188	1054	16											1880
H-3	12	9	68	48	WM-188	1055	16											1830
H-3	12	9	68	49	WM-188	1047	16											1870
H-3	13	9	68	50	WM-188	1043	16											1860
H-3	14	9	68	51	WM-188	1049	16											1880
H-3	15	9	68	52	WM-188	1056	16											1930
H-3	15	9	68	53	WM-188	1052	16											1890
H-3	16	9	68	54	WM-188	1049	16											1900
H-3	17	9	68	55	WM-188	939	16											1700
H-3	17	9	68	56	WM-188	1043	16											1880
H-3	18	9	68	57	WM-188	1043	16											1830
H-3	19	9	68	58	WM-188	1008	16											1770
H-3	20	9	68	59	WM-188	1048	16											1840
H-3	20	9	68	60	WM-188	1051	16											1860
H-3	21	9	68	61	WM-188	1045	16											1840
H-3	22	9	68	62	WM-188	1048	16											1880
H-3	23	9	68	63	WM-188	1051	16											1840
H-3	24	9	68	64	WM-188	1052	16											1840
H-3	24	9	68	65	WM-188	1048	16											1590
H-3	25	9	68	66	WM-188	1055	16											1770
H-3	26	9	68	67	WM-188	1037	16											1790
H-3	27	9	68	68	WM-188	1042	16											1770
H-3	27	9	68	69	WM-188	1045	16											1770
H-3	28	9	68	70	WM-188	1038	16											1760
H-3	29	9	68	71	WM-188	1045	16											1770
H-3	29	9	68	72	WM-188	1048	16											1770
H-3	30	9	68	73	WM-188	1041	16											1840
H-3	1	10	68	74	WM-188	1064	16											1900
H-3	2	10	68	75	WM-188	1045	16											1870
H-3	2	10	68	76	WM-188	1045	16											1820
H-3	3	10	68	77	WM-188	1044	16											1810
H-3	4	10	68	78	WM-188	1042	16											1840
H-3	5	10	68	79	WM-188	918	16											1640

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	5	10	68	80	WM-188	904	16											1620
H-3	6	10	68	81	WM-188	765	16											1400
H-3	7	10	68	82	WM-188	997	16											1800
H-3	7	10	68	83	WM-188	948	16											1970
H-3	8	10	68	84	WM-188	1102	16											2160
H-3	9	10	68	85	WM-188	1041	16											1880
H-3	10	10	68	86	WM-188	1043	16											1890
H-3	11	10	68	87	WM-188	1040	16											1610
H-3	11	10	68	88	WM-188	1099	16											1990
H-3	12	10	68	89	WM-188	1056	16											1930
H-3	13	10	68	90	WM-188	1044	16											1910
H-3	13	10	68	91	WM-188	1040	16											1870
H-3	14	10	68	92	WM-188	1056	16											1890
H-3	15	10	68	93	WM-188	1049	16											1910
H-3	15	10	68	94	WM-188	1053	16											1880
H-3	16	10	68	95	WM-188	1054	16											1800
H-3	17	10	68	96	WM-188	1056	16											1770
H-3	17	10	68	97	WM-188	1087	16											1600
H-3	18	10	68	98	WM-188	1041	16											1880
H-3	19	10	68	99	WM-188	1045	16											1910
H-3	20	10	68	100	WM-188	1052	16											1880
H-3	20	10	68	101	WM-188	1045	16											1930
H-3	21	10	68	102	WM-188	1043	16											1830
H-3	22	10	68	103	WM-188	1061	16											1810
H-3	22	10	68	104	WM-188	1035	16											1810
H-3	23	10	68	105	WM-188	1107	16											1930
H-3	24	10	68	106	WM-188	1048	16											1740
H-3	25	10	68	107	WM-188	1055	16											1860
H-3	25	10	68	108	WM-188	1044	16											1840
H-3	26	10	68	109	WM-188	1052	16											1850
H-3	27	10	68	110	WM-188	1044	16											1840
H-3	28	10	68	111	WM-188	1045	16											1840
H-3	28	10	68	112	WM-188	1040	16											1900
H-3	29	10	68	113	WM-188	1052	16											1920
H-3	30	10	68	114	WM-188	1044	16											1910
H-3	31	10	68	115	WM-188	1038	16											1940
H-3	31	10	68	116	WM-188	1028	16											1880
H-3	1	11	68	117	WM-188	1048	16											1880
H-3	2	11	68	118	WM-188	1067	16											1850
H-3	2	11	68	119	WM-188	1047	16											1800
H-3	3	11	68	120	WM-188	1042	16											1790
H-3	4	11	68	121	WM-188	1046	16											1800
H-3	5	11	68	122	WM-188	1056	16											1860
H-3	5	11	68	123	WM-188	1041	16											1810
H-3	6	11	68	124	WM-188	1033	16											1960
H-3	7	11	68	125	WM-188	1085	16											1960
H-3	8	11	68	126	WM-188	1044	16											1900
H-3	8	11	68	127	WM-188	1058	16											1860
H-3	9	11	68	128	WM-188	1047	16											1880
H-3	10	11	68	129	WM-188	1050	16											1590
H-3	11	11	68	130	WM-188	1051	16											1900
H-3	11	11	68	131	WM-188	1055	16											1860
H-3	28	11	68	11	Cold									8775	1.6		24.6	
H-3	28	11	68	DB	Dolomite Bed (approx. 22 cubic feet)							1550	92					
H-3	12	12	68	12	Cold									1000	1.6		2.8	
H-3	13	12	68	132	WM-188	1052	17											2120
H-3	14	12	68	133	WM-188	1055	17											2150
H-3	15	12	68	134	WM-188	1035	17											2160
H-3	15	12	68	135	WM-188	1046	17											1900
H-3	16	12	68	136	WM-188	1121	17											2320
H-3	17	12	68	137	WM-188	1045	17											2060
H-3	18	12	68	138	WM-188	1034	17											2070
H-3	18	12	68	139	WM-188	1042	17											2100
H-3	19	12	68	140	WM-188	1036	17											1950
H-3	20	12	68	141	WM-188	1044	17											1960
H-3	21	12	68	142	WM-188	1038	17											1950
H-3	21	12	68	143	WM-188	1047	17											1970
H-3	22	12	68	144	WM-188	1043	17											2030

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	23	12	68	145	WM-188	1044	17											2100
H-3	24	12	68	146	WM-188	1040	17											2080
H-3	25	12	68	147	WM-188	1059	17											2170
H-3	25	12	68	148	WM-188	1047	17											2100
H-3	26	12	68	149	WM-188	1144	17											2300
H-3	27	12	68	150	WM-188	1142	17											2210
H-3	28	12	68	151	WM-188	1141	17											2630
H-3	28	12	68	152	WM-188	1142	17											2180
H-3	29	12	68	153	WM-188	1055	17											2040
H-3	30	12	68	154	WM-188	983	17											1950
H-3	31	12	68	155	WM-188	1137	17											2270
H-3	31	12	68	156	WM-188	1150	17											2230
H-3	1	1	69	157	WM-188	1053	17											2040
H-3	2	1	69	158	WM-188	1062	17											2060
H-3	3	1	69	159	WM-188	1086	17											2120
H-3	4	1	69	160	WM-188	1042	17											2010
H-3	4	1	69	161	WM-188	1055	17											2140
H-3	5	1	69	162	WM-188	1047	17											2120
H-3	6	1	69	163	WM-188	1061	17											2500
H-3	7	1	69	164	WM-188	1036	17											2120
H-3	7	1	69	165	WM-188	1047	17											2100
H-3	8	1	69	166	WM-188	1027	17											2180
H-3	9	1	69	167	WM-188	1074	17											2100
H-3	10	1	69	168	WM-188	1065	17											2080
H-3	10	1	69	169	WM-188	1032	17											1980
H-3	11	1	69	170	WM-188	1044	17											2010
H-3	12	1	69	171	WM-188	1062	17											1910
H-3	13	1	69	172	WM-188	1087	17											2040
H-3	13	1	69	173	WM-188	1045	17											2170
H-3	14	1	69	174	WM-188	1030	17											2190
H-3	15	1	69	175	WM-188	1089	17											2190
H-3	16	1	69	176	WM-189	903	64											2470
H-3	16	1	69	177	WM-189	901	64											2140
H-3	17	1	69	178	WM-188	960	17											1600
H-3	18	1	69	179	WM-188	1078	17											1690
H-3	19	1	69	180	WM-188	1048	17											1580
H-3	20	1	69	181	WM-188	441	17											1430
H-3	21	1	69	182	WM-188	1052	17											1580
H-3	21	1	69	183	WM-188	1061	17											1580
H-3	22	1	69	184	WM-188	1045	17											1580
H-3	23	1	69	185	WM-188	1045	17											1560
H-3	24	1	69	186	WM-188	1041	17											1580
H-3	24	1	69	187	WM-188	1052	17											1470
H-3	25	1	69	188	WM-188	1045	17											1620
H-3	26	1	69	189	WM-188	1039	17											1600
H-3	26	1	69	190	WM-188	1041	17											1600
H-3	27	1	69	191	WM-188	1045	17											1570
H-3	28	1	69	192	WM-189	1000	64											2220
H-3	29	1	69	193	WM-189	1004	64											2210
H-3	29	1	69	194	WM-189	1003	64											2220
H-3	30	1	69	195	WM-189	1008	64											2230
H-3	31	1	69	196	WM-189	1000	64											2010
H-3	31	1	69	197	WM-189	1020	64											2230
H-3	1	2	69	198	WM-189	998	64											2180
H-3	2	2	69	199	WM-189	1007	64											2230
H-3	3	2	69	200	WM-189	1000	64											2190
H-3	4	2	69	201	WM-189	1000	64											2230
H-3	5	2	69	202	WM-189	998	18											2170
H-3	6	2	69	203	WM-189	1000	18											2170
H-3	7	2	69	204	WM-189	1008	18											2220
H-3	8	2	69	205	WM-189	1000	18											2180
H-3	9	2	69	206	WM-189	1000	18											2180
H-3	10	2	69	207	WM-189	1000	18											2190
H-3	11	2	69	208	WM-189	996	18											2180
H-3	12	2	69	209	WM-189	1007	18											2210
H-3	12	2	69	210	WM-189	1000	18											2190
H-3	13	2	69	211	WM-189	1014	18											2120
H-3	14	2	69	212	WM-189	1015	18											2120

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	15	2	69	213	WM-189	1000	18											2130
H-3	15	2	69	214	WM-189	1027	18											2190
H-3	16	2	69	215	WM-189	1042	18											2280
H-3	17	2	69	216	WM-189	1009	18											2210
H-3	18	2	69	217	WM-189	1002	18											2240
H-3	19	2	69	218	WM-189	1000	18											2180
H-3	20	2	69	219	WM-189	1000	18											2180
H-3	21	2	69	220	WM-189	1000	18											2080
H-3	22	2	69	221	WM-189	850	18											1860
H-3	22	2	69	222	WM-189	1002	18											2120
H-3	23	2	69	223	WM-189	1000	18											2060
H-3	24	2	69	224	WM-189	1000	18											2060
H-3	25	2	69	225	WM-189	1022	18											2080
H-3	26	2	69	226	WM-189	1010	18											2130
H-3	26	2	69	227	WM-189	1001	18											2160
H-3	27	2	69	228	WM-189	1001	18											1990
H-3	28	2	69	229	WM-189	1021	18											2060
H-3	1	3	69	230	WM-189	1000	18											2090
H-3	2	3	69	231	WM-189	1000	18											2120
H-3	3	3	69	232	WM-189	1007	18											2080
H-3	4	3	69	233	WM-189	1028	18											2130
H-3	4	3	69	234	WM-189	1005	18											1970
H-3	5	3	69	235	WM-189	1023	18											2010
H-3	6	3	69	236	WM-189	1014	18											1920
H-3	7	3	69	237	WM-189	1021	18											1930
H-3	8	3	69	238	WM-189	981	18											1840
H-3	9	3	69	239	WM-189	1033	18											1930
H-3	9	3	69	240	WM-189	1007	18											1880
H-3	10	3	69	241	WM-189	1046	18											2010
H-3	11	3	69	242	WM-189	1000	18											1920
H-3	12	3	69	243	WM-189	1084	18											2040
H-3	12	3	69	244	WM-189	1000	18											1890
H-3	13	3	69	245	WM-189	1110	18											2100
H-3	14	3	69	246	WM-189	1034	18											1810
H-3	15	3	69	247	WM-189	1000	18											1840
H-3	16	3	69	248	WM-189	1000	18											1840
H-3	17	3	69	249	WM-189	1003	18											1810
H-3	17	3	69	250	WM-189	1015	18											1850
H-3	18	3	69	251	WM-189	650	18											810
H-3	27	3	69	DB	Dolomite Bed (approx. 83 cubic feet)							5810	92					
H-3	26	3	69	13	Cold									1200	1.6		3.4	
H-3	27	3	69	252	WM-189	1000	20											1820
H-3	28	3	69	253	WM-189	910	20											1620
H-3	29	3	69	254	WM-189	970	20											1710
H-3	30	3	69	255	WM-189	921	20											1550
H-3	30	3	69	256	WM-189	200	20											450
H-3	1	4	69	257	WM-189	310	20											130
H-3	1	4	69	259	WM-185	1421	19										4.2	60
H-3	2	4	69	260	WM-185	1368	19										4.0	60
H-3	2	4	69	261	WM-185	1376	19										4.1	130
H-3	3	4	69	262	WM-185	1140	19										3.4	130
H-3	4	4	69	263	WM-185	1140	19										3.4	130
H-3	5	4	69	264	WM-185	1151	19										3.4	130
H-3	5	4	69	265	WM-185	1145	19										3.4	130
H-3	6	4	69	266	WM-185	1354	19										4.0	130
H-3	7	4	69	267	WM-185	1330	19										3.9	130
H-3	7	4	69	268	WM-185	1330	19										3.9	130
H-3	8	4	69	269	WM-185	1330	19										3.9	130
H-3	9	4	69	270	WM-185	1330	19										3.9	130
H-3	10	4	69	271	WM-185	1311	19										3.9	130
H-3	10	4	69	272	WM-189	1000	20											1620
H-3	11	4	69	273	WM-189	1008	20											1620
H-3	12	4	69	274	WM-189	1000	20											1530
H-3	12	4	69	275	WM-189	1000	20											1540
H-3	13	4	69	276	WM-189	1018	20											1570
H-3	14	4	69	277	WM-189	1000	20											1400
H-3	14	4	69	278	WM-189	996	20											1560
H-3	15	4	69	279	WM-189	1000	20											1490

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	16	4	69	280	WM-189	1002	20											1540
H-3	17	4	69	281	WM-189	1000	20											1470
H-3	17	4	69	282	WM-189	992	20											1480
H-3	18	4	69	283	WM-189	1003	20											1490
H-3	19	4	69	284	WM-189	1017	20											1520
H-3	19	4	69	285	WM-189	1000	20											1380
H-3	20	4	69	286	WM-189	995	20											1410
H-3	21	4	69	287	WM-189	1000	20											1450
H-3	22	4	69	288	WM-189	1040	20											1620
H-3	23	4	69	289	WM-189	1000	20											1490
H-3	23	4	69	290	WM-189	1007	20											1490
H-3	24	4	69	291	WM-189	1007	20											1540
H-3	25	4	69	292	WM-189	987	20											1510
H-3	26	4	69	293	WM-189	1000	20											1530
H-3	26	4	69	294	WM-189	1013	20											1600
H-3	27	4	69	295	WM-189	1005	20											1560
H-3	28	4	69	296	WM-189	1007	20											1570
H-3	29	4	69	297	WM-189	1020	20											1610
H-3	30	4	69	298	WM-189	1049	20											1580
H-3	30	4	69	299	WM-189	1025	20											1540
H-3	1	5	69	300	WM-189	1000	20											1470
H-3	2	5	69	301	WM-189	1007	20											1470
H-3	2	5	69	302	WM-189	1000	20											1560
H-3	3	5	69	303	WM-189	1007	20											1490
H-3	4	5	69	304	WM-189	1000	20											1460
H-3	5	5	69	305	WM-189	1014	20											1460
H-3	5	5	69	306	WM-189	1000	20											1460
H-3	6	5	69	307	WM-189	1002	20											1450
H-3	7	5	69	308	WM-189	1003	20											1450
H-3	8	5	69	309	WM-189	1000	20											1440
H-3	8	5	69	310	WM-189	1005	20											1450
H-3	9	5	69	311	WM-189	1006	20											1460
H-3	10	5	69	312	WM-189	1000	20											1450
H-3	11	5	69	313	WM-189	1000	20											1510
H-3	11	5	69	314	WM-189	1000	20											1510
H-3	12	5	69	315	WM-189	1024	20											1550
H-3	13	5	69	316	WM-189	1017	20											1500
H-3	14	5	69	317	WM-187	950	21											1750
H-3	14	5	69	318	WM-187	950	21											1640
H-3	15	5	69	319	WM-187	972	21											1650
H-3	16	5	69	320	WM-189	1018	20											1650
H-3	16	5	69	321	WM-189	1000	20											1310
H-3	17	5	69	322	WM-189	1019	20											1490
H-3	18	5	69	323	WM-189	1003	20											1470
H-3	19	5	69	324	WM-189	1016	20											1490
H-3	19	5	69	325	WM-189	1000	20											1320
H-3	20	5	69	326	WM-189	1105	20											1620
H-3	21	5	69	327	WM-189	1058	20											1610
H-3	22	5	69	328	WM-189	950	20											1440
H-3	22	5	69	329	WM-189	950	20											1440
H-3	23	5	69	330	WM-189	955	20											1450
H-3	24	5	69	331	WM-189	950	20											1370
H-3	25	5	69	332	WM-189	950	20											1430
H-3	25	5	69	333	WM-189	957	20											1490
H-3	26	5	69	334	WM-189	950	20											1470
H-3	27	5	69	335	WM-189	1047	20											1490
H-3	28	5	69	336	WM-189	959	20											1470
H-3	28	5	69	337	WM-189	955	20											1470
H-3	29	5	69	338	WM-189	950	20											1460
H-3	30	5	69	339	WM-189	950	20											1450
H-3	31	5	69	340	WM-189	1022	20											1550
H-3	31	5	69	341	WM-189	1045	20											1680
H-3	1	6	69	342	WM-189	950	20											1530
H-3	2	6	69	343	WM-189	960	20											1380
H-3	3	6	69	344	WM-189	950	20											1370
H-4	25	5	70		In Beb Combustion Installed													
H-4	25	5	70	DB	Dolomite Bed (approx. 61 cubic feet)						4260	92						
H-4	27	5	70	1	Cold									1000	1.75		2.8	

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	28	5	70	2	Cold									1050	1.75		2.9	
H-4	28	5	70	3	Cold									749	1.75		2.1	
H-4	29	5	70	4	Cold									912	1.75		2.6	
H-4	31	5	70	5	Cold									877	1.75		2.5	
H-4	1	6	70	6	Cold									1029	1.75		2.9	
H-4	1	6	70	7	Cold									1258	1.75		3.5	
H-4	2	6	70	8	Cold									1294	1.75		3.6	
H-4	3	6	70	9	Cold									1457	1.75		4.1	
H-4	3	6	70	10	Cold									1148	1.75		3.2	
H-4	4	6	70	11	Cold									1181	1.75		3.3	
H-4	5	6	70	12	Cold									1240	1.75		3.5	
H-4	5	6	70	13	Cold									1132	1.75		3.2	
H-4	6	6	70	14	Cold									1150	1.75		3.2	
H-4	7	6	70	15	Cold									1121	1.75		3.1	
H-4	8	6	70	16	Cold									1211	1.75		3.4	
H-4	8	6	70	17	Cold									1248	1.75		3.5	
H-4	9	6	70	18	Cold									1182	1.75		3.3	
H-4	10	6	70	19	Cold									876	1.75		2.5	
H-4	11	6	70	20	Cold									1259	1.75		3.5	
H-4	12	6	70	21	Cold									1137	1.75		3.2	
H-4	14	6	70	22	Cold									1151	1.75		3.2	
H-4	15	6	70	23	Cold									1185	1.75		3.3	
H-4	16	6	70	24	Cold									1213	1.75		3.4	
H-4	17	6	70	25	Cold									955	1.75		2.7	
H-4	18	6	70	26	Cold									932	1.75		2.6	
H-4	8	7	70	DB	Dolomite Bed (approx. 61 cubic feet)								4260	92				
H-4	10	7	70	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-4	11	7	70	28	Cold									1102	1.75		3.1	
H-4	12	7	70	29	Cold									1089	1.75		3.1	
H-4	16	7	70	30	Cold									977	1.75		2.7	
H-4	17	7	70	31	Cold									1224	1.75		3.4	
H-4	17	7	70	32	Cold									630	1.75		1.8	
H-4	18	7	70	33	Cold									1448	1.75		4.1	
H-4	19	7	70	34	Cold									1173	1.75		3.3	
H-4	20	7	70	35	Cold									1220	1.75		3.4	
H-4	21	7	70	36	Cold									1196	1.75		3.4	
H-4	22	7	70	37	Cold									806	1.75		2.3	
H-4	23	7	70	38	Cold									1157	1.75		3.2	
H-4	23	7	70	39	Cold									1199	1.75		3.4	
H-4	29	7	70	40	Cold									1201	1.75		3.4	
H-4	30	7	70	41	Cold									1222	1.75		3.4	
H-4	31	7	70	42	Cold									1027	1.75		2.9	
H-4	31	7	70	43	Cold									1234	1.75		3.5	
H-4	1	8	70	44	Cold									1230	1.75		3.5	
H-4	2	8	70	45	Cold									1280	1.75		3.6	
H-4	3	8	70	46	Cold									353	1.75		1.0	
H-4	3	8	70	47	WM-189	1002	22											1990
H-4	4	8	70	48	WM-189	1016	22											1880
H-4	5	8	70	49	WM-189	1000	22											1290
H-4	5	8	70	50	WM-189	1002	22											1290
H-4	6	8	70	51	WM-189	1001	22											1220
H-4	7	8	70	52	WM-189	1000	22											1040
H-4	7	8	70	53	WM-187	950	23											2050
H-4	8	8	70	54	WM-187	950	23											2090
H-4	9	8	70	55	WM-187	941	23											1920
H-4	10	8	70	56	WM-187	950	23											1880
H-4	11	8	70	57	WM-187	950	23											2040
H-4	11	8	70	58	WM-187	950	23											1950
H-4	12	8	70	59	WM-187	951	23											2230
H-4	13	8	70	60	WM-187	965	23											1840
H-4	14	8	70	61	WM-187	995	23											2190
H-4	15	8	70	62	WM-187	995	23											2280
H-4	16	8	70	63	WM-187	978	23											2270
H-4	16	8	70	64	WM-187	975	23											2370
H-4	17	8	70	65	WM-187	979	23											2190
H-4	18	8	70	66	WM-187	980	23											1820
H-4	19	8	70	67	WM-187	957	23											2080
H-4	19	8	70	68	WM-187	965	23											2020

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	20	8	70	69	WM-187	973	23											2020
H-4	21	8	70	70	WM-187	950	23											2140
H-4	21	8	70	71	WM-187	1000	23											2000
H-4	22	8	70	72	WM-187	973	23											1910
H-4	23	8	70	73	WM-187	981	23											2140
H-4	24	8	70	74	WM-187	940	23											2120
H-4	25	8	70	75	WM-187	952	23											2060
H-4	25	8	70	76	WM-187	974	23											2230
H-4	26	8	70	77	WM-187	977	23											1880
H-4	27	8	70	78	WM-187	961	23											1740
H-4	28	8	70	79	WM-187	962	23											1740
H-4	29	8	70	80	WM-187	963	23											2000
H-4	29	8	70	81	WM-187	993	23											1970
H-4	30	8	70	82	WM-187	884	23											1680
H-4	31	8	70	83	WM-187	973	23											2040
H-4	1	9	70	84	WM-187	958	23											1860
H-4	1	9	70	85	WM-187	949	23											1950
H-4	2	9	70	86	WM-187	1018	23											2160
H-4	3	9	70	87	WM-187	977	23											2100
H-4	4	9	70	88	WM-187	946	23											2150
H-4	4	9	70	89	WM-187	966	23											2400
H-4	5	9	70	90	WM-187	958	23											2630
H-4	6	9	70	91	WM-187	955	23											2060
H-4	7	9	70	92	WM-187	976	23											1940
H-4	7	9	70	93	WM-187	977	23											2220
H-4	8	9	70	94	WM-187	950	23											2140
H-4	9	9	70	95	WM-187	966	23											2120
H-4	10	9	70	96	WM-187	976	23											2230
H-4	11	9	70	97	WM-187	976	23											2080
H-4	11	9	70	98	WM-187	967	23											2050
H-4	12	9	70	99	WM-187	978	23											2030
H-4	13	9	70	100	WM-187	950	23											2170
H-4	14	9	70	101	WM-187	963	23											2250
H-4	14	9	70	102	WM-187	963	23											2190
H-4	15	9	70	103	WM-187	1001	23											2260
H-4	16	9	70	104	WM-187	952	23											2130
H-4	16	9	70	105	WM-187	982	23											2100
H-4	17	9	70	106	WM-187	951	23											2160
H-4	18	9	70	107	WM-183	1140	24										3.4	650
H-4	19	9	70	108	WM-183	1065	24										3.1	
H-4	19	9	70	109	WM-183	1188	24										3.5	
H-4	20	9	70	110	WM-183	1109	24										3.3	
H-4	20	9	70	111	WM-183	1189	24										3.5	
H-4	21	9	70	112	WM-183	1186	24										3.5	
H-4	22	9	70	113	WM-187	931	23											
H-4	23	9	70	114	WM-187	952	23											2110
H-4	23	9	70	115	WM-187	977	23											2150
H-4	24	9	70	116	WM-187	961	23											1970
H-4	25	9	70	117	WM-187	971	23											2270
H-4	26	9	70	118	WM-187	952	23											2230
H-4	27	9	70	119	WM-187	980	23											2280
H-4	27	9	70	120	WM-187	956	23											2140
H-4	28	9	70	121	WM-187	979	23											2260
H-4	29	9	70	122	WM-187	949	23											2190
H-4	30	9	70	123	WM-187	961	23											2190
H-4	30	9	70	124	WM-187	963	23											2150
H-4	1	10	70	125	WM-187	874	23											1950
H-4	2	10	70	126	WM-187	948	23											1970
H-4	3	10	70	127	WM-187	992	23											2320
H-4	3	10	70	128	WM-187	941	23											2190
H-4	4	10	70	129	WM-187	990	23											1970
H-4	5	10	70	130	WM-187	932	23											2080
H-4	5	10	70	131	WM-187	954	23											2180
H-4	6	10	70	132	WM-187	960	23											2190
H-4	6	10	70	133	WM-187	952	23											2100
H-4	7	10	70	134	WM-187	950	23											2090
H-4	8	10	70	135	WM-187	988	23											2210
H-4	9	10	70	136	WM-187	974	23											2130

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	9	10	70	137	WM-187	950	23											2080
H-4	10	10	70	138	WM-187	959	23											2100
H-4	10	10	70	139	WM-187	975	23											2230
H-4	11	10	70	140	WM-187	963	23											2140
H-4	11	10	70	141	WM-187	973	23											2180
H-4	12	10	70	142	WM-187	953	23											2150
H-4	13	10	70	143	WM-187	980	23											2210
H-4	13	10	70	144	WM-187	977	23											2130
H-4	14	10	70	145	WM-187	990	23											2090
H-4	15	10	70	146	WM-187	946	23											2060
H-4	15	10	70	147	WM-187	999	23											2000
H-4	16	10	70	148	WM-187	972	23											2290
H-4	17	10	70	149	WM-187	978	23											2120
H-4	17	10	70	150	WM-187	973	23											1860
H-4	18	10	70	151	WM-187	960	23											2100
H-4	18	10	70	152	WM-187	967	23											2100
H-4	19	10	70	153	WM-187	952	23											2000
H-4	19	10	70	154	WM-187	953	23											2040
H-4	20	10	70	155	WM-187	953	23											2110
H-4	21	10	70	156	WM-187	924	23											2010
H-4	21	10	70	157	WM-187	970	23											2020
H-4	22	10	70	158	WM-187	968	23											2120
H-4	22	10	70	159	WM-187	1010	23											2130
H-4	23	10	70	160	WM-187	953	23											1980
H-4	24	10	70	161	WM-187	975	23											2090
H-4	24	10	70	162	WM-187	962	23											2060
H-4	25	10	70	163	WM-187	1130	23											2360
H-4	26	10	70	164	WM-187	961	23											1820
H-4	26	10	70	165	WM-187	943	23											2120
H-4	27	10	70	166	WM-187	956	23											2010
H-4	27	10	70	167	WM-187	981	23											2060
H-4	28	10	70	168	WM-187	959	23											2040
H-4	28	10	70	169	WM-187	978	23											1880
H-4	29	10	70	170	WM-187	960	23											1970
H-4	30	10	70	171	WM-187	1007	23											2080
H-4	30	10	70	172	WM-187	958	23											2120
H-4	31	10	70	173	WM-187	970	23											2170
H-4	31	10	70	174	WM-187	946	23											2120
H-4	1	11	70	175	WM-187	977	23											2160
H-4	2	11	70	176	WM-187	961	23											2120
H-4	2	11	70	177	WM-187	952	23											2020
H-4	3	11	70	178	WM-187	963	23											2020
H-4	3	11	70	179	WM-187	948	23											1990
H-4	4	11	70	180	WM-187	955	23											2050
H-4	4	11	70	181	WM-187	974	23											2060
H-4	5	11	70	182	WM-187	929	23											1940
H-4	6	11	70	183	WM-187	977	23											2080
H-4	6	11	70	184	WM-187	951	23											1990
H-4	7	11	70	185	WM-187	966	23											2020
H-4	7	11	70	186	WM-187	975	23											2040
H-4	8	11	70	187	WM-187	966	23											2020
H-4	8	11	70	188	WM-187	963	23											2030
H-4	9	11	70	189	WM-187	962	23											2080
H-4	10	11	70	190	WM-187	952	23											1950
H-4	10	11	70	191	WM-187	968	23											2060
H-4	11	11	70	192	WM-187	954	23											2070
H-4	11	11	70	193	WM-187	970	23											1910
H-4	12	11	70	194	WM-187	957	23											2060
H-4	13	11	70	195	WM-187	951	23											2040
H-4	13	11	70	196	WM-187	960	23											2060
H-4	14	11	70	197	WM-187	954	23											1940
H-4	14	11	70	198	WM-187	954	23											2060
H-4	15	11	70	199	WM-187	970	23											1940
H-4	16	11	70	200	WM-187	960	23											2080
H-4	16	11	70	201	WM-187	970	23											1970
H-4	17	11	70	202	WM-187	951	23											2060
H-4	17	11	70	203	WM-187	974	23											2060
H-4	18	11	70	204	WM-187	970	23											1760

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream										Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	18	11	70	205	WM-187	974	23											2000
H-4	19	11	70	206	WM-187	970	23											1700
H-4	20	11	70	207	WM-187	954	23											1860
H-4	20	11	70	208	WM-187	970	23											2020
H-4	21	11	70	209	WM-187	948	23											1990
H-4	21	11	70	210	WM-187	960	23											2140
H-4	22	11	70	211	WM-187	974	23											2140
H-4	22	11	70	212	WM-187	960	23											2110
H-4	23	11	70	213	WM-187	973	23											2090
H-4	23	11	70	214	WM-187	947	23											1970
H-4	24	11	70	215	WM-187	980	23											2080
H-4	24	11	70	216	WM-187	957	23											2040
H-4	25	11	70	217	WM-187	960	23											2010
H-4	25	11	70	218	WM-187	946	23											2060
H-4	26	11	70	219	WM-187	948	23											2080
H-4	27	11	70	220	WM-187	954	23											2020
H-4	27	11	70	221	WM-187	960	23											2100
H-4	28	11	70	222	WM-187	971	23											2120
H-4	28	11	70	223	WM-187	975	23											1910
H-4	29	11	70	224	WM-187	950	23											1990
H-4	30	11	70	225	WM-187	971	23											2040
H-4	30	11	70	226	WM-187	951	23											1950
H-4	1	12	70	227	WM-187	970	23											2410
H-4	1	12	70	228	WM-187	948	23											2020
H-4	2	12	70	229	WM-187	951	23											2020
H-4	3	12	70	230	WM-187	951	23											2040
H-4	3	12	70	231	WM-187	948	23											2040
H-4	4	12	70	232	WM-187	947	23											2110
H-4	5	12	70	233	WM-187	970	23											2150
H-4	5	12	70	234	WM-187	838	23											1780
H-4	6	12	70	235	WM-187	874	23											1760
H-4	7	12	70	236	WM-187	971	23											2070
H-4	7	12	70	237	WM-187	968	23											2020
H-4	8	12	70	238	WM-187	979	23											2060
H-4	8	12	70	239	WM-187	970	23											1950
H-4	9	12	70	240	WM-187	956	23											2010
H-4	10	12	70	241	WM-187	951	23											2040
H-4	10	12	70	242	WM-187	967	23											1800
H-4	11	12	70	243	WM-187	951	23											2090
H-4	12	12	70	244	WM-187	952	23											2090
H-4	12	12	70	245	WM-187	970	23											2070
H-4	13	12	70	246	WM-187	941	23											2100
H-4	14	12	70	247	WM-187	970	23											2110
H-4	14	12	70	248	WM-187	970	23											2120
H-4	15	12	70	249	WM-187	947	23											2020
H-4	16	12	70	250	WM-187	950	23											2000
H-4	16	12	70	251	WM-187	970	23											2040
H-4	17	12	70	252	WM-187	955	23											1990
H-4	17	12	70	253	WM-187	948	23											2040
H-4	18	12	70	254	WM-187	971	23											2040
H-4	19	12	70	255	WM-187	946	23											1900
H-4	19	12	70	256	WM-187	948	23											1980
H-4	20	12	70	257	WM-187	965	23											2030
H-4	20	12	70	258	WM-187	950	23											2000
H-4	21	12	70	259	WM-187	950	23											2050
H-4	22	12	70	260	WM-187	950	23											2110
H-4	22	12	70	261	WM-187	973	23											2140
H-4	23	12	70	262	WM-187	992	23											2230
H-4	23	12	70	263	WM-187	955	23											2150
H-4	24	12	70	264	WM-187	981	23											2100
H-4	25	12	70	265	WM-187	995	23											2140
H-4	25	12	70	266	WM-187	960	23											2060
H-4	25	12	70	267	WM-187	971	23											2160
H-4	26	12	70	268	WM-187	963	23											2140
H-4	27	12	70	269	WM-187	952	23											1910
H-4	28	12	70	270	WM-187	940	23											2140
H-4	28	12	70	271	WM-187	948	23											1890
H-4	29	12	70	272	WM-187	970	23											2020

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

				Feed Stream										Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	29	12	70	273	WM-187	983	23											2140
H-4	30	12	70	274	WM-187	951	23											2070
H-4	31	12	70	275	WM-187	948	23											2060
H-4	31	12	70	276	WM-187	952	23											2150
H-4	1	1	71	277	WM-187	934	23											2030
H-4	1	1	71	278	WM-187	952	23											1850
H-4	2	1	71	279	WM-187	961	23											1900
H-4	2	1	71	280	WM-187	972	23											2140
H-4	3	1	71	281	WM-187	986	23											2210
H-4	4	1	71	282	WM-187	1010	23											2270
H-4	4	1	71	283	WM-187	962	23											2140
H-5	8	9	71	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-5	8	9	71	1	Cold									1205	1.62		2.8	
H-5	14	9	71	2	Cold									1205	1.62		2.8	
H-5	15	9	71	3	Cold									415	1.62		1.0	
H-5	15	9	71	4	Cold									1089	1.7		2.6	
H-5	16	9	71	5	Cold									957	1.7		2.3	
H-5	17	9	71	6	Cold									790	1.77		1.9	
H-5	18	9	71	7	Cold									959	1.77		2.3	
H-5	19	9	71	8	Cold									1056	1.77		2.5	
H-5	19	9	71	9	Cold									1050	1.76		2.5	
H-5	20	9	71	10	Cold									1090	1.76		48.4	
H-5	21	9	71	11	Cold									708	1.76		31.5	
H-5	21	9	71	12	Cold									630	1.76		28.0	
H-5	23	9	71	13	Cold									868	1.5		25.2	
H-5	23	9	71	1	WM-189	733	25											2350
H-5	24	9	71	2	WM-189	895	25											3220
H-5	24	9	71	3	WM-189	918	25											2630
H-5	25	9	71	4	WM-189	970	25											3080
H-5	26	9	71	5	WM-189	932	25											2750
H-5	27	9	71	6	WM-189	960	25											3130
H-5	27	9	71	7	WM-189	918	25											2830
H-5	28	9	71	8	WM-189	900	25											2760
H-5	29	9	71	9	WM-189	935	25											2800
H-5	30	9	71	10	WM-189	956	25											3010
H-5	1	10	71	11	WM-189	901	25											2820
H-5	1	10	71	12	WM-189	914	25											2860
H-5	2	10	71	13	WM-189	926	25											2970
H-5	3	10	71	14	WM-189	952	25											2880
H-5	3	10	71	15	WM-189	971	25											3130
H-5	4	10	71	16	WM-189	900	25											2660
H-5	4	10	71	17	WM-189	926	25											2660
H-5	5	10	71	18	WM-189	948	25											2550
H-5	6	10	71	19	WM-189	933	25											2740
H-5	6	10	71	20	WM-189	929	25											3080
H-5	7	10	71	21	WM-189	930	25											2880
H-5	7	10	71	22	WM-189	947	25											2980
H-5	8	10	71	23	WM-189	917	25											2950
H-5	8	10	71	24	WM-189	904	25											2840
H-5	9	10	71	25	WM-189	921	25											2790
H-5	9	10	71	26	WM-189	915	25											3030
H-5	10	10	71	27	WM-189	925	25											2870
H-5	10	10	71	28	WM-189	908	25											2940
H-5	11	10	71	29	WM-189	952	25											3030
H-5	11	10	71	30	WM-189	901	25											2910
H-5	12	10	71	31	WM-189	916	25											2660
H-5	12	10	71	32	WM-189	903	25											2740
H-5	13	10	71	33	WM-189	921	25											2740
H-5	14	10	71	34	WM-189	922	25											2520
H-5	14	10	71	35	WM-189	901	25											2870
H-5	15	10	71	36	WM-189	926	25											2970
H-5	15	10	71	37	WM-189	926	25											3030
H-5	16	10	71	38	WM-189	918	25											2610
H-5	16	10	71	39	WM-189	903	25											2950
H-5	17	10	71	40	WM-189	900	25											2780
H-5	17	10	71	41	WM-189	901	25											2710
H-5	18	10	71	42	WM-189	900	25											2880
H-5	18	10	71	43	WM-189	926	25											2950

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-5	18	10	71	44	WM-189	900	25											2950
H-5	19	10	71	45	WM-189	904	25											2950
H-5	19	10	71	46	WM-189	900	25											2930
H-5	20	10	71	47	WM-189	903	25											2910
H-5	20	10	71	48	WM-189	901	25											2830
H-5	21	10	71	49	WM-189	904	25											2760
H-5	21	10	71	50	WM-189	902	25											2750
H-5	22	10	71	51	WM-189	904	25											2800
H-5	22	10	71	52	WM-189	795	25											2530
H-5	23	10	71	53	WM-189	900	25											2840
H-5	23	10	71	54	WM-189	907	25											2860
H-5	23	10	71	55	WM-189	904	25											3020
H-5	24	10	71	56	WM-189	903	25											3080
H-5	24	10	71	57	WM-189	906	25											2990
H-5	24	10	71	58	WM-189	900	25											2840
H-5	25	10	71	59	WM-189	904	25											2920
H-5	25	10	71	60	WM-189	901	25											3100
H-5	26	10	71	61	WM-189	862	25											2790
H-5	26	10	71	62	WM-189	900	25											2930
H-5	27	10	71	63	WM-189	906	25											2980
H-5	27	10	71	64	WM-189	901	25											2880
H-5	28	10	71	65	WM-189	903	25											2500
H-5	28	10	71	66	WM-189	902	25											2870
H-5	29	10	71	67	WM-189	900	25											2820
H-5	29	10	71	68	WM-189	885	25											2860
H-5	29	10	71	69	WM-189	902	25											2870
H-5	30	10	71	70	WM-189	902	25											2950
H-5	30	10	71	71	WM-189	900	25											2180
H-5	31	10	71	72	WM-189	900	25											2660
H-5	31	10	71	73	WM-189	900	25											2840
H-5	1	11	71	74	WM-189	900	25											3020
H-5	1	11	71	75	WM-189	900	25											2880
H-5	2	11	71	76	WM-189	906	25											2990
H-5	2	11	71	77	WM-189	901	25											2640
H-5	2	11	71	78	WM-189	797	25											2510
H-5	3	11	71	79	WM-189	900	25											2800
H-5	3	11	71	80	WM-189	898	25											2800
H-5	4	11	71	81	WM-189	904	25											2740
H-5	4	11	71	82	WM-189	900	25											3150
H-5	5	11	71	83	WM-189	1098	25											3660
H-5	5	11	71	84	WM-189	900	25											2880
H-5	6	11	71	85	WM-189	902	25											2820
H-5	6	11	71	86	WM-189	903	25											3010
H-5	7	11	71	87	WM-189	900	25											2920
H-5	7	11	71	88	WM-189	940	25											3000
H-5	8	11	71	89	WM-189	902	25											2900
H-5	8	11	71	90	WM-189	900	25											2890
H-5	9	11	71	91	WM-189	900	25											2690
H-5	9	11	71	92	WM-189	874	25											2590
H-5	10	11	71	93	WM-189	902	25											2810
H-5	10	11	71	94	WM-189	904	25											2830
H-5	10	11	71	95	WM-189	910	25											2790
H-5	11	11	71	96	WM-189	908	25											3190
H-5	11	11	71	97	WM-189	900	25											2590
H-5	12	11	71	98	WM-189	908	25											2970
H-5	12	11	71	99	WM-189	904	25											2810
H-5	13	11	71	100	WM-189	900	25											2820
H-5	13	11	71	101	WM-189	900	25											3080
H-5	14	11	71	102	WM-189	900	25											2890
H-5	14	11	71	103	WM-189	900	25											2730
H-5	15	11	71	104	WM-189	900	25											2710
H-5	15	11	71	105	WM-189	900	25											2580
H-5	15	11	71	106	WM-189	900	25											2790
H-5	16	11	71	107	WM-189	900	25											2590
H-5	16	11	71	108	WM-189	900	25											2680
H-5	17	11	71	109	WM-189	903	25											2830
H-5	17	11	71	110	WM-189	900	25											2620
H-5	18	11	71	111	WM-189	900	25											3000

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-5	18	11	71	112	WM-189	900	25											2710
H-5	19	11	71	113	WM-189	900	25											3120
H-5	19	11	71	114	WM-189	900	25											2790
H-5	19	11	71	115	WM-189	903	25											2950
H-5	20	11	71	116	WM-189	904	25											3000
H-5	20	11	71	117	WM-189	901	25											2950
H-5	21	11	71	118	WM-189	900	25											2750
H-5	21	11	71	119	WM-189	900	25											2970
H-5	22	11	71	120	WM-189	900	25											2520
H-5	22	11	71	121	WM-189	900	25											3230
H-5	23	11	71	122	WM-189	900	25											2790
H-5	23	11	71	123	WM-189	905	25											2900
H-5	23	11	71	124	WM-189	900	25											2450
H-5	24	11	71	125	WM-189	906	25											2920
H-5	24	11	71	126	WM-189	900	25											2910
H-5	25	11	71	127	WM-189	900	25											2870
H-5	25	11	71	128	WM-189	903	25											2840
H-5	26	11	71	129	WM-189	900	25											2850
H-5	26	11	71	130	WM-189	904	25											2970
H-5	27	11	71	131	WM-189	907	25											2920
H-5	27	11	71	132	WM-189	900	25											2790
H-5	27	11	71	133	WM-189	903	25											2920
H-5	28	11	71	134	WM-189	900	25											2920
H-5	28	11	71	135	WM-189	901	25											2850
H-5	29	11	71	136	WM-189	900	25											2880
H-5	29	11	71	137	WM-189	903	25											2840
H-5	30	11	71	138	WM-189	900	25											2870
H-5	30	11	71	139	WM-189	901	25											2820
H-5	1	12	71	140	WM-189	900	25											2770
H-5	1	12	71	141	WM-189	900	25											2900
H-5	1	12	71	142	WM-189	900	25											2890
H-5	2	12	71	143	WM-189	900	25											2830
H-5	2	12	71	144	WM-189	904	25											2770
H-5	3	12	71	145	WM-189	900	25											2800
H-5	3	12	71	146	WM-189	900	25											2800
H-5	4	12	71	147	WM-189	900	25											2870
H-5	4	12	71	148	WM-189	900	25											2910
H-5	5	12	71	149	WM-189	901	25											2900
H-5	5	12	71	150	WM-189	900	25											2810
H-5	6	12	71	151	WM-189	900	25											3000
H-5	6	12	71	152	WM-189	902	25											2650
H-5	6	12	71	153	WM-189	900	25											3100
H-5	7	12	71	154	WM-189	901	25											2810
H-5	7	12	71	155	WM-189	900	25											2960
H-5	8	12	71	156	WM-189	902	25											2920
H-5	8	12	71	157	WM-189	900	25											2920
H-5	9	12	71	158	WM-189	900	25											2920
H-5	9	12	71	159	WM-189	900	25											2900
H-5	10	12	71	160	WM-189	897	25											2910
H-5	10	12	71	161	WM-189	900	25											2710
H-5	11	12	71	162	WM-189	901	25											2940
H-5	11	12	71	163	WM-189	900	25											2630
H-5	12	12	71	164	WM-189	900	25											2750
H-5	12	12	71	165	WM-189	900	25											2790
H-5	12	12	71	166	WM-189	900	25											2790
H-5	13	12	71	167	WM-189	900	25											2970
H-5	13	12	71	168	WM-189	900	25											2830
H-5	14	12	71	169	WM-189	900	25											3250
H-5	14	12	71	170	WM-189	900	25											2950
H-5	15	12	71	171	WM-189	903	25											2870
H-5	15	12	71	172	WM-189	900	25											2730
H-5	16	12	71	173	WM-189	900	25											2790
H-5	16	12	71	174	WM-189	900	25											2850
H-5	17	12	71	175	WM-189	900	25											2700
H-5	17	12	71	176	WM-189	900	25											2740
H-5	18	12	71	177	WM-189	900	25											2800
H-5	18	12	71	178	WM-189	900	25											2820
H-5	19	12	71	179	WM-189	900	25											2850

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-5	19	12	71	180	WM-189	901	25											2820
H-5	19	12	71	181	WM-189	901	25											2710
H-5	20	12	71	182	WM-189	904	25											2770
H-5	20	12	71	183	WM-189	903	25											2950
H-5	21	12	71	184	WM-189	900	25											2900
H-5	21	12	71	185	WM-189	903	25											2950
H-5	22	12	71	186	WM-189	900	25											2890
H-5	22	12	71	187	WM-189	900	25											3030
H-5	23	12	71	188	WM-189	900	25											2880
H-5	23	12	71	189	WM-189	900	25											2820
H-5	24	12	71	190	WM-189	900	25											2800
H-5	24	12	71	191	WM-189	900	25											2760
H-5	24	12	71	192	WM-189	900	25											2720
H-5	25	12	71	193	WM-189	910	25											2870
H-5	25	12	71	194	WM-189	902	25											2860
H-5	26	12	71	195	WM-189	900	25											2760
H-5	26	12	71	196	WM-189	900	25											2660
H-5	27	12	71	197	WM-189	901	25											2940
H-5	27	12	71	198	WM-189	900	25											2550
H-5	28	12	71	199	WM-189	900	25											2470
H-5	28	12	71	200	WM-189	901	25											2350
H-5	29	12	71	201	WM-189	903	25											2810
H-5	29	12	71	202	WM-189	903	25											2840
H-5	30	12	71	203	WM-189	900	25											2770
H-5	30	12	71	204	WM-189	900	25											2840
H-5	31	12	71	205	WM-189	900	25											2840
H-5	31	12	71	206	WM-189	900	25											2810
H-5	1	1	72	207	WM-189	900	25											2840
H-5	1	1	72	208	WM-189	900	25											2860
H-5	1	1	72	209	WM-189	900	25											2220
H-5	2	1	72	210	WM-189	900	25											2650
H-5	2	1	72	211	WM-189	900	25											2220
H-5	3	1	72	212	WM-189	900	25											2920
H-5	3	1	72	213	WM-189	900	25											2780
H-5	22	1	72	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-5	22	1	72	14	Cold									1058	2		3.0	
H-5	23	1	72	214	WM-189	900	25											2680
H-5	24	1	72	215	WM-189	920	25											2920
H-5	25	1	72	216	WM-189	562	25											1720
H-5	25	1	72	217	WM-189	894	25											2990
H-5	25	1	72	218	WM-189	900	25											2590
H-5	26	1	72	15	Cold									806	2		2.3	
H-5	28	1	72	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-5	28	1	72	16	Cold									780	2		2.2	
H-5	28	1	72	219	WM-183	1080	26										5.3	
H-5	29	1	72	220	WM-183	1080	26										5.3	
H-5	29	1	72	221	WM-189	900	25											3320
H-5	30	1	72	222	WM-189	901	25											3060
H-5	31	1	72	223	WM-189	904	25											2430
H-5	31	1	72	224	WM-189	902	25											2920
H-5	1	2	72	225	WM-189	905	25											2640
H-5	2	2	72	226	WM-189	900	25											3110
H-5	2	2	72	227	WM-189	896	25											2700
H-5	3	2	72	228	WM-189	896	25											3340
H-5	3	2	72	229	WM-189	900	25											2460
H-5	4	2	72	230	WM-189	900	25											3000
H-5	5	2	72	231	WM-189	604	25											2140
H-5	5	2	72	232	WM-189	951	25											3300
H-5	6	2	72	233	WM-189	849	25											2790
H-5	6	2	72	234	WM-189	896	25											3040
H-5	7	2	72	235	WM-189	900	25											2910
H-5	7	2	72	236	WM-189	900	25											2360
H-5	8	2	72	237	WM-189	904	25											2820
H-5	9	2	72	238	WM-189	900	25											2590
H-5	9	2	72	239	WM-189	900	25											2820
H-5	10	2	72	240	WM-189	900	25											2390
H-5	10	2	72	241	WM-189	900	25											2910
H-5	11	2	72	242	WM-189	900	25											2970

Table A2. Calcined material to Calcined Solids Storage Facility II (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-5	12	2	72	243	WM-189	703	25											2770
H-5	12	2	72	244	WM-189	900	25											2720
H-5	13	2	72	245	WM-189	900	25											2400
H-5	14	2	72	246	WM-189	900	25											2870
H-5	15	2	72	247	WM-189	917	25											2590
H-5	15	2	72	248	WM-189	903	25											2720
H-5	16	2	72	249	WM-189	900	25											2940

Table A3. Calcined material to Calcined Solids Storage Facility III.

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	m	yr	No.	Tank	gal	Stream ¹	Tank	gal	Stream ¹	Tank	gal	Stream ¹	gal	M	M	kg	lb
H-5	16	2	72	250	WM-189	900	25											2560
H-5	17	2	72	251	WM-189	900	25											2600
H-5	17	2	72	252	WM-189	900	25											2740
H-5	17	2	72	253	WM-189	900	25											2600
H-5	18	2	72	254	WM-189	900	25											2790
H-5	19	2	72	255	WM-189	900	25											2890
H-5	19	2	72	256	WM-189	906	25											2660
H-5	20	2	72	257	WM-189	900	25											2540
H-5	20	2	72	258	WM-189	891	25											2430
H-5	21	2	72	259	WM-189	900	25											2540
H-5	21	2	72	260	WM-189	900	25											2640
H-5	22	2	72	261	WM-189	900	25											2570
H-5	22	3	72	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-5	22	3	72	262	Cold									1248	1.44		3.6	
H-5	23	3	72	263	Cold									1519	1.44		4.4	
H-5	23	3	72	264	Cold									992	1.44		2.8	
H-5	24	3	72	265	Cold									1000	1.43		24.8	
H-5	25	3	72	266	Cold									1154	1.43		28.6	
H-5	25	3	72	267	Cold									790	1.43		19.6	
H-5	26	3	72	268	Cold									795	1.62		4.6	
H-5	26	3	72	269	Cold									1005	1.62		5.9	
H-5	27	3	72	270	Cold									1221	1.57		3.5	
H-5	28	3	72	271	Cold									355	1.57		1.0	
H-5	28	3	72	272	Cold									1033	1.58		39.6	
H-5	28	3	72	273	WM-183	941	27										4.8	
H-5	28	3	72	274	Cold									886	1.58		34.0	
H-5	29	3	72	275	WM-183	952	27										4.8	
H-5	29	3	72	276	WM-183	1031	27										5.2	
H-5	29	3	72	277	WM-183	1022	27										5.2	
H-5	30	3	72	278	WM-183	983	27										5.0	
H-5	30	3	72	279	WM-183	1044	27										5.3	
H-5	31	3	72	280	WM-183	943	27										4.8	
H-5	31	3	72	281	WM-183	1036	27										5.2	
H-5	1	4	72	282	WM-183	1109	27										5.6	
H-5	1	4	72	283	WM-183	1060	27										5.4	
H-5	2	4	72	284	WM-183	1017	27										5.1	
H-5	2	4	72	285	WM-183	1033	27										5.2	
H-5	3	4	72	286	WM-183	968	27										4.9	
H-5	3	4	72	287	WM-183	1019	27										5.2	
H-5	4	4	72	288	WM-183	1102	27										5.6	
H-5	4	4	72	289	WM-183	1052	27										5.3	
H-5	5	4	72	290	WM-183	1115	27										5.6	
H-5	10	4	72	291	WM-183	1021	27										5.2	
H-5	10	4	72	292	WM-183	1076	27										5.4	
H-5	11	4	72	293	WM-183	1047	27										5.3	
H-5	12	4	72	294	WM-183	1053	27										5.3	
H-5	13	4	72	295	WM-183	967	27										4.9	
H-5	14	4	72	296	WM-183	1048	27										5.3	
H-5	14	4	72	297	WM-183	1049	27										5.3	
H-5	15	4	72	298	WM-183	1031	27										5.2	
H-5	16	4	72	299	WM-183	1036	27										5.2	
H-5	17	4	72	300	WM-183	1109	27										5.6	
H-5	17	4	72	301	WM-183	1051	27										5.3	
H-5	18	4	72	302	WM-183	990	27										5.0	
H-5	19	4	72	303	WM-183	1030	27										5.2	
H-5	19	4	72	304	WM-183	1022	27										5.2	
H-5	20	4	72	305	WM-183	1059	27										5.4	
H-5	21	4	72	306	WM-183	1032	27										5.2	
H-5	21	4	72	307	WM-183	1039	27										5.3	
H-5	22	4	72	308	WM-183	1029	27										5.2	
H-5	22	4	72	309	WM-183	1037	27										5.2	
H-5	23	4	72	310	WM-183	1059	27										5.4	
H-5	24	4	72	311	WM-183	1178	27										6.0	
H-5	24	4	72	312	WM-183	1032	27										5.2	
H-5	25	4	72	313	WM-183	1160	27										5.9	
H-5	26	4	72	314	WM-183	1055	27										5.3	
H-5	26	4	72	315	WM-183	1169	27										5.9	

¹ "Stream" refers to the liquid waste stream number in Tables A8 and A10

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-5	27	4	72	316	WM-183	1021	27										5.2	
H-5	28	4	72	317	WM-183	1134	27										5.7	
H-5	28	4	72	318	WM-183	1045	27										5.3	
H-5	29	4	72	319	WM-183	1038	27										5.2	
H-5	29	4	72	320	WM-183	1026	27										5.2	
H-5	30	4	72	321	WM-183	1030	27										5.2	
H-5	1	5	72	322	WM-183	1031	27										5.2	
H-5	1	5	72	323	WM-183	1026	27										5.2	
H-5	2	5	72	324	WM-183	1090	27										5.5	
H-5	3	5	72	325	WM-106	950	28							192	1.8		5.3	
H-5	3	5	72	326	WM-106	950	28							208	1.8		2.7	
H-5	4	5	72	327	WM-106	929	28							318	1.8		5.3	
H-5	5	5	72	328	WM-106	951	28							319	1.8		4.2	
H-5	5	5	72	CF	Cold									1090	1.8		5.3	
H-5	11	5	72	329	WM-106	833	28							316	1.8		5.8	
H-6	9	5	73	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-6	9	5	73	1	Cold									1440	1.8		9.1	
H-6	12	5	73	DB	Dolomite Bed (approx. 33 cubic feet)							2323	92					
H-6	13	5	73	2	Cold									1324	1.8		9.1	
H-6	14	5	73	3	Cold									1018	1.8		9.1	
H-6	14	5	73	4	Cold									1139	1.8		9.1	
H-6	15	5	73	5	Cold									996	1.8		9.1	
H-6	15	5	73	6	Cold									1192	1.8		9.1	
H-6	18	5	73	7	Cold									1032	1.8		9.1	
H-6	18	5	73	8	Cold									660	1.8		9.1	
H-6	19	5	73	9	Cold									1409	1.8		9.1	
H-6	19	5	73	10	Cold									1268	1.8		9.1	
H-6	20	5	73	11	Cold									1443	1.8		9.1	
H-6	20	5	73	12	Cold									1414	1.8		9.1	
H-6	21	5	73	13	Cold									1388	1.8		9.1	
H-6	22	5	73	14	Cold									1396	1.8		9.1	
H-6	23	5	73	15	Cold									1419	1.8		9.1	
H-6	23	5	73	16	Cold									1158	1.8		9.1	
H-6	24	5	73	17	Cold									806	1.8		9.1	
H-6	25	5	73	18	Cold									941	1.8		9.1	
H-6	25	5	73	1	WM-189	1011	29											1490
H-6	26	5	73	2	WM-189	1004	29											1500
H-6	26	5	73	3	WM-189	1000	29											1390
H-6	27	5	73	4	WM-189	991	29											1040
H-6	28	5	73	5	WM-189	996	29											1540
H-6	28	5	73	6	WM-189	1000	29											2100
H-6	28	5	73	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-6	29	5	73	7	WM-189	1000	29											2130
H-6	29	5	73	8	WM-189	1000	29											1600
H-6	30	5	73	9	WM-189	1000	29											1640
H-6	30	5	73	10	WM-188	992	30											3000
H-6	31	5	73	11	WM-188	956	30											2740
H-6	1	6	73	12	WM-188	998	30											3620
H-6	2	6	73	13	WM-188	855	30											2930
H-6	2	6	73	14	WM-188	864	30											3230
H-6	3	6	73	15	WM-188	861	30											2350
H-6	5	6	73	19	Cold									3648	1.8		36.4	
H-6	6	6	73	16	WM-188	970	30											3140
H-6	6	6	73	17	WM-188	935	30											2690
H-6	7	6	73	18	WM-188	948	30											3790
H-6	7	6	73	19	WM-188	855	30											2920
H-6	8	6	73	20	WM-188	946	30											3520
H-6	9	6	73	21	WM-188	950	30											3020
H-6	9	6	73	22	WM-188	863	30											2690
H-6	10	6	73	23	WM-188	859	30											2570
H-6	10	6	73	24	WM-188	855	30											2950
H-6	11	6	73	25	WM-188	858	30											2550
H-6	11	6	73	26	WM-188	855	30											2740
H-6	12	6	73	27	WM-188	858	30											2550
H-6	12	6	73	28	WM-188	862	30											2630
H-6	13	6	73	29	WM-188	874	30											2800
H-6	13	6	73	30	WM-188	867	30											3280
H-6	13	6	73	31	WM-188	869	30											3150

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	14	6	73	32	WM-188	1000	30											4000
H-6	14	6	73	33	WM-188	869	30											3340
H-6	15	6	73	34	WM-188	873	30											3540
H-6	15	6	73	35	WM-188	855	30											3300
H-6	16	6	73	36	WM-188	855	30											3300
H-6	17	6	73	37	WM-188	855	30											3300
H-6	17	6	73	38	WM-188	859	30											2720
H-6	18	6	73	39	WM-188	858	30											2550
H-6	19	6	73	40	WM-188	855	30											2810
H-6	19	6	73	41	WM-188	857	30											2630
H-6	20	6	73	42	WM-188	855	30											3040
H-6	20	6	73	43	WM-188	855	30											2630
H-6	21	6	73	44	WM-188	664	30											2290
H-6	21	6	73	45	WM-188	855	30											2660
H-6	22	6	73	46	WM-188	665	30											2120
H-6	23	6	73	47	WM-188	763	30											1750
H-6	24	6	73	48	WM-188	701	30											2150
H-6	15	7	73	DB	Dolomite Bed (approx. 61 cubic feet)								4260	92				
H-6	15	7	73	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-6	16	7	73	20	Cold									1496	1.8		8.6	
H-6	17	7	73	21	Cold									1006	1.8		8.6	
H-6	17	7	73	22	Cold									744	1.8		8.6	
H-6	18	7	73	23	Cold									981	1.8		8.6	
H-6	19	7	73	24	Cold									994	1.8		8.6	
H-6	19	7	73	25	Cold									776	1.8		8.6	
H-6	20	7	73	48	WM-183	1282	31										9.1	
H-6	20	7	73	49	WM-183	1392	31										9.1	
H-6	21	7	73	50	WM-183	1282	31										9.1	
H-6	22	7	73	51	WM-183	1398	31										9.1	
H-6	22	7	73	52	WM-183	1358	31										9.1	
H-6	23	7	73	53	WM-183	1440	31										9.1	
H-6	24	7	73	54	WM-183	1262	31										9.1	
H-6	24	7	73	55	WM-183	1704	31										9.1	
H-6	25	7	73	56	WM-183	1392	31										9.1	
H-6	25	7	73	57	WM-183	1428	31										9.1	
H-6	26	7	73	58	WM-183	1388	31										9.1	
H-6	26	7	73	59	WM-183	1522	31										9.1	
H-6	27	7	73	60	WM-183	1560	31										9.1	
H-6	27	7	73	61	WM-183	1485	31										9.1	
H-6	27	7	73	62	WC-114	1702	31										9.1	
H-6	28	7	73	63	WM-183	1467	31										9.1	
H-6	29	7	73	64	WC-114	1530	31										9.1	
H-6	29	7	73	65	WM-183	1501	31										9.1	
H-6	29	7	73	66	WM-183	1526	31										9.1	
H-6	30	7	73	67	WM-183	1502	31										9.1	
H-6	30	7	73	68	WC-114	1583	31										9.1	
H-6	31	7	73	69	WM-183	1598	31										9.1	
H-6	1	8	73	70	WM-188	867	32											2780
H-6	1	8	73	71	WM-188	861	32											2430
H-6	2	8	73	72	WM-188	861	32											2650
H-6	2	8	73	73	WM-188	861	32											2680
H-6	3	8	73	74	WM-188	865	32											2740
H-6	4	8	73	75	WM-188	855	32											2540
H-6	4	8	73	76	WM-188	855	32											2750
H-6	5	8	73	77	WM-188	859	32											2720
H-6	5	8	73	78	WM-188	887	32											2870
H-6	6	8	73	79	WM-188	857	32											2840
H-6	6	8	73	80	WM-188	855	32											2990
H-6	7	8	73	81	WM-188	865	32											2840
H-6	8	8	73	82	WM-188	858	32											2650
H-6	8	8	73	83	WM-188	895	32											3050
H-6	9	8	73	84	WM-188	862	32											2790
H-6	9	8	73	85	WM-188	875	32											2960
H-6	10	8	73	86	WM-188	857	32											2840
H-6	10	8	73	87	WM-188	875	32											2600
H-6	11	8	73	88	WM-188	864	32											2840
H-6	11	8	73	89	WM-188	865	32											2700
H-6	12	8	73	90	WM-188	813	32											2660

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	12	8	73	91	WM-188	863	32											2800
H-6	13	8	73	92	WM-188	870	32											2810
H-6	14	8	73	93	WM-188	850	32											2580
H-6	14	8	73	94	WM-188	869	32											2750
H-6	15	8	73	95	WM-188	797	32											2610
H-6	15	8	73	96	WM-188	873	32											2750
H-6	16	8	73	97	WM-188	857	32											2600
H-6	16	8	73	98	WM-188	873	32											2800
H-6	17	8	73	99	WM-188	863	32											2780
H-6	17	8	73	100	WM-188	865	32											2660
H-6	18	8	73	101	WM-188	855	32											2750
H-6	18	8	73	102	WM-188	865	32											2880
H-6	19	8	73	103	WM-188	855	32											2620
H-6	19	8	73	104	WM-188	888	32											2720
H-6	19	8	73	105	WM-188	858	32											2570
H-6	20	8	73	106	WM-188	857	32											2740
H-6	20	8	73	107	WM-188	855	32											2740
H-6	21	8	73	108	WM-188	857	32											2940
H-6	21	8	73	109	WM-188	861	32											2700
H-6	22	8	73	110	WM-188	873	32											2910
H-6	22	8	73	111	WM-188	901	32											2840
H-6	23	8	73	112	WM-188	912	32											2880
H-6	23	8	73	113	WM-188	853	32											3090
H-6	24	8	73	114	WM-188	873	32											2650
H-6	24	8	73	115	WM-188	857	32											2790
H-6	25	8	73	116	WM-188	878	32											2870
H-6	25	8	73	117	WM-188	864	32											2670
H-6	26	8	73	118	WM-188	866	32											2950
H-6	26	8	73	119	WM-188	859	32											3190
H-6	27	8	73	120	WM-188	855	32											3160
H-6	28	8	73	121	WM-188	867	32											2730
H-6	28	8	73	122	WM-188	846	32											3370
H-6	28	8	73	123	WM-188	859	32											2700
H-6	29	8	73	124	WM-188	842	32											2910
H-6	29	8	73	125	WM-189	1000	33											1890
H-6	30	8	73	126	WM-189	906	33											2000
H-6	30	8	73	127	WM-189	1002	33											1930
H-6	31	8	73	128	WM-189	1005	33											2210
H-6	31	8	73	129	WM-189	1014	33											2000
H-6	1	9	73	130	WM-189	963	33											2010
H-6	1	9	73	131	WM-189	1018	33											1970
H-6	2	9	73	132	WM-189	1000	33											1930
H-6	2	9	73	133	WM-189	1012	33											2120
H-6	3	9	73	134	WM-189	1000	33											1970
H-6	3	9	73	135	WM-189	1000	33											1920
H-6	4	9	73	136	WM-189	1000	33											1900
H-6	4	9	73	137	WM-189	1000	33											1830
H-6	4	9	73	138	WM-189	1000	33											2170
H-6	5	9	73	139	WM-189	1000	33											1880
H-6	5	9	73	140	WM-189	1051	33											2120
H-6	6	9	73	141	WM-189	1000	33											1830
H-6	6	9	73	142	WM-189	1000	33											2070
H-6	7	9	73	143	WM-189	1000	33											1960
H-6	7	9	73	144	WM-189	1000	33											1870
H-6	8	9	73	145	WM-189	968	33											1930
H-6	8	9	73	146	WM-189	1000	33											1810
H-6	9	9	73	147	WM-189	1000	33											1890
H-6	9	9	73	148	WM-189	1004	33											2090
H-6	10	9	73	149	WM-189	1005	33											2160
H-6	10	9	73	150	WM-189	1000	33											1840
H-6	11	9	73	151	WM-188	963	32											2930
H-6	11	9	73	152	WM-188	873	32											2740
H-6	12	9	73	153	WM-188	862	32											2500
H-6	12	9	73	154	WM-188	873	32											2730
H-6	12	9	73	155	WM-188	910	32											2620
H-6	13	9	73	156	WM-188	954	32											2930
H-6	13	9	73	157	WM-188	950	32											3010
H-6	14	9	73	158	WM-188	975	32											3230

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	15	9	73	159	WM-188	988	32											2900
H-6	15	9	73	160	WM-188	979	32											2730
H-6	16	9	73	161	WM-188	960	32											2740
H-6	13	10	73	DB	Dolomite Bed (approx. 61 cubic feet)								4260	92				
H-6	13	10	73	164	Cold									1098	1.8		9.1	
H-6	13	10	73	165	Cold									1255	1.8		9.1	
H-6	14	10	73	166	Cold									1123	1.8		9.1	
H-6	14	10	73	167	Cold									1441	1.8		9.1	
H-6	18	10	73	DB	Dolomite Bed (approx. 33 cubic feet)								2323	92				
H-6	19	10	73	169	Cold									1689	1.8		18.2	
H-6	20	10	73	170	Cold									1195	1.8		9.1	
H-6	21	10	73	171	Cold									1183	1.8		9.1	
H-6	21	10	73	172	Cold									1096	1.8		9.1	
H-6	22	10	73	173	Cold									1179	1.8		9.1	
H-6	23	10	73	174	Cold									416	1.8		9.1	
H-6	23	10	73	175	Cold									824	1.8		9.1	
H-6	24	10	73	176	Cold									636	1.8		9.1	
H-6	25	10	73	178	WM-188	949	32											3560
H-6	26	10	73	179	WM-188	949	32											3160
H-6	27	10	73	180	WM-188	961	32											3770
H-6	27	10	73	181	WM-188	959	32											2730
H-6	28	10	73	182	WM-188	857	32											2630
H-6	28	10	73	183	WM-188	957	32											3120
H-6	29	10	73	184	WM-188	862	32											2700
H-6	29	10	73	185	WM-188	951	32											2870
H-6	30	10	73	186	WM-188	950	32											3180
H-6	30	10	73	187	WM-188	961	32											3070
H-6	31	10	73	188	WM-188	968	32											3280
H-6	31	10	73	189	WM-188	950	32											2690
H-6	1	11	73	190	WM-188	945	32											3020
H-6	1	11	73	191	WM-188	951	32											2940
H-6	2	11	73	192	WM-188	954	32											3110
H-6	2	11	73	193	WM-188	949	32											2880
H-6	3	11	73	194	WM-188	951	32											3230
H-6	3	11	73	195	WM-188	982	32											3230
H-6	4	11	73	196	WM-188	954	32											3150
H-6	4	11	73	197	WM-188	941	32											3160
H-6	5	11	73	198	WM-188	951	32											3050
H-6	5	11	73	199	WM-188	950	32											2810
H-6	6	11	73	200	WM-188	954	32											3110
H-6	6	11	73	201	WM-188	948	32											3100
H-6	7	11	73	202	WM-188	949	32											3960
H-6	7	11	73	203	WM-188	950	32											3010
H-6	8	11	73	204	WM-188	954	32											3160
H-6	8	11	73	205	WM-188	950	32											3010
H-6	9	11	73	206	WM-188	958	32											4040
H-6	9	11	73	207	WM-188	949	32											3940
H-6	10	11	73	208	WM-188	950	32											3160
H-6	10	11	73	209	WM-188	953	32											3050
H-6	11	11	73	210	WM-188	950	32											3210
H-6	12	11	73	211	WM-188	950	32											3150
H-6	12	11	73	212	WM-188	950	32											3020
H-6	13	11	73	213	WM-189	1051	34											1860
H-6	13	11	73	214	WM-189	1001	34											2020
H-6	13	11	73	215	WM-189	1060	34											1900
H-6	14	11	73	216	WM-188	950	32											3130
H-6	15	11	73	217	WM-188	949	32											2460
H-6	15	11	73	218	WM-188	951	32											2930
H-6	15	11	73	219	WM-189	1040	34											1740
H-6	16	11	73	220	WM-188	950	32											3000
H-6	17	11	73	221	WM-188	950	32											2930
H-6	17	11	73	222	WM-188	956	32											3020
H-6	18	11	73	223	WM-188	954	32											3010
H-6	18	11	73	224	WM-188	954	32											3210
H-6	19	11	73	225	WM-189	1049	35											2530
H-6	19	11	73	226	WM-189	1031	35											2390
H-6	19	11	73	227	WM-189	1017	35											2430
H-6	20	11	73	228	WM-189	999	35											2440

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	21	11	73	229	WM-189	999	35											2620
H-6	21	11	73	230	WM-189	1000	35											2540
H-6	22	11	73	231	WM-189	1021	35											2430
H-6	22	11	73	232	WM-189	1004	35											2410
H-6	23	11	73	233	WM-189	1000	35											2320
H-6	23	11	73	234	WM-189	1002	35											2530
H-6	24	11	73	235	WM-189	1000	35											2460
H-6	24	11	73	236	WM-189	1007	35											2410
H-6	25	11	73	237	WM-189	1007	35											2400
H-6	25	11	73	238	WM-189	1001	35											2430
H-6	26	11	73	239	WM-189	1004	35											2300
H-6	26	11	73	240	WM-189	991	35											2480
H-6	27	11	73	241	WM-189	1000	35											2110
H-6	27	11	73	242	WM-189	999	35											2650
H-6	28	11	73	243	WM-189	1000	35											2270
H-6	28	11	73	244	WM-189	1004	35											2490
H-6	29	11	73	245	WM-189	1003	35											2450
H-6	29	11	73	246	WM-189	1002	35											2460
H-6	30	11	73	247	WM-189	1000	35											2160
H-6	30	11	73	248	WM-189	1000	35											2180
H-6	1	12	73	249	WM-189	1004	35											
H-6	1	12	73	250	WM-189	1000	35											2450
H-6	2	12	73	251	WM-189	1000	35											2300
H-6	2	12	73	252	WM-189	1004	35											2540
H-6	2	12	73	253	WM-189	1000	35											2190
H-6	3	12	73	254	WM-189	1004	35											2460
H-6	6	12	73	DB	Dolomite Bed (approx. 17 cubic feet)									1162	92			
H-6	7	12	73	DB	Dolomite Bed (approx. 61 cubic feet)									4260	92			
H-6	7	12	73	DB	Dolomite Bed (approx. 17 cubic feet)									1162	92			
H-6	7	12	73	256	Cold											1409	1.8	9.1
H-6	7	12	73	257	Cold											1100	1.8	9.1
H-6	8	12	73	258	Cold											850	1.8	9.1
H-6	9	12	73	259	Cold											614	1.8	9.1
H-6	10	12	73	260	Cold											500	1.8	9.1
H-6	12	12	73	256	WM-189	1000	35											1510
H-6	13	12	73	257	WM-189	1004	35											2150
H-6	13	12	73	258	WM-189	1004	35											2110
H-6	14	12	73	259	WM-189	1000	35											4970
H-6	15	12	73	260	WM-189	1179	35											2450
H-6	15	12	73	261	WM-189	1000	35											2280
H-6	16	12	73	262	WM-189	1000	35											2630
H-6	17	12	73	263	WM-189	1017	35											2200
H-6	17	12	73	264	WM-189	1000	35											2460
H-6	18	12	73	265	WM-189	1000	35											2270
H-6	18	12	73	266	WM-189	1000	35											2960
H-6	19	12	73	267	WM-189	1000	35											2430
H-6	19	12	73	268	WM-189	1000	35											2300
H-6	20	12	73	269	WM-189	1006	35											2350
H-6	20	12	73	270	WM-189	1009	35											2350
H-6	20	12	73	271	WM-189	1004	35											2550
H-6	22	12	73	272	WM-189	1008	35											2250
H-6	22	12	73	273	WM-189	1000	35											2030
H-6	23	12	73	274	WM-189	1000	35											2400
H-6	23	12	73	275	WM-189	1154	35											2860
H-6	24	12	73	276	WM-189	1018	35											2350
H-6	24	12	73	277	WM-189	1162	35											2620
H-6	25	12	73	278	WM-189	1154	35											2670
H-6	26	12	73	279	WM-189	1150	35											2700
H-6	26	12	73	280	WM-189	1150	35											2720
H-6	27	12	73	281	WM-189	1156	35											2600
H-6	27	12	73	282	WM-189	1158	35											2700
H-6	28	12	73	283	WM-189	1154	35											2650
H-6	29	12	73	284	WM-189	1158	35											2930
H-6	30	12	73	285	WM-189	1158	35											2700
H-6	30	12	73	286	WM-189	1106	35											4870
H-6	31	12	73	287	WM-189	1150	35											4700
H-6	31	12	73	288	WM-189	1042	35											5470
H-6	1	1	74	289	WM-189	1125	35											4550

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	2	1	74	290	WM-189	1156	35											2850
H-6	3	1	74	291	WM-189	1150	35											2700
H-6	4	1	74	292	WM-189	1150	35											3820
H-6	4	1	74	293	WM-189	1167	35											2710
H-6	6	1	74	294	WM-189	1171	35											2900
H-6	6	1	74	295	WM-189	1150	35											2600
H-6	7	1	74	296	WM-189	1154	35											2810
H-6	8	1	74	297	WM-189	1164	35											2600
H-6	8	1	74	298	WM-189	1150	35											2770
H-6	9	1	74	299	WM-189	1150	35											2530
H-6	10	1	74	300	WM-189	1171	35											2270
H-6	10	1	74	301	WM-189	1158	35											2650
H-6	11	1	74	302	WM-189	1158	35											2810
H-6	11	1	74	303	WM-189	1150	35											2650
H-6	12	1	74	304	WM-189	1154	35											2810
H-6	12	1	74	305	WM-189	1154	35											2500
H-6	13	1	74	306	WM-189	1150	35											2840
H-6	14	1	74	307	WM-189	1152	35											2590
H-6	14	1	74	308	WM-189	1150	35											2670
H-6	15	1	74	309	WM-189	1150	35											2580
H-6	15	1	74	310	WM-189	560	35											1250
H-6	16	1	74	311	WM-189	1152	35											2690
H-6	16	1	74	312	WM-189	1233	35	WM-106	162	36								2470
H-6	17	1	74	313	WM-189	1026	35	WM-106	160	36								2370
H-6	18	1	74	314	WM-189	1040	35	WM-106	166	36								2420
H-6	18	1	74	315	WM-189	1000	35	WM-106	214	36								2280
H-6	19	1	74	316	WM-189	1080	35	WM-106	152	36								2600
H-6	20	1	74	317	WM-189	1000	35	WM-106	143	36								2180
H-6	20	1	74	318	WM-189	987	35	WM-106	151	36								3000
H-6	21	1	74	319	WM-189	1004	35	WM-106	133	36								2180
H-6	22	1	74	320	WM-189	1004	35	WM-106	143	36								2300
H-6	22	1	74	321	WM-189	1000	35	WM-106	138	36								2230
H-6	23	1	74	322	WM-189	1004	35	WM-106	252	36								2360
H-6	24	1	74	323	WM-189	1092	35	WM-106	166	36								2290
H-6	24	1	74	324	WM-189	987	35	WM-106	119	36								2400
H-6	25	1	74	325	WM-189	1026	35	WM-106	143	36								2590
H-6	26	1	74	326	WM-189	1044	35	WM-106	143	36								2420
H-6	26	1	74	327	WM-189	1026	35	WM-106	167	36								2370
H-6	27	1	74	328	WM-189	1017	35	WM-106	172	36								2420
H-6	28	1	74	329	WM-189	1013	35	WM-106	168	36								2560
H-6	29	1	74	330	WM-189	1000	35	WM-106	180	36								2330
H-6	30	1	74	331	WM-189	1026	35	WM-106	143	36								2290
H-6	30	1	74	332	WM-189	1000	35	WM-106	143	36								2560
H-6	31	1	74	333	WM-189	1000	35	WM-106	114	36								2390
H-6	1	2	74	334	WM-189	1000	35	WM-106	214	36								2230
H-6	2	2	74	335	WM-189	996	35	WM-106	190	36								2440
H-6	2	2	74	336	WM-189	1009	35	WM-106	228	36								2440
H-6	3	2	74	337	WM-189	1066	35	WM-106	192	36								2350
H-6	4	2	74	338	WM-189	1000	35	WM-106	214	36								2280
H-6	5	2	74	339	WM-189	947	35	WM-106	201	36								2180
H-6	6	2	74	340	WM-189	971	35	WM-106	71	36								2340
H-6	6	2	74	341	WM-183	1491	31										9.1	
H-6	7	2	74	342	WM-183	1869	31										9.1	
H-6	8	2	74	343	WM-183	1656	31										9.1	
H-6	25	3	74	DB	Dolomite Bed (approx. 61 cubic feet)						4260	92						
H-6	26	3	74	3	Cold									1020	1.8		9.1	
H-6	26	3	74	4	Cold									1658	1.8		9.1	
H-6	27	3	74	5	Cold									1026	1.8		9.1	
H-6	28	3	74	344	WM-183	1779	31										9.1	
H-6	29	3	74	345	WM-183	1873	31										9.1	
H-6	29	3	74	346	WM-183	1674	31										9.1	
H-6	30	3	74	347	WM-183	1789	31										9.1	
H-6	31	3	74	348	WM-183	1697	31										9.1	
H-6	1	4	74	349	WM-183	1808	31										9.1	
H-6	2	4	74	350	WM-183	1395	31										9.1	
H-6	3	4	74	351	WM-183	1720	31										9.1	
H-6	4	4	74	352	WM-183	1365	31										9.1	
H-6	4	4	74	353	WM-183	1457	31										9.1	

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-6	5	4	74	354	WM-183	1660	31										9.1	
H-6	6	4	74	355	WM-183	1667	31										9.1	
H-6	7	4	74	356	WM-183	1328	31										9.1	
H-6	8	4	74	357	WM-183	1719	31										9.1	
H-6	9	4	74	358	WM-183	1590	31										9.1	
H-6	10	4	74	359	WM-183	1893	31										9.1	
H-6	10	4	74	1	Cold									1275	1.8		9.1	
H-6	11	4	74	2	Cold									1263	1.8		9.1	
H-6	12	4	74	360	WM-183	1585	31										9.1	
H-6	13	4	74	361	WM-183	1653	31										9.1	
H-6	14	4	74	362	WM-183	1884	31										9.1	
H-6	15	4	74	363	WM-183	2272	31										9.1	
H-6	16	4	74	364	WM-183	1421	31										9.1	
H-6	17	4	74	365	WM-183	1674	31										9.1	
H-6	18	4	74	366	WM-183	1693	31										9.1	
H-6	19	4	74	367	WM-183	1656	31										9.1	
H-6	20	4	74	368	WM-183	1719	31										9.1	
H-6	21	4	74	369	WM-183	1729	31										9.1	
H-6	22	4	74	370	WM-183	1489	31										9.1	
H-6	23	4	74	371	WM-183	1734	31										9.1	
H-6	24	4	74	372	WM-183	1675	31										9.1	
H-6	25	4	74	373	WM-183	1623	31										9.1	
H-6	26	4	74	374	WM-183	1646	31										9.1	
H-6	27	4	74	375	WM-183	1646	31										9.1	
H-6	28	4	74	376	WM-183	1646	31										9.1	
H-6	29	4	74	377	WM-183	1666	31										9.1	
H-6	30	4	74	378	WM-183	1150	31										9.1	
H-6	2	5	74	379	WM-183	1674	31										9.1	
H-6	4	5	74	380	WM-183	1682	31										9.1	
H-6	5	5	74	381	WM-183	1741	31										9.1	
H-6	6	5	74	382	WM-183	1651	31										9.1	
H-6	7	5	74	383	WM-183	1166	31										9.1	
H-6	8	5	74	384	WM-183	1670	31										9.1	
H-7	29	5	75	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	30	5	75	1C	Cold									875	1.9		2.0	
H-7	30	5	75	2C	Cold									1287	1.9		3.0	
H-7	30	5	75	3C	Cold									735	1.9		1.7	
H-7	31	5	75	4C	Cold									875	1.9		2.0	
H-7	31	5	75	5C	Cold									1180	1.9		2.8	
H-7	1	6	75	6C	Cold									1068	1.9		2.5	
H-7	1	6	75	7C	Cold									1390	1.9		3.3	
H-7	2	6	75	8C	Cold									1034	1.9		2.4	
H-7	2	6	75	9C	Cold									990	1.9		2.3	
H-7	3	6	75	10C	Cold									1047	1.9		2.4	
H-7	4	6	75	11C	Cold									971	1.9		2.3	
H-7	4	6	75	12C	Cold									1326	1.9		3.1	
H-7	6	6	75	13C	Cold									1000	1.9		2.3	
H-7	8	6	75	14C	Cold									849	1.9		2.0	
H-7	8	6	75	15C	Cold									1200	1.9		2.8	
H-7	8	6	75	1	WM-187	861	37											2593
H-7	9	6	75	2	WM-187	951	37											2865
H-7	10	6	75	3	WM-187	942	37											2839
H-7	11	6	75	4	WM-187	950	37											2862
H-7	11	6	75	5	WM-187	951	37											2865
H-7	12	6	75	6	WM-187	966	37											2425
H-7	13	6	75	7				WM-189	981	38								2386
H-7	13	6	75	8				WM-189	1011	38								2459
H-7	14	6	75	9				WM-189	949	38								2308
H-7	14	6	75	10				WM-189	960	38								2335
H-7	15	6	75	11				WM-189	1012	38								2462
H-7	15	6	75	12				WM-189	1016	38								2471
H-7	16	6	75	13				WM-189	1018	38								2476
H-7	16	6	75	14				WM-189	1017	38								1940
H-7	17	6	75	15				WM-189	1040	38								1984
H-7	17	6	75	16				WM-189	1060	38								2022
H-7	18	6	75	17	WM-187	963	37											2466
H-7	18	6	75	18	WM-187	951	37											2435
H-7	19	6	75	19	WM-187	1093	37											2800

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	19	6	75	20	WM-187	948	37											2428
H-7	20	6	75	21	WM-187	941	37											2411
H-7	21	6	75	22	WM-187	952	37											2437
H-7	21	6	75	23	WM-187	941	37											2411
H-7	22	6	75	24	WM-187	982	37											2515
H-7	22	6	75	25	WM-187	937	37											2398
H-7	23	6	75	26	WM-187	893	37											2286
H-7	23	6	75	27	WM-187	958	37											2452
H-7	24	6	75	28				WM-189	1025	38								2151
H-7	24	6	75	29				WM-189	1022	38								2145
H-7	25	6	75	30				WM-189	1010	38								2120
H-7	26	6	75	31				WM-189	1013	38								2126
H-7	26	6	75	32				WM-189	1056	38								2216
H-7	27	6	75	33				WM-189	1004	38								2107
H-7	27	6	75	34				WM-189	1040	38								2183
H-7	28	6	75	35				WM-189	1008	38								2115
H-7	29	6	75	36				WM-189	999	38								2001
H-7	29	6	75	37				WM-189	1002	38								2007
H-7	30	6	75	38				WM-189	1039	38								2081
H-7	30	6	75	39				WM-189	1001	38								2005
H-7	1	7	75	40	WM-187	956	37											2447
H-7	1	7	75	41				WM-189	1007	38								2017
H-7	2	7	75	42				WM-189	1000	38								2146
H-7	3	7	75	43				WM-189	1020	38								2189
H-7	3	7	75	44				WM-189	1016	38								2181
H-7	4	7	75	45	WM-187	941	37											2408
H-7	4	7	75	46	WM-187	1049	37											2685
H-7	5	7	75	47	WM-187	950	37											2432
H-7	5	7	75	48	WM-187	974	37											2493
H-7	6	7	75	49	WM-187	945	37											2420
H-7	7	7	75	50	WM-187	880	37											2252
H-7	7	7	75	51	WM-187	955	37											2445
H-7	8	7	75	52				WM-189	1037	38								2226
H-7	8	7	75	53				WM-189	1010	38								2168
H-7	9	7	75	54	WM-187	960	37											2459
H-7	9	7	75	55	WM-187	928	37											2376
H-7	10	7	75	56	WM-187	960	37											2459
H-7	10	7	75	57	WM-187	944	37											2418
H-7	11	7	75	58				WM-189	1023	38								2196
H-7	11	7	75	59				WM-189	999	38								2144
H-7	12	7	75	60	WM-187	968	37											2479
H-7	13	7	75	61	WM-187	945	37											2420
H-7	13	7	75	62	WM-187	879	37											2250
H-7	14	7	75	63	WM-187	957	37											2449
H-7	14	7	75	64				WM-189	1022	38								2193
H-7	15	7	75	65				WM-189	1001	38								2148
H-7	16	7	75	66	WM-187	966	37											2474
H-7	16	7	75	67	WM-187	961	37											2462
H-7	17	7	75	68	WM-187	972	37											2488
H-7	17	7	75	69	WM-187	928	37											2376
H-7	18	7	75	70				WM-189	1013	38								2174
H-7	18	7	75	71				WM-189	1010	38								2168
H-7	19	7	75	72	WM-187	988	37											2530
H-7	19	7	75	73	WM-187	961	37											2462
H-7	20	7	75	74	WM-187	998	37											2554
H-7	20	7	75	75	WM-187	952	37											2437
H-7	21	7	75	76				WM-189	1063	38								2281
H-7	21	7	75	77				WM-189	1018	38								2185
H-7	22	7	75	78				WM-189	1045	38								2243
H-7	22	7	75	79				WM-189	1026	38								2202
H-7	23	7	75	80				WM-189	1036	38								2224
H-7	23	7	75	81				WM-189	1018	38								2185
H-7	24	7	75	82				WM-189	1040	38								2232
H-7	24	7	75	83				WM-189	1013	38								2174
H-7	24	7	75	84				WM-189	1040	38								2232
H-7	25	7	75	85				WM-189	1007	38								2161
H-7	26	7	75	86	WM-187	989	37											2532
H-7	27	7	75	87	WM-187	955	37											2445

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	29	8	75	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	30	8	75	88	Cold									1023	1.8		2.4	
H-7	21	9	75	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	22	9	75	89	Cold									1269	1.8		3.0	
H-7	22	9	75	90	Cold									765	1.8		1.8	
H-7	23	9	75	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-7	23	9	75	91	Cold									1500	1.8		3.5	
H-7	24	9	75	92	Cold									800	1.8		1.9	
H-7	25	9	75	93	Cold									807	1.8		1.9	
H-7	25	9	75	94	Cold									404	1.8		0.9	
H-7	26	9	75	95	Cold									558	1.8		1.3	
H-7	26	9	75	96	WM-187	955	37											2397
H-7	27	9	75	97	WM-187	950	37											2385
H-7	28	9	75	98	WM-187	961	37											2413
H-7	28	9	75	99	WM-187	933	37											2342
H-7	29	9	75	100	WM-187	950	37											2385
H-7	30	9	75	101	WM-187	935	37											2347
H-7	30	9	75	102	WM-187	970	37											2435
H-7	1	9	75	103	WM-187	956	37											2399
H-7	2	10	75	104	WM-187	979	37											2459
H-7	3	10	75	105	WM-187	962	37											2416
H-7	3	10	75	106	WM-187	975	37											2447
H-7	3	10	75	107	WM-187	956	37											2399
H-7	4	10	75	108	WM-187	931	37											2337
H-7	4	10	75	109	WM-187	956	37											2399
H-7	5	10	75	110	WM-187	990	37											2485
H-7	6	10	75	111	WM-187	956	37											2399
H-7	6	10	75	112	WM-187	1330	37											3339
H-7	7	10	75	113	WM-187	1349	37											3386
H-7	7	10	75	114	WM-187	1344	37											3374
H-7	8	10	75	115	WM-187	1320	37											3312
H-7	8	10	75	116	WM-187	1349	37											3386
H-7	10	10	75	117	WM-187	1321	37											3315
H-7	11	10	75	118	WM-187	1314	37											3298
H-7	12	10	75	119	WM-187	1365	37											3427
H-7	13	10	75	120	WM-187	1327	37											3331
H-7	13	10	75	121	WM-187	1387	37											3482
H-7	14	10	75	122	WM-187	1284	37											3224
H-7	15	10	75	123	WM-187	1328	37											3334
H-7	15	10	75	124	WM-187	1315	37											3300
H-7	16	10	75	125	WM-187	1355	37											3401
H-7	17	10	75	126	WM-187	1324	37											3324
H-7	22	10	75	CF	Cold									679	1.8		1.6	
H-7	23	10	75	127	WM-187	1259	37											3160
H-7	23	10	75	128	WM-187	1304	37											3274
H-7	24	10	75	129	WM-187	973	37											2442
H-7	25	10	75	130	WM-187	994	37											2494
H-7	25	10	75	131	WM-187	971	37											2437
H-7	26	10	75	132	WM-187	946	37											2375
H-7	27	10	75	133	WM-187	979	37											2456
H-7	28	10	75	134	WM-187	985	37											2473
H-7	28	10	75	135	WM-187	952	37											2389
H-7	29	10	75	136	WM-187	964	37											2420
H-7	30	10	75	137	WM-187	980	37											2461
H-7	30	10	75	138	WM-187	950	37											2385
H-7	31	10	75	139	WM-187	989	37											2483
H-7	1	11	75	140	WM-187	957	37											2401
H-7	2	11	75	141	WM-187	962	37											2416
H-7	3	11	75	142	WM-187	946	37											2375
H-7	3	11	75	143	WM-187	967	37											2428
H-7	4	11	75	144	WM-187	957	37											2401
H-7	5	11	75	145	WM-187	986	37											2475
H-7	6	11	75	146	WM-187	952	37											2389
H-7	7	11	75	147	WM-187	957	37											2401
H-7	7	11	75	148	WM-187	954	37											2394
H-7	8	11	75	149	WM-187	975	37											2447
H-7	10	11	75	150	WM-187	943	37											2368
H-7	11	11	75	151	WM-187	975	37											2447

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	12	11	75	152	WM-187	763	37											1915
H-7	13	11	75	153	WM-187	884	37											2218
H-7	13	11	75	154	WM-187	954	37											2394
H-7	14	11	75	155	WM-187	1349	37											3386
H-7	15	11	75	156	WM-187	923	37											2318
H-7	16	11	75	157	WM-187	953	37											2392
H-7	26	11	75	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	26	11	75	158	WM-187	932	37											2339
H-7	26	11	75	159	WM-187	190	37											478
H-7	24	3	76	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	25	3	76	CF	Cold									3700	1.8		8.6	
H-7	25	3	76	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-7	19	4	76	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-7	20	4	76	CF	Cold									19800	1.8		46.3	
H-7	21	4	76	160	WM-187	950	39											2385
H-7	22	4	76	161	WM-187	921	39											2311
H-7	22	4	76	162	WM-187	948	39											2380
H-7	23	4	76	163	WM-187	963	39											2418
H-7	24	4	76	164	WM-187	989	39											2483
H-7	25	4	76	165	WM-187	965	39											2423
H-7	25	4	76	166	WM-187	985	39											2473
H-7	26	4	76	167	WM-187	954	39											2394
H-7	27	4	76	168	WM-187	961	39											2413
H-7	27	4	76	169	WM-187	961	39											2413
H-7	27	4	76	170	WM-187	961	39											2413
H-7	28	4	76	171	WM-187	966	39											2425
H-7	29	4	76	172	WM-187	961	39											2413
H-7	29	4	76	173	WM-187	961	39											2413
H-7	30	4	76	174	WM-187	961	39											2413
H-7	30	4	76	175	WM-187	961	39											2413
H-7	1	4	76	176	WM-187	961	39											2413
H-7	1	5	76	177	WM-187	962	39											2416
H-7	2	5	76	178	WM-187	979	39											2456
H-7	2	5	76	179	WM-187	969	39											2432
H-7	3	5	76	180	WM-187	962	39											2416
H-7	3	5	76	181	WM-187	964	39											2420
H-7	4	5	76	182	WM-187	960	39											2411
H-7	5	5	76	183	WM-187	961	39											2413
H-7	5	5	76	184	WM-187	959	39											2406
H-7	6	5	76	185	WM-187	967	39											2428
H-7	6	5	76	186	WM-187	966	39											2425
H-7	7	5	76	187	WM-187	964	39											2420
H-7	7	5	76	188	WM-187	956	39											2399
H-7	8	5	76	189	WM-187	963	39											2418
H-7	9	5	76	190	WM-187	970	39											2435
H-7	9	5	76	191	WM-187	962	39											2416
H-7	10	5	76	192	WM-187	975	39											2447
H-7	10	5	76	193	WM-187	960	39											2409
H-7	11	5	76	194	WM-187	962	39											2416
H-7	11	5	76	195	WM-187	959	39											2406
H-7	12	5	76	196	WM-187	962	39											2416
H-7	13	5	76	197	WM-187	970	39											2435
H-7	13	5	76	198	WM-187	960	39											2411
H-7	14	5	76	199	WM-187	962	39											2416
H-7	15	5	76	200	WM-187	960	39											2409
H-7	15	5	76	201	WM-187	962	39											2416
H-7	16	5	76	202	WM-187	962	39											2416
H-7	16	5	76	203	WM-187	960	39											2411
H-7	17	5	76	204	WM-187	962	39											2416
H-7	17	5	76	205	WM-187	966	39											2425
H-7	18	5	76	206	WM-187	962	39											2416
H-7	18	5	76	207	WM-187	962	39											2416
H-7	19	5	76	208	WM-187	962	39											2416
H-7	19	5	76	209	WM-187	962	39											2416
H-7	19	5	76	210	WM-187	928	39											2330
H-7	20	5	76	211	WM-187	961	39											2413
H-7	20	5	76	212	WM-187	962	39											2416
H-7	21	5	76	213	WM-187	970	39											2435

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

WCF				Feed Stream									Cold Chemicals					
Date		Batch		1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	21	5	76	214	WM-187	966	39											2425
H-7	22	5	76	215	WM-187	962	39											2416
H-7	22	5	76	216	WM-187	962	39											2416
H-7	23	5	76	217	WM-187	962	39											2416
H-7	23	5	76	218	WM-187	962	39											2416
H-7	23	5	76	219	WM-187	1129	39											2833
H-7	24	5	76	220	WM-187	1104	39											2771
H-7	24	5	76	221	WM-187	1129	39											2833
H-7	25	5	76	222	WM-187	962	39											2416
H-7	25	5	76	223	WM-187	1129	39											2833
H-7	26	5	76	224	WM-187	966	39											2425
H-7	26	5	76	225	WM-187	1131	39											2840
H-7	27	5	76	226	WM-187	962	39											2416
H-7	27	5	76	227	WM-187	1129	39											2833
H-7	28	5	76	228	WM-187	1141	39											2864
H-7	28	5	76	229	WM-187	1137	39											2855
H-7	29	5	76	230	WM-187	1045	39											2623
H-7	29	5	76	231	WM-187	1141	39											2864
H-7	30	5	76	232	WM-187	1045	39											2623
H-7	31	5	76	233	WM-187	1140	39											2862
H-7	31	5	76	234	WM-187	1045	39											2623
H-7	1	6	76	235	WM-187	1137	39											2855
H-7	1	6	76	236	WM-187	1054	39											2645
H-7	2	6	76	237	WM-187	1148	39											2881
H-7	2	6	76	238	WM-187	1045	39											2623
H-7	3	6	76	239	WM-187	1137	39											2855
H-7	3	6	76	240	WM-187	1045	39											2623
H-7	4	6	76	241	WM-187	1125	39											2824
H-7	4	6	76	242	WM-187	1045	39											2623
H-7	5	6	76	243	WM-187	1129	39											2833
H-7	6	6	76	244	WM-187	1154	39											2897
H-7	7	6	76	245	WM-187	1015	39											2547
H-7	7	6	76	246	WM-187	1137	39											2855
H-7	8	6	76	247	WM-187	1137	39											2855
H-7	9	6	76	248	WM-187	1129	39											2833
H-7	9	6	76	249	WM-187	1141	39											2864
H-7	10	6	76	250	WM-187	1045	39											2623
H-7	10	6	76	251	WM-187	1145	39											2874
H-7	11	6	76	252	WM-187	1045	39											2623
H-7	12	6	76	253	WM-187	1129	39											2833
H-7	12	6	76	254	WM-187	1141	39											2864
H-7	13	6	76	255	WM-187	1140	39											2862
H-7	13	6	76	256	WM-187	1087	39											2728
H-7	14	6	76	257	WM-187	765	39	WM-180	210	40								1920
H-7	15	6	76	258	WM-187	1140	39											2862
H-7	15	6	76	259	WM-187	767	39	WM-180	172	40								1924
H-7	16	6	76	260	WM-187	760	39											1908
H-7	17	6	76	261	WM-187	961	39											2413
H-7	17	6	76	262	WM-187	950	39											2385
H-7	18	6	76	263	WM-187	950	39											2385
H-7	18	6	76	264	WM-187	1139	39											2859
H-7	19	6	76	265	WM-187	1141	39											2864
H-7	19	6	76	266	WM-187	1133	39											2845
H-7	20	6	76	267	WM-187	1146	39											2876
H-7	20	6	76	268	WM-187	1154	39											2897
H-7	21	6	76	269	WM-187	1129	39											2833
H-7	22	6	76	270	WM-187	767	39	WM-180	195	40								2449
H-7	22	6	76	271	WM-187	846	39	WM-180	234	40								2701
H-7	23	6	76	272	WM-187	759	39	WM-180	207	40								2425
H-7	23	6	76	273	WM-187	827	39	WM-180	239	40								2644
H-7	24	6	76	274	WM-187	777	39	WM-180	190	40								2483
H-7	24	6	76	275	WM-187	763	39	WM-180	179	40								2437
H-7	25	6	76	276	WM-187	1146	39											2876
H-7	26	6	76	277	WM-187	1141	39											2864
H-7	26	6	76	278	WM-187	1140	39											2862
H-7	27	6	76	279	WM-187	1140	39											2862
H-7	27	6	76	280	WM-187	1140	39											2862
H-7	28	6	76	281	WM-187	1140	39											2862

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	28	6	76	282	WM-187	1140	39											2862
H-7	29	6	76	283	WM-187	1141	39											2864
H-7	30	6	76	284	WM-187	1146	39											2876
H-7	30	6	76	285	WM-187	1141	39											2864
H-7	1	7	76	286	WM-187	1146	39											2876
H-7	1	7	76	287	WM-187	1140	39											2862
H-7	2	7	76	288	WM-187	1140	39											2862
H-7	2	7	76	289	WM-187	1141	39											2864
H-7	3	7	76	290	WM-187	1141	39											2864
H-7	4	7	76	291	WM-187	1140	39											2862
H-7	4	7	76	292	WM-187	1141	39											2864
H-7	5	7	76	293	WM-187	1140	39											2862
H-7	5	7	76	294	WM-187	1141	39											2864
H-7	6	7	76	295	WM-187	1140	39											2862
H-7	6	7	76	296	WM-187	1137	39											2855
H-7	7	7	76	297	WM-187	1140	39											2862
H-7	8	7	76	298	WM-187	1140	39											2862
H-7	8	7	76	299	WM-187	1141	39											2864
H-7	9	7	76	300	WM-187	1140	39											2862
H-7	9	7	76	301	WM-187	1254	39											3148
H-7	10	7	76	302	WM-187	1143	39											2869
H-7	11	7	76	303	WM-187	1137	39											2855
H-7	11	7	76	304	WM-187	1143	39											2869
H-7	12	7	76	305	WM-187	1141	39											2864
H-7	12	7	76	306	WM-187	1194	39											2998
H-7	13	7	76	307	WM-187	1141	39											2864
H-7	13	7	76	308	WM-187	898	39											2254
H-7	14	7	76	309	WM-187	1140	39											2862
H-7	14	7	76	310	WM-187	1150	39											2886
H-7	15	7	76	311	WM-187	1141	39											2864
H-7	15	7	76	312	WM-187	1158	39											2907
H-7	16	7	76	313	WM-187	1141	39											2864
H-7	16	7	76	314	WM-187	1153	39											2895
H-7	17	7	76	315	WM-187	1137	39											2855
H-7	20	7	76	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	21	7	76	CF	Cold									4800	1.7		11.2	
H-7	24	10	76	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-7	24	10	76	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-7	24	10	76	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-7	1	12	76	CF	Cold									1200	1.7		2.8	
H-7	2	12	76	CF	Cold									1028	1.7		2.4	
H-7	3	12	76	CF	Cold									1447	1.7		3.4	
H-7	3	12	76	CF	Cold									1079	1.7		2.5	
H-7	4	12	76	316	WM-185	965	41											3004
H-7	4	12	76	317	WM-185	950	41											2957
H-7	5	12	76	318	WM-185	970	41											3019
H-7	5	12	76	319	WM-185	950	41											2957
H-7	6	12	76	320	WM-185	966	41											3007
H-7	7	12	76	321	WM-185	979	41											3046
H-7	7	12	76	322	WM-185	961	41											2993
H-7	8	12	76	323	WM-185	950	41											2957
H-7	9	12	76	324	WM-185	958	41											2981
H-7	9	12	76	325	WM-185	958	41											2981
H-7	10	12	76	326	WM-185	1003	41											3123
H-7	11	12	76	327	WM-185	970	41											3019
H-7	11	12	76	328	WM-185	953	41											2966
H-7	12	12	76	329	WM-185	954	41											2969
H-7	12	12	76	330	WM-185	950	41											2957
H-7	13	12	76	331	WM-185	954	41											2969
H-7	13	12	76	332	WM-185	949	41											2954
H-7	14	12	76	333	WM-185	949	41											2954
H-7	14	12	76	334	WM-185	986	41											3069
H-7	15	12	76	335	WM-185	1189	41											3702
H-7	16	12	76	336	WM-185	1147	41											3569
H-7	16	12	76	337	WM-185	1142	41											3554
H-7	17	12	76	338	WM-185	1044	41											3250
H-7	17	12	76	339	WM-185	1163	41											3619
H-7	18	12	76	340				WM-187	1155	42								3596

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-7	19	12	76	341				WM-187	1170	42								3643
H-7	20	12	76	342	WM-185	982	41											3058
H-7	21	12	76	343	WM-185	979	41											3046
H-7	21	12	76	344	WM-185	965	41											3004
H-7	22	12	76	345	WM-185	950	41											2957
H-7	26	12	76	346	WM-185	769	41											2392
H-7	27	12	76	347	WM-185	869	41											2706
H-7	28	12	76	348	WM-185	760	41											2366
H-7	29	12	76	349	WM-185	760	41											2366
H-7	30	12	76	350	WM-185	971	41											3022
H-7	30	12	76	351	WM-185	779	41											2425
H-7	31	12	76	352	WM-185	777	41											2419
H-7	1	1	77	353	WM-185	772	41											2404
H-7	2	1	77	354	WM-185	772	41											2404
H-7	2	1	77	355	WM-185	769	41											2392
H-7	3	1	77	356	WM-185	954	41											2969
H-7	3	1	77	357	WM-185	765	41											2380
H-7	4	1	77	358	WM-185	1002	41											3120
H-7	5	1	77	359	WM-185	762	41											2372
H-7	5	1	77	360	WM-185	950	41											2957
H-7	6	1	77	361	WM-185	866	41	WM-180	99	40								2697
H-7	7	1	77	362	WM-185	875	41	WM-180	139	40								2723
H-7	7	1	77	363	WM-185	917	41											2854
H-7	8	1	77	364	WM-185	940	41	WM-180	138	40								2925
H-7	9	1	77	365	WM-185	1138	41	WM-180	200	40								3543
H-7	9	1	77	366	WM-185	1140	41	WM-180	79	40								3548
H-7	10	1	77	367	WM-185	948	41	WM-180	103	40								2951
H-7	11	1	77	368	WM-185	1007	41	WM-180	101	40								3134
H-7	11	1	77	369	WM-185	950	41	WM-180	164	40								2957
H-7	12	1	77	370	WM-185	954	41											2969
H-7	13	1	77	371	WM-185	958	41											2981
H-7	14	1	77	372	WM-185	1024	41											3188
H-7	15	1	77	373	WM-185	961	41											2993
H-7	16	1	77	374	WM-185	1134	41											3531
H-7	16	1	77	375	WM-185	1159	41											3608
H-7	17	1	77	376	WM-185	954	41											2969
H-7	18	1	77	377	WM-185	956	41											4575
H-7	19	1	77	378	WM-185	950	41											2957
H-7	19	1	77	379	WM-185	1155	41											3596
H-7	20	1	77	380	WM-185	1155	41											3596
H-7	21	1	77	381	WM-185	1138	41											3543
H-7	23	1	77	CF	Cold									1000	1.9		2.3	
H-8	7	9	77	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-8	8	9	77	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-8	8	9	77	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-8	10	9	77	CF	Cold									9999	1.9		23.4	
H-8	13	9	77	1	WM-185	974	43											2967
H-8	14	9	77	2	WM-185	954	43											2903
H-8	14	9	77	3	WM-185	954	43											2903
H-8	15	9	77	4	WM-185	912	43											2779
H-8	16	9	77	5	WM-185	994	43											3065
H-8	16	9	77	6	WM-185	963	43											2955
H-8	18	9	77	7	WM-185	968	43											2946
H-8	18	9	77	8	WM-185	949	43											2920
H-8	19	9	77	9	WM-185	945	43											2909
H-8	19	9	77	10	WM-185	966	43											2969
H-8	20	9	77	11	WM-185	917	43											2779
H-8	20	9	77	12	WM-185	941	43											2880
H-8	21	9	77	13	WM-185	941	43											2854
H-8	22	9	77	14	WM-185	1007	43											3053
H-8	22	9	77	15	WM-185	950	43											2895
H-8	23	9	77	16	WM-185	970	43											2938
H-8	23	9	77	17	WM-185	957	43											2987
H-8	24	9	77	18	WM-185	970	43											3115
H-8	24	9	77	19	WM-185	1013	43											3070
H-8	25	9	77	20	WM-185	953	43											2889
H-8	26	9	77	21	WM-185	966	43											2930
H-8	26	9	77	22	WM-185	925	43											2805

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	27	9	77	23	WM-185	961	43											2915
H-8	27	9	77	24	WM-185	998	43											3027
H-8	28	9	77	25	WM-185	1171	43											3551
H-8	28	9	77	26	WM-185	1232	43											3735
H-8	29	9	77	27	WM-185	1147	43											3476
H-8	30	9	77	28	WM-185	1147	43											3476
H-8	30	9	77	29	WM-185	1195	43											3623
H-8	1	10	77	30	WM-185	1163	43											3525
H-8	1	10	77	31	WM-185	1249	43											3787
H-8	2	10	77	32	WM-185	1147	43											3476
H-8	3	10	77	33	WM-185	1179	43											3574
H-8	3	10	77	34	WM-185	1334	43											4043
H-8	4	10	77	35	WM-185	1147	43											3476
H-8	4	10	77	36	WM-185	1143	43											3465
H-8	5	10	77	37	WM-185	1138	43											3450
H-8	6	10	77	38	WM-185	1199	43											3634
H-8	6	10	77	39	WM-185	1189	43											3605
H-8	7	10	77	40	WM-185	1168	43											3540
H-8	8	10	77	41	WM-185	1156	43											3505
H-8	8	10	77	42	WM-185	1171	43											3551
H-8	9	10	77	43	WM-185	1145	43											3456
H-8	10	10	77	44	WM-185	1159	43											3456
H-8	10	10	77	45	WM-185	1175	43											3563
H-8	11	10	77	46	WM-185	1221	43											3701
H-8	11	10	77	47	WM-185	1171	43											3551
H-8	12	10	77	48	WM-185	1207	43											3660
H-8	13	10	77	49	WM-185	1159	43											3514
H-8	13	10	77	50	WM-185	1221	43											3701
H-8	15	10	77	51	WM-185	1113	43											3376
H-8	16	10	77	52	WM-185	1138	43											3450
H-8	17	10	77	53	WM-185	1189	43											3606
H-8	17	10	77	54	WM-185	1131	43											3433
H-8	17	10	77	55	WM-185	1184	43											3589
H-8	21	10	77	56	WM-185	1168	43											3539
H-8	22	10	77	57	WM-185	1163	43											3525
H-8	22	10	77	58	WM-185	1192	43											3615
H-8	23	10	77	59	WM-185	1159	43											3514
H-8	23	10	77	60	WM-185	1177	43											3568
H-8	24	10	77	61	WM-185	1199	43											3634
H-8	25	10	77	62	WM-185	1159	43											3514
H-8	25	10	77	63	WM-185	1176	43											3565
H-8	26	10	77	64	WM-185	1159	43											3514
H-8	26	10	77	65	WM-185	1194	43											3620
H-8	27	10	77	66	WM-185	1134	43											3456
H-8	28	10	77	67	WM-185	1150	43											3488
H-8	28	10	77	68	WM-185	1149	43											3482
H-8	29	10	77	69	WM-185	1126	43											3413
H-8	29	10	77	70	WM-185	1188	43											3600
H-8	30	10	77	71	WM-185	1161	43											3519
H-8	30	10	77	72	WM-185	1147	43											3476
H-8	31	10	77	73	WM-185	1161	43											3519
H-8	1	11	77	74	WM-185	1147	43											3476
H-8	1	11	77	75	WM-185	1206	43											3654
H-8	2	11	77	76	WM-185	1138	43											3450
H-8	2	11	77	77	WM-185	1168	43											3540
H-8	3	11	77	78	WM-185	1175	43											3563
H-8	4	11	77	79	WM-185	1076	43											3263
H-8	5	11	77	80	WM-185	1117	43											3387
H-8	6	11	77	81	WM-185	1126	43											3413
H-8	6	11	77	82	WM-185	1163	43											3741
H-8	7	11	77	83	WM-185	1150	43											3489
H-8	7	11	77	84	WM-185	1147	43											3485
H-8	8	11	77	85	WM-185	1184	43											3589
H-8	8	11	77	86	WM-185	1134	43											3439
H-8	9	11	77	87	WM-185	1147	43											3476
H-8	10	11	77	88	WM-185	1142	43											3462
H-8	10	11	77	89	WM-185	1159	43											3514
H-8	11	11	77	90	WM-185	1165	43											3531

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	11	11	77	91	WM-185	1147	43											3476
H-8	12	11	77	92	WM-185	1155	43											3502
H-8	12	11	77	93	WM-185	1134	43											3439
H-8	13	11	77	94	WM-185	1175	43											3562
H-8	14	11	77	95	WM-185	1142	43											3462
H-8	14	11	77	96	WM-185	1138	43											3451
H-8	15	11	77	97	WM-185	1174	43											3560
H-8	15	11	77	98	WM-185	1147	43											3476
H-8	16	11	77	99	WM-185	1171	43											3551
H-8	16	11	77	100	WM-185	1138	43											3451
H-8	17	11	77	101	WM-185	1147	43											3476
H-8	18	11	77	102	WM-185	1143	43											3465
H-8	18	11	77	103	WM-185	1147	43											3476
H-8	19	11	77	104	WM-185	1188	43											3600
H-8	19	11	77	105	WM-185	1131	43											3427
H-8	20	11	77	106	WM-185	1155	43											3502
H-8	20	11	77	107	WM-185	1154	43											3499
H-8	21	11	77	108	WM-185	1159	43											3514
H-8	21	11	77	109	WM-185	1192	43											3614
H-8	22	11	77	110	WM-185	1163	43											3525
H-8	22	11	77	111	WM-185	1168	43											3545
H-8	23	11	77	112	WM-185	1154	43											3499
H-8	24	11	77	113	WM-185	1140	43											3456
H-8	24	11	77	114	WM-185	1159	43											3514
H-8	25	11	77	115	WM-185	1147	43											3476
H-8	26	11	77	116	WM-185	1088	43											3296
H-8	27	11	77	117	WM-185	1170	43											3548
H-8	27	11	77	118	WM-185	941	43											2610
H-8	28	11	77	119	WM-185	944	43											2618
H-8	29	11	77	120	WM-185	974	43											2699
H-8	29	11	77	121	WM-185	959	43											2657
H-8	30	11	77	122	WM-185	1143	43											3456
H-8	30	11	77	123	WM-185	970	43											2689
H-8	1	12	77	124	WM-185	1007	43											2791
H-8	2	12	77	125	WM-185	949	43											2631
H-8	2	12	77	126	WM-185	947	43											2626
H-8	3	12	77	127	WM-185	979	43											2712
H-8	3	12	77	128	WM-185	979	43											2712
H-8	4	12	77	129	WM-185	991	43											2747
H-8	4	12	77	130	WM-185	965	43											2676
H-8	5	12	77	131	WM-185	958	43											2655
H-8	5	12	77	132	WM-185	965	43											2676
H-8	6	12	77	133	WM-185	1002	43											3038
H-8	6	12	77	134	WM-185	1143	43											3465
H-8	7	12	77	135	WM-185	1018	43											3087
H-8	7	12	77	136	WM-185	971	43											2691
H-8	8	12	77	137	WM-185	970	43											2830
H-8	9	12	77	138	WM-185	872	43											2545
H-8	9	12	77	139	WM-185	908	43											2650
H-8	10	12	77	140	WM-185	990	43											2888
H-8	10	12	77	141	WM-185	1007	43											2938
H-8	11	12	77	142	WM-185	997	43											2908
H-8	11	12	77	143	WM-185	1027	43											2997
H-8	12	12	77	144	WM-185	958	43											2794
H-8	13	12	77	145	WM-185	995	43											2902
H-8	13	12	77	146	WM-185	979	43											2855
H-8	14	12	77	147	WM-185	982	43											2866
H-8	21	12	77	148	WM-185	995	43											2902
H-8	22	12	77	149	WM-185	958	43											2772
H-8	22	12	77	150	WM-185	965	43											2816
H-8	23	12	77	151	WM-185	958	43											2794
H-8	23	12	77	152	WM-185	945	43											2758
H-8	24	12	77	153	WM-185	955	43											2786
H-8	25	12	77	154	WM-185	958	43											2794
H-8	25	12	77	155	WM-185	958	43											2794
H-8	26	12	77	156	WM-185	959	43											2797
H-8	26	12	77	157	WM-185	951	43											2775
H-8	27	12	77	158	WM-185	958	43											2794

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	28	12	77	159	WM-185	965	43											2816
H-8	28	12	77	160	WM-185	974	43											2841
H-8	29	12	77	161	WM-185	958	43											2794
H-8	29	12	77	162	WM-185	974	43											2841
H-8	30	12	77	163	WM-185	974	43											2841
H-8	30	12	77	164	WM-182	957	44											2791
H-8	31	12	77	165	WM-185	949	43											2769
H-8	1	1	78	166	WM-185	982	43											2866
H-8	1	1	78	167	WM-185	945	43											2758
H-8	2	1	78	168	WM-185	950	43											2772
H-8	3	1	78	169	WM-185	967	43											2822
H-8	3	1	78	170	WM-185	928	43											2708
H-8	4	1	78	171	WM-185	972	43											2836
H-8	4	1	78	172	WM-185	941	43											2747
H-8	5	1	78	173	WM-185	933	43											2722
H-8	5	1	78	174	WM-185	954	43											2783
H-8	6	1	78	175	WM-185	966	43											2819
H-8	7	1	78	176	WM-185	958	43											2794
H-8	7	1	78	177	WM-185	954	43											2783
H-8	8	1	78	178	WM-185	960	43											2800
H-8	8	1	78	179	WM-185	974	43											2841
H-8	9	1	78	180	WM-185	1071	43											3124
H-8	13	1	78	181	WM-185	1010	43											2947
H-8	14	1	78	182	WM-185	954	43											2783
H-8	14	1	78	183	WM-185	970	43											2830
H-8	15	1	78	184	WM-185	960	43											2805
H-8	15	1	78	185	WM-185	912	43											2661
H-8	16	1	78	186	WM-185	941	43											2747
H-8	16	1	78	187	WM-185	968	43											2825
H-8	17	1	78	188	WM-185	981	43											2863
H-8	18	1	78	189	WM-185	991	43											2891
H-8	18	1	78	190	WM-185	843	43											2483
H-8	19	1	78	191	WM-185	954	43											2783
H-8	20	1	78	192	WM-185	859	43											2506
H-8	20	1	78	193	WM-185	874	43											2550
H-8	21	1	78	194	WM-185	954	43											2783
H-8	21	1	78	195	WM-185	954	43											2783
H-8	22	1	78	196	WM-185	949	43											2769
H-8	22	1	78	197	WM-185	961	43											2805
H-8	22	1	78	198	WM-185	954	43											2783
H-8	23	1	78	199	WM-185	956	43											2788
H-8	24	1	78	200	WM-185	960	43											2800
H-8	24	1	78	201	WM-185	949	43											2769
H-8	25	1	78	202	WM-185	943	43											2753
H-8	26	1	78	203	WM-185	965	43											2816
H-8	26	1	78	204	WM-185	953	43											2780
H-8	27	1	78	205	WM-185	1027	43											2997
H-8	28	1	78	206	WM-185	998	43											2913
H-8	29	1	78	207	WM-182	895	44											2611
H-8	30	1	78	208	WM-182	1134	44											3075
H-8	31	1	78	209	WM-182	1064	44											2884
H-8	1	2	78	210	WM-182	1143	44											3120
H-8	7	2	78	212	WM-182	1175	44											3185
H-8	7	2	78	DB	Dolomite Bed (approx. 7 cubic feet)							460	92					
H-8	8	2	78	213	WM-182	922	44											2480
H-8	8	2	78	214	WM-182	1078	44											3040
H-8	9	2	78	215	WM-182	1034	44											2800
H-8	10	2	78	216	WM-182	981	44											2640
H-8	11	2	78	217	WM-182	965	44											2640
H-8	12	2	78	218	WM-182	1163	44											3120
H-8	13	2	78	219	WM-182	1188	44											3200
H-8	14	2	78	220	WM-182	973	44											2640
H-8	15	2	78	221	WM-182	949	44											2560
H-8	16	2	78	222	WM-182	1019	44											2720
H-8	17	2	78	223	WM-182	1048	44											2800
H-8	18	2	78	224	WM-182	1062	44											2880
H-8	19	2	78	225	WM-182	941	44											2560
H-8	19	2	78	226	WM-182	1139	44											3120

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	20	2	78	227	WM-182	1125	44											3040
H-8	21	2	78	228	WM-182	1197	44											3280
H-8	22	2	78	229	WM-182	1281	44											3440
H-8	24	2	78	230	WM-182	1155	44											3120
H-8	25	2	78	231	WM-182	1147	44											3120
H-8	26	2	78	232	WM-182	777	44											2640
H-8	27	2	78	233	WM-182	1114	44											3040
H-8	28	2	78	234	WM-182	1167	44											3120
H-8	28	2	78	235	WM-182	1118	44											3040
H-8	1	3	78	236	WM-182	766	44											2800
H-8	2	3	78	237	WM-182	1057	44											2880
H-8	27	3	78	FB	Fluorapatite Bed (approx. 122 cubic feet)							8525	93					
H-8	28	3	78	CFDB	Cold Feed + Dolomite Bed (approx. 55 cubic feet)							3870	92	6800	1.9		6.1	
H-8	3	4	78	238	WM-182	985	46											2640
H-8	4	4	78	239	WM-182	1124	46											3120
H-8	5	4	78	240	WM-182	957	46											2560
H-8	5	4	78	241	WM-182	1155	46											3120
H-8	6	4	78	242	WM-182	977	46											2640
H-8	6	4	78	243	WM-182	1134	46											3040
H-8	7	4	78	244	WM-182	985	46											2640
H-8	7	4	78	245	WM-182	988	46											2640
H-8	8	4	78	246	WM-182	1009	46											2720
H-8	9	4	78	247	WM-182	991	46											2640
H-8	9	4	78	248	WM-182	1134	46											3040
H-8	10	4	78	249	WM-182	1150	46											3120
H-8	10	4	78	250	WM-182	1134	46											3040
H-8	11	4	78	251	WM-182	1143	46											3120
H-8	11	4	78	252	WM-182	1139	46											3200
H-8	12	4	78	253	WM-182	1156	46											3280
H-8	13	4	78	254	WM-182	1130	46											3040
H-8	13	4	78	255	WM-182	1183	46											3200
H-8	14	4	78	256	WM-182	1168	46											3200
H-8	15	4	78	257	WM-182	1127	46											3040
H-8	15	4	78	258	WM-182	1134	46											3040
H-8	16	4	78	259	WM-182	1134	46											3040
H-8	17	4	78	260	WM-182	743	46	WM-180	250	45								2640
H-8	17	4	78	261	WM-182	754	46	WM-180	240	45								2640
H-8	18	4	78	262	WM-182	795	46	WM-180	257	45								2720
H-8	18	4	78	263	WM-182	793	46	WM-180	210	45								2720
H-8	19	4	78	264	WM-182	770	46	WM-180	221	45								2640
H-8	19	4	78	265	WM-182	761	46	WM-180	217	45								2640
H-8	20	4	78	266	WM-182	811	46	WM-180	234	45								2800
H-8	20	4	78	267	WM-182	759	46											2080
H-8	21	4	78	268	WM-182	803	46	WM-180	199	45								2800
H-8	22	4	78	269	WM-182	787	46	WM-180	225	45								2720
H-8	22	4	78	270	WM-182	763	46	WM-180	214	45								2640
H-8	23	4	78	271	WM-182	815	46	WM-180	232	45								2800
H-8	24	4	78	272	WM-182	757	46	WM-180	172	45								2640
H-8	24	4	78	273	WM-182	754	46	WM-180	198	45								2640
H-8	25	4	78	274	WM-182	779	46	WM-180	222	45								2720
H-8	25	4	78	275	WM-182	783	46	WM-180	199	45								2720
H-8	26	4	78	276	WM-182	763	46	WM-180	221	45								2640
H-8	14	5	78	277	WM-182	872	46	WM-180	250	45								2960
H-8	15	5	78	278	WM-182	871	46											2400
H-8	16	5	78	279	WM-182	964	46											2640
H-8	17	5	78	280	WM-182	968	46											2640
H-8	18	5	78	281	WM-182	759	46	WM-180	218	45								2640
H-8	19	5	78	282	WM-182	763	46	WM-180	222	45								2720
H-8	19	5	78	283	WM-182	777	46	WM-180	220	45								2800
H-8	20	5	78	284	WM-182	798	46	WM-180	232	45								2880
H-8	20	5	78	286	WM-182	759	46	WM-180	234	45								2800
H-8	21	5	78	286	WM-182	779	46	WM-180	209	45								2800
H-8	22	5	78	287	WM-182	783	46	WM-180	222	45								2800
H-8	22	5	78	288	WM-182	827	46	WM-180	200	45								2880
H-8	23	5	78	289	WM-182	781	46	WM-180	226	45								2800
H-8	23	5	78	290	WM-182	811	46	WM-180	230	45								2880
H-8	24	5	78	291	WM-182	800	46	WM-180	233	45								2960
H-8	24	5	78	292	WM-182	763	46	WM-180	214	45								2800

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	25	5	78	293	WM-182	783	46	WM-180	214	45								2800
H-8	26	5	78	294	WM-182	769	46	WM-180	226	45								2800
H-8	26	5	78	295	WM-182	783	46	WM-180	250	45								2800
H-8	27	5	78	296	WM-182	809	46	WM-180	238	45								2960
H-8	28	5	78	297	WM-182	864	46	WM-180	247	45								3120
H-8	29	5	78	298	WM-182	803	46	WM-180	231	45								2880
H-8	30	5	78	299	WM-182	808	46	WM-180	234	45								2800
H-8	31	5	78	300	WM-182	817	46	WM-180	240	45								2800
H-8	31	5	78	301	WM-182	774	46	WM-180	223	45								2640
H-8	1	6	78	302	WM-182	775	46	WM-180	194	45								2640
H-8	2	6	78	303	WM-182	791	46	WM-180	225	45								2720
H-8	2	6	78	304	WM-182	787	46	WM-180	240	45								2720
H-8	3	6	78	305	WM-182	767	46	WM-180	222	45								2640
H-8	4	6	78	306	WM-182	770	46	WM-180	220	45								2640
H-8	4	6	78	307	WM-182	795	46	WM-180	222	45								2720
H-8	5	6	78	308	WM-182	819	46	WM-180	226	45								2800
H-8	5	6	78	309	WM-182	795	46	WM-180	240	45								2720
H-8	6	6	78	310	WM-182	827	46	WM-180	235	45								2880
H-8	7	6	78	311	WM-182	762	46	WM-180	215	45								2640
H-8	7	6	78	312	WM-182	808	46	WM-180	250	45								2800
H-8	8	6	78	313	WM-182	767	46	WM-180	240	45								2640
H-8	9	6	78	314	WM-182	797	46	WM-180	233	45								2720
H-8	9	6	78	315	WM-182	787	46	WM-180	227	45								2720
H-8	10	6	78	316	WM-182	758	46	WM-180	219	45								2640
H-8	11	6	78	317	WM-182	763	46	WM-180	218	45								2640
H-8	12	6	78	318	WM-182	754	46	WM-180	222	45								2640
H-8	12	6	78	319	WM-182	787	46	WM-180	243	45								2720
H-8	13	6	78	320	WM-182	770	46	WM-180	222	45								2640
H-8	13	6	78	321	WM-182	813	46	WM-180	219	45								2800
H-8	14	6	78	322	WM-182	803	46	WM-180	206	45								2720
H-8	15	6	78	323	WM-182	772	46	WM-180	217	45								2640
H-8	15	6	78	324	WM-182	752	46	WM-180	224	45								2640
H-8	16	6	78	325	WM-182	790	46	WM-180	226	45								2720
H-8	17	6	78	326	WM-182	815	46	WM-180	235	45								2800
H-8	17	6	78	327	WM-182	754	46	WM-180	223	45								2640
H-8	18	6	78	328	WM-182	779	46	WM-180	220	45								2640
H-8	19	6	78	329	WM-182	759	46	WM-180	212	45								2640
H-8	20	6	78	330	WM-182	759	46	WM-180	219	45								2640
H-8	20	6	78	331	WM-182	775	46	WM-180	221	45								2640
H-8	20	6	78	332	WM-182	751	46	WM-180	219	45								2560
H-8	21	6	78	333	WM-182	783	46	WM-180	224	45								2720
H-8	21	6	78	334	WM-182	753	46	WM-180	216	45								2560
H-8	22	6	78	335	WM-182	788	46	WM-180	233	45								2720
H-8	22	6	78	336	WM-182	747	46	WM-180	219	45								2560
H-8	23	6	78	337	WM-182	804	46	WM-180	251	45								2720
H-8	23	6	78	338	WM-182	751	46	WM-180	250	45								2640
H-8	24	6	78	339	WM-182	753	46	WM-180	220	45								2560
H-8	25	6	78	340	WM-182	794	46	WM-180	187	45								2640
H-8	26	6	78	341	WM-182	814	46	WM-180	240	45								2800
H-8	27	6	78	342	WM-182	794	46	WM-180	228	45								2720
H-8	27	6	78	343	WM-182	1177	46											3200
H-8	29	6	78	344	WM-182	968	46											2640
H-8	29	6	78	345	WM-182	1165	46											3120
H-8	30	6	78	346	WM-182	1177	46											3200
H-8	1	7	78	347	WM-182	764	46	WM-180	214	45								3640
H-8	2	7	78	348	WM-182	827	46	WM-180	249	45								2880
H-8	3	7	78	349	WM-182	777	46	WM-180	224	45								2680
H-8	4	7	78	350	WM-182	770	46	WM-180	228	45								2640
H-8	5	7	78	351	WM-182	764	46	WM-180	249	45								2960
H-8	5	7	78	352	WM-182	788	46	WM-180	244	45								2720
H-8	6	7	78	353	WM-182	802	46	WM-180	229	45								2800
H-8	7	7	78	354	WM-182	762	46	WM-180	220	45								2640
H-8	8	7	78	355	WM-182	950	46											2560
H-8	8	7	78	356	WM-182	974	46											2640
H-8	9	7	78	357	WM-182	941	46											2560
H-8	9	7	78	358	WM-182	968	46											2640
H-8	10	7	78	359	WM-182	953	46	WM-180	294	45								3280
H-8	16	7	78	360	WM-182	770	46	WM-180	224	45								2640

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	17	7	78	361	WM-182	818	46	WM-180	233	45								2800
H-8	23	7	78	362	WM-182	1038	46											2800
H-8	23	7	78	363	WM-182	916	46											2480
H-8	24	7	78	364	WM-182	751	46	WM-180	216	45								2560
H-8	25	7	78	365	WM-182	750	46	WM-180	222	45								2560
H-8	26	7	78	366	WM-182	778	46	WM-180	222	45								2720
H-8	26	7	78	367	WM-182	794	46	WM-180	224	45								2720
H-8	27	7	78	368	WM-182	736	46	WM-180	214	45								2560
H-8	28	7	78	369	WM-188	761	47	WM-180	217	45								2640
H-8	29	7	78	370	WM-182	969	46	WM-180	261	45								3360
H-8	29	7	78	371	WM-182	766	46	WM-180	236	45								2640
H-8	30	7	78	372	WM-182	770	46	WM-180	219	45								2640
H-8	31	7	78	373	WM-182	765	46	WM-180	223	45								2640
H-8	31	7	78	374	WM-182	770	46	WM-180	219	45								2640
H-8	1	8	78	375	WM-189	920	52	WM-180	170	45								1840
H-8	1	8	78	376	WM-182	784	46	WM-180	206	45								2720
H-8	2	8	78	377	WM-182	766	46	WM-180	221	45								2640
H-8	3	8	78	378	WM-182	757	46	WM-180	222	45								2640
H-8	3	8	78	379				WM-180	222	45	WM-188	778	47					2640
H-8	4	8	78	380	WM-182	750	46	WM-180	214	45								2560
H-8	5	8	78	381	WM-182	794	46	WM-180	232	45								2720
H-8	6	8	78	382	WM-182	766	46	WM-180	220	45								2640
H-8	6	8	78	383				WM-180	226	45	WM-189	839	52					2040
H-8	7	8	78	384	WM-182	757	46	WM-180	216	45								2640
H-8	8	8	78	385	WM-182	766	46	WM-180	216	45								2640
H-8	8	8	78	386	WM-182	790	46	WM-180	285	45								2880
H-8	9	8	78	387	WM-182	1145	46											3120
H-8	10	8	78	388	WM-182	1140	46											3120
H-8	11	8	78	389	WM-182	1141	46											3120
H-8	10	8	78	390	WM-182	745	46	WM-180	213	45								2560
H-8	12	8	78	391	WM-182	765	46	WM-180	219	45								2640
H-8	13	8	78	392	WM-182	788	46	WM-180	222	45								2720
H-8	13	8	78	393	WM-182	753	46	WM-180	222	45								2640
H-8	14	8	78	394	WM-182	786	46	WM-180	228	45								2720
H-8	15	8	78	395	WM-182	768	46	WM-180	216	45								2640
H-8	15	8	78	396	WM-182	753	46	WM-180	216	45								2560
H-8	16	8	78	397	WM-182	782	46	WM-180	220	45								2720
H-8	17	8	78	398	WM-182	755	46	WM-180	235	45								2640
H-8	17	8	78	399	WM-182	762	46	WM-180	216	45								2640
H-8	18	8	78	400	WM-182	757	46	WM-180	228	45								2640
H-8	19	8	78	401	WM-182	827	46	WM-180	237	45								2880
H-8	20	8	78	402	WM-182	786	46	WM-180	224	45								2720
H-8	21	8	78	403	WM-182	782	46	WM-180	224	45								2720
H-8	21	8	78	404	WM-182	761	46	WM-180	220	45								2640
H-8	22	8	78	405	WM-182	751	46											2560
H-8	23	8	78	406	WM-182	953	46											2560
H-8	23	8	78	407	WM-182	1149	46											3120
H-8	24	8	78	408	WM-182	766	46	WM-180	214	45								2080
H-8	25	8	78	409	WM-182	766	46	WM-180	219	45								2640
H-8	26	8	78	410	WM-182	773	46	WM-180	220	45								2640
H-8	27	8	78	411	WM-182	750	46	WM-180	216	45								2560
H-8	28	8	78	412	WM-182	713	46	WM-180	294	45								3520
H-8	29	8	78	413	WM-182	783	46	WM-180	227	45								2720
H-8	30	8	78	414	WM-182	766	46	WM-180	224	45								2640
H-8	30	8	78	415	WM-182	807	46	WM-180	236	45								3200
H-8	31	8	78	416	WM-182	757	46	WM-180	415	45								3040
H-8	1	9	78	417	WM-182	777	46	WM-180	405	45								3120
H-8	2	9	78	418	WM-182	757	46	WM-180	390	45								2960
H-8	2	9	78	419	WM-182	766	46	WM-180	224	45								2640
H-8	3	9	78	420	WM-182	750	46	WM-180	228	45								2560
H-8	4	9	78	421	WM-182	750	46	WM-180	208	45								2560
H-8	5	9	78	422	WM-182	941	46											2560
H-8	5	9	78	423	WM-182	963	46											2560
H-8	6	9	78	424	WM-182	1134	46											3040
H-8	7	9	78	425	WM-182	745	46	WM-180	213	45								2560
H-8	8	9	78	426	WM-182	770	46	WM-180	219	45								2640
H-8	9	9	78	427	WM-182	784	46	WM-180	210	45								2720
H-8	9	9	78	428	WM-182	803	46	WM-180	330	45								2960

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-8	10	9	78	429	WM-182	808	46	WM-180	333	45								3040
H-8	11	9	78	430	WM-182	808	46	WM-180	345	45								3040
H-8	12	9	78	431	WM-182	805	46	WM-180	324	45								2960
H-8	13	9	78	432	WM-182	808	46	WM-180	333	45								3040
H-8	14	9	78	433	WM-182	843	46	WM-180	355	45								3120
H-8	14	9	78	434	WM-182	607	46	WM-180	342	45								2480
H-8	15	9	78	435	WM-182	627	46	WM-180	359	45								2640
H-8	16	9	78	436	WM-182	521	46	WM-180	343	45								2240
H-8	16	9	78	437	WM-182	808	46	WM-180	247	45								2800
H-8	17	9	78	438	WM-182	851	46	WM-180	243	45								2960
H-8	18	9	78	439	WM-182	798	46	WM-180	224	45								2720
H-8	19	9	78	440	WM-182	1166	46											3200
H-8	19	9	78	441	WM-182	1177	46											3200
H-8	20	9	78	442	WM-182	770	46	WM-180	224	45								2720
H-8	21	9	78	443	WM-182	732	46	WM-180	261	45								2480
H-8	22	9	78	444	WM-182	732	46	WM-180	267	45								2640
H-8	23	9	78	445	WM-182	1110	46	WM-180	443	45								4000
H-8	24	9	78	446	WM-182	745	46	WM-180	282	45								2720
H-8	24	9	78	447	WM-182	766	46	WM-180	293	45								2800
H-8	25	9	78	448	WM-182	762	46	WM-180	301	45								2800
H-8	26	9	78	449	WM-182	770	46	WM-180	318	45								2880
H-8	27	9	78	450	WM-182	737	46	WM-180	338	45								2800
H-8	28	9	78	451	WM-182	445	46	WM-180	219	45								1760
H-8	28	9	78	452	WM-182	447	46	WM-180	212	45								1760
H-9	8	6	79	FB	Fluorapatite Bed (approx. 66 cubic feet)							4650	93					
H-9	10	6	79	FB	Fluorapatite Bed (approx. 17 cubic feet)							1162	93					
H-9	11	6	79	CF	Cold									1200	1.9		3.4	
H-9	11	6	79	DB	Dolomite Bed (approx. 22 cubic feet)							1550	92					
H-9	11	6	79	DB	Dolomite Bed (approx. 4 cubic feet)							300	92					
H-9	11	6	79	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-9	11	6	79	CF	Cold									765	1.9		2.0	
H-9	12	6	79	DB	Dolomite Bed (approx. 4 cubic feet)							300	92					
H-9	12	6	79	CF	Cold									527	1.9		1.5	
H-9	12	6	79	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-9	12	6	79	CF	Cold									912	2		2.6	
H-9	13	6	79	CF	Cold									1260	2		3.5	
H-9	14	6	79	CF	Cold									720	1.8		2.0	
H-9	14	6	79	CF	Cold									670	1.8		1.9	
H-9	15	6	79	CF	Cold									463	1.8		1.3	
H-9	15	6	79	CF	Cold									500	1.8		1.4	
H-9	16	6	79	1	WM-182	349	49											640
H-9	17	6	79	CF	Cold									680	1.7		1.9	
H-9	17	6	79	CF	Cold									520	1.7		1.5	
H-9	17	6	79	CF	Cold									395	1.8		1.1	
H-9	18	6	79	CF	Cold									640	1.8		1.8	
H-9	18	6	79	CF	Cold									875	1.8		2.5	
H-9	18	6	79	CF	Cold									110	1.8		0.3	
H-9	19	6	79	CF	Cold									985	1.8		2.8	
H-9	20	6	79	CF	Cold									920	1.8		2.6	
H-9	21	6	79	CF	Cold									944	1.8		2.6	
H-9	21	6	79	1	WM-182	570	49											1040
H-9	21	6	79	2	WM-182	946	49											1700
H-9	22	6	79	3	WM-182	946	49											1680
H-9	22	6	79	4	WM-182	929	49											1680
H-9	23	6	79	5	WM-182	950	49											1680
H-9	23	6	79	6	WM-182	975	49											1760
H-9	24	6	79	7	WM-182	950	49											1680
H-9	24	6	79	8	WM-182	975	49											1760
H-9	25	6	79	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-9	25	6	79	9	WM-182	992	49											1760
H-9	25	6	79	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-9	26	6	79	10	WM-182	1205	49											2160
H-9	26	6	79	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-9	27	6	79	11	WM-182	1205	49											2160
H-9	27	6	79	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-9	27	6	79	12	WM-182	971	49	WM-180	243	50								1360
H-9	27	6	79	13	WM-182	966	49	WM-180	214	50								1680
H-9	28	6	79	DB	Dolomite Bed (approx. 6 cubic feet)							390	92					

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	29	6	79	14	WM-182	967	49	WM-180	159	50								1680
H-9	30	6	79	15	WM-182	971	49	WM-180	163	50								1760
H-9	1	7	79	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-9	1	7	79	16	WM-182	954	49	WM-180	248	50								1760
H-9	2	7	79	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-9	2	7	79	17	WM-182	950	49	WM-180	269	50								1680
H-9	15	7	79	DB	Dolomite Bed (approx. 72 cubic feet)								5030	92				
H-9	16	7	79	CF	Cold									1719	1.8		4.0	
H-9	16	7	79	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-9	16	7	79	DB	Dolomite Bed (approx. 17 cubic feet)								1162	92				
H-9	18	7	79	CF	Cold									1375	1.8		3.2	
H-9	18	7	79	CF	Cold									1013	1.8		2.4	
H-9	19	7	79	CF	Cold									350	1.8		0.8	
H-9	19	7	79	CF	Cold									550	1.8		1.3	
H-9	19	7	79	CF	Cold									350	1.8		0.8	
H-9	19	7	79	CF	Cold									400	1.8		0.9	
H-9	21	7	79	18	WM-188	965	51	WM-180	210	50								1760
H-9	22	7	79	19	WM-188	859	51	WM-180	201	50								2160
H-9	22	7	79	20	WM-188	904	51	WM-180	214	50								2240
H-9	23	7	79	21	WM-188	904	51	WM-180	203	50								2232
H-9	24	7	79	22	WM-188	938	51	WM-180	253	50								2320
H-9	25	7	79	23	WM-188	964	51	WM-180	259	50								2400
H-9	26	7	79	24	WM-188	950	51	WM-180	285	50								2400
H-9	26	7	79	25	WM-188	908	51	WM-180	276	50								2240
H-9	27	7	79	26	WM-188	970	51	WM-180	271	50								2560
H-9	28	7	79	27	WM-188	904	51	WM-180	240	50								2320
H-9	28	7	79	28	WM-188	945	51	WM-180	269	50								2400
H-9	29	7	79	29	WM-188	938	51	WM-180	335	50								2480
H-9	30	7	79	30	WM-188	950	51	WM-180	171	50								2400
H-9	30	7	79	31	WM-188	954	51	WM-180	212	50								2320
H-9	31	7	79	32	WM-188	945	51	WM-180	274	50								2320
H-9	1	8	79	33	WM-188	869	51	WM-180	200	50								2160
H-9	1	8	79	34	WM-188	1036	51	WM-180	233	50								2560
H-9	1	8	79	35	WM-188	1045	51	WM-180	212	50								2560
H-9	2	8	79	36	WM-188	956	51											2560
H-9	3	8	79	37	WM-188	1132	51											2800
H-9	4	8	79	38	WM-188	1136	51											2560
H-9	5	8	79	39	WM-188	1149	51											2240
H-9	6	8	79	40	WM-188	1066	51											2080
H-9	6	8	79	41	WM-188	1178	51											2240
H-9	7	8	79	42	WM-188	1140	51											2560
H-9	8	8	79	43	WM-188	1157	51											2240
H-9	8	8	79	44	WM-188	966	51	WM-180	162	50								2400
H-9	9	8	79	45	WM-188	954	51	WM-180	160	50								2320
H-9	9	8	79	46	WM-188	958	51	WM-180	149	50								2320
H-9	10	8	79	47	WM-188	954	51	WM-180	162	50								2320
H-9	11	8	79	48	WM-188	970	51	WM-180	162	50								2400
H-9	11	8	79	49	WM-188	982	51	WM-180	166	50								2400
H-9	12	8	79	50	WM-188	950	51	WM-180	157	50								2320
H-9	13	8	79	51	WM-188	958	51	WM-180	158	50								2320
H-9	13	8	79	52	WM-182	998	49	WM-180	191	50								2080
H-9	14	8	79	53	WM-182	946	49	WM-180	166	50								2000
H-9	15	8	79	54	WM-182	1024	49	WM-180	203	50								2080
H-9	16	8	79	55	WM-182	984	49	WM-180	175	50								2080
H-9	16	8	79	56	WM-182	1017	49	WM-180	180	50								2080
H-9	17	8	79	57	WM-182	1142	49											2160
H-9	17	8	79	58	WM-182	1133	49											2080
H-9	19	8	79	59	WM-182	1125	49											2000
H-9	20	8	79	60	WM-182	1154	49											2000
H-9	21	8	79	61	WM-182	1159	49											2080
H-9	21	8	79	62	WM-182	1140	49											2080
H-9	22	8	79	63	WM-182	1150	49											2080
H-9	23	8	79	64	WM-182	1138	49											2080
H-9	25	8	79	65	WM-182	1140	49											2080
H-9	26	8	79	66	WM-188	1152	51											2080
H-9	26	8	79	67	WM-188	1140	51											2160
H-9	27	8	79	68	WM-188	1140	51											2160
H-9	28	8	79	69	WM-188	1152	51											2240

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	29	8	79	70	WM-188	1159	51											2240
H-9	29	8	79	71	WM-182	1142	49											2080
H-9	30	8	79	72	WM-182	989	49											1760
H-9	30	8	79	73	WM-182	1140	49											2080
H-9	31	8	79	74	WM-182	1164	49											2080
H-9	31	8	79	75	WM-182	1150	49											2080
H-9	1	9	79	76	WM-182	1159	49											2080
H-9	2	9	79	77	WM-182	1154	49											2080
H-9	2	9	79	78	WM-182	1155	49											2080
H-9	3	9	79	79	WM-182	1163	49											2080
H-9	4	9	79	80	WM-182	1018	49	WM-180	132	50								2320
H-9	4	9	79	81	WM-182	1023	49	WM-180	132	50								2320
H-9	5	9	79	82	WM-182	1133	49	WM-180	141	50								2560
H-9	5	9	79	83	WM-182	1010	49	WM-180	128	50								2320
H-9	6	9	79	84	WM-182	1027	49	WM-180	128	50								2320
H-9	6	9	79	85	WM-182	1032	49	WM-180	127	50								2320
H-9	7	9	79	86	WM-182	951	49											2160
H-9	7	9	79	87	WM-182	1006	49	WM-180	130	50								2320
H-9	8	9	79	88	WM-182	1027	49	WM-180	128	50								2320
H-9	8	9	79	89	WM-182	1168	49	WM-180	136	50								2640
H-9	9	9	79	90	WM-182	1150	49	WM-180	148	50								2640
H-9	9	9	79	91	WM-182	1150	49	WM-180	141	50								2640
H-9	10	9	79	92	WM-182	1142	49	WM-180	149	50								2640
H-9	10	9	79	93	WM-182	1168	49	WM-180	144	50								2640
H-9	11	9	79	94	WM-182	1142	49	WM-180	141	50								2640
H-9	11	9	79	95	WM-182	1188	49	WM-180	100	50								2640
H-9	12	9	79	96	WM-182	1140	49	WM-180	150	50								2720
H-9	12	9	79	97	WM-182	1155	49	WM-180	144	50								2640
H-9	13	9	79	98	WM-182	972	49	WM-180	125	50								2240
H-9	13	9	79	99	WM-182	1147	49	WM-180	148	50								2640
H-9	14	9	79	100	WM-182	1161	49	WM-180	149	50								2640
H-9	14	9	79	101	WM-182	1142	49	WM-180	144	50								2640
H-9	15	9	79	102	WM-182	1163	49	WM-180	145	50								2640
H-9	15	9	79	103	WM-182	951	49	WM-180	117	50								2160
H-9	15	9	79	104	WM-182	1049	49	WM-180	131	50								2400
H-9	18	9	79	105	WM-182	1150	49	WM-180	143	50								2640
H-9	20	9	79	106	WM-182	1164	49	WM-180	144	50								2640
H-9	20	9	79	107	WM-182	1180	49	WM-180	151	50								2720
H-9	21	9	79	108	WM-182	1146	49	WM-180	149	50								2640
H-9	21	9	79	109	WM-189	1348	52	WM-180	171	50								2800
H-9	22	9	79	110	WM-189	1293	52	WM-180	151	50								2720
H-9	22	9	79	111	WM-189	1270	52	WM-180	139	50								2640
H-9	23	9	79	112	WM-189	1256	52	WM-180	108	50								2000
H-9	23	9	79	113	WM-189	1325	52	WM-180	158	50								2800
H-9	24	9	79	114	WM-189	1257	52	WM-180	146	50								2640
H-9	25	9	79	115	WM-189	1170	52	WM-180	116	50								2480
H-9	26	9	79	116	WM-182	1140	49	WM-180	119	50								2560
H-9	26	9	79	117	WM-182	1140	49	WM-180	143	50								2560
H-9	27	9	79	118	WM-182	1125	49	WM-180	144	50								2480
H-9	27	9	79	119	WM-182	1127	49	WM-180	147	50								2480
H-9	28	9	79	120	WM-182	1140	49	WM-180	146	50								2560
H-9	28	9	79	121	WM-182	1125	49	WM-180	141	50								2480
H-9	29	9	79	122	WM-182	1255	49	WM-180	160	50								2800
H-9	29	9	79	123	WM-182	1147	49	WM-180	143	50								2560
H-9	30	9	79	124	WM-182	1206	49	WM-180	156	50								2640
H-9	18	11	79	FB	Fluorapatite Bed (approx. 61 cubic feet)							4260	93					
H-9	18	11	79	CF	Cold									900	1.9		2.1	
H-9	18	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	18	11	79	CF	Cold									900	1.9		2.1	
H-9	19	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	19	11	79	CF	Cold									800	1.9		1.9	
H-9	19	11	79	CF	Cold									420	1.9		1.0	
H-9	19	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	20	11	79	CF	Cold									735	1.9		1.7	
H-9	20	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	20	11	79	CF	Cold									850	1.9		2.0	
H-9	20	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	20	11	79	CF	Cold									990	1.9		2.3	

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	21	11	79	CF	Cold									475	1.9		1.1	
H-9	21	11	79	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	21	11	79	CF	Cold									935	1.9		2.2	
H-9	21	11	79	CF	Cold									925	1.9		2.2	
H-9	22	11	79	CF	Cold									912	1.9		2.1	
H-9	27	11	79	CF	Cold									935	1.9		2.2	
H-9	29	11	79	CF	Cold									980	1.9		2.3	
H-9	1	12	79	CF	Cold									865	1.9		2.0	
H-9	2	12	79	125	WM-182	963	49	WM-180	135	50								1840
H-9	2	12	79	126	WM-182	950	49	WM-180	94	50								1680
H-9	3	12	79	127	WM-182	963	49	WM-180	93	50								1760
H-9	3	12	79	128	WM-182	963	49	WM-180	98	50								1760
H-9	4	12	79	129	WM-182	955	49	WM-180	98	50								1680
H-9	5	12	79	130	WM-182	955	49	WM-180	98	50								1680
H-9	5	12	79	131	WM-182	950	49	WM-180	98	50								2640
H-9	6	12	79	132	WM-182	955	49	WM-180	119	50								2160
H-9	7	12	79	133	WM-182	953	49	WM-180	117	50								2160
H-9	8	12	79	134	WM-182	963	49	WM-180	124	50								2240
H-9	9	12	79	135	WM-182	961	49	WM-180	122	50								2200
H-9	9	12	79	136	WM-182	1138	49	WM-180	161	50								2640
H-9	10	12	79	137	WM-182	1095	49	WM-180	141	50								2480
H-9	10	12	79	138	WM-182	1142	49	WM-180	141	50								2640
H-9	11	12	79	139	WM-182	1142	49	WM-180	149	50								2640
H-9	12	12	79	140	WM-182	1138	49	WM-180	144	50								2560
H-9	12	12	79	141	WM-182	1159	49	WM-180	127	50								2640
H-9	14	12	79	142	WM-182	1150	49	WM-180	170	50								2640
H-9	14	12	79	143	WM-182	1133	49	WM-180	143	50								2560
H-9	15	12	79	144	WM-182	1155	49	WM-180	140	50								2640
H-9	16	12	79	145	WM-182	1131	49	WM-180	146	50								2560
H-9	17	12	79	146	WM-182	1142	49	WM-180	144	50								2640
H-9	17	12	79	147	WM-182	1142	49	WM-180	141	50								2640
H-9	19	12	79	148	WM-182	1142	49	WM-180	144	50								2640
H-9	19	12	79	149	WM-182	1130	49	WM-180	148	50								2560
H-9	20	12	79	150	WM-182	1142	49	WM-180	141	50								2640
H-9	20	12	79	151	WM-182	1155	49	WM-180	165	50								2640
H-9	21	12	79	152	WM-182	1138	49	WM-180	162	50								2640
H-9	22	12	79	153	WM-182	1154	49	WM-180	162	50								2640
H-9	22	12	79	154	WM-182	1150	49	WM-180	162	50								2640
H-9	23	12	79	155	WM-182	1140	49	WM-180	162	50								2640
H-9	23	12	79	156	WM-182	1144	49	WM-180	164	50								2640
H-9	24	12	79	157	WM-182	1142	49	WM-180	166	50								2640
H-9	25	12	79	158	WM-182	1138	49	WM-180	162	50								2640
H-9	25	12	79	159	WM-182	1138	49	WM-180	170	50								2640
H-9	26	12	79	160	WM-182	1140	49	WM-180	162	50								2640
H-9	27	12	79	161	WM-182	1133	49	WM-180	166	50								2640
H-9	27	12	79	162	WM-182	1152	49	WM-180	164	50								2640
H-9	28	12	79	163	WM-182	1142	49	WM-180	162	50								2640
H-9	29	12	79	164	WM-182	1145	49	WM-180	165	50								2640
H-9	30	12	79	165	WM-182	1140	49	WM-180	162	50								2640
H-9	31	12	79	166	WM-182	1147	49	WM-180	162	50								2640
H-9	1	1	80	167	WM-182	1144	49	WM-180	168	50								2640
H-9	2	1	80	168	WM-189	1070	52	WM-180	132	50								2000
H-9	3	1	80	169	WM-189	1314	52	WM-180	180	50								2720
H-9	4	1	80	170	WM-189	1159	52	WM-180	153	50								2400
H-9	5	1	80	171	WM-189	1225	52	WM-180	164	50								2560
H-9	5	1	80	172	WM-189	1188	52	WM-180	164	50								2480
H-9	6	1	80	173	WM-189	1220	52	WM-180	173	50								2560
H-9	7	1	80	174	WM-189	1216	52	WM-180	164	50								2480
H-9	7	1	80	175	WM-189	1216	52	WM-180	177	50								2508
H-9	8	1	80	176	WM-189	1216	52	WM-180	168	50								2480
H-9	8	1	80	177	WM-189	1172	52	WM-180	159	50								2400
H-9	9	1	80	178	WM-189	1238	52	WM-180	169	50								2560
H-9	10	1	80	179	WM-189	1202	52	WM-180	164	50								2320
H-9	10	1	80	180	WM-189	1238	52	WM-180	169	50								2400
H-9	11	1	80	181	WM-189	1202	52	WM-180	160	50								2400
H-9	12	1	80	182	WM-189	1266	52	WM-180	173	50								2480
H-9	13	1	80	183	WM-189	1197	52	WM-180	161	50								2320
H-9	14	1	80	184	WM-189	1202	52	WM-180	199	50								2400

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	14	1	80	185	WM-189	1193	52	WM-180	160	50								2320
H-9	15	1	80	186	WM-189	1181	52	WM-180	159	50								2320
H-9	16	1	80	187	WM-189	1311	52	WM-180	171	50								2560
H-9	16	1	80	188	WM-189	1202	52											1840
H-9	16	2	80	FB	Fluorapatite Bed (approx. 61 cubic feet)							4260	93					
H-9	17	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	17	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	17	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	18	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	18	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	18	2	80	CF	Cold									747	1.7		1.7	
H-9	18	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	19	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	19	2	80	CF	Cold									256	1.7		0.6	
H-9	19	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	20	2	80	CF	Cold									1440	1.93		3.4	
H-9	20	2	80	FB	Fluorapatite Bed (approx. 11 cubic feet)							780	93					
H-9	22	2	80	CF	Cold									149	1.92		0.4	
H-9	21	2	80	CF	Cold									889	1.92		2.1	
H-9	22	2	80	CF	Cold									442	1.94		1.0	
H-9	22	2	80	189	WM-188	1231	51											2000
H-9	22	2	80	190	WM-189	1302	53	WM-180	127	50								2080
H-9	23	2	80	191	WM-189	1197	53	WM-180	124	50								2320
H-9	24	2	80	192	WM-189	1288	53	WM-180	124	50								2560
H-9	24	2	80	193	WM-189	1265	53	WM-180	147	50								2480
H-9	25	2	80	194	WM-189	1270	53	WM-180	138	50								2480
H-9	26	2	80	195	WM-189	1252	53	WM-180	132	50								2480
H-9	27	2	80	196	WM-189	1197	53	WM-180	126	50								2320
H-9	27	2	80	197	WM-189	1184	53	WM-180	129	50								2320
H-9	28	2	80	198	WM-189	1225	53	WM-180	129	50								2400
H-9	28	2	80	199	WM-189	1216	53	WM-180	129	50								2400
H-9	28	2	80	200	WM-189	1202	53	WM-180	127	50								2400
H-9	29	2	80	201	WM-189	1142	53	WM-180	123	50								2240
H-9	29	2	80	202	WM-189	1082	53	WM-180	116	50								2160
H-9	1	3	80	203	WM-189	1375	53											1920
H-9	14	3	80	DB	Dolomite Bed (approx. 6 cubic feet)							390	92					
H-9	14	3	80	DB	Dolomite Bed (approx. 7 cubic feet)							460	92					
H-9	15	3	80	DB	Dolomite Bed (approx. 13 cubic feet)							930	92					
H-9	15	3	80	CF	Cold									1250	1.99		2.9	
H-9	15	3	80	DB	Dolomite Bed (approx. 13 cubic feet)							930	92					
H-9	15	3	80	DB	Dolomite Bed (approx. 13 cubic feet)							930	92					
H-9	15	3	80	DB	Dolomite Bed (approx. 13 cubic feet)							930	92					
H-9	16	3	80	CF	Cold									910	1.99		2.6	
H-9	17	3	80	CF	Cold									226	1.99		0.6	
H-9	17	3	80	CF	Cold									884	1.99		2.1	
H-9	17	3	80	CF	Cold									1001	2.12		2.4	
H-9	18	3	80	CF	Cold									800	2.12		1.9	
H-9	19	3	80	206	WM-185	1045	54											1542.629
H-9	20	3	80	CF	Cold									287	1.95		1.2	
H-9	20	3	80	CF	Cold									157	1.95		0.7	
H-9	20	3	80	CF	Cold									700	1.95		2.9	
H-9	21	3	80	CF	Cold									250	1.95		0.8	
H-9	22	3	80	CF	Cold									547	1.95		1.7	
H-9	22	3	80	207	WM-185	1138	54											1680
H-9	23	3	80	208	WM-185	1150	54											1760
H-9	23	3	80	209	WM-185	1140	54											1680
H-9	24	3	80	210	WM-185	1143	54											1680
H-9	25	3	80	211	WM-185	1147	54											1680
H-9	26	3	80	212	WM-185	1036	54											1520
H-9	26	3	80	213	WM-185	1147	54											1680
H-9	27	3	80	214	WM-185	1150	54											1760
H-9	28	3	80	215	WM-185	1138	54											1680
H-9	6	4	80	CF	Cold									1370	2.15		5.2	
H-9	9	4	80	CF	Cold									875	2.15		3.3	
H-9	9	4	80	CF	Cold									840	2.15		3.1	
H-9	10	4	80	CF	Cold									460	2.15		1.7	
H-9	11	4	80	CF	Cold									825	1.86		7.7	
H-9	11	4	80	CF	Cold									920	1.99		4.3	

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals				
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	12	4	80	CF	Cold									75	1.99		0.4	
H-9	12	4	80	CF	Cold									1189	1.81		11.1	
H-9	13	4	80	CF	Cold									920	1.94		5.0	
H-9	13	4	80	216	WM-185	855	54											1280
H-9	14	4	80	217	WM-185	957	54											1440
H-9	15	4	80	218	WM-185	1143	54											1680
H-9	15	4	80	219	WM-185	1150	54											1760
H-9	16	4	80	220	WM-185	1143	54											1680
H-9	17	4	80	221	WM-185	1130	54											1680
H-9	18	4	80	222	WM-185	1138	54											2480
H-9	18	4	80	223	WM-185	1055	54											2320
H-9	19	4	80	224	WM-185	1046	54											2320
H-9	20	4	80	225	WM-185	1085	54											2400
H-9	21	4	80	226	WM-185	1134	54											2480
H-9	21	4	80	227	WM-185	1134	54											2560
H-9	22	4	80	228	WM-185	1147	54											2560
H-9	23	4	80	229	WM-185	1149	54											2560
H-9	23	4	80	230	WM-185	1132	54											2560
H-9	25	4	80	231	WM-185	1145	54											2560
H-9	26	4	80	232	WM-185	1459	54											1680
H-9	27	4	80	233	WM-185	937	54											2160
H-9	9	5	80	DB	Dolomite Bed (approx. 72 cubic feet)							5035	92					
H-9	10	5	80	CF	Cold									1635	1.94		4.9	
H-9	13	5	80	CF	Cold									1475	1.94		4.4	
H-9	15	5	80	CF	Cold									1039	1.89		3.1	
H-9	17	5	80	CF	Cold									620	1.85		1.9	
H-9	18	5	80	234	WM-185	1231	54											2720
H-9	18	5	80	235	WM-185	1102	54											2480
H-9	19	5	80	236	WM-185	1138	54											2560
H-9	19	5	80	237	WM-185	1134	54											2560
H-9	21	5	80	238	WM-185	1142	54											2560
H-9	21	5	80	239	WM-185	1142	54											2560
H-9	22	5	80	240	WM-185	1131	54											2560
H-9	22	5	80	241	WM-185	1147	54											2560
H-9	23	5	80	242	WM-185	1171	54											2640
H-9	24	5	80	243	WM-185	1138	54											2560
H-9	24	5	80	244	WM-185	1138	54											2560
H-9	25	5	80	245	WM-185	1134	54											2560
H-9	26	5	80	246	WM-185	1184	54											2640
H-9	26	5	80	247	WM-185	1140	54											2560
H-9	27	5	80	248	WM-185	1140	54											2560
H-9	28	5	80	249	WM-185	1138	54											2560
H-9	29	5	80	250	WM-185	958	54											2160
H-9	29	5	80	251	WM-185	974	54											2160
H-9	30	5	80	252	WM-185	703	54											1600
H-9	31	5	80	253	WM-185	707	54											1600
H-9	31	5	80	254	WM-185	855	54											1920
H-9	31	5	80	255	WM-185	674	54											1520
H-9	1	6	80	256	WM-185	937	54											2080
H-9	2	6	80	257	WM-185	1347	54											1200
H-9	10	10	80	DB	Dolomite Bed (approx. 72 cubic feet)							5035	92					
H-9	10	10	80	CF	Cold									560	1.9		2.6	
H-9	10	10	80	CF	Cold									515	1.9		2.4	
H-9	10	10	80	CF	Cold									555	1.9		2.6	
H-9	11	10	80	CF	Cold									4658	1.9		22.0	
H-9	13	10	80	258	WM-185	970	55											2160
H-9	14	10	80	259	WM-185	1143	55											2560
H-9	15	10	80	260	WM-185	1138	55											2560
H-9	15	10	80	261	WM-185	1147	55											2560
H-9	16	10	80	262	WM-185	1138	55											2560
H-9	17	10	80	263	WM-185	991	55											2560
H-9	18	10	80	264	WM-185	1159	55											2640
H-9	18	10	80	265	WM-185	1143	55											2560
H-9	19	10	80	266	WM-185	1134	55											2560
H-9	20	10	80	267	WM-185	1073	55											2400
H-9	20	10	80	268	WM-185	1140	55											2560
H-9	20	10	80	269	WM-185	1134	55											2560
H-9	22	10	80	270	WM-185	1143	55											2560

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	22	10	80	271	WM-185	1228	55											2720
H-9	23	10	80	272	WM-185	1188	55											2640
H-9	24	10	80	273	WM-185	1138	55											2560
H-9	24	10	80	274	WM-185	1134	55											2560
H-9	25	10	80	275	WM-185	1155	55											2560
H-9	25	10	80	276	WM-185	1138	55											2560
H-9	26	10	80	277	WM-185	1143	55											2560
H-9	26	10	80	278	WM-185	1138	55											2560
H-9	27	10	80	279	WM-185	1138	55											2560
H-9	28	10	80	280	WM-185	1143	55											2560
H-9	31	10	80	281	WM-185	998	55											2240
H-9	5	11	80	DB	Dolomite Bed (approx. 61 cubic feet)							4260	92					
H-9	5	11	80	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-9	6	11	80	DB	Dolomite Bed (approx. 11 cubic feet)							780	92					
H-9	7	11	80	282	WM-185	1147	55											2560
H-9	8	11	80	283	WM-185	945	55											2160
H-9	9	11	80	284	WM-185	1036	55											2320
H-9	5	12	80	CF	Cold									2241	2.1		12.8	
H-9	5	12	80	CF	Cold									925	2.1		5.3	
H-9	6	12	80	CF	Cold									520	2.1		3.0	
H-9	6	12	80	CF	Cold									701	2.1		4.0	
H-9	7	12	80	CF	Cold									530	2.1		3.0	
H-9	7	12	80	CF	Cold									420	2.1		2.4	
H-9	7	12	80	CF	Cold									460	2.1		2.6	
H-9	8	12	80	CF	Cold									480	2.1		2.7	
H-9	8	12	80	CF	Cold									430	2.1		2.5	
H-9	8	12	80	CF	Cold									475	2.1		2.7	
H-9	9	12	80	285	WM-185	1192	56										41.0	2720
H-9	10	12	80	286	WM-185	1134	56											2480
H-9	11	12	80	287	WM-185	1134	56											2480
H-9	13	12	80	288	WM-185	1147	56											2480
H-9	13	12	80	289	WM-185	1138	56											2480
H-9	14	12	80	290	WM-185	1138	56											2480
H-9	15	12	80	291	WM-185	1138	56											2480
H-9	16	12	80	292	WM-185	1138	56											2480
H-9	17	12	80	293	WM-185	1138	56											2480
H-9	18	12	80	294	WM-185	1142	56											2480
H-9	18	12	80	295	WM-185	1131	56											2480
H-9	19	12	80	296	WM-185	1044	56											2320
H-9	20	12	80	297	WM-185	947	56											2080
H-9	21	12	80	298	WM-185	1035	56											2240
H-9	22	12	80	299	WM-185	1233	56											2720
H-9	22	12	80	300	WM-185	1253	56											2720
H-9	23	12	80	301	WM-185	1134	56											2640
H-9	24	12	80	302	WM-185	1138	56											2240
H-9	25	12	80	303	WM-185	1138	56											2240
H-9	25	12	80	304	WM-185	1233	56											2720
H-9	26	12	80	305	WM-185	1225	56											2720
H-9	27	12	80	306	WM-185	1138	56											2480
H-9	28	12	80	307	WM-185	1131	56											2400
H-9	29	12	80	308	WM-185	1140	56											2480
H-9	29	12	80	309	WM-185	1138	56											2480
H-9	30	12	80	310	WM-185	1044	56											2320
H-9	31	12	80	311	WM-185	1089	56											2480
H-9	1	1	81	312	WM-185	1134	56											2480
H-9	1	1	81	313	WM-185	1130	56											2480
H-9	2	1	81	314	WM-185	1136	56											2480
H-9	3	1	81	315	WM-185	885	56											1920
H-9	4	1	81	316	WM-185	846	56											1840
H-9	4	1	81	317	WM-185	949	56											2080
H-9	5	1	81	318	WM-185	974	56											2160
H-9	6	1	81	319	WM-185	945	56											2080
H-9	8	1	81	320	WM-185	1140	56											2480
H-9	9	1	81	321	WM-185	949	56											2080
H-9	9	1	81	322	WM-185	1126	56											2480
H-9	10	1	81	323	WM-185	1138	56											2480
H-9	11	1	81	324	WM-185	1138	56											2480
H-9	12	1	81	325	WM-185	1126	56											2480

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

				Feed Stream									Cold Chemicals					
WCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-9	12	1	81	326	WM-185	1131	56											2480
H-9	13	1	81	327	WM-185	1138	56											2480
H-9	14	1	81	328	WM-185	1140	56											2480
H-9	15	1	81	329	WM-185	1152	56											2560
H-9	15	1	81	330	WM-185	1143	56											2480
H-9	16	1	81	331				WM-189	1204	57								1680
H-9	17	1	81	332	WM-185	1140	56											2480
H-9	18	1	81	333				WM-189	1270	57								1680
H-9	18	1	81	334	WM-185	1150	56											2480
H-9	19	1	81	335				WM-189	1204	57								1680
H-9	20	1	81	336	WM-185	1126	56											2480
H-9	21	1	81	337				WM-189	1019	57								1440
H-9	21	1	81	338	WM-185	1245	56											2720
H-9	22	1	81	339				WM-189	1231	57								1760
H-9	23	1	81	340	WM-185	1134	56											2480
H-9	23	1	81	341				WM-189	1486	57								2080
H-9	24	1	81	342	WM-185	1131	56											2624
H-9	25	1	81	343	WM-185	1131	56											2560
H-9	26	1	81	344	WM-185	1126	56											2560
H-9	26	1	81	345	WM-185	1138	56											2560
H-9	27	1	81	346	WM-185	1138	56											2560
H-9	29	1	81	347	WM-185	1138	56											2560
H-9	30	1	81	348	WM-185	1126	56											2560
H-9	31	1	81	349	WM-185	1138	56											2560
H-9	1	2	81	350	WM-185	1126	56											2560
H-9	2	2	81	351	WM-185	1138	56											2560
H-9	2	2	81	352	WM-185	1138	56											2560
H-9	3	2	81	353	WM-185	1217	56											2720
H-9	4	2	81	354	WM-185	1138	56											2640
H-9	5	2	81	355	WM-185	953	56											2160
H-9	6	2	81	356	WM-185	945	56											2160
H-9	7	2	81	357	WM-185	1044	56											2320
H-9	7	2	81	358	WM-185	1138	56											2560
H-9	8	2	81	359	WM-185	1039	56											2320
H-9	9	2	81	360	WM-185	1138	56											2560
H-9	10	2	81	361	WM-185	1126	56											2560
H-9	11	2	81	362				WM-189	1258	57								1680
H-9	11	2	81	363				WM-189	1186	57								1520
H-9	12	2	81	364				WM-189	1232	57								1600
H-9	13	2	81	365				WM-189	1362	57								1760
H-9	13	2	81	366				WM-189	1195	57								1600
H-9	14	2	81	367				WM-189	1258	57								1680
H-9	15	2	81	368				WM-189	1317	57								1760
H-9	16	2	81	369				WM-189	1333	57								1760
H-9	16	2	81	370				WM-189	1344	57								1760
H-9	17	2	81	371				WM-189	1254	57								1600
H-9	18	2	81	372				WM-189	1299	57								1680
H-9	18	2	81	373				WM-189	1326	57								1760
H-9	19	2	81	374	WM-185	598	56	WM-189	388	57								640
H-9	20	2	81	375				WM-189	1141	57								1520
H-9	21	2	81	376				WM-189	1317	57								1680
H-9	21	2	81	377				WM-189	1326	57								1760
H-9	22	2	81	378				WM-189	1150	57								1520
H-9	23	2	81	379				WM-189	1186	57								1520
H-9	23	2	81	380				WM-189	1245	57								1440
H-9	24	2	81	381				WM-189	1245	57								1600
H-9	25	2	81	382				WM-189	1213	57								1600
H-9	26	2	81	383				WM-189	1240	57								1600
H-9	26	2	81	384				WM-189	1240	57								1600
H-9	27	2	81	385				WM-189	1348	57								1760
H-9	28	2	81	386				WM-189	1340	57								1760
H-9	1	3	81	387	WM-182	1204	58											3600
H-9	1	3	81	388				WM-189	1100	57								1440
H-9	2	3	81	389				WM-189	1098	57								1440
H-9	3	3	81	390	WM-182	1064	58											3200
H-9	4	3	81	391	WM-185	570	56	WM-189	600	57								1360
H-9	4	3	81	392				WM-189	1110	57								1440
H-9	5	3	81	393				WM-189	1159	57								1520

Table A3. Calcined material to Calcined Solids Storage Facility III (continued).

					Feed Stream									Cold Chemicals					
WCF		Date		Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb	
H-9	6	3	81	394	WM-182	933	58											2800	
H-9	6	3	81	395				WM-189	1353	57								1760	
H-9	7	3	81	396	WM-185	475	56	WM-189	545	57								1200	
H-9	8	3	81	397				WM-189	1254	57								1600	
H-9	9	3	81	398				WM-189	1191	57								1520	
H-9	10	3	81	399				WM-189	1200	57								1600	
H-9	10	3	81	400				WM-189	1245	57								1600	
H-9	11	3	81	401				WM-189	1504	57								1820	
H-9	12	3	81	402				WM-189	1204	57								1600	
H-9	13	3	81	403				WM-189	1381	57								1840	
H-9	13	3	81	404				WM-189	1250	57								1600	
H-9	14	3	81	405				WM-189	1329	57								1680	
H-9	15	3	81	406				WM-189	1335	57								1440	

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Table A4. Calcined material to Calcined Solids Storage Facility IV.

					Feed Stream									Cold Chemicals					
Stream ¹	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	m	yr	No.	Tank	gal	Stream ¹	Tank	gal	Stream ¹	Tank	gal	Stream ¹	gal	M	M	kg	lb	
H-1	26	8	82	DB	Dolomite Bed (approx. 111 cubic feet)							7752	92						
H-1	28	8	82	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92						
H-1	28	8	82	1C	Cold									2481	2.2		11.4		
H-1	28	8	82	2C	Cold									2322	2.2		11.8		
H-1	29	8	82	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92						
H-1	29	8	82	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92						
H-1	29	8	82	3C	Cold									1810	2.2		11.3		
H-1	30	8	82	4C	Cold									2170	2.2		13.3		
H-1	31	8	82	5C	Cold									1923	2.2		11.5		
H-1	1	9	82	6C	Cold									1948	2.2		11.9		
H-1	2	9	82	7C	Cold									2183	2.2		11.4		
H-1	3	9	82	8C	Cold									2058	2.2		12.2		
H-1	4	9	82	9C	Cold									978	2.2		5.9		
H-1	4	9	82	1	WM-182	86	59							2250	2.1		11.4	274	
H-1	5	9	82	2	WM-182	100	59							2015	2.2		9.6	301	
H-1	6	9	82	3	WM-182	90	59							2000	1.95		9.4	297	
H-1	7	9	82	4	WM-182	76	59							2003	2.2		9.5	320	
H-1	8	9	82	5	WM-182	1672	59											5200	
H-1	9	9	82	6	WM-182	1887	59											5360	
H-1	10	9	82	7	WM-182	1692	59											4960	
H-1	11	9	82	8	WM-182	1872	59											2880	
H-1	12	9	82	9	WM-182	1929	59											2560	
H-1	13	9	82	10	WM-182	1809	59							300	2.2		2.8	6400	
H-1	13	9	82	11	WM-182	1781	59							250	2.2		2.2	5360	
H-1	14	9	82	12	WM-182	1834	59											3040	
H-1	15	9	82	13	WM-182	1689	59											3520	
H-1	16	9	82	14	WM-182	1930	59											5440	
H-1	17	9	82	15	WM-182	2043	59											5600	
H-1	17	9	82	16	WM-182	2032	59											5360	
H-1	18	9	82	17	WM-182	1874	59											5280	
H-1	19	9	82	18	WM-182	1980	59											5760	
H-1	20	9	82	19	WM-182	1981	59											5600	
H-1	20	9	82	20	WM-182	2057	59											5600	
H-1	21	9	82	21				WM-185	1626	60								4840	
H-1	22	9	82	22				WM-185	2446	60								5360	
H-1	22	9	82	23	WM-182	2235	59											6400	
H-1	29	9	82	24	WM-182	2311	59											6320	
H-1	30	9	82	25	WM-182	1506	59											4240	
H-1	30	9	82	26	WM-182	2072	59											5760	
H-1	1	10	82	27	WM-182	2032	59											6240	
H-1	1	10	82	28	WM-182	2209	59											6560	
H-1	2	10	82	29	WM-182	2107	59											6480	
H-1	3	10	82	30	WM-182	2286	59											6000	
H-1	3	10	82	31	WM-182	1651	59											4880	
H-1	4	10	82	32	WM-182	2412	59											6560	
H-1	5	10	82	33	WM-182	1803	59											5680	
H-1	5	10	82	34	WM-182	1829	59											5440	
H-1	6	10	82	35	WM-182	1473	59											4480	
H-1	7	10	82	36	WM-182	1828	59											5280	
H-1	7	10	82	37	WM-182	1853	59											5280	
H-1	8	10	82	38	WM-182	2031	59											5680	
H-1	8	10	82	39	WM-182	1702	59											5200	
H-1	9	10	82	40	WM-182	2006	59											5760	
H-1	9	10	82	41	WM-182	2031	59											5920	
H-1	10	10	82	42	WM-182	1778	59											5280	
H-1	11	10	82	43	WM-182	1905	59											5680	
H-1	11	10	82	44	WM-182	1776	59											4960	
H-1	12	10	82	45	WM-182	1549	59											4480	
H-1	12	10	82	46	WM-182	2031	59											5360	
H-1	13	10	82	47	WM-182	1651	59											5120	
H-1	14	10	82	48	WM-182	1841	59											5440	
H-1	14	10	82	49	WM-182	939	59	WM-189	1014	61								4720	
H-1	15	10	82	50	WM-182	916	59	WM-189	1100	61								5360	
H-1	15	10	82	51	WM-182	813	59	WM-189	1046	61								4160	
H-1	16	10	82	52	WM-182	893	59	WM-189	1029	61								4640	
H-1	16	10	82	53	WM-182	838	59	WM-189	1010	61								4560	
H-1	17	10	82	54	WM-182	888	59	WM-189	1065	61								4640	

¹ "Stream" refers to the liquid waste stream number in Tables A8 and A10

Table A4. Calcined material to Calcined Solids Storage Facility IV (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	18	10	82	55	WM-182	1015	59	WM-189	974	61								5360
H-1	18	10	82	56	WM-182	1016	59	WM-189	968	61								4960
H-1	19	10	82	57	WM-182	1269	59	WM-189	1019	61								5840
H-1	20	10	82	58	WM-182	869	59	WM-189	851	61								4320
H-1	21	10	82	59	WM-182	1201	59	WM-189	590	61								5200
H-1	22	10	82	60	WM-182	1066	59	WM-189	549	61								4240
H-1	22	10	82	61	WM-182	1270	59	WM-189	686	61								5680
H-1	23	10	82	62	WM-182	1346	59	WM-189	750	61								5840
H-1	23	10	82	63	WM-182	1288	59	WM-189	694	61								6080
H-1	24	10	82	64	WM-182	1320	59	WM-189	655	61								5680
H-1	25	10	82	65	WM-182	1326	59	WM-189	727	61								5920
H-1	26	10	82	66	WM-182	1397	59	WM-189	744	61								6480
H-1	26	10	82	67	WM-182	1169	59	WM-189	638	61								5440
H-1	27	10	82	68	WM-182	1346	59	WM-189	694	61								5760
H-1	28	10	82	69	WM-182	1397	59	WM-189	722	61								6160
H-1	29	10	82	70	WM-182	1270	59	WM-189	688	61								5840
H-1	29	10	82	71	WM-182	1321	59	WM-189	686	61								6160
H-1	30	10	82	72	WM-182	1397	59	WM-189	715	61								5920
H-1	31	10	82	73	WM-182	1219	59	WM-189	723	61								5760
H-1	31	10	82	74	WM-182	1574	59	WM-189	859	61								6640
H-1	1	11	82	75	WM-182	1245	59	WM-189	639	61								6000
H-1	2	11	82	76	WM-182	1270	59	WM-189	720	61								5760
H-1	2	11	82	77	WM-182	1270	59	WM-189	726	61								5680
H-1	3	11	82	78	WM-182	1397	59	WM-189	727	61								5920
H-1	4	11	82	79	WM-182	1270	59	WM-189	679	61								5520
H-1	4	11	82	80	WM-182	1295	59	WM-189	686	61								5600
H-1	5	11	82	81	WM-182	1270	59	WM-189	645	61								5840
H-1	6	11	82	82	WM-182	1193	59	WM-189	677	61								5920
H-1	6	11	82	83	WM-182	1270	59	WM-189	691	61								5440
H-1	7	11	82	84	WM-182	1345	59	WM-189	667	61								5600
H-1	8	11	82	85	WM-182	1372	59	WM-189	714	61								5840
H-1	8	11	82	86	WM-182	1270	59	WM-189	688	61								5920
H-1	9	11	82	87	WM-182	1219	59	WM-189	810	61								5360
H-1	10	11	82	88	WM-182	1193	59	WM-189	847	61								5360
H-1	10	11	82	89	WM-182	1193	59	WM-189	862	61								5520
H-1	11	11	82	90	WM-182	1270	59	WM-189	892	61								5600
H-1	12	11	82	91	WM-182	1263	59	WM-189	858	61								5520
H-1	12	11	82	92	WM-182	1346	59	WM-189	889	61								6080
H-1	13	11	82	93	WM-182	1194	59	WM-189	925	61								5760
H-1	13	11	82	94	WM-182	1219	59	WM-189	837	61								5440
H-1	14	11	82	95	WM-182	1270	59	WM-189	833	61								5920
H-1	15	11	82	96	WM-182	1270	59	WM-189	782	61								5600
H-1	15	11	82	97	WM-182	1194	59	WM-189	870	61								5440
H-1	16	11	82	98	WM-182	1295	59	WM-189	1021	61								6240
H-1	17	11	82	99	WM-182	1244	59	WM-189	807	61								5760
H-1	17	11	82	100	WM-182	1422	59	WM-189	1060	61								6480
H-1	18	11	82	101	WM-182	1321	59	WM-189	983	61								6080
H-1	19	11	82	102	WM-182	1473	59	WM-189	935	61								6080
H-1	19	11	82	103	WM-182	1371	59	WM-189	960	61								6320
H-1	20	11	82	104	WM-182	1524	59	WM-189	971	61								6640
H-1	21	11	82	105	WM-182	1219	59	WM-189	969	61								6240
H-1	22	11	82	106	WM-182	1270	59	WM-189	900	61								6240
H-1	22	11	82	107	WM-182	1270	59	WM-189	810	61								5520
H-1	23	11	82	108	WM-182	1587	59											4720
H-1	24	11	82	109	WM-182	1854	59											5440
H-1	25	11	82	110	WM-182	2286	59											6640
H-1	26	11	82	111	WM-182	1981	59											5760
H-1	27	11	82	112	WM-182	1879	59											5600
H-1	27	11	82	113	WM-182	2006	59											6080
H-1	28	11	82	114	WM-182	1777	59											5280
H-1	28	11	82	115	WM-182	1651	59											4720
H-1	29	11	82	116	WM-182	2032	59											6000
H-1	30	11	82	117	WM-182	1143	59	WM-189	895	62								5200
H-1	30	11	82	118	WM-182	1092	59	WM-189	917	62								5120
H-1	1	12	82	119	WM-182	1168	59	WM-189	899	62								5360
H-1	2	12	82	120	WM-182	1143	59	WM-189	864	62								5760
H-1	2	12	82	121	WM-182	1270	59	WM-189	1001	62								6560
H-1	3	12	82	122	WM-182	1270	59	WM-189	922	62								5840

Table A4. Calcined material to Calcined Solids Storage Facility IV (continued).

NWCF				Feed Stream									Cold Chemicals					
Date		Batch		1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	4	12	82	123	WM-182	1015	59	WM-189	833	62								5520
H-1	5	12	82	124	WM-182	1371	59	WM-189	902	62								6080
H-1	5	12	82	125	WM-182	1371	59	WM-189	976	62								6400
H-1	6	12	82	126	WM-182	990	59	WM-189	697	62								4800
H-1	7	12	82	127	WM-182	1193	59	WM-189	881	62								5840
H-1	8	12	82	128	WM-182	1346	59	WM-189	926	62								6080
H-1	8	12	82	129	WM-182	1067	59	WM-189	864	62								5520
H-1	9	12	82	130	WM-182	1143	59	WM-189	970	62								5840
H-1	10	12	82	131	WM-182	1321	59	WM-189	1126	62								6480
H-1	11	12	82	132	WM-182	1016	59	WM-189	771	62								5120
H-1	12	12	82	133	WM-182	1016	59	WM-189	837	62								5440
H-1	12	12	82	134	WM-182	1270	59	WM-189	845	62								5520
H-1	13	12	82	135	WM-182	1444	59	WM-189	1001	62								6240
H-1	14	12	82	136	WM-182	1219	59	WM-189	901	62								5920
H-1	14	12	82	137	WM-182	1224	59	WM-189	822	62								5440
H-1	15	12	82	138	WM-182	1164	59	WM-189	860	62								5600
H-1	16	12	82	139	WM-182	1269	59	WM-189	982	62								6000
H-1	17	12	82	140	WM-182	1219	59	WM-189	875	62								5680
H-1	18	12	82	141	WM-182	1219	59	WM-189	845	62								5760
H-1	19	12	82	142	WM-182	1270	59	WM-189	871	62								5520
H-1	20	12	82	143	WM-182	1193	59	WM-189	892	62								5840
H-1	21	12	82	144	WM-182	1181	59	WM-189	888	62								5920
H-1	21	12	82	145	WM-182	1269	59	WM-189	880	62								5920
H-1	22	12	82	146	WM-182	1219	59	WM-189	847	62								5760
H-1	23	12	82	147	WM-182	1219	59	WM-189	923	62								5920
H-1	24	12	82	148	WM-182	1219	59	WM-189	876	62								5680
H-1	25	12	82	149	WM-182	1245	59	WM-189	938	62								6160
H-1	25	12	82	150	WM-182	1270	59	WM-189	891	62								5760
H-1	26	12	82	151	WM-182	1397	59	WM-189	990	62								6400
H-1	27	12	82	152	WM-182	1219	59	WM-189	925	62								5600
H-1	28	12	82	153	WM-182	1244	59	WM-189	885	62								5840
H-1	28	12	82	154	WM-182	1194	59	WM-189	898	62								5760
H-1	29	12	82	155	WM-182	1396	59	WM-189	974	62								6400
H-1	30	12	82	156	WM-182	1803	59											5600
H-1	31	12	82	157	WM-182	1904	59											5680
H-1	1	1	83	158	WM-182	2031	59											6080
H-1	1	1	83	159	WM-182	1905	59											6240
H-1	2	1	83	160	WM-182	1650	59											4960
H-1	3	1	83	161	WM-182	1930	59											5360
H-1	4	1	83	162	WM-182	1880	59											5360
H-1	5	1	83	163	WM-182	1449	59											4320
H-1	6	1	83	164	WM-182	1473	59											4160
H-1	7	1	83	165	WM-182	1904	59											5520
H-1	7	1	83	166	WM-182	1955	59											5200
H-1	8	1	83	167	WM-182	1880	59											5760
H-1	8	1	83	168	WM-182	2260	59											7280
H-1	9	1	83	169	WM-182	1778	59											4960
H-1	10	1	83	170	WM-182	1626	59											4880
H-1	10	1	83	171	WM-182	2209	59											6560
H-1	11	1	83	172	WM-182	1879	59											5680
H-1	12	1	83	173	WM-182	1956	59											5680
H-1	12	1	83	174	WM-182	1981	59											5760
H-1	13	1	83	175	WM-182	1879	59											5760
H-1	14	1	83	176	WM-182	1575	59											4640
H-1	14	1	83	177	WM-182	1904	59											5520
H-1	15	1	83	178	WM-182	1905	59											5600
H-1	16	1	83	179	WM-182	1601	59											4800
H-1	16	1	83	180	WM-182	1853	59											5680
H-1	17	1	83	181	WM-182	1473	59											4240
H-1	17	1	83	182	WM-182	1575	59											4880
H-1	18	1	83	183	WM-182	1854	59											5440
H-1	19	1	83	184	WM-182	1676	59											5040
H-1	19	1	83	185	WM-182	1752	59											5280
H-1	20	1	83	186	WM-182	1670	59											5120
H-1	20	1	83	187	WM-182	1701	59											5200
H-1	21	1	83	188	WM-182	2006	59											5840
H-1	21	1	83	189	WM-182	1778	59											4960
H-1	22	1	83	190	WM-182	1854	59											5040

Table A4. Calcined material to Calcined Solids Storage Facility IV (continued).

NWCF	Date			Batch	Feed Stream									Cold Chemicals				
					1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	23	1	83	191	WM-182	1460	59											4240
H-1	23	1	83	192	WM-185	1708	60											4880
H-1	24	1	83	193	WM-185	1989	60											4480
H-1	24	1	83	194	WM-185	1836	60											4560
H-1	25	1	83	195	WM-185	2012	60											4560
H-1	25	1	83	196	WM-185	1275	60	WM-189	690	62								4400
H-1	26	1	83	197	WM-185	1326	60	WM-189	708	62								4720
H-1	27	1	83	198	WM-185	1199	60	WM-189	659	62								4240
H-1	27	1	83	199	WM-185	1198	60	WM-189	627	62								4160
H-1	28	1	83	200	WM-185	1275	60	WM-189	700	62								4480
H-1	29	1	83	201	WM-185	1428	60	WM-189	793	62								5120
H-1	29	1	83	202	WM-185	1046	60	WM-189	771	62								5040
H-1	30	1	83	203	WM-185	1224	60	WM-189	723	62								4480
H-1	31	1	83	204	WM-185	1244	60	WM-189	698	62								4646
H-1	31	1	83	205	Returned to tank Farm													
H-1	13	3	83	DB	Dolomite Bed (approx. 99 cubic feet)							6977	92					
H-1	14	3	83	205C	Cold									2273	2.2		13.0	
H-1	14	3	83	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-1	14	3	83	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-1	19	3	83	DB	Dolomite Bed (approx. 17 cubic feet)							1162	92					
H-1	19	3	83	206C	Cold									2885	2.2		13.5	
H-1	21	3	83	207C	Cold									2208	2.2		14.2	
H-1	22	3	83	208C	Cold									2056	2.2		12.9	
H-1	23	3	83	209C	Cold									2004	2.2		12.5	
H-1	23	3	83	210	WM-185	1658	60											4320
H-1	24	3	83	211	WM-185	1835	60											4640
H-1	25	3	83	212	WM-185	1657	60											4400
H-1	26	3	83	213	WM-185	1964	60											4400
H-1	26	3	83	214	WM-185	1785	60											4160
H-1	27	3	83	215	WM-185	1862	60											4560
H-1	27	3	83	216	WM-185	1836	60											4640
H-1	28	3	83	217	WM-185	1836	60											4560
H-1	29	3	83	218	WM-185	1887	60											4800
H-1	29	3	83	219	WM-185	2168	60											4800
H-1	30	3	83	220	WM-185	1504	60											4080
H-1	31	3	83	221	WM-185	1811	60											4640
H-1	31	3	83	222	WM-185	1402	60	WM-189	600	63								4960
H-1	1	4	83	223	WM-185	1122	60	WM-189	492	63								4400
H-1	2	4	83	224	WM-185	1607	60	WM-189	564	63								5120
H-1	2	4	83	225	WM-185	1453	60	WM-189	565	63								5280
H-1	3	4	83	226	WM-185	1785	60	WM-189	673	63								5760
H-1	3	4	83	227	WM-185	1785	60	WM-189	608	63								5760
H-1	4	4	83	228	WM-185	1581	60	WM-189	641	63								5520
H-1	5	4	83	229	WM-185	1785	60	WM-189	682	63								5440
H-1	5	4	83	230	WM-185	1606	60	WM-189	582	63								5440
H-1	6	4	83	231	WM-185	1530	60	WM-189	661	63								5600
H-1	7	4	83	232	WM-185	1530	60	WM-189	580	63								5440
H-1	7	4	83	233	WM-185	1529	60	WM-189	603	63								5440
H-1	8	4	83	234	WM-185	1913	60	WM-189	869	63								6080
H-1	9	4	83	235	WM-185	1657	60	WM-189	619	63								5680
H-1	9	4	83	236	WM-185	1530	60	WM-189	592	63								5520
H-1	10	4	83	237	WM-185	1658	60	WM-189	660	63								5520
H-1	11	4	83	238	WM-185	1733	60	WM-189	605	63								5600
H-1	11	4	83	239	WM-185	1759	60	WM-189	592	63								5680
H-1	12	4	83	240	WM-185	1632	60	WM-189	660	63								5600
H-1	13	4	83	241	WM-185	1811	60	WM-189	716	63								5360
H-1	13	4	83	242	WM-185	1760	60	WM-189	586	63								5120
H-1	14	4	83	243	WM-185	1530	60	WM-189	581	63								5120
H-1	14	4	83	244	WM-185	1785	60	WM-189	661	63								5200
H-1	15	4	83	245	WM-185	1249	60	WM-189	486	63								4160
H-1	16	4	83	246	WM-185	1402	60	WM-189	510	63								4160
H-1	16	4	83	247	WM-185	1657	60	WM-189	651	63								5040
H-1	17	4	83	248	WM-185	1530	60	WM-189	595	63								5120
H-1	18	4	83	249	WM-185	1658	60	WM-189	670	63								5040
H-1	18	4	83	250	WM-185	1683	60	WM-189	667	63								5360
H-1	19	4	83	251	WM-185	1556	60	WM-189	670	63								5200
H-1	19	4	83	252	WM-185	1785	60	WM-189	584	63								5120
H-1	20	4	83	253	WM-185	1887	60	WM-189	684	63								5200

Table A4. Calcined material to Calcined Solids Storage Facility IV (continued).

NWCF	Date			Batch	Feed Stream									Cold Chemicals				
					1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	1	6	83	322	WM-185	1631	60	WM-189	587	63								5360
H-1	2	6	83	323	WM-185	1530	60	WM-189	590	63								5120
H-1	3	6	83	324	WM-185	1658	60	WM-189	597	63								5360
H-1	3	6	83	325	WM-185	1658	60	WM-189	595	63								5360
H-1	4	6	83	326	WM-185	1709	60	WM-189	735	63								5600
H-1	5	6	83	327	WM-185	1735	60	WM-189	683	63								5360
H-1	5	6	83	328	WM-185	1543	60	WM-189	626	63								5440
H-1	6	6	83	329	WM-185	1479	60	WM-189	524	63								4880
H-1	6	6	83	330	WM-185	1683	60	WM-189	621	63								5520
H-1	7	6	83	331	WM-185	1658	60	WM-189	686	63								5440
H-1	8	6	83	332	WM-185	1607	60	WM-189	593	63								5360
H-1	8	6	83	333	WM-185	1709	60	WM-189	625	63								5360
H-1	9	6	83	334	WM-185	1555	60	WM-189	589	63								5360
H-1	10	6	83	335	WM-185	1683	60	WM-189	597	63								5280
H-1	10	6	83	336	WM-185	1657	60	WM-189	647	63								5520
H-1	11	6	83	337	WM-185	1632	60	WM-189	611	63								5280
H-1	11	6	83	338	WM-185	2116	60											4960
H-1	12	6	83	339	WM-185	2295	60											5040
H-1	13	6	83	340	WM-185	2116	60											4960
H-1	13	6	83	341	WM-185	2218	60											4960
H-1	14	6	83	342	WM-185	1760	60	WM-189	611	63								5440
H-1	14	6	83	343	WM-185	1632	60	WM-189	582	63								5440
H-1	15	6	83	344	WM-185	1658	60	WM-189	592	63								5360
H-1	16	6	83	345	WM-185	1606	60	WM-189	540	63								4960
H-1	16	6	83	346	WM-185	1657	60	WM-189	642	63								5360
H-1	17	6	83	347	WM-185	1581	60	WM-189	680	63								5360
H-1	17	6	83	348	WM-185	1734	60	WM-189	614	63								5360
H-1	18	6	83	349	WM-185	1580	60	WM-189	659	63								5280
H-1	19	6	83	350	WM-185	1709	60	WM-189	609	63								5440
H-1	19	6	83	351	WM-185	1607	60	WM-189	689	63								5360
H-1	20	6	83	352	WM-185	1734	60	WM-189	720	63								6000
H-1	21	6	83	353	WM-185	1786	60	WM-189	605	63								5440
H-1	21	6	83	354	WM-185	1734	60	WM-189	630	63								5440
H-1	22	6	83	355	WM-185	1582	60	WM-189	612	63								5280
H-1	22	6	83	356	WM-185	1683	60	WM-189	605	63								5600
H-1	23	6	83	357	WM-185	1581	60	WM-189	601	63								5200
H-1	24	6	83	358	WM-185	1708	60	WM-189	573	63								5200
H-1	24	6	83	359	WM-185	1810	60	WM-189	644	63								5360
H-1	25	6	83	360	WM-185	1071	60	WM-189	658	63	WM-188	471	66					5200
H-1	25	6	83	361	WM-188	1778	66	WM-189	632	63								4960
H-1	26	6	83	362	WM-188	1883	66	WM-189	705	63								5280
H-1	27	6	83	363	WM-188	1700	66	WM-189	660	63								4800
H-1	27	6	83	364	WM-188	1674	66	WM-189	582	63								4800
H-1	28	6	83	365	WM-188	1779	66	WM-189	678	63								4720
H-1	29	6	83	366	WM-188	1674	66	WM-189	584	63								4800
H-1	29	6	83	367	WM-188	1726	66	WM-189	595	63								4800
H-1	30	6	83	368	WM-188	2380	66											4480
H-1	1	7	83	369	WM-188	1831	66	WM-189	482	63								5120
H-1	1	7	83	370	WM-188	1962	66	WM-189	494	63								4640
H-1	2	7	83	371	WM-188	1857	66	WM-189	490	63								4560
H-1	3	7	83	372	WM-188	1909	66	WM-189	558	63								4560
H-1	3	7	83	373	WM-188	1962	66	WM-189	595	63								4800
H-1	4	7	83	374	WM-188	1936	66	WM-189	496	63								4640
H-1	5	7	83	375	WM-188	1857	66	WM-189	552	63								4400
H-1	5	7	83	376	WM-188	1988	66	WM-189	560	63								4800
H-1	6	7	83	377	WM-188	2040	66	WM-189	530	63								4880
H-1	6	7	83	378	WM-188	1854	66	WM-189	483	63								4640
H-1	7	7	83	379	WM-188	1988	66	WM-189	547	63								4800
H-1	8	7	83	380	WM-188	1883	66	WM-189	539	63								4960
H-1	8	7	83	381	WM-188	1582	66	WM-189	458	63								4160
H-1	9	7	83	382	WM-188	1752	66	WM-189	431	63								4160
H-1	10	7	83	383	WM-188	1752	66	WM-189	435	63								4080
H-1	10	7	83	384	WM-188	1727	66	WM-189	493	63								4160
H-1	11	7	83	385	WM-188	1701	66	WM-189	463	63								4160
H-1	12	7	83	386	WM-188	1700	66	WM-189	427	63								4240
H-1	12	7	83	387	WM-188	1752	66	WM-189	506	63								4240
H-1	13	7	83	388	WM-188	1753	66	WM-189	408	63								4160
H-1	13	7	83	389	WM-188	1570	66	WM-189	383	63								3680

Table A4. Calcined material to Calcined Solids Storage Facility IV (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	14	7	83	390	WM-188	1616	66	WM-189	479	63								4160
H-1	15	7	83	391	WM-188	1805	66	WM-189	490	63								4400

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Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals					
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb	
H-1	26	8	83	459	WM-188	1307	66	WM-189	645	63	WM-102	694	74					3840	
H-1	27	8	83	460	WM-188	1308	66	WM-189	668	63	WM-102	802	74					4160	
H-1	27	8	83	461	WM-188	1020	66	WM-189	733	63	WM-102	595	74					3200	
H-1	28	8	83	462	WM-188	1125	66	WM-189	662	63	WM-102	735	74					3840	
H-1	29	8	83	463	WM-188	1177	66	WM-189	697	63	WM-100	667	71					3680	
H-1	29	8	83	464	WM-188	1883	66	WM-189	521	63								4480	
H-1	30	8	83	465	WM-188	1883	66	WM-189	494	63								4480	
H-1	30	8	83	466	WM-188	1883	66	WM-189	488	63								4560	
H-1	31	8	83	467	WM-188	1909	66	WM-189	500	63								4560	
H-1	1	9	83	468	WM-188	1770	66	WM-189	498	63								4480	
H-1	1	9	83	469	WM-188	1831	66	WM-189	558	63								4480	
H-1	2	9	83	470	WM-188	1936	66	WM-189	487	63								4560	
H-1	2	9	83	471	WM-188	1909	66	WM-189	353	63								4480	
H-1	3	9	83	472	WM-187	2083	67	WM-184	282	65								7280	
H-1	4	9	83	473	WM-187	2186	67	WM-184	248	65								7280	
H-1	5	9	83	474	WM-187	2288	67	WM-184	223	65								7440	
H-1	5	9	83	475	WM-187	2083	67	WM-184	280	65								7120	
H-1	6	9	83	476	WM-187	2109	67	WM-184	254	65								7280	
H-1	6	9	83	477	WM-187	2132	67	WM-184	233	65								7040	
H-1	7	9	83	478	WM-187	2031	67	WM-184	265	65								7040	
H-1	8	9	83	479	WM-187	2135	67	WM-184	306	65								6480	
H-1	8	9	83	480	WM-187	2058	67	WM-184	263	65								6640	
H-1	9	9	83	481	WM-187	2160	67	WM-184	278	65								6960	
H-1	10	9	83	482	WM-187	2212	67	WM-184	244	65								6720	
H-1	10	9	83	483	WM-187	2237	67	WM-184	242	65								6720	
H-1	11	9	83	484	WM-187	2314	67	WM-184	247	65								6320	
H-1	11	9	83	485	WM-187	2160	67	WM-184	261	65								6480	
H-1	12	9	83	486	WM-187	2597	67											3240	
H-1	13	9	83	487	WM-187	2545	67											5760	
H-1	14	9	83	488	WM-187	2494	67											5920	
H-1	15	9	83	489	WM-187	2391	67											6000	
H-1	15	9	83	490	WM-187	2443	67											6000	
H-1	16	9	83	491	WM-187	2263	67											5760	
H-1	17	9	83	492	WM-187	2005	67											4880	
H-1	17	9	83	493	WM-187	2186	67											5520	
H-1	18	9	83	494	WM-187	2134	67											5360	
H-1	19	9	83	495	WM-187	1941	67											4800	
H-1	19	9	83	496	WM-187	2006	67											5280	
H-1	20	9	83	497	WM-187	2185	67											5280	
H-1	21	9	83	498	WM-187	1980	67											4880	
H-1	22	9	83	499	WM-182	2133	68										54.5	880	
H-1	22	9	83	500	WM-182	2412	68										58.2	960	
H-1	23	9	83	501	WM-182	2412	68										57.3	960	
H-1	24	9	83	502	WM-182	2056	68										50.5	800	
H-1	25	9	83	503	WM-182	2235	68										50.5	800	
H-1	26	9	83	504	WM-182	2260	68										55.0	880	
H-1	27	9	83	505	WM-182	2057	68										9.6	800	
H-1	28	9	83	506	WM-182	2031	68										9.6	800	
H-1	28	9	83	507	WM-182	2073	68										22.5	800	
H-1	29	9	83	508	WM-182	2286	68										23.6	880	
H-1	30	9	83	509	WM-182	1980	68										20.6	800	
H-1	1	10	83	510	WM-182	2108	68										9.4	800	
H-1	2	10	83	511	WM-182	1981	68										8.9	720	
H-1	2	10	83	512	WM-182	1913	68										9.4	800	
H-1	3	10	83	513	WM-182	2184	68										10.3	880	
H-1	4	10	83	514	WM-182	1828	68										9.3	800	
H-1	5	10	83	515	WM-182	1727	68										9.8	640	
H-1	6	10	83	516	WM-182	1701	68										8.0	640	
H-1	6	10	83	517	WM-182	2083	68										9.4	800	
H-1	7	10	83	518				WM-100	2111	72							10.0	160	
H-1	8	10	83	519				WM-100	1550	72							7.3	120	
H-1	9	10	83	520				WM-100	1070	72							6.0	100	
H-1	10	10	83	521				WM-100	1080	72							6.0	100	
H-1	13	1	84	101C	Cold									2515	2.2		70.0		
H-1	14	1	84	102C	Cold									2538	2.2		70.0		
H-1	15	1	84	103C	Cold									1297	2.2		60.0		
H-1	16	1	84	522	WM-188	523	66	WM-189	252	63	WM-102	252	74					2080	
H-1	17	1	84	523	WM-188	710	66	WM-189	389	63	WM-102	388	74					2400	

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals					
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb	
H-1	4	3	84	592	WM-188	836	66	WM-189	490	63	WM-102	1069	74					3440	
H-1	4	3	84	593	WM-188	1046	66	WM-189	515	63	WM-102	888	74					3280	
H-1	5	3	84	594	WM-188	1020	66	WM-189	514	63	WM-102	900	74					3520	
H-1	5	3	84	595	WM-188	994	66	WM-189	490	63	WM-102	1007	74					3440	
H-1	6	3	84	596							WM-102	2350	74				13.0	480	
H-1	7	3	84	597							WM-102	2100	74				12.5	480	
H-1	7	3	84	598							WM-102	2720	74				13.7	560	
H-1	8	3	84	599							WM-102	2000	74				14.0	480	
H-1	9	3	84	600							WM-102	2250	74				13.0	480	
H-1	9	3	84	601							WM-102	1975	74				12.7	400	
H-1	10	3	84	602							WM-102	1710	74				10.1	320	
H-1	10	3	84	603							WM-102	1677	74				10.2	320	
H-1	11	3	84	604	WM-188	915	66	WM-189	538	63	WM-102	900	74					3360	
H-1	11	3	84	605	WM-188	994	66	WM-189	465	63	WM-102	825	74					3440	
H-1	12	3	84	606	WM-188	785	66	WM-189	489	63	WM-102	937	74					3120	
H-1	13	3	84	607	WM-188	785	66	WM-189	343	63	WM-102	903	74					2800	
H-1	13	3	84	608	WM-188	1020	66	WM-189	465	63	WM-102	1042	74					3280	
H-1	14	3	84	609	WM-188	968	66	WM-189	440	63	WM-102	988	74					3280	
H-1	15	3	84	610	WM-188	706	66	WM-189	440	63	WM-102	1101	74					3280	
H-1	15	3	84	611	WM-188	889	66	WM-189	465	63	WM-102	850	74					3360	
H-1	16	3	84	612	WM-188	942	66	WM-189	490	63	WM-102	971	74					3360	
H-1	16	3	84	613							WM-102	2209	74					1680	
H-1	16	4	84	DB	Dolomite Bed (approx. 100 cubic feet)							7014	92						
H-1	17	4	84	001C	Cold									3175	2.2		14.9		
H-1	18	4	84	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92						
H-1	18	4	84	002C	Cold									1600	2.2		7.5		
H-1	20	4	84	614				WM-189	734	70	WM-102	1350	74					2080	
H-1	21	4	84	615				WM-189	636	70	WM-102	1600	74					2000	
H-1	21	4	84	616				WM-189	734	70	WM-102	1450	74					2080	
H-1	22	4	84	617				WM-189	808	70	WM-102	1600	74					2160	
H-1	22	4	84	618				WM-189	734	70	WM-102	1550	74					2160	
H-1	24	4	84	619				WM-189	790	70	WM-102	1550	74					1680	
H-1	24	4	84	620				WM-189	1127	70	WM-102	1850	74					2160	
H-1	25	4	84	621				WM-189	826	70	WM-102	1500	74					1760	
H-1	26	4	84	622				WM-189	1126	70	WM-102	1850	74					2160	
H-1	26	4	84	623				WM-189	571	70	WM-102	2260	74					2000	
H-1	27	4	84	624				WM-189	657	70	WM-102	2400	74					2240	
H-1	28	4	84	625				WM-189	528	70	WM-102	1765	74					1840	
H-1	28	4	84	626				WM-189	530	70	WM-102	1900	74					1840	
H-1	29	4	84	627				WM-189	576	70	WM-102	2450	74					2240	
H-1	29	4	84	628				WM-189	495	70	WM-102	1950	74					1840	
H-1	30	4	84	629							WM-102	2430	74					1440	
H-1	30	4	84	630							WM-102	2100	74					1280	
H-1	1	5	84	631							WM-102	2800	74					1600	
H-1	1	5	84	632							WM-102	2500	74					1600	
H-1	3	5	84	633							WM-102	2808	74					1600	
H-1	3	5	84	634							WM-102	609	74					400	
H-1	3	5	84	635				WM-189	392	70	WM-102	1850	74					1600	
H-1	4	5	84	636				WM-189	472	70	WM-102	1750	74					1520	
H-1	4	5	84	637				WM-189	543	70	WM-102	2000	74					1600	
H-1	5	5	84	638				WM-189	496	70	WM-102	1950	74					1760	
H-1	5	5	84	639				WM-189	492	70	WM-102	1900	74					1680	
H-1	6	5	84	640				WM-189	475	70	WM-102	1850	74					1520	
H-1	6	5	84	641				WM-189	604	70	WM-102	2151	74					1760	
H-1	7	5	84	642				WM-189	570	70	WM-102	2050	74					1760	
H-1	8	5	84	643				WM-189	575	70	WM-102	1850	74					1600	
H-1	8	5	84	644				WM-189	542	70	WM-102	1800	74					1520	
H-1	9	5	84	645				WM-189	475	70	WM-102	1540	74					1280	
H-1	9	5	84	646				WM-189	511	70	WM-102	1650	74					1360	
H-1	10	5	84	647				WM-189	505	70	WM-102	1520	74					1440	
H-1	10	5	84	648				WM-189	476	70	WM-102	1700	74					1440	
H-1	11	5	84	649	WM-188	2093	66											4720	
H-1	12	5	84	650	WM-188	2249	66											4080	
H-1	12	5	84	651	WM-188	2746	66											4480	
H-1	13	5	84	652	WM-188	2301	66											4000	
H-1	14	5	84	653	WM-187	1157	67	WM-189	972	70								5280	
H-1	14	5	84	654	WM-187	1697	67	WM-189	1062	70								5760	
H-1	15	5	84	655	WM-187	1416	67	WM-189	1072	70								5360	

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

				Feed Stream									Cold Chemicals					
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-1	16	5	84	656	WM-187	1415	67	WM-189	894	70								5280
H-1	17	5	84	657	WM-187	1316	67	WM-189	883	70								5280
H-1	17	5	84	658				WM-189	466	70	WM-102	1950	74					1600
H-1	18	5	84	659				WM-189	955	70	WM-102	1414	74					5600
H-1	18	5	84	660				WM-189	637	70	WM-102	2200	74					1840
H-1	19	5	84	661				WM-189	638	70	WM-102	1825	74					1840
H-1	20	5	84	662	WM-187	1414	67	WM-189	1133	70								5440
H-1	20	5	84	663	WM-187	1491	67	WM-189	1011	70								5520
H-1	21	5	84	664	WM-187	1594	67	WM-189	1053	70								5840
H-1	22	5	84	665	WM-187	1359	67	WM-189	1050	70								5440
H-1	23	5	84	666	WM-187	1414	67	WM-189	1172	70								5280
H-1	24	5	84	667	WM-187	1080	67	WM-189	857	70								4560
H-1	27	5	84	668	WM-187	1209	67	WM-189	882	70								4480
H-1	27	5	84	669	WM-187	1234	67	WM-189	753	70								4400
H-1	28	5	84	670	WM-187	1362	67	WM-189	1067	70								5120
H-1	29	5	84	671				WM-189	540	70	WM-102	1800	74					1680
H-1	30	5	84	672				WM-189	581	70	WM-102	1700	74					1680
H-1	30	5	84	673				WM-189	495	70	WM-102	1800	74					1760
H-1	31	5	84	674				WM-189	568	70	WM-102	1700	74					1760
H-1	1	6	84	675				WM-189	438	70	WM-102	1600	74					2240
H-1	1	6	84	676	WM-187	1542	67	WM-189	979	70								5520
H-1	2	6	84	677	WM-187	1337	67	WM-189	1034	70								5200
H-1	3	6	84	678	WM-187	1363	67	WM-189	1165	70								5520
H-1	4	6	84	679							WM-102	2175	74					1760
H-1	5	6	84	680	WM-187	2237	67											5520
H-1	6	6	84	681	WM-187	1260	67	WM-189	897	70								4960
H-1	6	6	84	682	WM-187	1285	67	WM-189	891	70								5120
H-1	7	6	84	683	WM-187	1414	67	WM-189	1046	70								5360
H-1	8	6	84	684	WM-187	617	67	WM-189	777	70	WM-102	1350	74					3200
H-1	8	6	84	685	WM-187	592	67	WM-189	577	70	WM-102	1050	74					2640
H-1	9	6	84	686	WM-187	617	67	WM-189	775	70	WM-102	1150	74					3040
H-1	10	6	84	687	WM-187	566	67	WM-189	677	70	WM-102	1000	74					2880
H-1	10	6	84	688	WM-187	643	67	WM-189	710	70	WM-102	1300	74					2800
H-1	11	6	84	689	WM-187	566	67	WM-189	672	70	WM-102	1000	74					2960
H-1	12	6	84	690	WM-187	669	67	WM-189	702	70	WM-102	1200	74					3600
H-1	12	6	84	691	WM-187	592	67	WM-189	750	70	WM-102	1150	74					3840
H-1	13	6	84	692	WM-187	617	67	WM-189	569	70	WM-102	1225	74					3520
H-1	14	6	84	693	WM-182	2272	69										10.3	880
H-1	14	6	84	694	WM-182	1942	69										9.1	720
H-1	15	6	84	695							WM-102	2525	74					720
H-1	15	6	84	696							WM-102	2600	74					880
H-1	16	6	84	697							WM-102	1900	74					640
H-1	16	6	84	698							WM-102	1700	74	1414	2.2		14.5	720
H-2	11	9	87	PPC	Cold Pilot Plant Calcine (approx. 50 cubic feet)							3507	94					
H-2	12	9	87	DB	Dolomite Bed (approx. 50 cubic feet)							3507	92					
H-2	12	9	87	1	Cold									2005	1.94		8.3	
H-2	14	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	14	9	87	2	Cold									1661	1.92		11.3	
H-2	15	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	17	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	18	9	87	3C	Cold									2929	2		12.5	
H-2	18	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	19	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	19	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	19	9	87	4C	Cold									2460	2.2		15.6	
H-2	20	9	87	DB	Dolomite Bed (approx. 15 cubic feet)							1052	92					
H-2	20	9	87	5C	Cold									2814	2.2		15.6	
H-2	22	9	87	6C	Cold									2550	2.2		13.7	
H-2	24	9	87	7C	Cold									1984	2.2		12.4	
H-2	23	9	87	8C	Cold									2315	2.2		13.7	
H-2	24	9	87	9C	Cold									2304	2.2		12.6	
H-2	25	9	87	10C	Cold									1732	2.2		10.8	
H-2	26	9	87	11C	Cold									2057	2.2		11.1	
H-2	26	9	87	12C	Cold									2616	2.2		13.7	
H-2	27	9	87	13C	Cold									2368	2.2		13.3	
H-2	28	9	87	14C	Cold									2261	2.2		14.0	
H-2	29	9	87	15C	Cold									2209	2.2		13.3	
H-2	29	9	87	16C	Cold									1974	2.2		11.8	

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals				
NWCF		Date		Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	30	9	87	1	WM-187	2134	75							321	2.2			5680
H-2	2	10	87	2	WM-187	2126	75											5520
H-2	2	10	87	3	WM-187	1896	75											4720
H-2	3	10	87	4	WM-187	2037	75							350	2.2			4720
H-2	3	10	87	5	WM-187	1989	75							100	2.2			5200
H-2	4	10	87	6	WM-187	1967	75							198	2.2			4640
H-2	5	10	87	7	WM-187	1935	75							174	2.2			5360
H-2	5	10	87	8	WM-187	2025	75											5040
H-2	6	10	87	9	WM-187	1803	75											4560
H-2	7	10	87	10	WM-187	1923	75											4880
H-2	7	10	87	11	WM-187	2049	75											4720
H-2	8	10	87	12	WM-187	1962	75											4080
H-2	8	10	87	13	WM-187	2206	75											4880
H-2	9	10	87	14	WM-187	1989	75											4496
H-2	10	10	87	15	WM-187	1961	75											4400
H-2	10	10	87	16	WM-189	1761	77	WM-186	195	76								5360
H-2	11	10	87	17	WM-189	1980	77	WM-186	204	76								5704
H-2	11	10	87	18	WM-189	1870	77	WM-186	220	76								6400
H-2	12	10	87	19	WM-189	2141	77	WM-186	200	76								6160
H-2	13	10	87	20	WM-189	1919	77	WM-186	200	76								5440
H-2	14	10	87	21	WM-189	1904	77	WM-186	282	76								6480
H-2	14	10	87	22	WM-189	2041	77	WM-186	214	76								5520
H-2	15	10	87	23	WM-189	1863	77	WM-186	185	76								5040
H-2	15	10	87	24	WM-189	2081	77	WM-186	247	76								6480
H-2	16	10	87	25	WM-189	1891	77	WM-186	208	76								6000
H-2	17	10	87	26	WM-189	2035	77	WM-186	261	76								6640
H-2	17	10	87	27	WM-189	2246	77	WM-186	354	76								6960
H-2	18	10	87	28	WM-189	1791	77	WM-186	317	76								6240
H-2	19	10	87	29	WM-189	1850	77	WM-186	202	76								6000
H-2	20	10	87	30	WM-189	1862	77	WM-186	356	76								6320
H-2	20	10	87	31	WM-189	1996	77	WM-186	280	76								6560
H-2	21	10	87	32	WM-189	1678	77	WM-186	287	76								4720
H-2	22	10	87	33	WM-189	1490	77	WM-186	263	76								4240
H-2	23	10	87	34	WM-189	1658	77	WM-186	306	76								4960
H-2	23	10	87	35	WM-189	1636	77	WM-186	309	76								5200
H-2	24	10	87	36	WM-189	1586	77	WM-186	292	76								5120
H-2	24	10	87	37	WM-189	1470	77	WM-186	289	76								4960
H-2	25	10	87	38	WM-189	1699	77	WM-186	267	76								5360
H-2	25	10	87	39	WM-189	1718	77	WM-186	277	76								5120
H-2	26	10	87	40	WM-189	1591	77	WM-186	276	76								4720
H-2	27	10	87	41	WM-189	1128	77	WM-186	261	76								4320
H-2	28	10	87	42	WM-189	1343	77	WM-186	283	76								4160
H-2	28	10	87	43	WM-189	1520	77	WM-186	250	76								4560
H-2	30	10	87	44	WM-189	1544	77	WM-186	290	76								4960
H-2	9	11	87	45	WM-189	1584	77	WM-186	299	76								5120
H-2	10	11	87	46	WM-189	1530	77	WM-186	305	76								5360
H-2	10	11	87	47	WM-189	1649	77	WM-186	289	76								5120
H-2	11	11	87	48	WM-189	1099	77	WM-186	179	76								3962
H-2	12	11	87	49	WM-189	1754	77	WM-186	270	76								4960
H-2	13	11	87	50	WM-189	1585	77	WM-186	256	76								4960
H-2	14	11	87	51	WM-189	1435	77	WM-186	278	76								4640
H-2	14	11	87	52	WM-189	1482	77	WM-186	261	76								4400
H-2	15	11	87	53	WM-189	1550	77	WM-186	276	76								4720
H-2	16	11	87	54	WM-189	1586	77	WM-186	274	76								4800
H-2	17	11	87	55	WM-189	1729	77	WM-186	290	76								5040
H-2	18	11	87	56	WM-189	1676	77	WM-186	266	76								4800
H-2	18	11	87	57	WM-189	1763	77	WM-186	298	76								5136
H-2	19	11	87	58	WM-189	1632	77	WM-186	297	76								5040
H-2	20	11	87	59	WM-189	1600	77	WM-186	268	76								4480
H-2	20	11	87	60	WM-189	1437	77	WM-186	346	76								5360
H-2	21	11	87	61	WM-189	1421	77	WM-186	254	76								4320
H-2	22	11	87	62	WM-189	1729	77	WM-186	291	76								5200
H-2	22	11	87	63	WM-189	1597	77	WM-186	292	76								4960
H-2	23	11	87	64	WM-189	1729	77	WM-186	288	76								4880
H-2	23	11	87	65	WM-189	1889	77	WM-186	266	76								4880
H-2	24	11	87	66	WM-189	1467	77	WM-186	301	76								5120
H-2	25	11	87	67	WM-189	1597	77	WM-186	276	76								4880
H-2	25	11	87	68	WM-189	1543	77	WM-186	305	76								4640

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

NWCF				Feed Stream									Cold Chemicals					
Date				1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	26	11	87	69	WM-189	1590	77	WM-186	273	76								4800
H-2	27	11	87	70	WM-189	1459	77	WM-186	289	76								4960
H-2	28	11	87	71	WM-189	1517	77	WM-186	321	76								4800
H-2	29	11	87	72	WM-189	1710	77	WM-186	270	76								5280
H-2	29	11	87	73	WM-189	1649	77	WM-186	289	76								4880
H-2	30	11	87	74	WM-189	1682	77	WM-186	290	76								4960
H-2	1	12	87	75	WM-189	1556	77	WM-186	258	76								4800
H-2	1	12	87	76	WM-189	1433	77	WM-186	285	76								4720
H-2	2	12	87	77	WM-189	1614	77	WM-186	271	76								4904
H-2	3	12	87	78	WM-189	1720	77	WM-186	297	76								4800
H-2	3	12	87	79	WM-189	1613	77	WM-186	283	76								4480
H-2	4	12	87	80	WM-189	1201	77	WM-186	238	76								3600
H-2	4	12	87	81	WM-189	1338	77	WM-186	223	76								3680
H-2	5	12	87	82	WM-189	1353	77	WM-186	274	76								3680
H-2	6	12	87	83	WM-189	1505	77	WM-186	255	76								3920
H-2	7	12	87	84	WM-189	1308	77	WM-186	228	76								3840
H-2	7	12	87	85	WM-189	1443	77	WM-186	243	76								4080
H-2	8	12	87	86	WM-189	1519	77	WM-186	279	76								4400
H-2	9	12	87	87	WM-189	1452	77	WM-186	290	76								4320
H-2	9	12	87	88	WM-189	1303	77	WM-186	280	76								3920
H-2	10	12	87	89	WM-189	1219	77	WM-186	284	76								3680
H-2	10	12	87	90	WM-189	1323	77	WM-186	283	76								3928
H-2	11	12	87	91	WM-189	1188	77	WM-186	294	76								3680
H-2	11	12	87	92	WM-189	1376	77	WM-186	288	76								3920
H-2	12	12	87	93	WM-189	1270	77	WM-186	289	76								3680
H-2	13	12	87	94	WM-189	1612	77	WM-186	387	76								4560
H-2	13	12	87	95	WM-189	1474	77	WM-186	337	76								3760
H-2	14	12	87	96	WM-187	1791	75	WM-186	21	76								4080
H-2	14	12	87	97	WM-187	1744	75											4680
H-2	15	12	87	98	WM-187	1419	75											3360
H-2	16	12	87	99	WM-187	1858	75											3920
H-2	17	12	87	100	WM-187	1560	75											3760
H-2	18	12	87	101	WM-187	1369	75											3360
H-2	18	12	87	102	WM-187	1478	75											3440
H-2	19	12	87	103	WM-187	1777	75											4000
H-2	19	12	87	104	WM-187	1353	75											3200
H-2	20	12	87	105	WM-187	1692	75											3840
H-2	21	12	87	106	WM-187	1936	75											4320
H-2	21	12	87	107	WM-187	1912	75											4240
H-2	22	12	87	108	WM-187	1768	75											4000
H-2	23	12	87	109	WM-187	1768	75											3920
H-2	23	12	87	110	WM-187	1563	75											3520
H-2	24	12	87	111	WM-187	1639	75											3600
H-2	25	12	87	112	WM-187	1713	75											3920
H-2	25	12	87	113	WM-187	1848	75											4160
H-2	26	12	87	114	WM-187	1570	75											3840
H-2	27	12	87	115	WM-189	1380	77	WM-186	300	76								4000
H-2	27	12	87	116	WM-189	1410	77	WM-186	281	76								3760
H-2	28	12	87	117	WM-189	1485	77	WM-186	334	76								4400
H-2	29	12	87	118	WM-189	1443	77	WM-186	318	76								4160
H-2	29	12	87	119	WM-189	1473	77	WM-186	275	76								4400
H-2	30	12	87	120	WM-189	1500	77	WM-186	329	76								4400
H-2	31	12	87	121	WM-189	1538	77	WM-186	321	76								3920
H-2	31	12	87	122	WM-189	1475	77	WM-186	350	76								4080
H-2	1	1	88	123	WM-189	1507	77	WM-186	343	76								4400
H-2	1	1	88	124	WM-189	1503	77	WM-186	344	76								4640
H-2	5	1	88	125	WM-189	1502	77	WM-186	286	76								3920
H-2	5	1	88	126	WM-189	1414	77	WM-186	258	76								3920
H-2	6	1	88	127	WM-189	1473	77	WM-186	296	76								3840
H-2	6	1	88	128	WM-189	1553	77	WM-186	333	76								4240
H-2	7	1	88	129	WM-189	1627	77	WM-186	327	76								4400
H-2	8	1	88	130	WM-189	1489	77	WM-186	285	76								3920
H-2	8	1	88	131	WM-189	1517	77	WM-186	323	76								3840
H-2	9	1	88	132	WM-189	1581	77	WM-186	312	76								4320
H-2	9	1	88	133	WM-189	1665	77	WM-186	305	76								4400
H-2	10	1	88	134	WM-189	1430	77	WM-186	303	76								3920
H-2	11	1	88	135	WM-189	1535	77	WM-186	295	76								3920
H-2	11	1	88	136	WM-189	1636	77	WM-186	311	76								4320

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals				
NWCF		Date		Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	12	1	88	137	WM-189	1626	77	WM-186	283	76								4160
H-2	12	1	88	138	WM-189	1419	77	WM-186	271	76								4160
H-2	13	1	88	139	WM-189	1416	77	WM-186	294	76								4240
H-2	14	1	88	140	WM-189	1654	77	WM-186	217	76								4640
H-2	14	1	88	141	WM-189	1513	77	WM-186	329	76								4240
H-2	15	1	88	142	WM-189	1527	77	WM-186	326	76								4400
H-2	15	1	88	143	WM-189	1630	77	WM-186	290	76								4320
H-2	16	1	88	144	WM-189	1663	77	WM-186	361	76								4720
H-2	17	1	88	145	WM-189	1842	77	WM-186	330	76								4960
H-2	17	1	88	146	WM-189	1571	77	WM-186	290	76								4560
H-2	18	1	88	147	WM-189	1478	77	WM-186	361	76								4480
H-2	18	1	88	148	WM-189	1500	77	WM-186	355	76								4480
H-2	19	1	88	149	WM-189	1528	77	WM-186	304	76								4480
H-2	20	1	88	150	WM-189	1507	77	WM-186	296	76								4400
H-2	20	1	88	151	WM-189	1713	77	WM-186	347	76								4960
H-2	21	1	88	152	WM-189	1541	77	WM-186	360	76								4640
H-2	21	1	88	153	WM-189	1565	77	WM-186	343	76								4480
H-2	22	1	88	154	WM-189	1606	77	WM-186	304	76								4480
H-2	22	1	88	155	WM-189	1570	77	WM-186	312	76								4640
H-2	23	1	88	156	WM-189	1491	77	WM-186	263	76								4080
H-2	24	1	88	157	WM-189	1623	77	WM-186	304	76								4240
H-2	24	1	88	158	WM-189	1464	77	WM-186	288	76								4240
H-2	25	1	88	159	WM-189	1463	77	WM-186	310	76								4400
H-2	25	1	88	160	WM-189	1730	77	WM-186	357	76								5200
H-2	26	1	88	161	WM-189	1596	77	WM-186	333	76								4640
H-2	26	1	88	162	WM-189	1650	77	WM-186	332	76								4880
H-2	27	1	88	163	WM-189	1596	77	WM-186	351	76								4560
H-2	28	1	88	164	WM-189	1748	77	WM-186	354	76								4960
H-2	28	1	88	165	WM-189	1783	77	WM-186	333	76								4880
H-2	29	1	88	166	WM-189	1730	77	WM-186	342	76								4800
H-2	30	1	88	167	WM-189	1677	77	WM-186	277	76								4400
H-2	30	1	88	168	WM-189	1555	77	WM-186	309	76								4480
H-2	31	1	88	169	WM-189	1601	77	WM-186	337	76								4880
H-2	31	1	88	170	WM-189	1415	77	WM-186	303	76								4320
H-2	1	2	88	171	WM-189	1725	77	WM-186	351	76								4960
H-2	2	2	88	172	WM-189	1463	77	WM-186	331	76								4880
H-2	2	2	88	173	WM-189	1727	77	WM-186	248	76								5120
H-2	3	2	88	174	WM-189	1662	77	WM-186	341	76								5040
H-2	3	2	88	175	WM-189	1720	77	WM-186	352	76								5120
H-2	4	2	88	176	WM-189	1251	77	WM-186	255	76								3920
H-2	4	2	88	177	WM-189	1597	77	WM-186	316	76								4800
H-2	5	2	88	178	WM-189	1367	77	WM-186	324	76								4320
H-2	6	2	88	179	WM-189	1627	77	WM-186	365	76								4960
H-2	6	2	88	180	WM-189	1466	77	WM-186	349	76								4720
H-2	7	2	88	181	WM-189	1460	77	WM-186	295	76								4480
H-2	7	2	88	182	WM-189	1586	77	WM-186	298	76								4480
H-2	8	2	88	183	WM-189	1335	77	WM-186	266	76								4000
H-2	8	2	88	184	WM-189	1809	77	WM-186	358	76								5360
H-2	9	2	88	185	WM-189	1650	77	WM-186	340	76								4880
H-2	9	2	88	186	WM-189	1527	77	WM-186	309	76								4480
H-2	10	2	88	187	WM-189	1633	77	WM-186	321	76								5120
H-2	10	2	88	188	WM-189	1464	77	WM-186	356	76								4480
H-2	11	2	88	189	WM-189	1589	77	WM-186	299	76								4960
H-2	19	2	88	190	WM-189	1783	77	WM-186	340	76								5120
H-2	19	2	88	191	WM-189	1729	77	WM-186	343	76								4800
H-2	20	2	88	192	WM-189	1464	77	WM-186	280	76								4160
H-2	21	2	88	193	WM-189	1570	77	WM-186	294	76								4160
H-2	21	2	88	194	WM-189	1384	77	WM-186	318	76								4400
H-2	22	2	88	195	WM-189	1730	77	WM-186	313	76								4640
H-2	24	2	88	196	WM-189	1437	77	WM-186	285	76								4240
H-2	24	2	88	197	WM-187	1562	75	WM-186	313	76								3920
H-2	25	2	88	198	WM-188	1221	78	WM-186	229	76								4560
H-2	25	2	88	199	WM-187	1536	75	WM-186	287	76								4080
H-2	26	2	88	200	WM-187	1505	75	WM-186	338	76								4160
H-2	26	2	88	201	WM-187	1621	75	WM-186	321	76								4400
H-2	27	2	88	202	WM-187	1674	75	WM-186	308	76								4320
H-2	27	2	88	203	WM-187	1622	75	WM-186	326	76								4400
H-2	28	2	88	204	WM-187	1736	75	WM-186	311	76								4400

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals					
NWCF		Date		Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb	
H-2	28	2	88	205	WM-187	1716	75	WM-186	309	76								4400	
H-2	29	2	88	206	WM-187	1509	75	WM-186	310	76								4160	
H-2	1	3	88	207	WM-187	1726	75	WM-186	303	76								4160	
H-2	1	3	88	208	WM-188	1491	78	WM-186	257	76								5520	
H-2	2	3	88	209	WM-188	1752	78	WM-186	195	76								5440	
H-2	2	3	88	210	WM-188	1413	78	WM-186	220	76								5440	
H-2	3	3	88	211	WM-188	1386	78	WM-186	218	76								5200	
H-2	4	3	88	212	WM-188	1465	78	WM-186	249	76								5280	
H-2	4	3	88	213	WM-188	1528	78	WM-186	223	76								5600	
H-2	4	3	88	214	WM-188	1517	78	WM-186	236	76								5680	
H-2	24	3	88	DB	Dolomite Bed (approx. 30 cubic feet)								2104	92					
H-2	25	3	88	215	WM-188	1771	78	WM-186	242	76								5040	
H-2	26	3	88	216	WM-188	1786	78	WM-186	343	76								5040	
H-2	27	3	88	217	WM-188	1675	78	WM-186	308	76								4720	
H-2	27	3	88	218	WM-188	1481	78	WM-186	295	76								4240	
H-2	28	3	88	219	WM-188	1647	78	WM-186	322	76								4640	
H-2	29	3	88	220	WM-188	1657	78	WM-186	334	76								4880	
H-2	31	3	88	221	WM-188	1741	78	WM-186	335	76								4960	
H-2	2	4	88	222	WM-188	1517	78	WM-186	318	76								4560	
H-2	3	4	88	223	WM-188	1646	78	WM-186	313	76								4720	
H-2	4	4	88	224	WM-188	1569	78	WM-186	331	76								4800	
H-2	6	4	88	225	WM-188	1664	78	WM-186	326	76								4800	
H-2	8	4	88	226	WM-188	1759	78	WM-186	317	76								4800	
H-2	10	4	88	227	WM-188	1463	78	WM-186	261	76								3920	
H-2	11	4	88	228	WM-188	1364	78	WM-186	260	76								3920	
H-2	12	4	88	229	WM-188	1333	78	WM-186	242	76								3680	
H-2	13	4	88	230	WM-188	1477	78	WM-186	271	76								4240	
H-2	15	4	88	231	WM-188	1809	78	WM-186	325	76								4880	
H-2	16	4	88	232	WM-188	1348	78	WM-186	276	76								3200	
H-2	17	4	88	233	WM-188	1447	78	WM-186	281	76								4240	
H-2	17	4	88	234	WM-188	1255	78	WM-186	252	76								3920	
H-2	18	4	88	235	WM-188	1438	78	WM-186	314	76								4640	
H-2	18	4	88	236	WM-188	1435	78	WM-186	297	76								4480	
H-2	19	4	88	237	WM-188	1651	78	WM-186	322	76								4720	
H-2	20	4	88	238	WM-188	1432	78	WM-186	291	76								4160	
H-2	20	4	88	239	WM-188	1393	78	WM-186	284	76								4480	
H-2	21	4	88	240	WM-188	1335	78	WM-186	278	76								4240	
H-2	21	4	88	241	WM-188	1493	78	WM-186	309	76								4720	
H-2	22	4	88	242	WM-188	1430	78	WM-186	347	76								4640	
H-2	22	4	88	243	WM-188	1808	78	WM-186	342	76								5040	
H-2	23	4	88	244	WM-188	1532	78	WM-186	313	76								4720	
H-2	24	4	88	245	WM-188	1524	78	WM-186	304	76								4480	
H-2	25	4	88	246	WM-188	1593	78	WM-186	342	76								5040	
H-2	25	4	88	247	WM-188	1842	78	WM-186	358	76								5120	
H-2	26	4	88	248	WM-188	1627	78	WM-186	312	76								4640	
H-2	27	4	88	249	WM-188	1425	78	WM-186	309	76								4560	
H-2	27	4	88	250	WM-188	1603	78	WM-186	308	76								4480	
H-2	28	4	88	251	WM-188	1414	78	WM-186	303	76								4640	
H-2	28	4	88	252	WM-188	1354	78	WM-186	310	76								4480	
H-2	29	4	88	253	WM-188	1449	78	WM-186	291	76								4480	
H-2	29	4	88	254	WM-188	1498	78	WM-186	355	76								4960	
H-2	30	4	88	255	WM-188	1590	78	WM-186	334	76								4960	
H-2	30	4	88	256	WM-188	1497	78	WM-186	339	76								4880	
H-2	1	5	88	257	WM-188	1817	78	WM-186	432	76								5680	
H-2	2	5	88	258	WM-188	1577	78	WM-186	339	76								5040	
H-2	2	5	88	259	WM-188	1768	78	WM-186	343	76								400	
H-2	3	5	88	260	WM-188	1379	78	WM-186	274	76								4480	
H-2	3	5	88	261	WM-188	889	78	WM-186	172	76								3200	
H-2	4	5	88	262	WM-188	1407	78	WM-186	309	76								4640	
H-2	5	5	88	263	WM-188	280	78											1840	
H-2	23	5	88	264	WM-188	2000	78	WM-186	388	76								5680	
H-2	24	5	88	265	WM-188	1506	78	WM-186	308	76								4640	
H-2	24	5	88	266	WM-188	1643	78	WM-186	342	76								5120	
H-2	25	5	88	267	WM-188	1730	78	WM-186	346	76								5120	
H-2	25	5	88	268	WM-188	1448	78	WM-186	293	76								4240	
H-2	26	5	88	269	WM-188	1473	78	WM-186	278	76								4160	
H-2	27	5	88	270	WM-188	1579	78	WM-186	337	76								4800	
H-2	27	5	88	271	WM-188	1551	78	WM-186	323	76								4880	

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals					
NWCF		Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb	
H-2	28	5	88	272	WM-188	1409	78	WM-186	295	76								4320	
H-2	28	5	88	273	WM-188	1560	78	WM-186	294	76								4560	
H-2	29	5	88	274	WM-188	1527	78	WM-186	314	76								4640	
H-2	29	5	88	275	WM-188	1568	78	WM-186	346	76								5040	
H-2	30	5	88	276	WM-188	1571	78	WM-186	359	76								5280	
H-2	30	5	88	277	WM-188	1624	78	WM-186	354	76								5280	
H-2	31	5	88	278	WM-188	1498	78	WM-186	304	76								4560	
H-2	1	6	88	279	WM-188	1665	78	WM-186	344	76								5120	
H-2	1	6	88	280	WM-188	1778	78	WM-186	333	76								5200	
H-2	2	6	88	281	WM-188	1658	78	WM-186	340	76								4960	
H-2	3	6	88	282	WM-188	1647	78	WM-186	316	76								4640	
H-2	3	6	88	283	WM-188	1771	78	WM-186	361	76								5120	
H-2	4	6	88	284	WM-188	1658	78	WM-186	328	76								4720	
H-2	4	6	88	285	WM-188	1527	78	WM-186	318	76								4640	
H-2	5	6	88	286	WM-188	1745	78	WM-186	323	76								4960	
H-2	6	6	88	287	WM-188	1516	78	WM-186	314	76								4480	
H-2	7	6	88	288	WM-188	1379	78	WM-186	338	76								4720	
H-2	7	6	88	289	WM-188	1684	78	WM-186	344	76								5040	
H-2	8	6	88	290	WM-188	1564	78	WM-186	324	76								4880	
H-2	9	6	88	291	WM-188	1479	78	WM-186	320	76								4800	
H-2	9	6	88	292	WM-188	1653	78	WM-186	339	76								5040	
H-2	10	6	88	293	WM-188	1526	78	WM-186	293	76								4560	
H-2	26	6	88	1B	Cold									1555	2.2		8.9		
H-2	27	6	88	2B	Cold									1648	2.2		9.0		
H-2	27	6	88	3B	Cold									1800	2.2		8.4		
H-2	28	6	88	4B	Cold									1100	2.2		5.2		
H-2	28	6	88	5B	Cold									2065	2.2		13.1		
H-2	29	6	88	6B	Cold									1800	2.2		9.5		
H-2	29	6	88	7B	Cold									2311	2.2		12.0		
H-2	30	6	88	8B	Cold									1800	2.2		8.7		
H-2	30	6	88	9B	Cold									1446	2.2		6.8		
H-2	1	7	88	10B	Cold									1500	2.2		9.6		
H-2	2	7	88	294	WM-188	1749	78	WM-186	346	76								4960	
H-2	2	7	88	295	WM-188	1666	78	WM-186	316	76								5040	
H-2	3	7	88	296	WM-188	1452	78	WM-186	333	76								4480	
H-2	4	7	88	297	WM-188	1487	78	WM-186	321	76								4480	
H-2	5	7	88	298	WM-188	1363	78	WM-186	277	76								3920	
H-2	5	7	88	299	WM-188	1714	78	WM-186	344	76								5200	
H-2	6	7	88	300	WM-188	1517	78	WM-186	305	76								4560	
H-2	6	7	88	301	WM-188	1684	78	WM-186	340	76								5120	
H-2	7	7	88	302	WM-188	1634	78	WM-186	283	76								4720	
H-2	8	7	88	303	WM-188	1439	78	WM-186	320	76								4720	
H-2	9	7	88	304	WM-188	1464	78	WM-186	324	76								4720	
H-2	9	7	88	305	WM-188	1478	78	WM-186	314	76								4640	
H-2	10	7	88	306	WM-188	1291	78	WM-186	315	76								4400	
H-2	11	7	88	307	WM-188	1530	78	WM-186	307	76								4720	
H-2	12	7	88	308	WM-188	1505	78	WM-186	342	76								4640	
H-2	13	7	88	309	WM-188	1483	78	WM-186	303	76								4400	
H-2	14	7	88	310	WM-188	1390	78	WM-186	314	76								4640	
H-2	14	7	88	311	WM-188	1351	78	WM-186	259	76								4000	
H-2	15	7	88	312	WM-188	1556	78	WM-186	333	76								5040	
H-2	16	7	88	313	WM-188	1734	78	WM-186	359	76								5120	
H-2	17	7	88	314	WM-188	1631	78	WM-186	352	76								5040	
H-2	17	7	88	315	WM-188	1540	78	WM-186	280	76								4480	
H-2	18	7	88	316	WM-188	1691	78	WM-186	332	76								4880	
H-2	18	7	88	317	WM-188	1554	78	WM-186	314	76								4720	
H-2	19	7	88	318	WM-188	1552	78	WM-186	285	76								4800	
H-2	19	7	88	319	WM-188	1465	78	WM-186	331	76								5040	
H-2	20	7	88	320	WM-188	1203	78	WM-186	340	76								5120	
H-2	20	7	88	321	WM-188	1641	78	WM-186	322	76								4800	
H-2	21	7	88	322	WM-188	1530	78	WM-186	309	76								4480	
H-2	22	7	88	323	WM-188	1678	78	WM-186	337	76								5040	
H-2	22	7	88	324	WM-188	1593	78	WM-186	314	76								4720	
H-2	23	7	88	325	WM-188	1509	78	WM-186	316	76								4560	
H-2	23	7	88	326	WM-188	1770	78	WM-186	372	76								5360	
H-2	24	7	88	327	WM-188	1533	78	WM-186	322	76								4880	
H-2	24	7	88	328	WM-188	1601	78	WM-186	320	76								5040	
H-2	25	7	88	329	WM-188	1491	78	WM-186	265	76								4400	

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃	NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂	
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-2	25	7	88	330	WM-188	1473	78	WM-186	339	76								5040
H-2	26	7	88	331	WM-188	1488	78	WM-186	313	76								4560
H-2	27	7	88	332	WM-188	1653	78	WM-186	309	76								4560
H-2	27	7	88	333	WM-188	1551	78	WM-186	292	76								4160
H-2	27	7	88	334	WM-188	1810	78	WM-186	320	76								4720
H-2	29	7	88	335	WM-189	1976	79	WM-186	281	76								6480
H-2	30	7	88	336	WM-189	1517	79	WM-186	230	76								4800
H-2	30	7	88	337	WM-189	1739	79	WM-186	254	76								5760
H-2	31	7	88	338	WM-189	1451	79	WM-186	251	76								5760
H-2	31	7	88	339	WM-189	1574	79	WM-186	223	76								5680
H-2	1	8	88	340	WM-189	1579	79	WM-186	252	76								5760
H-2	1	8	88	341	WM-189	1752	79	WM-186	279	76								4960
H-2	2	8	88	342	WM-189	1583	79	WM-186	264	76								4640
H-2	3	8	88	343	WM-189	1708	79	WM-186	254	76								4960
H-2	3	8	88	344	WM-189	1851	79	WM-186	330	76								5680
H-2	4	8	88	345	WM-189	1817	79	WM-186	281	76								4960
H-2	4	8	88	346	WM-189	1598	79	WM-186	282	76								4880
H-2	5	8	88	347	WM-189	1771	79	WM-186	300	76								4720
H-2	5	8	88	348	WM-189	1478	79	WM-186	329	76								4640
H-2	6	8	88	349	WM-189	1621	79	WM-186	306	76								4400
H-2	6	8	88	350	WM-189	1581	79	WM-186	329	76								4640
H-2	7	8	88	351	WM-189	1777	79	WM-186	342	76								4960
H-2	8	8	88	352	WM-189	1769	79	WM-186	330	76								4960
H-2	8	8	88	353	WM-189	1836	79	WM-186	342	76								5120
H-2	9	8	88	354	WM-189	1950	79	WM-186	361	76								5200
H-2	10	8	88	355	WM-189	1668	79	WM-186	352	76								5040
H-2	10	8	88	1C				WM-186	142	76				1184	2.2			4640
H-2	13	8	88	356	WM-189	1548	79	WM-186	324	76								9
H-2	15	8	88	357	WM-189	1693	79	WM-186	333	76								4960
H-2	15	8	88	358	WM-189	1855	79	WM-186	341	76								5200
H-2	16	8	88	359	WM-189	1663	79	WM-186	368	76								5280
H-2	16	8	88	360	WM-189	1745	79	WM-186	389	76								5120
H-2	17	8	88	361	WM-189	1668	79	WM-186	382	76								5360
H-2	18	8	88	362	WM-189	1721	79	WM-186	336	76								5040
H-2	18	8	88	363	WM-189	1681	79	WM-186	357	76								5120
H-2	19	8	88	364	WM-189	1804	79	WM-186	331	76								5040
H-2	20	8	88	365	WM-189	1729	79	WM-186	333	76								4960
H-2	20	8	88	366	WM-189	1605	79	WM-186	299	76								4400
H-2	21	8	88	367	WM-189	1781	79	WM-186	324	76								4880
H-2	22	8	88	368	WM-189	1907	79	WM-186	377	76								5520
H-2	23	8	88	369	WM-189	1522	79	WM-186	308	76								4400
H-2	24	8	88	370	WM-189	1537	79	WM-186	344	76								5040
H-2	24	8	88	371	WM-189	1665	79	WM-186	317	76								4640
H-2	25	8	88	372	WM-189	1513	79	WM-186	328	76								4720
H-2	25	8	88	373	WM-189	1726	79	WM-186	322	76								4720
H-2	26	8	88	374	WM-189	1575	79	WM-186	326	76								4720
H-2	26	8	88	375	WM-189	1752	79	WM-186	320	76								4720
H-2	27	8	88	376	WM-189	1376	79	WM-186	298	76								4320
H-2	28	8	88	377	WM-189	1581	79	WM-186	357	76								4880
H-2	28	8	88	378	WM-189	1515	79	WM-186	340	76								4560
H-2	28	8	88	379	WM-189	1382	79	WM-186	324	76								4560
H-2	29	8	88	380	WM-189	1509	79	WM-186	335	76								4880
H-2	30	8	88	381	WM-189	1202	79	WM-186	286	76								3920
H-2	31	8	88	382	WM-189	1416	79	WM-186	333	76								4400
H-2	31	8	88	383	WM-189	1275	79	WM-186	309	76								4400
H-2	3	9	88	384	WM-189	1288	79	WM-186	316	76								4480
H-2	3	9	88	385	WM-189	1380	79	WM-186	306	76								4400
H-2	4	9	88	386	WM-189	1464	79	WM-186	362	76								4560
H-2	5	9	88	387	WM-189	1271	79	WM-186	330	76								4640
H-2	5	9	88	388	WM-189	1468	79	WM-186	334	76								4640
H-2	6	9	88	389	WM-189	1185	79	WM-186	275	76								4320
H-2	7	9	88	390	WM-189	1241	79	WM-186	327	76								4720
H-2	7	9	88	391	WM-189	1429	79	WM-186	337	76								4400
H-2	8	9	88	392	WM-189	1526	79	WM-186	314	76								4480
H-2	8	9	88	393	WM-189	1402	79	WM-186	361	76								4960
H-2	9	9	88	394	WM-189	1571	79	WM-186	359	76								4960
H-2	10	9	88	395	WM-189	1544	79	WM-186	340	76								4880
H-2	10	9	88	396	WM-189	1660	79	WM-186	347	76								4960

Table A5. Calcined material to Calcined Solids Storage Facility V (continued).

					Feed Stream									Cold Chemicals											
NWCF		Date		Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂							
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb							
H-3	16	8	91	DB	Dolomite Bed (approx. 5 cubic feet)								354	92											
H-3	16	8	91	DB	Dolomite Bed (approx. 11 cubic feet)								796	92											
H-3	16	8	91	21C	Cold									1924	2.2		9.0								
H-3	17	8	91	DB	Dolomite Bed (approx. 15 cubic feet)								1062	92											
H-3	17	8	91	DB	Dolomite Bed (approx. 13 cubic feet)								885	92											
H-3	17	8	91	DB	Dolomite Bed (approx. 10 cubic feet)								708	92											
H-3	17	8	91	22C	Cold									2052	2.2		14.2								
H-3	19	8	91	233	WM-182	603	83	WM-185	205	81	WM-187	664	82	532	2.2		30.0	1680							
H-3	19	8	91	DB	Dolomite Bed (approx. 13 cubic feet)								885	92											
H-3	18	8	91	234	WM-182	624	83	WM-185	223	81	WM-187	722	82	589	2.2		33.8	1760							
H-3	20	8	91	235	WM-182	611	83	WM-185	215	81	WM-187	694	82				32.6	1680							
H-3	21	8	91	236	WM-182	1272	83	WM-185	237	81	WM-187	765	82				34.7	1920							
H-3	22	8	91	237	WM-182	1309	83	WM-185	241	81	WM-187	779	82				33.9	2000							
H-3	22	8	91	238	WM-182	1201	83	WM-185	226	81	WM-187	732	82				32.4	1840							
H-3	23	8	91	239	WM-182	1204	83	WM-185	226	81	WM-187	732	82				33.4	1840							
H-3	24	8	91	240	WM-182	1218	83	WM-185	220	81	WM-187	711	82				33.4	1760							
H-3	24	8	91	241	WM-182	1200	83	WM-185	229	81	WM-187	740	82				32.5	1840							
H-3	25	8	91	242	WM-182	1205	83	WM-185	223	81	WM-187	722	82				32.2	1840							
H-3	26	8	91	243	WM-182	1233	83	WM-185	227	81	WM-187	735	82				33.1	1840							
H-3	26	8	91	244	WM-182	1274	83	WM-185	237	81	WM-187	767	82				33.2	1920							
H-3	27	8	91	245	WM-182	1243	83	WM-185	236	81	WM-187	764	82				31.7	1920							
H-3	28	8	91	246	WM-182	1196	83	WM-185	223	81	WM-187	722	82				31.2	1840							
H-3	29	8	91	247	WM-182	608	83	WM-185	113	81	WM-187	367	82				16.0	920							
H-3	10	1	92	DB	Dolomite Bed (approx. 100 cubic feet)								70	92											
H-3	10	1	92	20C	Cold									18.74	2.2		0.1								
H-3	11	1	92	DB	Dolomite Bed (approx. 11 cubic feet)								8	92											
H-3	12	1	92	21C	Cold									19.66	2.2		0.1								
H-3	12	1	92	DB	Dolomite Bed (approx. 16 cubic feet)								12	92											
H-3	12	1	92	DB	Dolomite Bed (approx. 10 cubic feet)								7	92											
H-3	12	1	92	22C	Cold									10.1	2.2		0.1								
H-3	13	1	92	23C	Cold	CSSF V was on line during the Jan 1992 startup, but received very little calcine. The bulk of the material remained in the calciner in a slumped condition and was used as the starting bed in Jan 1993. CSSF V is assumed to contain only 1% of the material added to the calciner during Jan 1992, the rest is in CSSF VI.									20.36	2.2		0.1							
H-3	13	1	92	24C	Cold																16.78	2.2		0.1	
H-3	15	1	92	25C	Cold																16.91	2.2		0.1	
H-3	16	1	92	26C	Cold																16.61	2.2		0.1	
H-3	17	1	92	27C	Cold																11.93	2.1		0.1	

CSSF V was on line during the Jan 1992 startup, but received very little calcine. The bulk of the material remained in the calciner in a slumped condition and was used as the starting bed in Jan 1993. CSSF V is assumed to contain only 1% of the material added to the calciner during Jan 1992, the rest is in CSSF VI.

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Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-3	5	7	93	405	WM-188	1397	80	WM-185	283	81								3602
H-3	6	7	93	406	WM-188	1408	80	WM-185	291	81								4098
H-3	13	9	93	407	WM-188	933	80	WM-185	190	81								2696
H-3	14	9	93	408	WM-188	1796	80	WM-185	275	81								5098
H-3	15	9	93	409	WM-100	1720	85							833	2.2		21.0	256
H-3	16	9	93	DB	Dolomite Bed (approx. 9 cubic feet)							609	92					
H-3	16	9	93	410	WM-100	1397	85							794	2.2		19.0	411
H-3	17	9	93	411	WM-100	703	85							1927	2.2		22.0	604
H-3	17	9	93	DB	Dolomite Bed (approx. 8 cubic feet)							541	92					
H-3	18	9	93	DB	Dolomite Bed (approx. 15 cubic feet)							1046	92					
H-3	18	9	93	412	WM-100	722	85							1919	2.2		21.4	372
H-3	19	9	93	DB	Dolomite Bed (approx. 10 cubic feet)							690	92					
H-3	19	9	93	413	WM-188	857	80	WM-185	306	81								4059
H-3	20	9	93	414	WM-188	909	80	WM-185	192	81								2828
H-3	22	9	93	415	WM-100	708	85							1988	2.13		21.4	7
H-3	24	9	93	416	WM-100	634	85							1715	2.13		21.2	240
H-3	24	9	93	DB	Dolomite Bed (approx. 15 cubic feet)							1035	92					
H-3	25	9	93	417	WM-100	628	85							1752	2.17		21.4	532
H-3	26	9	93	418	WM-100	504	85							1390	2.17		21.0	486
H-3	28	9	93	419	WM-100	491	85							1380	2.17		20.6	625
H-3	29	9	93	420	WM-100	584	85							1511	2.17		21.0	447
H-3	30	9	93	421	WM-100	1262	85							1043	2.17		20.8	247
H-3	1	10	93	422	WM-100	830	85							1135	2.17		20.0	416
H-3	2	10	93	423	WM-100	822	85							1176	2.2		20.1	501
H-3	4	10	93	424	WM-100	840	85							1177	2.2		20.3	794
H-3	7	10	93	425	WM-100	1092	85							930	2.2		20.5	532
H-3	9	10	93	426	WM-100	1055	85							892	2.2		20.1	339
H-3	11	10	93	427	WM-100	680	85							942	2.2		19.0	470
H-3	12	10	93	428				WM-185	297	81				1303	2.2		88.0	347
H-3	14	10	93	429				WM-185	433	81				1846	2.2		63.4	293
H-3	16	10	93	430				WM-185	338	81				1448	2.15		56.7	393
H-3	18	10	93	431				WM-185	356	81				1527	2.15		57.0	601
H-3	20	10	93	432				WM-185	352	81				1533	2.15		91.0	231
H-3	22	10	93	433				WM-185	430	81				1853	2.15		61.0	463
H-3	24	10	93	434				WM-185	379	81				1661	2.15		66.4	455
H-3	26	10	93	435				WM-185	281	81				1230	2.13		85.0	594
H-3	28	10	93	436				WM-185	283	81				1249	2.13		85.0	771
H-3	30	10	93	36C	Cold									903	2.13		4.0	
H-3	31	10	93	37C	Cold									915	2.13		4.3	
H-3	1	11	93	38C	Cold									821	2.13		3.8	
H-3	1	11	93	39C	Cold									906	2.13		4.2	
H-4	3	6	97	PPC	Pilot Plant Calcine (approx. 53 cubic feet)							3100	94					
H-4	4	6	97	DB	Dolomite Bed (approx. 68 cubic feet)							4791	92					
H-4	5	6	97	1-C	Cold									1787	1.52		25.4	
H-4	5	6	97	DB	Dolomite Bed (approx. 24 cubic feet)							1681	92					
H-4	6	6	97	DB	Dolomite Bed (approx. 14 cubic feet)							973	92					
H-4	6	6	97	DB	Dolomite Bed (approx. 11 cubic feet)							796	92					
H-4	6	6	97	2-C	Cold									1805	1.205		24.6	
H-4	7	6	97	DB	Dolomite Bed (approx. 15 cubic feet)							1046	92					
H-4	7	6	97	DB	Dolomite Bed (approx. 13 cubic feet)							941	92					
H-4	7	6	97	3-C	Cold									2233	1.589		16.3	
H-4	8	6	97	4-C	Cold									1822	1.49		25.6	
H-4	9	6	97	5-C	Cold									1828	1.496		17.2	
H-4	10	6	97	6-C	Cold									1602	1.464		28.1	
H-4	11	6	97	7-C	Cold									1806	1.627		17.5	
H-4	11	6	97	8-C	Cold									1704	1.434		19.5	
H-4	12	6	97	9-C	Cold									1905	1.46		18.8	
H-4	15	6	97	10-C	Cold									428.3	1.51		4.2	
H-4	15	6	97	11-C	Cold									2190	1.311		15.3	
H-4	17	6	97	1	WM-188	779	86							1466	2.17		17.2	294.6544
H-4	18	6	97	2	WM-188	732	86							1332	2.17		12.1	294.6544
H-4	19	6	97	3	WM-188	792	86							1328	2.17		20.7	305.8438
H-4	20	6	97	4	WM-188	930	86							1582	2.17		15.8	361.7908
H-4	20	6	97	5	WM-188	807	86							1366	2.17		14.2	350.6014
H-4	21	6	97	6	WM-188	847	86							1427	2.13		13.0	317.0332
H-4	22	6	97	7	WM-188	691	86							1149	2.13		16.5	358.061
H-4	22	6	97	8	WM-188	787	86							1334	2.13		15.3	395.359
H-4	23	6	97	9	WM-188	819	86							1393	2.13		10.9	309.5736

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	26	9	97	146	WM-188	974	86							1314	2.296		20.9	440.1166
H-4	26	9	97	147	WM-188	957	86							1297	2.3		20.0	436.3868
H-4	20	10	97	DB	Dolomite Bed (approx. 42 cubic feet)								2972	92				
H-4	21	10	97	148	WM-188	1044	86							1415	2.3		21.1	432.657
H-4	22	10	97	149	WM-188	968	86							1351	2.3		22.3	421.4676
H-4	23	10	97	150	WM-188	941	86							1313	2.3		19.3	428.9272
H-4	24	10	97	151	WM-188	991	86							1363	2.3		23.0	425.1974
H-4	24	10	97	152	WM-188	954	86							1305	2.3		20.0	466.2253
H-4	25	10	97	153	WM-188	933	86							1299	2.3		20.5	414.008
H-4	26	10	97	154	WM-188	947	86							1286	2.3		16.7	414.008
H-4	26	10	97	155	WM-188	843	86							1155	2.3		17.0	384.1696
H-4	27	10	97	156	WM-188	875	86							1202	2.3		18.4	365.5206
H-4	28	10	97	157	WM-188	894	86							1206	2.3		18.2	324.4928
H-4	28	10	97	158	WM-188	929	86							1265	2.2		18.4	395.359
H-4	29	10	97	159	WM-188	934	86							1258	2.3		16.8	399.0888
H-4	30	10	97	160	WM-188	931	86							1287	2.3		21.4	410.2782
H-4	30	10	97	161	WM-188	889	86							1280	2.3		29.6	361.7908
H-4	31	10	97	162	WM-188	960	86							1300	2.3		17.5	380.4398
H-4	1	11	97	163	WM-188	970	86							1336	2.217		20.0	346.8716
H-4	1	11	97	164	WM-188	912	86							1260	2.217		17.4	372.9802
H-4	2	11	97	165	WM-188	961	86							1307	2.271		19.5	417.7378
H-4	2	11	97	166	WM-188	939	86							1288	2.217		17.7	358.061
H-4	3	11	97	167	WM-188	922	86							1270	2.217		21.2	380.4398
H-4	4	11	97	168	WM-188	939	86							1263	2.217		23.3	440.1166
H-4	4	11	97	169	WM-188	915	86							1268	2.217		18.9	365.5206
H-4	5	11	97	170	WM-188	897	86							1231	2.217		19.3	421.4676
H-4	6	11	97	171	WM-188	930	86							1258	2.271		18.1	455.0359
H-4	6	11	97	172	WM-188	975	86							1288	2.299		17.9	421.4676
H-4	7	11	97	173	WM-188	942	86							1293	2.299		18.6	376.71
H-4	8	11	97	174	WM-188	1001	86							1314	2.217		15.4	361.7908
H-4	8	11	97	175	WM-188	915	86							1192	2.275		18.8	350.6014
H-4	9	11	97	176	WM-188	931	86							1255	2.275		18.1	436.3868
H-4	10	11	97	177	WM-188	935	86							1260	2.299		18.2	361.7908
H-4	10	11	97	178	WM-188	951	86							1220	2.299		20.0	391.6292
H-4	11	11	97	179	WM-188	952	86							1252	2.299		17.7	358
H-4	11	11	97	180	WM-188	951	86							1256	2.294		20.4	436
H-4	12	11	97	181	WM-188	930	86							1216	2.294		18.6	387
H-4	13	11	97	182	WM-188	886	86							1171	2.294		16.1	380
H-4	13	11	97	183	WM-188	1031	86							1343	2.133		20.4	436
H-4	14	11	97	184	WM-188	947	86							1254	2.233		19.5	362
H-4	15	11	97	185	WM-188	951	86							1249	2.26		19.8	402
H-4	15	11	97	186	WM-188	947	86							1254	2.26		19.0	380
H-4	16	11	97	187	WM-188	956	86							1250	2.133		20.7	372
H-4	16	11	97	188	WM-188	946	86							1242	2.26		19.0	387.9779
H-4	17	11	97	189	WM-188	914	86							1204	2.26		18.8	414.8675
H-4	18	11	97	190	WM-188	894	86							1174	2.26		17.2	353.4056
H-4	18	11	97	191	WM-188	967	86							1229	2.133		13.9	426.3916
H-4	19	11	97	192	WM-188	976	86							1229	2.133		17.9	372.6125
H-4	20	11	97	193	WM-188	984	86							1233	2.289		18.1	391.8193
H-4	20	11	97	194	WM-188	950	86							1212	2.289		12.5	403.3434
H-4	21	11	97	195	WM-188	1135	86							1431	2.289		21.9	487.8534
H-4	22	11	97	196	WM-188	961	86							1211	2.253		19.3	449.4398
H-4	23	11	97	197	WM-188	943	86							1194	2.253		17.9	460.9639
H-4	23	11	97	198	WM-188	999	86							1262	2.26		19.5	391.8193
H-4	24	11	97	199	WM-188	1013	86							1307	2.253		21.2	357.247
H-4	25	11	97	200	WM-188	866	86							1130	2.253		19.2	380.2952
H-4	25	11	97	201	WM-188	1061	86							1354	2.253		21.5	426.3916
H-4	26	11	97	202	WM-188	904	86							1125	2.25		16.1	426.3916
H-4	27	11	97	203	WM-188	999	86							1264	2.27		18.8	411.0261
H-4	27	11	97	204	WM-188	973	86							1209	2.248		22.1	495.5362
H-4	28	11	97	205	WM-188	906	86							1149	2.27		16.6	353.4056
H-4	29	11	97	206	WM-188	960	86							1226	2.25		20.6	318.8334
H-4	29	11	97	207	WM-188	1012	86							1275	2.25		16.1	414.8675
H-4	30	11	97	208	WM-188	957	86							1199	2.25		18.6	395.6607
H-4	1	12	97	209	WM-188	1027	86							1316	2.25		18.8	484.0121
H-4	1	12	97	210	WM-188	1043	86							1334	2.25		19.7	422.5502
H-4	2	12	97	211	WM-188	977	86							1218	2.25		20.3	379.8607
H-4	3	12	97	212	WM-188	960	86							1211	2.27		20.4	418.6219

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	3	12	97	213	WM-188	1008	86							1286	2.28		19.7	441.8787
H-4	15	12	97	214	WM-188	1070	86							1462	2.26		16.6	490.4259
H-4	16	12	97	215	WM-188	1088	86							1488	2.26		24.2	446.8325
H-4	16	12	97	216	WM-188	1036	86							1333	2.26		17.9	423.7669
H-4	17	12	97	217	WM-188	1011	86							1295	2.26		20.8	347.8087
H-4	18	12	97	218	WM-188	1048	86							1312	2.26		24.1	466.0741
H-4	19	12	97	219	WM-188	1013	86							1276	2.24		20.8	424.3927
H-4	19	12	97	220	WM-188	1009	86							1298	2.24		16.1	431.9711
H-4	20	12	97	221	WM-188	1023	86							1291	2.26		19.0	409.2358
H-4	21	12	97	222	WM-188	925	86							1177	2.26		21.5	375.1328
H-4	21	12	97	223	WM-188	1063	86							1332	2.26		15.2	390.2897
H-4	22	12	97	224	WM-188	929	86							1188	2.26		17.9	380.6602
H-4	23	12	97	225	WM-188	1024	86							1295	2.24		16.6	384.4668
H-4	23	12	97	226	WM-188	933	86							1220	2.23		21.5	361.6272
H-4	24	12	97	227	WM-188	941	86							1205	2.24		15.9	414.9196
H-4	25	12	97	228	WM-188	980	86							1229	2.24		10.7	445.3725
H-4	25	12	97	229	WM-188	972	86							1252	2.26		19.8	418.7262
H-4	26	12	97	230	WM-188	992	86							1266	2.24		17.3	449.1791
H-4	27	12	97	231	WM-188	1016	86							1294	2.237		17.0	455.3322
H-4	28	12	97	232	WM-188	995	86							1271	2.24		21.4	409.0272
H-4	28	12	97	233	WM-188	928	86							1184	2.26		18.9	424.4622
H-4	29	12	97	234	WM-188	1018	86							1244	2.26		17.9	443.756
H-4	29	12	97	235	WM-188	1029	86							1308	2.26		15.0	384.4668
H-4	30	12	97	236	WM-188	1135	86							1428	2.24		25.0	536.3659
H-4	31	12	97	237	WM-188	1019	86							1309	2.26		19.5	455.0541
H-4	31	12	97	238	WM-188	913	86							1158	2.26		16.3	344.1586
H-4	1	1	98	239	WM-188	951	86							1219	2.23		17.3	405.3423
H-4	1	1	98	240	WM-188	994	86							1235	2.23		17.3	367.1025
H-4	2	1	98	241	WM-188	956	86							1221	2.23		21.3	382.3984
H-4	3	1	98	242	WM-188	983	86							1247	2.22		18.9	382.3984
H-4	4	1	98	243	WM-188	926	86							1201	2.213		17.9	378.5744
H-4	4	1	98	244	WM-188	916	86							1147	2.213		16.4	416.8142
H-4	5	1	98	245	WM-188	1045	86							1338	2.213		15.7	435.7603
H-4	5	1	98	246	WM-188	958	86							1208	2.213		18.4	375.1328
H-4	7	1	98	247	WM-188	960	86							1203	2.213		18.2	371.3436
H-4	7	1	98	248	WM-188	978	86							1234	2.208		16.8	386.5005
H-4	8	1	98	249	WM-188	890	86							1119	2.208		16.1	333.4514
H-4	9	1	98	250	WM-188	945	86							1194	2.208		17.3	401.6574
H-4	10	1	98	251	WM-188	911	86							1174	2.205		10.8	398.9111
H-4	11	1	98	252	WM-188	916	86							1164	2.205		29.7	410.6437
H-4	12	1	98	253	WM-188	908	86							1147	2.205		15.5	375.4457
H-4	13	1	98	254	WM-188	960	86							1208	2.204		18.0	359.8021
H-4	14	1	98	255	WM-188	953	86							1214	2.204		16.8	351.9803
H-4	15	1	98	256	WM-188	936	86							1180	2.204		18.0	359.8021
H-4	15	1	98	257	WM-188	838	86							1048	2.204		16.3	363.713
H-4	16	1	98	258	WM-188	1011	86							1339	2.204		20.1	414.5546
H-4	17	1	98	259	WM-188	955	86							1209	2.2		16.1	430.2503
H-4	18	1	98	260	WM-188	904	86							1165	2.2		16.4	360.48
H-4	19	1	98	261	WM-188	906	86							1152	2.2		13.6	441.8787
H-4	20	1	98	262	WM-188	954	86							1216	2.21		19.4	441.8787
H-4	21	1	98	263	WM-188	984	86							1272	2.21		18.9	406.9936
H-4	22	1	98	264	WM-188	978	86							1221	2.24		14.5	356.6039
H-4	23	1	98	265	WM-188	928	86							1177	2.21		19.4	414.7458
H-4	24	1	98	266	WM-188	877	86							1095	2.23		18.2	399.502
H-4	25	1	98	267	WM-188	993	86							1280	2.23		18.4	460.9639
H-4	26	1	98	268	WM-188	943	86							1231	2.27		17.3	411.0261
H-4	27	1	98	269	WM-188	960	86							1239	2.23		17.5	414.8675
H-4	28	1	98	270	WM-188	910	86							1148	2.23		15.7	387.9779
H-4	29	1	98	271	WM-188	953	86							1204	2.25		15.9	403.3434
H-4	29	1	98	272	WM-188	1033	86							1312	2.25		17.1	456.7923
H-4	30	1	98	273	WM-188	1130	86							1423	2.23		19.3	426.3394
H-4	31	1	98	274	WM-188	976	86							1243	2.23		19.8	388.2734
H-4	1	2	98	275	WM-188	1137	86							1426	2.21		19.8	445.3725
H-4	2	2	98	276	WM-188	1017	86							1288	2.23		22.1	395.8866
H-4	3	2	98	277	WM-188	1009	86							1316	2.23		16.4	392.08
H-4	4	2	98	278	WM-188	979	86							1230	2.21		16.1	369.2404
H-4	5	2	98	279	WM-188	936	86							1183	2.21		19.8	377.1839
H-4	6	2	98	280	WM-188	964	86							1277	2.21		11.5	399.8149

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	7	2	98	281	WM-188	930	86							1163	2.22		16.6	403.5867
H-4	8	2	98	282	WM-188	996	86							1264	2.22		19.3	441.3271
H-4	9	2	98	283	WM-188	892	86							1131	2.22		17.5	399.8349
H-4	10	2	98	284	WM-188	979	86							1224	2.22		19.7	426.239
H-4	11	2	98	285	WM-188	991	86							1257	2.22		20.5	396.0628
H-4	12	2	98	286	WM-188	752	86							938	2.21		14.5	331.8688
H-4	13	2	98	287	WM-188	1198	86							1517	2.21		24.3	547.9695
H-4	14	2	98	288	WM-188	933	86							1158	2.21		19.7	466.9317
H-4	15	2	98	289	WM-188	910	86							1163	2.21		19.7	424.4834
H-4	17	2	98	290	WM-188	959	86							1203	2.21		19.1	439.9192
H-4	18	2	98	291	WM-188	978	86							1247	2.21		19.5	459.2139
H-4	19	2	98	292	WM-188	975	86							1238	2.24		20.2	439.9192
H-4	20	2	98	293	WM-188	757	86							981	2.24		13.8	340.2646
H-4	20	2	98	294	WM-185	668	81							1684	2.24		27.6	285.5094
H-4	21	2	98	295	WM-185	687	81							1731	2.24		29.9	258.1318
H-4	22	2	98	296	WM-185	678	81							1720	2.24		31.7	391.1088
H-4	23	2	98	297	WM-185	747	81							1885	2.24		33.5	297.2427
H-4	24	2	98	298	WM-185	751	81							1926	2.24		36.7	312.887
H-4	26	2	98	299	WM-185	615	81							1542	2.22		24.3	297.2427
H-4	27	2	98	300	WM-185	601	81							1535	2.21		27.3	293.3316
H-4	1	3	98	301	WM-185	631	81							1618	2.24		29.2	328.5314
H-4	2	3	98	302	WM-185	607	81							1540	2.24		23.9	269.2219
H-4	4	3	98	303	WM-185	617	81							1533	2.24		26.0	275.3406
H-4	5	3	98	304	WM-185	655	81							1650	2.24		29.5	287.5779
H-4	6	3	98	305	WM-185	618	81							1567	2.2		26.0	232.5098
H-4	7	3	98	306	WM-185	658	81							1632	2.2		27.2	223.3318
H-4	7	3	98	307	WM-185	618	81							1569	2.2		29.5	260.0439
H-4	8	3	98	308	WM-185	636	81							1616	2.2		25.5	293.6966
H-4	9	3	98	309	WM-185	675	81							1726	2.2		30.3	177.4417
H-4	9	3	98	310	WM-185	619	81							1585	2.2		24.9	260.0439
H-4	10	3	98	311	WM-185	659	81							1493	2.2		27.6	224.5834
H-4	11	3	98	312	WM-185	656	81							1488	2.2		27.2	227.5384
H-4	12	3	98	313	WM-185	667	81							1532	2.2		25.7	265.954
H-4	12	3	98	314	WM-185	693	81							1602	2.2		28.8	254.1338
H-4	13	3	98	315	WM-185	676	81							1588	2.2		54.4	286.6393
H-4	14	3	98	316	WM-185	621	81							1420	2.2		27.3	227.5384
H-4	14	3	98	317	WM-185	773	81							1740	2.2		32.0	289.5943
H-4	15	3	98	318	WM-185	673	81							1576	2.2		26.4	280.3468
H-4	16	3	98	319	WM-185	663	81							1525	2.2		25.1	230.702
H-4	17	3	98	320	WM-185	671	81							1579	2.21		30.2	277.4265
H-4	17	3	98	321	WM-185	670	81							1558	2.17		28.9	286.1873
H-4	18	3	98	322	WM-185	677	81							1584	2.21		29.3	297.8684
H-4	19	3	98	323	WM-185	606	81							1368	2.21		24.0	256.9845
H-4	19	3	98	324	WM-185	621	81							1401	2.17		26.7	230.702
H-4	20	3	98	325	WM-185	649	81							1446	2.19		27.3	262.8251
H-4	21	3	98	326	WM-185	582	81							1323	2.19		23.1	277.4265
H-4	22	3	98	327	WM-185	675	81							1571	2.17		27.8	248.2237
H-4	22	3	98	328	WM-185	669	81							1539	2.19		23.8	265.7454
H-4	23	3	98	329	WM-185	670	81							1546	2.17		26.7	239.4629
H-4	24	3	98	330	WM-185	656	81							1512	2.19		26.2	306.6293
H-4	24	3	98	331	WM-185	599	81							1406	2.17		22.0	207.3398
H-4	25	3	98	332	WM-185	656	81							1504	2.18		25.3	233.6223
H-4	26	3	98	333	WM-185	645	81							1504	2.18		25.3	245.2687
H-4	26	3	98	334	WM-185	668	81							1544	2.18		26.4	248.1542
H-4	27	3	98	335	WM-185	749	81							1703	2.17		28.5	236.6121
H-4	28	3	98	336	WM-185	638	81							1470	2.17		28.7	271.2383
H-4	29	3	98	337	WM-185	684	81							1575	2.17		25.3	291.4369
H-4	30	3	98	338	WM-185	680	81							1560	2.17		25.3	291.4369
H-4	1	4	98	339	WM-185	702	81							1752	2.16		30.1	274.1238
H-4	2	4	98	340	WM-185	591	81							1470	2.16		25.5	225.9044
H-4	3	4	98	341	WM-185	585	81							1470	2.17		24.6	249.6838
H-4	4	4	98	342	WM-185	581	81							1480	2.17		26.2	207.757
H-4	4	4	98	343	WM-185	681	81							1726	2.17		31.8	268.3528
H-4	5	4	98	344	WM-185	625	81							1574	2.17		28.5	282.7803
H-4	6	4	98	345	WM-185	608	81							1536	2.17		24.8	222.932
H-4	6	4	98	346	WM-185	675	81							1679	2.17		32.0	282.3805
H-4	7	4	98	347	WM-185	624	81							1600	2.17		25.1	160.511
H-4	8	4	98	348	WM-185	618	81							1561	2.16		28.5	267.5184

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	9	4	98	349	WM-185	635	81							1614	2.17		29.6	249.4405
H-4	9	4	98	350	WM-185	645	81							1665	2.17		26.6	231.1887
H-4	10	4	98	351	WM-185	649	81							1652	2.17		29.9	240.3146
H-4	11	4	98	352	WM-185	703	81							1682	2.18		27.5	243.3566
H-4	11	4	98	353	WM-185	189	81							467	2.17		15.3	240.3146
H-4	12	4	98	12-C	Cold									1104	1.69		14.6	
H-4	12	4	98	13-C	Cold									1115	1.69		15.9	
H-4	10	1	99	DB	Dolomite Bed (approx. 110 cubic feet)								7750	92				
H-4	11	1	99	12-C	Cold									2008	2.18		16.8	
H-4	19	1	99	DB	Dolomite Bed (approx. 20 cubic feet)								1416	92				
H-4	20	1	99	13-C	Cold									2614	2.18		14.6	
H-4	22	1	99	14-C	Cold									1704	2.18		10.9	
H-4	22	1	99	15-C	Cold									1728	2.18		14.3	
H-4	23	1	99	16-C	Cold									1700	2.18		14.6	
H-4	23	1	99	353	WM-189	798	87							1212	2.19		19.6	268.1009
H-4	24	1	99	354	WM-189	863	87							1354	2.19		25.7	288.463
H-4	25	1	99	355	WM-189	821	87							1257	2.19		24.3	285.0693
H-4	26	1	99	356	WM-189	816	87							1280	2.3		24.4	323.0785
H-4	27	1	99	357	WM-189	831	87							1292	2.19		24.8	292.0133
H-4	27	1	99	358	WM-189	904	87							1398	2.19		24.6	333.4336
H-4	28	1	99	359	WM-189	909	87							1592	2.19		23.5	323.0785
H-4	29	1	99	360	WM-189	783	87							1381	2.2		25.2	296.1553
H-4	30	1	99	361	WM-189	779	87							1387	2.19		23.5	395.9644
H-4	31	1	99	362	WM-189	810	87							1406	2.3		23.7	310.722
H-4	31	1	99	363	WM-189	835	87							1495	2.19		24.3	310.722
H-4	1	2	99	364	WM-189	781	87							1366	2.2		22.7	294.2235
H-4	2	2	99	365	WM-189	864	87							1509	2.2		23.4	294.2235
H-4	3	2	99	366	WM-189	817	87							1422	2.2		22.8	266.726
H-4	3	2	99	367	WM-189	863	87							1513	2.2		27.3	324.4708
H-4	4	2	99	368	WM-189	831	87							1433	2.19		21.9	281.4319
H-4	5	2	99	369	WM-189	891	87							1591	2.2		30.5	344.276
H-4	6	2	99	370	WM-189	825	87							1435	2.19		27.9	319.6848
H-4	6	2	99	371	WM-189	839	87							1498	2.19		26.0	308.7554
H-4	7	2	99	372	WM-189	984	87							1698	2.2		27.3	521.8787
H-4	8	2	99	373	WM-189	887	87							1523	2.2		28.5	355.2054
H-4	9	2	99	374	WM-189	875	87							1786	2.2		34.1	390.7259
H-4	21	2	99	DB	Dolomite Bed (approx. 33 cubic feet)								2301	92				
H-4	24	2	99	375	WM-189	797	87							1383	2.2		23.0	279.4131
H-4	24	2	99	376	WM-189	800	87							1414	2.2		20.0	276.4719
H-4	25	2	99	377	WM-189	955	87							1681	2.19		29.4	370.5901
H-4	26	2	99	378	WM-189	839	87							1482	2.19		26.6	302.9427
H-4	27	2	99	379	WM-189	835	87							1456	2.19		28.7	291.1779
H-4	27	2	99	380	WM-189	839	87							1461	2.19		25.8	326.4722
H-4	28	2	99	381	WM-189	839	87							1466	2.19		26.6	300.0015
H-4	1	3	99	382	WM-189	846	87							1468	2.19		27.9	323.7572
H-4	2	3	99	383	WM-189	832	87							1466	2.19		24.1	301.62
H-4	3	3	99	384	WM-189	959	87							1681	2.19		31.1	312.6886
H-4	4	3	99	385	WM-189	829	87							1463	2.19		29.9	304.3872
H-4	4	3	99	386	WM-189	836	87							1474	2.19		25.8	273.9484
H-4	5	3	99	387	WM-189	911	87							1414	2.19		24.9	293.9799
H-4	6	3	99	388	WM-189	895	87							1400	2.19		28.1	359.6259
H-4	7	3	99	389	WM-189	908	87							1414	2.19		30.0	359.6259
H-4	8	3	99	390	WM-189	902	87							1395	2.19		28.6	313.9591
H-4	8	3	99	391	WM-189	896	87							1404	2.19		28.3	391.0218
H-4	9	3	99	392	WM-189	880	87							1331	2.19		27.1	311.1049
H-4	10	3	99	393	WM-189	832	87							1452	2.19		25.3	281.4145
H-4	10	3	99	394	WM-189	845	87							1453	2.19		27.6	304.3872
H-4	11	3	99	395	WM-189	864	87							1340	2.19		25.5	301.5156
H-4	12	3	99	396	WM-189	854	87							1362	2.19		26.0	307.2587
H-4	12	3	99	397	WM-189	832	87							1453	2.19		27.6	301.5156
H-4	13	3	99	398	WM-189	916	87							1394	2.19		24.8	226.8546
H-4	14	3	99	399	WM-189	910	87							1382	2.19		27.2	163.6799
H-4	15	3	99	400	WM-189	858	87							1337	2.19		27.4	226.8546
H-4	15	3	99	401	WM-189	861	87							1342	2.19		28.1	241.2125
H-4	16	3	99	402	WM-189	873	87							1332	2.19		26.5	244.084
H-4	17	3	99	403	WM-189	867	87							1334	2.19		24.3	212.4967
H-4	18	3	99	404	WM-189	867	87							1337	2.19		23.9	203.882
H-4	18	3	99	405	WM-189	865	87							1340	2.19		24.8	258.4411

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	19	3	99	406	WM-189	878	87							1373	2.2		24.6	264.1851
H-4	20	3	99	407	WM-189	878	87							1399	2.2		27.7	246.9556
H-4	21	3	99	408	WM-189	886	87							1369	2.19		24.6	255.5703
H-4	21	3	99	409	WM-189	886	87							1383	2.19		31.7	235.4693
H-4	22	3	99	410	WM-189	770	87							1204	2.19		23.7	241.2125
H-4	23	3	99	411	WM-189	850	87							1309	2.19		28.8	292.9008
H-4	24	3	99	412	WM-185	588	81							1627	2.19		25.8	134.9641
H-4	24	3	99	413	WM-185	595	81							1625	2.19		29.5	269.9282
H-4	25	3	99	414	WM-185	588	81							1617	2.19		28.4	137.8357
H-4	26	3	99	415	WM-185	591	81							1629	2.19		27.7	264.1851
H-4	26	3	99	416	WM-185	583	81							1638	2.19		32.3	249.8272
H-4	27	3	99	417	WM-185	588	81							1616	2.19		28.1	232.5977
H-4	28	3	99	418	WM-185	598	81							1630	2.19		30.0	275.6714
H-4	29	3	99	419	WM-185	589	81							1628	2.19		27.7	274.0007
H-4	29	3	99	420	WM-185	591	81	Start high temp adjust NO3						1638	2.19		26.8	229.7784
H-4	30	3	99	421	WM-185	599	81							1630	2.19		29.6	243.9622
H-4	31	3	99	422	WM-185	588	81							1641	2.19		28.8	245.4589
H-4	31	3	99	423	WM-185	588	81							1618	2.19		28.4	179.6041
H-4	1	4	99	424	WM-185	594	81							1635	2.19		25.3	257.4325
H-4	2	4	99	425	WM-185	1053	81							1140	2.18		29.6	407.1026
H-4	3	4	99	426	WM-185	1056	81							1147	2.18			368.1884
H-4	3	4	99	427	WM-185	1055	81							1136	2.18			404.1092
H-4	4	4	99	428	WM-185	1053	81							1140	2.18			377.1686
H-4	5	4	99	429	WM-185	968	81							1050	2.18			344.2412
H-4	6	4	99	430	WM-185	956	81							1025	2.19			341.1085
H-4	6	4	99	431	WM-185	945	81							1035	2.19			370.9555
H-4	7	4	99	432	WM-185	1053	81							1140	2.18			375.2194
H-4	8	4	99	433	WM-185	1052	81							1152	2.18			383.7471
H-4	8	4	99	434	WM-185	1056	81							1142	2.2			413.5941
H-4	9	4	99	435	WM-185	916	81							989	2.18			358.164
H-4	10	4	99	436	WM-185	1065	81							1160	2.18			379.4832
H-4	11	4	99	437	WM-185	1065	81							1139	2.18			392.2748
H-4	12	4	99	438	WM-185	1017	81							1094	2.18			410.0264
H-4	12	4	99	439	WM-185	995	81							1093	2.18			366.8657
H-4	13	4	99	440	WM-185	1055	81							1142	2.18			345.2854
H-4	14	4	99	441	WM-185	584	81							1635	2.18			310.7568
H-4	14	4	99	442	WM-185	591	81							1640	2.18			284.8604
H-4	15	4	99	443	WM-185	589	81							1633	2.17			297.8086
H-4	16	4	99	444	WM-185	584	81							1634	2.17			405.7103
H-4	16	4	99	445	WM-185	669	81	Return to 500 degrees centigrade						1778	2.17		20.5	237.3837
H-4	17	4	99	446	WM-185	529	81							1700	2.17		28.9	336.6532
H-4	18	4	99	447	WM-185	514	81							1731	2.17		35.7	379.8139
H-4	19	4	99	448	WM-185	512	81							1710	2.17		30.5	144.101
H-4	19	4	99	449	WM-185	512	81							1710	2.18		30.9	147.2336
H-4	20	4	99	450	WM-185	560	81							1562	2.19		30.3	203.6209
H-4	21	4	99	451	WM-185	561	81							1576	2.19		28.3	244.3451
H-4	21	4	99	452	WM-185	564	81							1569	2.18		31.9	263.1409
H-4	22	4	99	453	WM-185	565	81							1558	2.18		28.7	191.0904
H-4	23	4	99	454	WM-185	551	81							1511	2.18		35.3	244.3451
H-4	24	4	99	455	WM-185	573	81							1561	2.19		27.1	291.3345
H-4	25	4	99	456	WM-185	587	81							1621	2.19		34.7	203.6209
H-4	27	4	99	457	WM-185	556	81							1605	2.18		31.5	225.5493
H-4	28	4	99	458	WM-185	726	81							2014	2.18		37.6	231.8146
H-4	29	4	99	459	WM-185	564	81							1571	2.18		30.7	257.1367
H-4	30	4	99	460	WM-185	574	81							1561	2.18		22.7	315.421
H-4	30	4	99	461	WM-185	588	81							1635	2.17		40.2	236.5657
H-4	1	5	99	462	WM-185	578	81							1626	2.17		28.8	215.9948
H-4	1	5	99	463	WM-185	604	81							1624	2.17		30.5	335.9919
H-4	2	5	99	464	WM-185	617	81							1630	2.17		28.5	305.1355
H-4	3	5	99	465	WM-185	594	81							1609	2.17		30.9	287.9931
H-4	4	5	99	466	WM-185	584	81							1635	2.19		29.0	267.4221
H-4	5	5	99	467	WM-185	596	81	Return to high temp adjust NO3						1656	2.19		28.8	236.5657
H-4	6	5	99	468	WM-185	612	81							1623	2.19		30.9	294.85
H-4	7	5	99	469	WM-185	590	81							1626	2.17		29.9	228.1598
H-4	8	5	99	470	WM-185	607	81							1625	2.17		28.5	198.3999
H-4	9	5	99	471	WM-185	303	81							1620	2.17		30.0	294.2931
H-4	10	5	99	472	WM-185	585	81							1636	2.17		28.2	244.6932
H-4	11	5	99	473	WM-185	709	81							1526	2.18		0.2	238.0798

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

NWCF	Date			Batch	Feed Stream									Cold Chemicals				
					1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	12	5	99	474	WM-185	696	81							1510	2.18			175.2532
H-4	13	5	99	475	WM-185	695	81							1519	2.19		0.2	162.0266
H-4	15	5	99	476	WM-185	696	81							1515	2.19			201.7065
H-4	16	5	99	477	WM-185	672	81							1473	2.19			148.7999
H-4	16	5	99	478	WM-185	650	81							1433	2.19			175.2532
H-4	17	5	99	479	WM-185	683	81							1455	2.19			314.1331
H-4	18	5	99	480	WM-185	586	81							1542	2.19		30.9	254.6132
H-4	19	5	99	481	WM-185	604	81							1603	2.19		33.6	241.3865
H-4	20	5	99	482	WM-185	594	81	Return to 500 degrees centigrade						1612	2.19		33.0	307.5198
H-4	21	5	99	483	WM-185	492	81							1344	2.19		29.7	277.7598
H-4	22	5	99	484	WM-185	493	81							1333	2.18		32.6	277.7598
H-4	23	5	99	485	WM-185	468	81							1329	2.18		31.9	267.8398
H-4	24	5	99	486	WM-185	470	81							1318	2.18		31.2	154.282
H-4	25	5	99	487	WM-185	612	81							1631	2.18		30.4	171.4244
H-4	27	5	99	488	WM-185	555	81							1549	2.18		33.1	116.5686
H-4	29	5	99	489	WM-185	551	81							1468	2.18		20.8	116.5686
H-4	6	3	2000	DB	Dolomite Bed (approx. 110 cubic feet)							7750	92					
H-4	7	3	2000	DB	Dolomite Bed (approx. 11 cubic feet)							796	92					
H-4	8	3	2000	17C	Cold									3012	2.1			
H-4	8	3	2000	DB	Dolomite Bed (approx. 18 cubic feet)							1239	92					
H-4	9	3	2000	DB	Dolomite Bed (approx. 11 cubic feet)							796	92					
H-4	10	3	2000	18C	Cold									2816	2.1			
H-4	10	3	2000	489	WM-189	715	87							1869	2.1		21.6	
H-4	11	3	2000	490	WM-189	710	87							1863	2.1		21.6	
H-4	12	3	2000	491	WM-189	724	87							1850	2.1		21.6	
H-4	13	3	2000	492	WM-189	651	87							1715	2.1		21.6	
H-4	14	3	2000	493	WM-189	625	87							1623	2.1		20.6	
H-4	15	3	2000	494	WM-189	629	87							1617	2.19		20.2	
H-4	15	3	2000	495	WM-189	878	87							1272	2.2		19.7	121.8245
H-4	16	3	2000	496	WM-189	883	87							1285	2.2		22.5	135.7473
H-4	17	3	2000	497	WM-189	873	87							1283	2.2		22.6	142.7087
H-4	18	3	2000	498	WM-189	879	87							1281	2.2		24.4	153.1508
H-4	18	3	2000	499	WM-189	870	87							1272	2.2		21.3	167.0736
H-4	19	3	2000	500	WM-189	875	87							1269	2.2		22.5	151.4104
H-4	20	3	2000	501	WM-189	868	87							1617	2.2		29.3	165.3332
H-4	21	3	2000	502	WM-189	762	87							1174	2.2		19.0	158.3718
H-4	22	3	2000	503	WM-189	768	87							1095	2.18		19.2	121.8245
H-4	23	3	2000	504	WM-189	767	87							1097	2.18		21.1	142.7087
H-4	23	3	2000	505	WM-189	736	87							1098	2.2		24.5	144.449
H-4	24	3	2000	506	WM-189	827	87							1223	2.1		20.2	165.3332
H-4	25	3	2000	507	WM-189	825	87	Start high temp adjust NO3						1194	2.1		16.5	128.7859
H-4	26	3	2000	508	WM-189	837	87							1200	2.1		23.3	144.449
H-4	26	3	2000	509	WM-189	1102	87							1476	2.1			158.3718
H-4	27	3	2000	510	WM-189	975	87							1308	2.2			161.8525
H-4	28	3	2000	511	WM-189	869	87							1151	2.2			144.449
H-4	29	3	2000	512	WM-189	861	87							1142	2.1			142.7087
H-4	29	3	2000	513	WM-189	975	87							1302	2.2			111.3824
H-4	30	3	2000	514	WM-189	876	87							1189	2.2			140.9683
H-4	31	3	2000	515	WM-189	895	87							1195	2.2			137.4876
H-4	1	4	2000	516	WM-189	1045	87							1242	2.2			151.4104
H-4	1	4	2000	517	WM-189	894	87							1073	2.19			158.3718
H-4	2	4	2000	518	WM-189	908	87							1074	2.19			139.228
H-4	3	4	2000	519	WM-189	904	87							1078	2.19			128.7859
H-4	3	4	2000	520	WM-189	907	87							1087	2.19			125.3052
H-4	4	4	2000	521	WM-189	1039	87							1227	2.18			130.5262
H-4	5	4	2000	522	WM-189	982	87							1195	2.18			144.449
H-4	6	4	2000	523	WM-189	1001	87							1173	2.18			153.1508
H-4	6	4	2000	524	WM-189	958	87							1134	2.17			140.9683
H-4	7	4	2000	525	WM-189	950	87							1236	2.18			137.4876
H-4	8	4	2000	526	WM-189	945	87							1125	2.16			132.2666
H-4	8	4	2000	527	WM-189	1029	87							1056	2.16			156.6315
H-4	9	4	2000	528	WM-189	1020	87							1050	2.16			142.7087
H-4	10	4	2000	529	WM-189	1015	87							1044	2.16			137.4876
H-4	11	4	2000	530	WM-189	1020	87							1061	2.18			146.1894
H-4	11	4	2000	531	WM-189	1039	87							1059	2.18			142.7087
H-4	12	4	2000	532	WM-189	1028	87							1056	2.18			149.6701
H-4	13	4	2000	533	WM-189	1033	87							1046	2.18			140.9683
H-4	14	4	2000	534	WM-189	1020	87							1049	2.18			151.4104

Table A6. Calcined material to Calcined Solids Storage Facility VI (continued).

					Feed Stream									Cold Chemicals				
NWCF	Date			Batch	1			2			3			Al(NO ₃) ₃		NaNO ₃	H ₃ BO ₃	Ca(NO ₃) ₂
Camp.	d	mo	yr	No.	Tank	gal	Stream	Tank	gal	Stream	Tank	gal	Stream	gal	M	M	kg	lb
H-4	14	4	2000	535	WM-189	1029	87							1061	2.18			127.0455
H-4	15	4	2000	536	WM-189	1025	87							1042	2.18			128.7859
H-4	16	4	2000	537	WM-189	1011	87							1049	2.18			182.7367
H-4	17	4	2000	538	WM-189	1037	87							1067	2.18			137.4876
H-4	17	4	2000	539	WM-189	1023	87							1061	2.18			172.2946
H-4	18	4	2000	540	WM-189	1022	87							1074	2.16			142.7087
H-4	19	4	2000	541	WM-189	1009	87							1024	2.18		13.7	140.9683
H-4	20	4	2000	542	WM-189	1190	87							1229	2.17		14.2	146.1894
H-4	21	4	2000	543	WM-189	975	87							1208	2.17			120.0841
H-4	22	4	2000	544	WM-189	962	87							1179	2.17			163.5929
H-4	22	4	2000	545	WM-189	954	87							1172	2.17			144.449
H-4	23	4	2000	546	WM-189	946	87							1186	2.17			121.8245
H-4	24	4	2000	547	WM-189	905	87							1115	2.17			130.5262
H-4	25	4	2000	548	WM-189	869	87							1107	2.18			142.7087
H-4	25	4	2000	549	WM-189	857	87							1139	2.18			142.7087
H-4	26	4	2000	550	WM-189	855	87							1130	2.18			172.2946
H-4	27	4	2000	551	WM-189	858	87							1139	2.18			121.8245
H-4	28	4	2000	552	WM-189	856	87							1140	2.18			123.5648
H-4	29	4	2000	553	WM-189	826	87							1070	2.18			132.2666
H-4	30	4	2000	554	WM-189	816	87							1076	2.18			175.7753
H-4	1	5	2000	555	WM-189	854	87							1121	2.18			114.8631
H-4	1	5	2000	556	WM-189	911	87							1174	2.18			134.0069
H-4	2	5	2000	557	WM-189	848	87							1119	2.18			144.449
H-4	3	5	2000	558	WM-189	862	87							1116	2.18			160.1122
H-4	4	5	2000	559	WM-189	895	87							1180	2.17			142.7087
H-4	5	5	2000	560	WM-189	869	87							1113	2.17			165.3332
H-4	5	5	2000	561	WM-189	858	87							1120	2.17			135.7473
H-4	7	5	2000	562	WM-189	808	87							1073	2.17			140.9683
H-4	7	5	2000	563	WM-189	860	87							1340	2.17			132.2666
H-4	8	5	2000	564	WM-189	852	87							1118	2.17			139.228
H-4	9	5	2000	565	WM-189	820	87							1111	2.17			154.8911
H-4	10	5	2000	566	WM-189	893	87							1169	2.17			139.228
H-4	11	5	2000	567	WM-189	895	87							1173	2.17			161.8525
H-4	12	5	2000	568	WM-189	905	87							1186	2.17			130.5262
H-4	12	5	2000	569	WM-189	1116	87							1094	2.17			156.6315
H-4	12	5	2000	DB	Dolomite Bed (approx. 15 cubic feet)							1062	92					
H-4	13	5	2000	570	WM-189	1057	87							1043	2.17			170.5543
H-4	14	5	2000	571	WM-189	1069	87							1033	2.17			144.449
H-4	15	5	2000	572	WM-189	1076	87							1037	2.17			186.2174
H-4	16	5	2000	573	WM-189	1067	87							1052	2.17			142.7087
H-4	17	5	2000	574	WM-189	1086	87							1036	2.17			135.7473
H-4	17	5	2000	575	WM-189	1082	87							1062	2.17			154.8911
H-4	18	5	2000	576	WM-189	1172	87							978	2.17			156.6315
H-4	19	5	2000	577	WM-189	1151	87							997	2.17			135.7473
H-4	20	5	2000	578	WM-189	1133	87							972	2.17			147.9297
H-4	21	5	2000	579	WM-189	1132	87							973	2.17			170.5543
H-4	21	5	2000	580	WM-189	1135	87							964	2.17			116.6034
H-4	22	5	2000	581	WM-189	1130	87							982	2.17			174.035
H-4	23	5	2000	582	WM-189	1073	87							921	2.17			156.6315
H-4	24	5	2000	583	WM-189	862	87							742	2.17			132.2666
H-4	24	5	2000	584	NCC-119			NCC-119 contained scrub solution that was blended with aluminum nitrate and recycled as final feed to flush radioactivity from system.						1400	2.17		5.0	
H-4	25	5	2000	585	NCC-119									1400	2.17		5.0	
H-4	26	5	2000	586	NCC-119									1400	2.17		5.0	

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Table A7. Chemical analyses of liquid waste samples.

Date	Primary Source	Tank/Stream	H+ (N)	Al (M)	B (M)	Ca (M)	Cd (M)	Cr (M)	Fe (M)	Hg (M)	K (M)	Mg (M)	Mn (M)	Na (M)	Nb (M)	Ni (M)	Sn (M)	U (M)	Zr (M)	Cl (M)	F (M)	NO ₃ (M)	PO ₄ (M)	SO ₄ (M)
Feb 60	IDO-14662 p11	WM-185 stream 1	0.60	1.58					0.011	0.013				0.04				2.8E-05				5.4		
Mar 64	IDO-14662 p11	WM-187 stream 2	0.88	1.49					0.021	0.011				0.06				2.7E-05				5.6		
Aug 64	IDO-14662 p11	WM-188 stream 3	0.53	1.08														8.8E-06				3.8		
Mar 60	IDO-14662 p11	WM-183 streams 4 & 6	0.91	1.49					0.005	0.012				0.05				3.5E-05				5.5	0.010	0.013
Mar 60	IDO-14662 p11	WM-180 streams 5 & 8		1.63					0.001	0.013				0.01				1.8E-05				7.1		0.015
Jun 66	Ay-125-66A p4	WM-182 stream 7	1.17	1.65	0.01					0.018				0.10				1.1E-05				6.6	0.019	0.020
Apr 67	Ay-111-67	WM-182 stream 9	0.71	1.53						0.014	0.004			0.06				1.7E-05						
Jul 67	Amb-40-67	WM-182 stream 10	1.02	1.48						0.013	0.009			0.09				2.7E-05						
Sep 67	Amb-93-67	WM-182 stream 11	0.90	1.30						0.007	0.009			0.09				2.3E-05						
Sep 67	Amb-139-67	WM-182 stream 12	1.52	1.61						0.015	0.013			0.13				2.9E-05						
Nov 67	Amb-139-67	WM-182 stream 13	2.65	1.55						0.021	0.026			0.26				2.8E-05						
Nov 67	Log 67-6049	WM-188 stream 14	1.55	0.63				8.9E-03	0.005				1.4E-04			1.1E-03	3.8E-03	8.8E-06	0.31			2.40	2.2	
Nov 67	Log 67-6072	WM-188 stream 14	1.31	0.63				9.8E-03	0.005				1.4E-04			1.1E-03	4.2E-03	8.8E-06	0.35			2.26	2.3	
Aug 68	Log 68-5028	WM-188 stream 16	1.64	0.58	0.12						0.003						3.6E-03	2.4E-05	0.30			2.2		
Aug 68	Log 68-5043	WM-188 stream 16	1.44		0.12						0.003						3.2E-03		0.26			2.11	2.1	
Aug 68	Log 68-5115	WM-188 stream 16	1.40	0.55	0.12			8.3E-03	0.005		0.003		1.4E-04			1.0E-03	3.5E-03	2.3E-05	0.29			2.09	2.1	
Aug 68	Log 68-5304	WM-188 stream 16	1.11	0.52	0.09			7.8E-03	0.004		0.002		1.2E-04			9.2E-04	3.3E-03	2.2E-05	0.27			1.93	1.8	
Dec 68	Log 68-7245	WM-188 stream 17	1.58	0.45	0.11			5.6E-03			0.003						2.8E-03	8.8E-06	0.23			1.74	2.3	
Dec 68	Log 68-7365	WM-188 stream 17	1.59	0.46	0.12			6.1E-03			0.002						3.1E-03	8.9E-06	0.25			1.67	2.3	
Jan 69	Log 69-110	WM-188 stream 17	1.60	0.44	0.10			5.9E-03	0.004		0.002		1.2E-04			8.7E-04	2.4E-03	8.6E-06	0.20			1.55	2.2	
Jan 69	Log 69-161	WM-189 stream 64	1.40	0.65	0.15			1.1E-02	0.006		0.002		1.7E-04			1.3E-03	4.5E-03	1.3E-05	0.37			2.70	2.2	
Feb 69	Log 69-513	WM-189 stream 18	1.38	0.54				9.9E-03	0.006				1.7E-04			1.3E-03	4.1E-03	1.1E-05	0.34			2.67	2.1	
Mar 69	Log 69-844	WM-189 stream 18	1.29	0.56	0.11			9.2E-03	0.005		0.002		1.5E-04			1.1E-03	3.9E-03	1.1E-05	0.32			2.71	2.1	
Mar 69	Log 69-1078	WM-189 stream 20	1.26	0.54	0.15						0.002						3.5E-03	4.2E-05	0.29			2.02	2.1	
Apr 69	Log 69-1170	WM-185 stream 19	0.74	0.96							0.019							1.7E-05						
Apr 69	Log 69-1378	WM-189 stream 20	1.43	0.53	0.12			6.4E-03	0.005		0.002		1.3E-04			9.4E-04	2.6E-03	4.1E-05	0.21			1.75	2.2	
May 69	Log 69-1674	WM-187 stream 21	1.08	0.54	0.12			1.0E-02	0.005		0.003		1.5E-04			1.2E-03	4.5E-03	1.4E-05	0.37			2.34	1.9	
Aug 70	Log 70-5195	WM-189 stream 22	1.14	0.35				5.7E-03	0.005				1.4E-04			9.3E-04	2.2E-03		0.18			1.17	2.0	
Aug 70	Log 70-5208	WM-189 stream 22	1.17	0.33				5.1E-03	0.004				1.1E-04			7.6E-04	2.1E-03	4.6E-06	0.17				1.8	
Aug 70	Log 70-5216	WM-189 stream 22	1.08	0.34				5.9E-03	0.005				1.4E-04			9.3E-04	2.3E-03	5.5E-06	0.19			1.08	1.9	
Aug 70	Log 70-5227	WM-189 stream 22	1.14	0.36				5.1E-03	0.004				1.3E-04			8.9E-04	1.9E-03	9.2E-06	0.16			1.03	1.8	
Aug 70	Log 70-5267	WM-187 stream 23	1.46	0.58				1.1E-02	0.007				2.1E-04			1.5E-03	4.5E-03	1.2E-05	0.37				1.9	
Aug 70	Log 70-5278	WM-187 stream 23	0.95	0.56				1.0E-02	0.005				1.5E-04			1.1E-03	4.5E-03	1.6E-05	0.37			2.33	1.8	
Aug 70	Log 70-5302	WM-187 stream 23	0.74	0.58				1.1E-02	0.005				1.6E-04			1.2E-03	4.9E-03	1.6E-05	0.40			2.48	1.9	
Dec 70	Log 70-8260	WM-187 stream 23	1.11	0.57	0.12			9.5E-03	0.005				1.5E-04			1.1E-03	4.0E-03	1.3E-05	0.33			2.30	1.8	
Sep 70	Log 70-5899	WM-183 stream 24	1.17	1.05																		4.1		
Sep 70	Log 70-5907	WM-183 stream 24	0.76	1.16					0.005									4.0E-06					4.4	
Sep 70	Log 70-5922	WM-183 stream 24	1.00	1.16						5.0E-03													4.6	
Sep 70	Log 70-5926	WM-183 stream 24	1.00	1.17						6.0E-03													4.6	
Sep 71	Log 71-7231	WM-189 stream 25	1.60	0.66	0.18				0.004				1.3E-04					2.0E-06				3.30	2.3	
Sep 71	Log 71-7241	WM-189 stream 25	1.60	0.65	0.19			1.2E-02	0.004				1.1E-04			1.0E-03	5.6E-03		0.46			3.47	2.5	
Sep 71	Log 71-7252	WM-189 stream 25	1.68	0.62	0.19			1.3E-02	0.004				1.2E-04			1.1E-03	6.0E-03		0.49			3.49	2.5	
Sep 71	Log 71-7262	WM-189 stream 25	1.72	0.62	0.19			1.2E-02	0.004				1.1E-04			1.0E-03	5.7E-03	1.1E-06	0.47			3.24	2.4	
Sep 71	Log 71-7272	WM-189 stream 25	1.62	0.60	0.19			1.2E-02	0.003				1.0E-04			9.4E-04	5.6E-03	1.1E-06	0.46			3.44	2.4	
Oct 71	Log 71-7455	WM-180 streams 40 & 45	1.33	0.53	0.01			3.5E-03	0.011	4.7E-03	0.226		0.022	1.52		8.9E-04		9.2E-05		3.8E-02	6.2E-04	4.2	0.019	0.033
Mar 72	Log 72-1188	WM-183 streams 26 & 27	0.94	1.09					0.004									5.1E-06				4.6		
Mar 72	Log 72-1225	WM-183 streams 26 & 27	1.04	1.12					0.005	5.0E-03								5.2E-06				4.4		
Apr 72	Log 72-1271	WM-183 streams 26 & 27	1.02	1.11					0.004	6.0E-03								5.3E-06				4.6		
May 72	Log 72-1663	WM-106 streams 28 & 36	2.62					1.7E-02	0.061				1.8E-03			9.2E-03						2.8		0.500
May 72	Log 72-1676	WM-106 streams 28 & 36	2.52					1.8E-02	0.068				2.0E-03			9.9E-03						2.4		0.480
May 72	Log 72-1691	WM-106 streams 28 & 36	2.76	0.04				1.7E-02	0.066				2.0E-03			1.1E-02						2.6		0.520
May 73	Log 73-3356	WM-189 stream 29	1.56	0.51	0.16			8.4E-03	0.006				1.7E-04			1.2E-03	3.4E-03	2.2E-06	0.28			2.12	2.3	
May 73	Log 73-3369	WM-189 stream 29	1.62	0.48	0.15			9.7E-03	0.011				3.3E-04			2.1E-03	3.3E-03	2.8E-06	0.27			2.15	2.2	
May 73	Log 73-3376	WM-189 stream 29	1.70	0.50	0.15			8.8E-03	0.004				1.1E-04			8.7E-04	3.9E-03		0.32			2.13	2.2	
May 73	Log 73-3411	WM-188 stream 30	1.62	0.72	0.21												6.5E-03	3.5E-06	0.53			3.50	2.4	
May 73	Log 73-3448	WM-188 stream 30	1.80		0.19																	3.51		
May 73	Log 73-3459	WM-188 stream 30	1.67		0.18				0.006				1.9E-04					6.3E-06				2.94	2.2	
May 73	Log 73-3466	WM-188 stream 30	1.72	0.58	0.20			1.4E-02	0.007				2.1E-04			1.6E-03	5.8E-03	1.0E-05	0.48			2.90	2.4	
May 73	Log 73-3527	WM-188 stream 30	1.58	0.67	0.17			1.1E-02	0.008				2.2E-04			1.6E-03	4.6E-03		0.38			2.48	2.3	
Jul 73	Log 73-4185	WM-183 stream 31	1.16	0.96						3.7E-03												1.5		

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Table A7. Chemical analyses of liquid waste samples (continued).

Date	Primary Source	Tank/Stream	H+ (N)	Al (M)	B (M)	Ca (M)	Cd (M)	Cr (M)	Fe (M)	Hg (M)	K (M)	Mg (M)	Mn (M)	Na (M)	Nb (M)	Ni (M)	Sn (M)	U (M)	Zr (M)	Cl (M)	F (M)	NO ₃ (M)	PO ₄ (M)	SO ₄ (M)
Jul 73	Log 73-4197	WM-183 stream 31	1.25	1.07						4.4E-03												1.8		
Aug 73	Log 73-4782	WM-189 stream 33	1.56	0.57	0.19			1.0E-02	0.006				1.9E-04			1.4E-03	4.1E-03	1.6E-06	0.34		2.34	2.3		
Aug 73	Log 73-4790	WM-189 stream 33	1.71	0.50	0.16			8.8E-03	0.006				1.9E-04			1.3E-03	3.5E-03	1.3E-06	0.29		1.91	2.2		
Aug 73	Log 73-4802	WM-189 stream 33	1.81	0.55	0.15			9.8E-03	0.007				1.9E-04			1.4E-03	4.0E-03	1.6E-06	0.33		2.33	2.2		
Aug 73	Log 73-4812	WM-189 stream 33	1.66	0.50				1.1E-02	0.005				1.6E-04			1.1E-03	3.4E-03		0.28		2.03	2.0		
Sep 73	Log 73-4950	WM-188 stream 32	1.74	0.64	0.19			1.2E-02	0.006				1.6E-04			1.3E-03	5.4E-03	2.8E-06	0.44		3.08	2.1		
Sep 73	Log 73-4961	WM-188 stream 32	1.88	0.66	0.20			1.4E-02	0.009				2.7E-04			2.0E-03	5.8E-03	3.2E-06	0.48		3.02	2.3		
Sep 73	Log 73-4967	WM-188 stream 32	1.73	0.62	0.22			1.3E-02	0.006				1.8E-04			1.4E-03	5.7E-03	3.7E-06	0.47		3.42	2.4		
Oct 73	Log 73-5483	WM-188 stream 32	1.75	0.63	0.17				0.006	1.8E-04			1.7E-04					3.1E-06		1.9E-03	3.14	2.2		
Nov 73	Log 73-5708	WM-189 stream 34	1.36	0.41	0.13			9.1E-03	0.010				2.9E-04			1.9E-03	3.2E-03	9.7E-07	0.26	4.7E-03	1.83	2.2		
Nov 73	Log 73-5783	WM-189 stream 35	1.56	0.52	0.15			9.9E-03	0.009				2.5E-04			1.7E-03	3.8E-03	2.5E-06	0.31		2.26	2.0		
Nov 73	Log 73-5789	WM-189 stream 35	1.62	0.54	0.17			1.1E-02	0.006				1.8E-04			1.3E-03	4.5E-03	2.5E-06	0.37		2.58	1.8		
Jun 75	Log 75-3741	WM-187 stream 37	1.70	0.57				1.0E-02	0.004				1.2E-04			1.0E-03	4.5E-03	2.4E-06	0.37		2.30	2.2		
Jun 75	Log 75-3755	WM-187 stream 37	1.56	0.61	0.17			1.2E-02	0.006				1.8E-04			1.3E-03	5.0E-03	3.0E-06	0.41		2.40	2.2		
Jun 75	Log 75-3762	WM-187 stream 37	1.67	0.58	0.18			1.1E-02	0.004				1.1E-04			9.3E-04	4.9E-03	3.2E-06	0.40		2.50	2.2		
Jun 75	Log 75-3772	WM-187 stream 37	1.74	0.58	0.17			1.1E-02	0.004				1.3E-04			1.1E-03	5.0E-03	2.5E-06	0.41		2.60	2.2		
Jun 75	Log 75-3797	WM-189 stream 38	1.76	0.48	0.14			9.6E-03	0.013				3.7E-04			2.3E-03	3.0E-03	2.7E-06	0.25		2.05	2.5		
Jun 75	Log 75-3809	WM-189 stream 38	1.41	0.43	0.11	0.14		8.8E-03	0.010				3.1E-04			2.0E-03	2.9E-03	3.2E-06	0.24		1.86	2.3		
Jun 75	Log 75-3816	WM-189 stream 38	1.86	0.45	0.12												3.2E-03	2.9E-06	0.26		1.81	2.6		
Jun 75	Log 75-3821	WM-189 stream 38	1.73	0.42	0.13	0.068		9.1E-03	0.011				3.2E-04			2.0E-03	3.0E-03	3.5E-06	0.25		1.80	2.3		
Apr 76	Log 76-2338	WM-187 streams 39 & 42	1.08	0.53	0.15			1.1E-02	0.009				2.7E-04			1.8E-03	4.0E-03	5.5E-06	0.33		2.29	2.0		
Apr 76	Log 76-2367	WM-187 streams 39 & 42	1.59	0.55	0.16			1.0E-02	0.006				1.6E-04			1.2E-03	4.3E-03	4.2E-06	0.35		2.36	2.1		
Apr 76	Log 76-2424	WM-187 streams 39 & 42	1.48	0.55	0.16			1.0E-02	0.004				1.3E-04			1.1E-03	4.4E-03		0.36		2.50	2.2		
Apr 76	Log 76-2427	WM-187 streams 39 & 42	1.62	0.51	0.15			9.1E-03	0.005				1.4E-04			1.1E-03	3.9E-03	3.8E-06	0.32		2.44	2.1		
Dec 76	Log 76-7317	WM-185 stream 41		0.66	0.18			1.2E-02	0.006				1.7E-04			1.3E-03	5.2E-03		0.43		2.86	2.4		
Dec 76	Log 76-7334	WM-185 stream 41	1.53		0.19				0.006				1.8E-04								3.00	2.4		
Dec 76	Log 76-7343	WM-185 stream 41		0.68	0.18			1.2E-02	0.005				1.6E-04			1.3E-03	5.5E-03		0.45		2.98	2.6		
Dec 76	Log 76-7374	WM-185 stream 41	1.58	0.66	0.20			1.3E-02	0.006				1.7E-04			1.4E-03	5.7E-03	1.3E-05	0.47			2.3		
Sep 77	Log 77-6810	WM-185 stream 43	1.48	0.63	0.18			1.2E-02	0.007				2.1E-04			1.6E-03	5.1E-03	2.1E-05	0.42	2.5E-04		2.3		
Sep 77	Log 77-6834	WM-185 stream 43	1.51	0.67	0.18			1.1E-02									5.6E-03		0.46		2.89	2.3		
Dec 77	Log 77-9804	WM-182 stream 44	1.42	0.64	0.16			1.1E-02	0.007				2.1E-04	0.078		1.5E-03	4.6E-03		0.38		2.48	2.3		
Jan 78	Log 78-763	WM-182 stream 44	1.52		0.18			1.2E-02	0.008				2.4E-04			1.7E-03	4.9E-03	6.2E-06	0.40	1.6E-03	2.70	2.3		
Feb 78	Log 78-791	WM-182 stream 44	1.55	0.60	0.17			1.1E-02	0.007	8.2E-04			2.2E-04			1.5E-03	4.4E-03	8.0E-06	0.36	2.0E-03	2.45	2.6		
Apr 78	Log 78-1609	WM-182 stream 46	1.58	0.63	0.17			1.1E-02	0.007				2.0E-04			1.4E-03	4.4E-03	5.5E-06	0.36		2.44	2.7		
Aug 78	Log 78-3704	WM-188 stream 47	1.34	0.61	0.16			1.2E-02	0.013	2.0E-03	0.015	4.1E-03	1.1E-03	0.10		2.7E-03	3.8E-03	6.1E-06	0.31	2.1E-03	1.85			
Dec 79	ENICO-1100 p21	WM-182 stream 49	1.29	0.39	0.10			6.8E-03	0.006	5.9E-04			1.8E-04	0.060		1.2E-03	2.6E-03	4.7E-06	0.21	4.0E-03	1.40	2.0		
Jun 79	ENICO-1100 p21	WM-180 stream 50	0.92	0.55	0.022	0.026		3.5E-03	0.060	4.7E-03	0.220		2.2E-02	1.20		8.9E-04		9.2E-05		2.6E-02	6.2E-04	4.0	0.018	0.031
Jul 79	ENICO-1100 p21	WM-188 stream 51	1.35	0.59	0.17			1.1E-02	0.013	2.0E-03	0.015	4.1E-03	1.1E-03	0.10		2.5E-03	3.7E-03	6.1E-06	0.30	2.1E-03	1.94	2.6		
Jan 81	Log 810128-4	WM-185 stream 56	1.55	0.57	0.15			8.8E-03	0.004				1.3E-04	0.025		9.8E-04	3.8E-03	5.7E-06	0.31	1.6E-03	2.00	2.7		
Feb 81	Log 81-02284	WM-182 stream 58	1.80	0.66				1.3E-02	0.006				1.7E-04			1.4E-03	5.9E-03		0.48		2.98	2.7		
Mar 81	Log 81-030535	WM-182 stream 58	1.71	0.66	0.24			1.2E-02	0.005		0.002		1.5E-04	0.011		1.2E-03	5.5E-03	4.1E-06	0.45		3.04	2.6		
Sep 82	RID-5-82	WM-182 stream 59	1.70	0.62	0.23			1.1E-02	0.005		0.003		1.5E-04	0.015		1.2E-03	5.0E-03	5.3E-06	0.41		2.91	2.7		
Dec 82	Log 82-09213	WM-185 stream 60	1.53	0.63	0.19			1.2E-02	0.012		0.007		3.6E-04	0.054		2.3E-03	4.5E-03	2.1E-05	0.37		2.32			
Oct 82	RID-7-82	WM-189 stream 61	1.76	0.84	0.050	0.19		1.2E-02	0.043	2.0E-03	0.080		1.3E-03	0.60		5.1E-03	1.5E-03	1.5E-04	0.13	1.5E-02	0.96	4.9		
Dec 82	Log 82-120633	WM-189 stream 62	1.76	0.84	0.047	0.19		1.2E-02	0.044	2.0E-03	0.087		1.3E-03	0.60		5.1E-03	1.5E-03	1.8E-04	0.13	1.2E-02	0.96			
Jan 83	Log 83-012510	WM-185 stream 60	1.50	0.58	0.16	0.10				2.6E-03	0.006			0.052			3.3E-03	1.8E-05	0.27	4.6E-03	2.06	2.8		
Jan 83	Log 83-01265	WM-185 stream 60	1.53	0.61	0.15	0.089		1.2E-02	0.013	4.0E-03	0.008		3.8E-04	0.057		2.5E-03	4.2E-03	1.8E-05	0.35	3.6E-03	2.40	2.8		
Jan 83	Log 83-012617	WM-185 stream 60	1.36	0.56		0.077		1.1E-02	0.013	2.9E-03	0.008		3.8E-04	0.052		2.4E-03	3.6E-03	1.6E-05	0.29	3.3E-03	1.94	2.5		
Jan 83	Log 83-01285	WM-185 stream 60	1.62	0.69	0.16	0.076		1.3E-02	0.014	2.7E-03	0.012		4.1E-04	0.052		2.7E-03	4.4E-03	1.8E-05	0.37	1.4E-03	2.16	2.7		
Jan 83	Log 83-012818	WM-185 stream 60	1.55	0.49	0.18			1.0E-02	0.012	3.0E-03	0.008		3.6E-04	0.057		2.3E-03	3.5E-03	2.1E-05	0.29	2.6E-03	2.23	2.5		
Mar 83	Log 83-03303	WM-189 stream 63	1.57	0.54	0.055	0.15		1.1E-02	0.040				1.2E-03			4.7E-03	1.1E-03	1.3E-04	0.091	1.6E-02	0.78	4.7		
Apr 83	Log 83-040818	WM-189 stream 63	1.81	0.82	0.050	0.16		1.1E-02	0.040	4.1E-03	0.077		1.2E-03	0.54		4.7E-03	1.2E-03	1.9E-04	0.10	1.8E-02	0.75	4.8		
Apr 83	Log 83-041833	WM-189 stream 63	1.56	0.68		0.14		1.2E-02	0.044	3.8E-03	0.079		1.3E-03	0.53		5.2E-03	1.1E-03	1.6E-04	0.088		0.73	4.7		
Jun 83	Log 83-060606	WM-184 stream 65	0.38	0.76	2.2E-03	0.006		1.9E-03	0.019	2.8E-03	0.152		1.5E-02	2.28		1.1E-03		2.4E-04		4.5E-02	0.032	4.8	0.025	0.074
Oct 83	Log 83-10018	WM-184 stream 65	0.54	0.58							0.156			2.37				3.1E-04		5.0E-02	0.032	5.2		
Jun 83	Log 83-062510	WM-188 stream 66			0.17					3.0E-03	0.010	3.7E-03		0.074						3.7E-03	1.7	2.9		
Jun 83	Log 83-06263	WM-188 stream 66	1.66	0.53	0.17			1.0E-02	0.014	3.0E-03	0.013		4.0E-04	0.087		2.5E-03	3.3E-03	7.6E-06	0.27	2.9E-03		2.2		
Jun 83	Log 83-06276	WM-188 stream 66	1.40		0.11				0.011	3.0E-03	0.013		3.1E-04	0.078				1.0E-05		3.2E-03		2.1		

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Table A7. Chemical analyses of liquid waste samples (continued).

Date	Primary Source	Tank/Stream	H+ (N)	Al (M)	B (M)	Ca (M)	Cd (M)	Cr (M)	Fe (M)	Hg (M)	K (M)	Mg (M)	Mn (M)	Na (M)	Nb (M)	Ni (M)	Sn (M)	U (M)	Zr (M)	Cl (M)	F (M)	NO ₃ (M)	PO ₄ (M)	SO ₄ (M)	
Jun 83	Log 83-06294	WM-188 stream 66	1.56	0.59	0.13				0.012	2.5E-03	0.013		3.5E-04	0.083							1.77	2.5			
Sep 83	Log 83-09051	WM-187 stream 67	1.11		0.17			1.1E-02	0.005	4.0E-03	0.006		1.6E-04	0.033		1.2E-03	4.8E-03		0.40	3.8E-03	2.59	2.6			
Sep 83	Log 83-09057	WM-187 stream 67	1.50	0.62	0.18			1.2E-02	0.007	3.5E-03	0.006		1.9E-04	0.034		1.5E-03	5.3E-03		0.43	2.7E-03	2.55	2.6			
Sep 83	Log 83-090611	WM-187 stream 67	1.55	0.60	0.14				0.005	3.0E-03	0.006		1.5E-04	0.038				8.7E-06		2.0E-03	2.53	1.9			
Sep 83	Log 83-09071	WM-187 stream 67	1.69	0.62	0.14			1.5E-02	0.017	3.0E-03	0.006		4.9E-04	0.040		3.2E-03	5.2E-03	7.9E-06	0.43	4.6E-03	2.90	2.8			
Sep 83	Log 83-09166	WM-182 streams 68 & 69	0.92	1.43	0.019			3.0E-03	0.022		0.046			0.23		4.8E-04	9.8E-04	4.0E-05	0.081	1.1E-02	0.42	5.4			
Sep 83	Log 83-09214	WM-182 streams 68 & 69	1.01	1.43	0.034	0.058		2.2E-03	0.022	0.019	0.067		2.2E-03	0.32		2.9E-04	6.0E-04	3.4E-05	0.049	1.4E-02	0.39	5.4			
Sep 83	Log 83-092135	WM-182 streams 68 & 69	2.48	1.32	0.031			2.2E-03	0.025		0.054			0.13		3.0E-04	6.1E-04	2.0E-05	0.050	5.1E-03	0.30	5.3			
Jul 83	Log 83-07311	WM-102 stream 73	0.88	0.50	0.19	0.006			0.005		0.001	6.9E-04		0.006		1.7E-03		7.2E-04		3.5E-03	0.64	1.7			
Aug 83	Log 83-08071	WM-100 stream 71	0.92	0.32	0.14	0.004		1.4E-03	0.004		0.001	6.0E-03		0.006	0.10	7.4E-04	7.6E-05	6.1E-04	6.2E-03	2.7E-03	0.77	1.8			
Oct 83	Log 83-100512	WM-100 streams 72 & 69		1.79	0.014				0.023		0.005			0.032				1.0E-05		7.4E-03	0.073	5.9			
Jun 83	Log 83-061324	WM-102 stream 73	0.88	0.48	0.15	0.011		3.8E-04	0.012		0.051	8.2E-04		0.021	0.012	1.7E-03		8.7E-04		7.5E-03	0.59	1.6			
Apr 84	Log 84-042017	WM-189 stream 70	1.38	0.45	0.04			6.5E-03	0.023	7.5E-03	0.038		6.9E-04	0.30		2.7E-03	9.0E-04	1.4E-04	0.074	1.3E-02	0.48	3.5			
Apr 84	Log 84-04216	WM-189 stream 70	2.23	0.58	0.04			7.3E-03	0.026	7.5E-03	0.041		7.7E-04	0.34		3.1E-03	1.0E-03	1.6E-04	0.086	2.0E-02	0.64	4.5			
Apr 84	Log 84-042215	WM-189 stream 70	2.00	0.41	0.07	0.135		9.1E-03	0.032	8.0E-03	0.097		9.6E-04	0.36		3.8E-03	8.0E-04		0.066	1.5E-02	0.56	3.7			
Apr 84	Log 84-042223	WM-102 stream 74	2.04	0.53	0.16				0.001		2.6E-04			0.005							0.63	2.0			
May 84	Log 84-050238	WM-102 stream 74	0.86	0.41	0.14						2.5E-04			0.009				1.1E-05			0.52	1.5			
May 84	Log 84-05077	WM-102 stream 74	0.77	0.47	0.14				0.018		0.004			0.17				7.6E-06			0.47	1.7			
Aug 87	Log 87-08293	WM-187 stream 75	1.54	0.41	0.14		0.052		0.005		0.002		1.5E-04	0.021			3.5E-03	3.4E-05	0.28		1.96	1.8		0.036	
Aug 87	Log 87-08303	WM-187 stream 75	1.56	0.43	0.16		0.053		0.005		0.003		1.5E-04	0.022			3.9E-03	2.8E-05	0.32		1.94	1.8		0.032	
Aug 87	Log 87-08311	WM-187 stream 75	1.58	0.41	0.15		0.050		0.005				1.5E-04				3.4E-03	3.0E-05	0.28			1.8		0.041	
Oct 87	Log 87-10026	WM-187 stream 75	1.43	0.39	0.14				0.006		0.002		1.6E-04	0.019			3.6E-03	2.7E-05	0.30		1.87	1.8			
Oct 87	Log 87-100224	WM-187 stream 75	1.59	0.44	0.15				0.005		0.002		1.6E-04				3.7E-03	2.6E-05	0.30			1.9			
Oct 87	Log 87-100310	WM-187 stream 75	1.66	0.43					0.006				1.7E-04				4.0E-03	2.7E-05	0.33		1.95	1.9			
Oct 87	Log 87-10056	WM-187 stream 75	1.46	0.42	0.15				0.005		0.005		1.5E-04				3.9E-03	2.8E-05	0.32		1.75	1.9			
Oct 87	Log 87-100527	WM-187 stream 75	1.50								0.005							2.7E-05							
Oct 87	Log 87-10073	WM-187 stream 75	1.45	0.45	0.15	0.019		7.6E-03	0.007	9.5E-04	0.006		2.0E-04			1.6E-03		2.4E-05			2.26	1.9			
Sep 87	Log 87-09098	WM-186 stream 76	1.76	0.41	0.013	0.062	4.3E-4	5.3E-03	0.024	2.1E-03	0.205		1.4E-02	1.44		2.6E-03	3.2E-06	6.9E-04	2.6E-04	3.0E-02	0.049	4.5	7.3E-3	0.039	
Oct 87	Log 87-10104	WM-189 stream 77	3.99	0.41	0.18			2.3E-03	0.008		0.005		2.0E-04	0.078		1.7E-03	4.4E-03	4.0E-05	0.36		2.56	2.4			
Oct 87	Log 87-101419	WM-189 stream 77	2.78	0.38	0.18			2.1E-03	0.007		0.005		1.8E-04	0.048		1.5E-03	4.0E-03	5.1E-05	0.33		2.15	2.2			
Mar 88	Log 88-030230	WM-188 stream 78	2.04	0.35	0.17		0.11	2.2E-03	0.007		0.002		2.0E-04	0.022		1.6E-03	4.1E-03	1.5E-05	0.33	1.6E-03	2.34	2.3		0.079	
Mar 88	Log 88-030324	WM-188 stream 78	1.99	0.34	0.16		0.11	2.2E-03	0.007		0.003		1.9E-04	0.034		1.6E-03	3.5E-03		0.29	1.1E-03	2.13	2.4		0.074	
Mar 88	Log 88-030337	WM-188 stream 78	2.09		0.18			2.5E-03	0.008		0.002		2.3E-04	0.026		1.9E-03	3.4E-03		0.28		2.21	2.2		0.080	
Jul 88	Log 88-072815	WM-189 stream 79	2.33	0.29	0.20		0.12	2.6E-03	0.009		0.004		2.3E-04	0.023		1.9E-03	3.5E-03	1.9E-05	0.29	4.4E-03	2.29	2.0		0.061	
Jul 88	Log 88-072911	WM-189 stream 79	2.17	0.32	0.20		0.12	3.2E-03	0.011		0.006		2.9E-04	0.032		2.4E-03	3.6E-03		0.30	3.3E-03	2.22	2.6		0.098	
Jul 88	Log 88-07301	WM-189 stream 79	2.19	0.30	0.20		0.12	2.6E-03	0.009		0.009		2.3E-04	0.036		1.9E-03	3.5E-03		0.28	1.4E-03	1.99			0.061	
Jul 88	Log 88-07312	WM-189 stream 79	2.29	0.31	0.20		0.12	2.6E-03	0.009		0.012		2.3E-04			1.9E-03				2.1E-03		3.0		0.078	
Aug 88	Log 88-080127	WM-189 stream 79	2.34	0.32	0.21		0.12	2.4E-03	0.008		0.006	0.12	2.2E-04	0.033		1.8E-03	3.6E-03		0.30	1.3E-03	2.35	2.3		0.076	
Sep 88	Log 88-102120	WM-185 stream 81	1.69	0.71	0.024	0.067	9.3E-04	5.4E-03	0.022		0.182		2.0E-02	1.35		1.7E-03	1.1E-04	3.5E-04	9.0E-03	3.2E-02	0.14	4.9		0.042	
Sep 88	Log 88-10228	WM-185 stream 81	1.75	0.68	0.030	0.062	7.8E-04	5.4E-03	0.021	3.6E-03	0.177		1.9E-02	1.39		1.5E-03	1.1E-04	3.2E-04	8.7E-3	3.0E-02	0.16	4.7		0.037	
Dec 90	Log 90-121023	WM-188 stream 80	1.84	0.26	0.13		0.08		0.006				1.7E-04							3.5E-03	2.17	1.4		0.028	
Dec 90	Log 90-121117	WM-188 stream 80	1.78		0.14		0.10		0.007		0.005		1.8E-04	0.028		1.5E-03	2.7E-03		0.22	1.6E-03	1.98	1.4		0.028	
Dec 90	Log 90-12124	WM-188 stream 80		0.32	0.17		0.11		0.007		0.005		2.0E-04			1.7E-03	3.1E-03		0.25	1.6E-03		1.8		0.043	
Dec 90	Log 90-12132	WM-188 stream 80	1.84	0.27	0.16				0.007		0.007		1.8E-04			1.5E-03	2.7E-03	2.1E-05	0.22	1.6E-03	2.13	1.7		0.035	
Dec 90	Log 90-121316	WM-188 stream 80	1.84	0.26	0.13		0.088		0.006	0.13	0.004		1.6E-04	0.023								1.8		0.049	
Dec 90	Log 90-121718	WM-187 stream 82	1.63	0.39	0.12		0.049		0.006		0.004		1.7E-04				3.4E-03		0.28	1.7E-03		1.7		0.026	
Dec 90	Log 90-121812	WM-187 stream 82	1.41	0.43	0.14		0.051		0.006		0.004		1.7E-04				3.6E-03		0.29	1.8E-03	1.74	2.1		0.028	
Dec 90	Log 90-121911	WM-187 stream 82	1.39	0.44	0.12		0.049		0.006				1.9E-04				3.8E-03		0.31	2.9E-03	1.78	2.3		0.030	
Dec 90	Log 90-122211	WM-182 stream 83	0.85	1.13					0.021		0.003							1.4E-04		1.4E-03		4.1		0.027	
Dec 90	Log 90-12238	WM-182 stream 83	0.85	1.21			4.4E-3		0.020		0.004						1.1E-04	1.3E-04	8.7E-03			4.1		0.030	
Dec 90	Log 90-12244	WM-182 stream 83	0.83	1.21			6.0E-3		0.020								8.9E-05	1.6E-04	7.3E-03	1.0E-03	0.076	4.0		0.025	
Dec 90	Log 90-12255	WM-182 stream 83	0.88	1.26			5.6E-3		0.022							6.1E-05	1.3E-04	1.3E-04	0.010	2.7E-03	0.087	4.2		0.025	
May 93	Log 93-050514	WM-102 stream 84		1.19			2.8E-4	6.0E-04	0.029		0.009		8.5E-04	0.011					7.0E-06			4.8E-3	2.7		0.001
May 93	Log 93-050515	WM-102 stream 84		1.00			2.3E-4	5.1E-04	0.033	7.5E-07	0.008		9.8E-04	0.011					7.0E-06			4.5E-3	2.8		0.001
May 93	Log 93-050516	WM-102 stream 84		1.09			2.6E-4	6.1E-04	0.022	4.5E-07	0.008		6.4E-04	0.010		9.5E-05			7.0E-06			3.6E-3	2.7		0.002
Aug 93	Log 93-082013	WM-100 stream 85	0.12	1.09		0.012	5.5E-4	6.4E-04	0.021	8.2E-04	0.021		6.1E-04	0.17		2.3E-04		4.5E-05		4.4E-03	0.022	6.1		0.001	
Aug 93	Log 93-08223	WM-100 stream 85	0.11	1.36	2.8E-03	0.009	3.7E-4	7.3E-04	0.024	7.0E-04	0.021		7.0E-04	0.17		2.5E-04	1.3E-05								

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Table A7. Chemical analyses of liquid waste samples (continued).

Date	Primary Source	Tank/Stream	H+ (N)	Al (M)	B (M)	Ca (M)	Cd (M)	Cr (M)	Fe (M)	Hg (M)	K (M)	Mg (M)	Mn (M)	Na (M)	Nb (M)	Ni (M)	Sn (M)	U (M)	Zr (M)	Cl (M)	F (M)	NO ₃ (M)	PO ₄ (M)	SO ₄ (M)
Feb 97	Log 97-02062	WM-188 stream 86	2.63	0.82	0.037	0.146	9.0E-3	1.3E-02	0.052	7.3E-03	0.132			0.74		5.2E-03	3.0E-04	4.9E-04	0.025	1.2E-02	0.30	5.6	3.3E-4	0.033
Feb 97	Log 97-02063	WM-188 stream 86	2.65	0.80	0.036	0.147	8.8E-3	1.2E-02	0.054	7.1E-03	0.149			0.73		5.2E-03	3.0E-04	5.0E-04	0.024	1.5E-02	0.29	6.0	3.6E-4	0.036
Feb 97	Log 97-02064	WM-188 stream 86	2.64	0.85	0.038	0.154	9.3E-3	1.3E-02	0.057	7.8E-03	0.146			0.71		5.4E-03	3.2E-04	5.2E-04	0.026	1.6E-02	0.29	6.0	3.5E-4	0.035
Nov 98	Log 98-11105	WM-189 stream 87	2.59	0.93	0.023	0.100	4.9E-3	3.9E-03	0.030	5.8E-03	0.116		1.0E-02	0.91			4.3E-04	2.2E-04	0.035	2.5E-02	0.23	6.2	2.7E-4	0.007
Nov 98	Log 98-11106	WM-189 stream 87	2.58	0.98	0.026	0.079	4.7E-3	4.7E-03	0.025	5.2E-03	0.113			0.89			4.5E-04	2.3E-04	0.037	2.4E-02	0.22	6.3	3.0E-4	0.008
Nov 98	Log 98-11107	WM-189 stream 87	2.54	0.84	0.026	0.073	4.8E-3	4.4E-03	0.021	4.4E-03	0.113			0.90			4.3E-04	2.3E-04	0.035	2.3E-02	0.22	6.2	3.1E-4	0.005
Sep 90	Log 90-09042	WM-185 stream 81	1.65	0.84			8.7E-4	5.3E-03		3.2E-03	0.171			1.26		1.4E-03		3.0E-04		3.6E-02	0.13	5.1		0.053
Sep 90	Log 90-09053	WM-185 stream 81	1.50	0.81			8.6E-4	4.8E-03		3.0E-03	0.179			1.26		1.4E-03		2.7E-04		2.5E-02	0.19	4.9		0.050
Sep 90	Log 90-09069	WM-185 stream 81	1.64		0.024		9.0E-4	5.2E-03	0.021	3.5E-03	0.166					1.6E-03	1.1E-04	2.7E-04	9.3E-3	2.5E-02	0.19	5.1		0.027
Sep 90	Log 90-09089	WM-187 stream 82	1.38		0.12		4.4E-2	7.9E-03	0.005	1.0E-03	0.002		1.5E-04	0.015		1.6E-03	3.4E-03	2.5E-05	0.28	1.4E-03	2.07	1.8		0.039
Sep 90	Log 90-09102	WM-187 stream 82	1.40				0.043	7.5E-03	0.005	9.7E-04			1.5E-04	0.014		1.5E-03		2.4E-05		1.4E-03	1.72	1.8		0.023
Sep 90	Log 90-09114	WM-187 stream 82	1.41		0.12		0.046	7.6E-03	0.005	1.0E-03	0.002		1.6E-04	0.014		1.7E-03	3.3E-03	3.2E-05	0.27	1.4E-03	1.86	1.8		0.030
Sep 90	Log 90-09149	WM-188 stream 80	1.80	0.22	0.15		0.11	2.9E-03	0.006	7.5E-04	0.004		1.7E-04	0.018		2.1E-03	2.6E-03	2.1E-05	0.21	1.5E-03	1.98	1.6		0.049
Sep 90	Log 90-09157	WM-188 stream 80	1.74	0.27	0.16		0.11	3.2E-03	0.006	7.7E-04	0.004		1.6E-04	0.019		2.0E-03	2.9E-03	1.8E-05	0.24	1.5E-03		1.6		0.060
Sep 90	Log 90-09169	WM-188 stream 80	1.72	0.29	0.15		0.10	2.9E-03	0.007	7.5E-04	0.004		1.8E-04	0.018		1.9E-03	2.8E-03	1.8E-05	0.23	1.2E-03	1.88	1.5		0.043
Oct 90	Log 90-10218	WM-182 stream 83	0.52	1.14	7.4E-03		2.2E-03	6.6E-04	0.020	1.8E-03	0.002			0.017			7.0E-05		5.7E-3		0.074	4.0		0.033
Oct 90	Log 90-102228	WM-182 stream 83	0.83	1.05	6.3E-03		1.9E-03	5.5E-04	0.017	1.8E-03	0.002			0.017			6.8E-05	1.3E-04	5.6E-3		0.071	2.9		
Oct 90	Log 90-102316	WM-182 stream 83	0.88	1.18	6.5E-03		2.1E-03	5.4E-04	0.018	1.8E-03	0.002			0.017			6.7E-05		5.5E-3		0.079	3.9		
May 91	Log 91-050413	WM-182 stream 83	0.83	1.18	8.6E-03	0.009	2.3E-03	6.1E-04	0.020							3.0E-04	7.9E-05		6.5E-3	1.0E-03		3.6		
May 91	Log 91-050731	WM-182 stream 83	0.94	1.17		0.010			0.021	1.6E-03						4.3E-04		1.1E-04				3.6		0.015
May 91	Log 91-05184	WM-182 stream 83	0.80	1.19	6.0E-03	0.009	2.0E-03	6.0E-04	0.020		0.003			0.020		2.8E-04	7.8E-05		0.006		0.086	3.7		0.013
Jun 91	Log 91-061219	WM-185 stream 81	1.71	0.89	0.029	0.063		5.2E-03	0.020	3.6E-03	0.194			1.30		1.3E-03	1.7E-04	3.1E-04	0.014			4.9		
Aug 91	Log 91-08044	WM-182 stream 83	0.78				2.3E-03	6.5E-04	0.020	2.7E-03	0.003			0.021		2.6E-04				8.7E-04	0.077	3.9		
Aug 91	Log 91-08047	WM-185 stream 81	1.41	0.87		0.074	1.3E-03	5.1E-03	0.028		0.184			1.35		1.5E-03		3.2E-04		6.1E-02	0.11	4.9		0.012
May 93	Log 93-050726	WM-182 stream 83	0.78		3.7E-03	0.004	2.2E-03	5.2E-04	0.015	1.4E-03	0.003			0.016								3.6		0.045
May 93	Log 93-05121	WM-187 stream 82	1.34	0.39	0.13	0.019	0.042		0.006	8.5E-04	0.005		1.8E-04	0.024		1.6E-03		3.3E-05		1.9E-03		2.0		0.028
May 93	Log 93-051314	WM-102 stream 84	0.18	0.96			2.4E-04		0.033		0.009			0.012				1.3E-05			5.1E-03	3.5		0.002
Jul 93	Log 93-071212	WM-102 stream 84	0.15	0.91			2.5E-04		0.034		0.009			0.012						8.7E-04	5.2E-03	3.4		0.002
Aug 93	Log 93-08205	WM-100 stream 85		1.30		0.003	8.9E-04		0.018		0.002			0.023				1.0E-05		7.9E-04	0.022	4.2		0.006
Aug 93	Log 93-082211	WM-100 stream 85		1.40			1.1E-04				0.005			0.048				1.8E-05		2.0E-03		6.7		0.001
Sep 93	Log 93-090123	WM-100 stream 85		1.41		0.004	2.2E-04		0.024		0.005			0.050				1.5E-05		1.3E-03	7.1E-03	4.5		0.001
Sep 93	Log 93-090319	WM-100 stream 85		1.69		0.004			0.018		0.006			0.049				4.4E-05		6.5E-04		3.9		0.000
Sep 93	Log 93-090320	WM-100 stream 85		1.33		0.004			0.019		0.006			0.051				1.6E-05		4.8E-04		4.0		0.000
Sep 93	Log 93-090321	WM-100 stream 85		1.44		0.004			0.019		0.006			0.048				1.5E-05		6.8E-04	0.010	4.4		0.001
Sep 93	Log 93-09136	WM-188 stream 80	1.60	0.26	0.12	0.033	0.082	2.3E-03	0.006	1.3E-03						1.7E-03			0.22	1.8E-03	1.47	1.8		0.047
Sep 93	Log 93-091517	WM-188 stream 80	1.67	0.34	0.12	0.012	0.079	2.3E-03	0.009	1.5E-03				0.024		1.6E-03			0.20		1.57	1.8		0.019
Aug 78	Log 78-3778	WM-189 stream 52	1.53		0.12			9.6E-03			0.008	7.8E-03	8.2E-04	0.057		1.7E-03	2.9E-03	2.2E-06	0.24	2.3E-03	1.73	2.4		0.045
Sep 79	Log 79-0911-7	WM-189 stream 52	1.61	0.47																	1.59			
Sep 79	Log 79-0921-6	WM-189 stream 52	1.55	0.44													1.8E-02		0.22		1.50			
Sep 79	Log 79-0924-15	WM-189 stream 52	1.56	0.45																	1.63			
Jan 80	Log 80-0104-4	WM-189 stream 52	1.58	0.46	0.12			8.4E-03	0.010					0.061		1.9E-03	2.8E-03	3.5E-06	0.23	2.1E-03	1.65	2.5		
Jan 80	Log 80-0105-11	WM-189 stream 52	1.58	0.44							0.006						3.0E-03	2.6E-06	0.24	3.6E-03	1.51	2.4		
Jan 80	Log 80-0105-15	WM-189 stream 52	1.54	0.43	0.11			7.6E-03	0.009		0.006			0.043		1.7E-03	2.5E-03	2.5E-06	0.21	3.3E-03	1.58	2.5		
Jan 80	Log 80-0106-7	WM-189 stream 52	1.73	0.49	0.11						0.008			0.049			2.8E-03	3.9E-06	0.23	3.3E-03	1.71	2.8		
Jan 80	Log 80-0107-5	WM-189 stream 52	1.59	0.44	0.13			7.5E-03	0.008							1.6E-03	2.5E-03	2.4E-06	0.21	2.0E-03	1.66	2.6		
Jan 81	Log 81-0117-5	WM-189 stream 57	1.85	0.38	0.095			7.1E-03	0.008		0.003			0.015		1.5E-03	2.4E-03		0.20	9.8E-04	1.33	2.8		
Jan 81	Log 81-0118-8	WM-189 stream 57	1.84	0.40	0.087	0.093		7.0E-03	0.007		0.003			0.017		1.4E-03	2.5E-03	3.5E-06	0.20		1.38	2.6		
Jan 81	Log 81-0121-18	WM-189 stream 57	1.78	0.44	0.10	0.196		7.2E-03	0.007							1.4E-03	2.6E-03	4.3E-06	0.21	4.4E-03	1.37	2.8		
Jan 81	Log 81-0123-3	WM-189 stream 57	1.80		0.10			7.2E-03	0.007							1.4E-03	2.6E-03	3.7E-06	0.21		1.40	2.7		
Jan 80	Log 800323-7	WM-185 stream 54	1.44	0.64	0.16				0.008					0.016		9.8E-04	4.5E-03	7.5E-06	0.37		2.26	2.5		
Jan 80	Log 800322-21	WM-185 stream 54	1.20	0.63					0.005					0.015		1.5E-03		4.4E-06			2.25	2.6		
Jan 80	Log 800325-16	WM-185 stream 54	1.36	0.69	0.18						0.001			0.012			4.5E-03	5.0E-06	0.37	9.9E-04	2.22	2.9		
Jan 80	Log 800326-10	WM-185 stream 54	1.43		0.16				0.006					0.021			4.4E-03	7.8E-06	0.36	1.4E-03	2.40	2.4		
Jan 80	Log 800311-4	WM-185 stream 54	1.39	0.62	0.18				0.006								4.2E-03	7.5E-06	0.34		2.22	2.5		0.011
Oct 80	Log 801013-41	WM-185 stream 55	1.55	0.60	0.15	0.031			0.005								3.9E-03	5.0E-06	0.32		2.26	2.6		
Oct 80	Log 801014-22	WM-185 stream 55	1.33		0.17									0.028			3.8E-03		0.31		1.95	4.0		
Oct 80	Log 801017-17	WM-185 stream 55	1.46	0.57	0.15	0.062								0.024			4.4E-03		0.36		2.39	2.3		

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Table A12. Calcine radioactivity by bin segment decayed to January 2016.

1/1/2016	TC	Highest Temp		Batches			Vol. (ft3)	Activity (Curies)																			
	Point	Date	° F	Run	Start	End		⁶⁰ Co	⁶³ Ni	⁷⁹ Se	⁹⁰ Sr	⁹⁰ Y	⁹⁹ Tc	¹²⁶ Sn	¹²⁹ I	^{137m} Ba	¹³⁷ Cs	¹⁵⁴ Eu	¹⁵⁵ Eu	²³⁷ Np	²³⁸ Pu	²³⁹ Pu	²⁴⁰ Pu	²⁴¹ Pu	²⁴² Pu	²⁴¹ Am	²⁴² Cm
VES-WS6-160	242																										
VES-WS6-160	241																										
VES-WS6-160	240																										
VES-WS6-160	239																										
VES-WS6-160	238																										
VES-WS6-160	237																										
VES-WS6-160	236																										
VES-WS6-160	235	not covered		N-4	503	586	330	2.4E-01	4.5E+00	7.0E-03	2.5E+03	2.5E+03	1.0E+00	2.9E-02	1.7E-05	2.7E+03	2.9E+03	3.6E+00	9.7E-01	6.0E-02	5.8E+01	2.0E+00	1.1E+00	3.0E+01	2.3E-03	4.1E+00	1.2E-03
VES-WS6-160	234	Sep-99	85	N-4	15-C	502	607	2.9E-01	6.7E+00	1.2E-02	4.1E+03	4.1E+03	1.7E+00	4.9E-02	2.9E-05	4.4E+03	4.7E+03	6.1E+00	1.5E+00	9.7E-02	6.7E+01	3.5E+00	1.4E+00	3.3E+01	2.4E-03	6.5E+00	2.5E-03
VES-WS6-160	233	Sep-99	91	N-4	203	14-C	605	1.5E+00	1.2E+01	3.0E-02	9.5E+03	9.5E+03	4.5E+00	1.2E-01	7.4E-05	1.2E+04	1.3E+04	2.1E+01	2.6E+00	7.1E-02	6.8E+01	8.2E+00	4.2E+00	1.3E+02	1.0E-02	5.5E+00	5.0E-03
VES-WS6-160	232	Sep-98	103	N-4	61	202	604	2.4E+00	1.6E+01	4.4E-02	1.4E+04	1.4E+04	6.5E+00	1.8E-01	1.1E-04	1.7E+04	1.8E+04	3.1E+01	3.6E+00	6.2E-02	9.4E+01	1.2E+01	6.6E+00	2.1E+02	1.7E-02	5.4E+00	6.4E-03
VES-WS6-160	231	Sep-98	116	N-3/4	356	60	602	8.2E+00	2.2E+01	4.0E-02	1.5E+04	1.5E+04	6.0E+00	1.6E-01	9.9E-05	1.6E+04	1.7E+04	5.7E+01	5.6E+00	2.5E-01	2.0E+02	6.9E+00	4.8E+00	1.7E+02	1.2E-02	1.7E+01	5.8E-03
VES-WS6-160	230	Sep-98	123	N-3	30C	355	593	2.8E+00	1.4E+01	9.7E-02	2.9E+04	2.9E+04	1.5E+01	3.9E-01	2.4E-04	2.9E+04	3.1E+04	8.0E+01	7.0E+00	2.0E-01	1.9E+02	1.4E+01	6.7E+00	1.0E+02	8.0E-03	1.6E+01	3.0E-03
VES-WS6-160	229	Aug-94	124	N-3	DB	DB	76																				
VES-WS6-160		Bin Totals					3417	1.5E+01	7.6E+01	2.3E-01	7.4E+04	7.4E+04	3.5E+01	9.4E-01	5.7E-04	8.1E+04	8.6E+04	2.0E+02	2.1E+01	7.4E-01	6.8E+02	4.6E+01	2.5E+01	6.8E+02	5.2E-02	5.5E+01	2.4E-02
CSSF VI Totals							25,181	1.1E+02	5.5E+02	1.7E+00	5.4E+05	5.4E+05	2.5E+02	6.8E+00	4.1E-03	5.9E+05	6.2E+05	1.4E+03	1.5E+02	5.4E+00	5.0E+03	3.3E+02	1.8E+02	4.9E+03	3.8E-01	4.0E+02	1.7E-01

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Table A13. Calcine chemical content by bin segment (weight percent) (continued).

	TC Point	Vol. (ft3)	Chemical Content of Calcine (weight percent)																														
			Ag	Al	As	B	Ba	Ca	Cd	Cr	Cs	Fe	Hg	K	Mg	Mn	Na	Nb	Ni	Pb	Se	Sr	Sn	U	Zr	Cl	F	CO ₃	NO ₃	PO ₄	SO ₄	O	Total
VES-WCS-140-5	TOPV	393	9.9E-04	8.7	6.5E-04	0.65	0.013	28.6	7.0E-05	0.21	0.008	0.18	1.8E-03	0.51	0.61	0.14	2.14	1.5E-03	0.03	1.5E-02	2.4E-04	0.28	0.19	1.6E-03	11.7	0.10	16.8	1.1	4.3	5.04	1.9	16.7	100
VES-WCS-140-5	37	1123	8.8E-04	7.7	7.4E-04	0.85	0.016	28.5	8.9E-05	0.27	0.010	0.20	1.6E-03	0.07	0.21	0.09	0.42	1.8E-03	0.04	1.3E-03	3.1E-04	0.31	0.28	2.0E-03	17.4	0.03	23.9	0.0	0.8	0.70	2.0	16.2	100
VES-WCS-140-5	38	1123	1.1E-03	8.8	8.2E-04	0.80	0.013	28.0	6.3E-05	0.25	0.007	0.17	8.3E-04	0.11	0.86	0.09	0.56	1.4E-03	0.03	1.9E-03	2.2E-04	0.29	0.24	9.7E-04	15.4	0.04	21.9	1.7	1.1	0.72	2.0	16.9	100
VES-WCS-140-5	39	1119	1.2E-03	14.2	1.0E-03	0.72	0.011	23.7	6.1E-05	0.31	0.007	0.43	1.3E-03	0.06	1.40	0.07	0.37	1.0E-03	0.06	1.2E-03	2.2E-04	0.23	0.20	4.8E-04	12.6	0.04	17.2	3.2	0.7	0.88	2.8	20.8	100
VES-WCS-140-5	40	1117	1.1E-03	8.7	8.7E-04	0.85	0.011	28.0	5.3E-05	0.26	0.006	0.18	1.2E-04	0.07	0.81	0.09	0.41	1.2E-03	0.04	3.5E-04	1.8E-04	0.30	0.25	2.9E-04	15.6	0.05	22.5	1.6	0.8	0.72	2.0	16.7	100
VES-WCS-140-5	41	645	1.2E-03	25.2	1.1E-03	0.63	0.015	15.8	9.5E-05	0.35	0.011	0.42	4.4E-03	0.08	1.19	0.06	0.49	6.4E-04	0.05	2.7E-03	3.5E-04	0.16	0.13	8.5E-04	8.4	0.04	11.7	2.6	1.0	1.03	2.6	28.0	100
VES-WCS-140-5	42	6	5.5E-04	3.6	4.8E-04	0.43	0.007	28.7	3.1E-05	0.14	0.004	0.05	8.3E-06	0.03	8.28	0.05	0.20	7.0E-04	0.01	7.3E-04	1.0E-04	0.18	0.14	2.1E-04	9.0	0.02	13.5	21.1	0.4	0.35	1.0	12.8	100
Bin Totals		5527	1.1E-03	11.1	8.6E-04	0.77	0.013	26.1	7.0E-05	0.27	0.008	0.25	1.4E-03	0.11	0.89	0.09	0.57	1.3E-03	0.04	2.4E-03	2.4E-04	0.27	0.23	9.9E-04	14.3	0.04	20.1	1.8	1.1	1.11	2.2	18.5	100
VES-WCS-140-6	TOPV	168	1.3E-03	8.80	9.0E-04	0.91	0.020	25.7	1.2E-04	0.29	0.01	0.61	2.5E-03	0.89	0.22	0.19	3.00	2.5E-03	0.08	1.8E-02	4.2E-04	0.28	0.21	2.2E-03	13.4	0.13	18.1		6.3	0.90	2.3	17.70	100
VES-WCS-140-6	43	1123	1.1E-03	9.2	6.8E-04	0.62	0.013	27.3	6.8E-05	0.20	0.008	0.22	1.9E-03	0.73	1.09	0.17	2.93	1.5E-03	0.04	2.1E-02	2.3E-04	0.27	0.17	2.1E-03	10.9	0.14	15.5	2.4	6.0	2.77	1.9	17.5	100
VES-WCS-140-6	44	1123	9.5E-04	8.0	7.1E-04	0.78	0.015	28.5	8.3E-05	0.25	0.010	0.19	1.8E-03	0.27	0.32	0.12	1.19	1.7E-03	0.04	7.3E-03	2.9E-04	0.30	0.24	1.9E-03	15.4	0.06	21.4	0.3	2.4	1.83	1.9	16.4	100
VES-WCS-140-6	45	1121	1.0E-03	9.7	8.0E-04	0.78	0.012	27.1	5.8E-05	0.24	0.007	0.16	6.8E-04	0.09	1.20	0.09	0.48	1.3E-03	0.03	1.3E-03	2.0E-04	0.28	0.24	8.1E-04	14.9	0.04	20.7	2.7	0.9	0.69	2.0	17.7	100
VES-WCS-140-6	46	1117	1.4E-03	13.1	1.1E-03	0.77	0.013	24.9	6.8E-05	0.34	0.008	0.50	1.4E-03	0.07	0.88	0.08	0.40	1.1E-03	0.07	1.3E-03	2.4E-04	0.26	0.21	5.0E-04	13.1	0.04	18.9	1.8	0.8	0.97	3.0	19.8	100
VES-WCS-140-6	47	869	1.1E-03	14.6	8.9E-04	0.75	0.012	23.3	6.4E-05	0.30	0.008	0.32	1.5E-03	0.06	1.11	0.08	0.39	9.8E-04	0.05	1.2E-03	2.3E-04	0.24	0.21	5.3E-04	13.0	0.04	18.4	2.4	0.8	0.79	2.4	20.7	100
VES-WCS-140-6	48	6	1.3E-03	24.5	1.1E-03	0.63	0.018	15.8	1.1E-04	0.34	0.013	0.17	5.5E-03	0.11	1.37	0.05	0.63	6.6E-04	0.01	3.1E-03	4.2E-04	0.16	0.14	7.0E-04	8.8	0.04	13.1	3.0	1.2	1.10	1.9	26.9	100
Bin Totals		5527	1.1E-03	10.5	8.3E-04	0.74	0.013	26.4	7.0E-05	0.26	0.008	0.28	1.5E-03	0.29	0.89	0.11	1.23	1.4E-03	0.04	7.4E-03	2.5E-04	0.27	0.21	1.3E-03	13.5	0.07	18.9	1.8	2.5	1.47	2.2	18.2	100
CSSF III Totals		39,546	1.1E-03	10.7	8.7E-04	0.76	0.013	26.5	6.8E-05	0.26	0.008	0.26	1.2E-03	0.23	0.86	0.10	0.98	1.4E-03	0.04	5.4E-03	2.4E-04	0.27	0.22	1.2E-03	13.7	0.06	19.2	1.8	2.0	1.66	2.2	18.3	100

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Table A13. Calcine chemical content by bin segment (weight percent) (continued).

	TC Point	Vol. (ft3)	Chemical Content of Calcine (weight percent)																															
			Ag	Al	As	B	Ba	Ca	Cd	Cr	Cs	Fe	Hg	K	Mg	Mn	Na	Nb	Ni	Pb	Se	Sr	Sn	U	Zr	Cl	F	CO ₃	NO ₃	PO ₄	SO ₄	O	Total	
VES-WS5-150	129	526	1.5E-03	14.4	1.0E-03	0.86	0.016	21.9	3.37	0.12	0.011	0.42	1.9E-03	0.62	0.80	0.15	2.65	1.4E-03	0.05	0.032	3.3E-04	0.22	0.14	1.3E-02	8.7	0.14	13.9	1.6	5.4	0.97	2.3	21.3	100	
VES-WS5-150	130	497	1.4E-03	19.2	9.8E-04	0.81	0.017	18.1	1.83	0.12	0.012	0.53	2.2E-03	0.59	1.74	0.13	2.52	8.9E-04	0.04	0.031	3.9E-04	0.17	0.11	1.7E-02	6.9	0.13	10.0	4.0	5.1	1.01	2.0	24.8	100	
VES-WS5-150	131	497	1.2E-03	13.8	7.6E-04	0.69	0.012	23.2	3.48	0.09	0.008	0.30	9.8E-04	0.60	1.41	0.13	2.46	1.4E-03	0.04	0.023	2.4E-04	0.23	0.13	1.1E-02	8.0	0.13	12.8	3.3	5.0	0.68	2.2	21.2	100	
VES-WS5-150	132	497	1.5E-03	4.7	9.0E-04	0.88	0.016	29.1	5.33	0.08	0.010	0.33	4.1E-04	0.81	0.20	0.16	3.22	2.0E-03	0.06	0.021	2.9E-04	0.32	0.17	1.6E-02	11.0	0.15	17.4		6.6	0.74	3.7	15.1	100	
VES-WS5-150	133	497	1.4E-03	7.5	8.4E-04	0.76	0.014	26.8	4.90	0.07	0.008	0.29	4.3E-04	0.70	0.18	0.15	3.01	1.7E-03	0.05	0.020	2.4E-04	0.29	0.17	1.5E-02	11.0	0.13	17.1		6.1	0.69	3.6	16.5	100	
VES-WS5-150	134	497	1.4E-03	5.2	8.8E-04	0.79	0.015	27.3	4.93	0.08	0.010	0.29	8.9E-04	0.73	0.29	0.15	3.24	1.9E-03	0.05	0.020	2.8E-04	0.29	0.20	1.7E-02	12.4	0.13	17.9	0.3	6.5	0.73	3.6	14.8	100	
VES-WS5-150	135	495	1.3E-03	5.3	8.8E-04	0.82	0.016	28.3	4.83	0.09	0.010	0.26	9.8E-04	0.56	0.19	0.14	2.56	2.0E-03	0.05	0.015	2.9E-04	0.31	0.21	1.4E-02	13.1	0.11	18.4		5.1	0.74	3.5	15.3	100	
VES-WS5-150	136	495	1.1E-03	16.1	9.3E-04	0.94	0.012	22.9	0.62	0.18	0.007	0.49	3.4E-03	0.42	0.86	0.08	1.80	0.98	0.05	1.3E-02	2.2E-04	0.23	0.13	6.8E-03	8.2	0.14	14.2	1.7	3.6	1.08	2.2	23.0	100	
VES-WS5-150	137	493	1.3E-03	14.7	1.1E-03	1.03	0.016	23.0	9.6E-05	0.24	0.011	0.75	4.6E-03	0.57	0.68	0.08	2.36	0.97	0.08	1.1E-02	3.4E-04	0.24	0.13	6.4E-03	8.5	0.17	14.6	1.1	4.8	1.25	2.5	22.1	100	
VES-WS5-150	138	493	1.2E-03	10.4	9.9E-04	0.88	0.020	25.6	1.2E-04	0.30	0.014	0.58	4.0E-03	0.52	0.21	0.10	2.19	0.24	0.09	1.2E-02	4.2E-04	0.27	0.21	1.2E-02	13.1	0.17	18.6		4.5	1.01	2.4	18.6	100	
VES-WS5-150	139	106	1.3E-03	10.2	1.1E-03	0.93	0.018	26.8	1.1E-04	0.33	0.012	0.69	3.5E-03	0.60	0.22	0.10	2.05	0.12	0.11	1.3E-02	3.8E-04	0.28	0.20	2.5E-02	12.3	0.19	17.9		4.3	1.09	2.7	18.9	100	
Bin Totals		5092	1.3E-03	10.8	9.3E-04	0.85	0.015	24.8	2.97	0.14	0.010	0.42	1.9E-03	0.62	0.62	0.13	2.61	0.19	0.06	0.020	3.1E-04	0.26	0.16	1.3E-02	10.3	0.14	15.7	1.1	5.3	0.89	2.8	19.0	100	
VES-WS5-151	161	526	1.4E-03	15.5	9.9E-04	0.84	0.016	20.8	2.81	0.12	0.011	0.46	2.0E-03	0.60	1.41	0.14	2.58	1.2E-03	0.04	0.031	3.5E-04	0.20	0.13	1.4E-02	8.0	0.14	12.4	3.2	5.2	0.98	2.2	22.1	100	
VES-WS5-151	162	497	1.4E-03	19.2	9.8E-04	0.81	0.017	18.1	1.83	0.12	0.012	0.53	2.2E-03	0.59	1.75	0.13	2.53	8.9E-04	0.04	0.031	3.9E-04	0.17	0.11	1.7E-02	6.9	0.13	10.0	4.0	5.1	1.01	2.0	24.8	100	
VES-WS5-151	163	497	1.2E-03	13.2	7.6E-04	0.70	0.012	23.7	3.61	0.09	0.008	0.29	9.2E-04	0.61	1.36	0.13	2.49	1.4E-03	0.04	0.022	2.4E-04	0.24	0.13	1.1E-02	8.2	0.13	13.1	3.1	5.1	0.67	2.3	20.8	100	
VES-WS5-151	164	497	1.5E-03	4.7	9.0E-04	0.88	0.016	29.0	5.33	0.08	0.010	0.33	4.1E-04	0.80	0.20	0.16	3.21	2.0E-03	0.06	0.021	2.9E-04	0.31	0.18	1.6E-02	11.1	0.15	17.5		6.5	0.74	3.7	15.0	100	
VES-WS5-151	165	497	1.4E-03	6.9	8.5E-04	0.76	0.014	27.3	4.76	0.08	0.009	0.29	5.0E-04	0.69	0.29	0.15	2.96	1.7E-03	0.05	0.020	2.4E-04	0.29	0.18	1.5E-02	11.2	0.13	17.2	0.3	6.0	0.71	3.5	16.1	100	
VES-WS5-151	166	497	1.4E-03	5.4	8.9E-04	0.82	0.016	27.0	4.87	0.09	0.010	0.27	1.0E-03	0.66	0.18	0.14	2.96	2.0E-03	0.05	0.018	3.0E-04	0.29	0.21	1.6E-02	13.2	0.12	18.5		6.0	0.75	3.5	15.0	100	
VES-WS5-151	167	495	1.3E-03	7.8	8.3E-04	0.78	0.015	27.0	4.57	0.08	0.010	0.24	9.2E-04	0.53	0.18	0.13	2.39	1.9E-03	0.05	0.014	2.8E-04	0.29	0.20	1.3E-02	12.4	0.10	17.4		4.8	0.70	3.3	17.1	100	
VES-WS5-151	168	495	1.3E-03	14.9	1.0E-03	1.02	0.012	23.4	2.4E-02	0.19	0.007	0.61	4.2E-03	0.52	1.01	0.08	2.24	1.29	0.06	1.6E-02	2.3E-04	0.23	0.12	7.8E-03	7.5	0.16	14.2	2.1	4.5	1.23	2.4	22.2	100	
VES-WS5-151	169	493	1.3E-03	15.3	1.1E-03	1.01	0.016	22.7	9.3E-05	0.23	0.011	0.73	4.5E-03	0.56	0.77	0.08	2.32	0.96	0.08	1.1E-02	3.3E-04	0.23	0.13	6.3E-03	8.3	0.17	14.2	1.4	4.7	1.22	2.4	22.5	100	
VES-WS5-151	170	493	1.2E-03	10.3	9.6E-04	0.85	0.020	25.5	1.2E-04	0.30	0.014	0.55	4.1E-03	0.48	0.21	0.10	2.19	0.25	0.08	1.1E-02	4.4E-04	0.27	0.21	6.4E-03	13.5	0.16	18.8		4.4	0.98	2.4	18.4	100	
VES-WS5-151	171	106	1.3E-03	10.4	1.1E-03	0.95	0.018	26.6	1.1E-04	0.32	0.012	0.71	3.4E-03	0.63	0.22	0.10	2.10	0.14	0.12	1.3E-02	3.7E-04	0.28	0.19	2.9E-02	12.0	0.20	17.8		4.4	1.11	2.7	19.0	100	
Bin Totals		5092	1.3E-03	11.0	9.3E-04	0.85	0.015	24.7	2.83	0.14	0.010	0.43	2.0E-03	0.61	0.70	0.13	2.59	0.22	0.06	0.020	3.1E-04	0.26	0.16	1.3E-02	10.2	0.14	15.5	1.3	5.3	0.89	2.8	19.2	100	
VES-WS5-152	193	526	1.5E-03	15.3	1.0E-03	0.86	0.017	20.9	2.85	0.12	0.012	0.48	2.1E-03	0.61	1.22	0.15	2.63	1.2E-03	0.04	0.032	3.7E-04	0.21	0.13	1.5E-02	8.3	0.14	12.7	2.7	5.3	1.02	2.2	22.0	100	
VES-WS5-152	194	497	1.3E-03	17.8	8.5E-04	0.70	0.013	20.1	2.79	0.11	0.009	0.39	1.7E-03	0.57	1.34	0.14	2.46	1.1E-03	0.04	0.029	2.9E-04	0.20	0.11	1.2E-02	7.2	0.13	11.5	3.0	5.0	0.82	1.9	23.7	100	
VES-WS5-152	195	497	1.3E-03	6.7	7.9E-04	0.78	0.014	27.9	4.50	0.08	0.009	0.29	4.0E-04	0.73	1.42	0.14	2.89	1.7E-03	0.05	0.019	2.5E-04	0.28	0.15	1.5E-02	9.5	0.14	14.9	3.2	5.9	0.65	3.1	16.6	100	
VES-WS5-152	196	497	1.4E-03	7.4	8.5E-04	0.80	0.014	27.1	5.00	0.07	0.009	0.30	4.0E-04	0.71	0.18	0.15	2.95	1.8E-03	0.05	0.019	2.6E-04	0.29	0.17	1.5E-02	10.8	0.13	16.9		6.0	0.70	3.6	16.6	100	
VES-WS5-152	197	497	1.4E-03	5.1	8.8E-04	0.79	0.015	28.0	4.93	0.08	0.009	0.30	6.9E-04	0.73	0.29	0.16	3.15	1.8E-03	0.05	0.020	2.7E-04	0.30	0.19	1.6E-02	12.0	0.13	17.9	0.3	6.4	0.73	3.6	14.9	100	
VES-WS5-152	198	497	1.4E-03	5.4	8.9E-04	0.82	0.016	27.3	4.89	0.09	0.010	0.27	1.0E-03	0.64	0.19	0.14	2.88	2.0E-03	0.05	0.017	3.0E-04	0.30	0.21	1.6E-02	13.1	0.11	18.4		5.8	0.75	3.5	15.1	100	
VES-WS5-152	199	495	1.0E-03	14.0	7.5E-04	0.75	0.012	23.6	2.83	0.11	0.008	0.27	1.5E-03	0.37	0.98	0.09	1.63	0.25	0.04	9.4E-03	2.3E-04	0.24	0.16	8.2E-03	10.0	0.09	14.5	2.1	3.3	0.71	2.4	21.4	100	
VES-WS5-152	200	495	1.4E-03	12.7	1.1E-03	1.16	0.012	24.8	6.6E-05	0.20	0.008	0.67	3.8E-03	0.52	0.95	0.08	2.36	1.50	0.06	1.6E-02	2.3E-04	0.25	0.12	8.1E-03	7.7	0.17	15.3	1.8	4.7	1.37	2.6	20.8	100	
VES-WS5-152	201	493	1.3E-03	15.1	1.1E-03	0.95	0.019	22.6	1.2E-04	0.25	0.013	0.71	5.6E-03	0.61	0.23	0.08	2.25	0.66	0.08	1.0E-02	4.2E-04	0.24	0.16	5.9E-03	10.0	0.17	15.5		4.6	1.16	2.4	22.2	100	
VES-WS5-152	202	493	1.3E-03	9.9	1.0E-03	0.88	0.018	26.3	1.1E-04	0.31	0.012	0.62	3.3E-03	0.54	0.21	0.10	2.41	0.29	0.10	1.4E-02	3.8E-04	0.28	0.20	1.5E-02	12.5	0.18	18.1		4.9	1.05	2.6	18.5	100	
VES-WS5-152	203	106	1.3E-03	10.1	1.1E-03	0.92	0.018	26.8	1.1E-04	0.33	0.012	0.69	3.5E-03	0.60	0.22	0.10	2.05	0.11	0.11	1.3E-02	3.8E-04	0.28	0.20	2.4E-02	12.4	0.19	17.9		4.3	1.09	2.7	18.9	100	
Bin Totals		5092	1.3E-03	10.6	9.2E-04	0.85	0.015	25.1	2.80	0.15	0.010	0.43	2.0E-03	0.61	0.68	0.12	2.57	0.24	0.06	0.019	3.0E-04	0.26	0.16	1.3E-02	10.3	0.14								

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Table A13. Calcine chemical content by bin segment (weight percent) (continued).

	TC Point	Vol. (ft3)	Chemical Content of Calcine (weight percent)																														
			Ag	Al	As	B	Ba	Ca	Cd	Cr	Cs	Fe	Hg	K	Mg	Mn	Na	Nb	Ni	Pb	Se	Sr	Sn	U	Zr	Cl	F	CO ₃	NO ₃	PO ₄	SO ₄	O	Total
VES-WS6-154	14																																
VES-WS6-154	13																																
VES-WS6-154	12																																
VES-WS6-154	11																																
VES-WS6-154	10																																
VES-WS6-154	9	420	1.9E-03	37.6	3.9E-04	0.13	0.003	3.0	0.22	0.09	0.002	0.57	4.1E-03	1.80	0.20	0.23	8.36	4.6E-04	0.05	0.087	5.5E-05	0.016	0.021	2.2E-02	1.3	0.35	1.7	0.5	5.9	0.01	0.3	37.5	100
VES-WS6-154	8	609	1.5E-03	34.7	3.1E-04	0.23	0.002	5.0	0.17	0.07	0.001	0.44	3.2E-03	1.38	1.70	0.18	6.41	3.6E-04	0.03	0.067	4.3E-05	0.016	0.016	1.7E-02	1.0	0.27	1.3	4.3	7.4	0.01	0.2	35.0	100
VES-WS6-154	7	608	1.3E-03	36.6	2.6E-04	0.44	0.002	3.3	0.08	0.07	0.001	0.36	2.3E-03	1.61	0.15	0.24	7.14	4.5E-04	0.03	0.086	3.7E-05	0.025	0.008	1.8E-02	0.53	0.29	0.9	0.4	10.8	0.24	0.7	36.1	100
VES-WS6-154	6	607	1.3E-03	34.3	2.6E-04	0.45	0.003	4.5	0.17	0.12	0.002	0.58	3.0E-03	1.68	0.50	0.21	6.28	6.1E-04	0.05	0.079	7.0E-05	0.013	0.008	2.6E-02	0.50	0.22	1.2	1.2	12.9	0.17	0.9	33.9	100
VES-WS6-154	5	605	1.6E-03	32.9	3.2E-04	0.42	0.005	5.4	0.34	0.22	0.004	1.00	4.9E-03	2.03	0.19	0.19	6.23	9.0E-04	0.10	0.079	1.3E-04	0.004	0.012	4.0E-02	0.78	0.18	1.9	0.4	13.2	0.01	1.2	33.2	100
VES-WS6-154	4	604	1.6E-03	33.4	3.2E-04	0.44	0.005	4.9	0.35	0.22	0.004	1.00	5.0E-03	2.04	0.02	0.19	6.28	9.1E-04	0.10	0.080	1.3E-04	0.004	0.012	4.1E-02	0.78	0.18	1.9		13.3	0.01	1.2	33.5	100
VES-WS6-154	3	602	1.1E-03	24.7	6.5E-04	0.60	0.008	16.4	2.07	0.08	0.005	0.42	1.6E-03	0.66	1.54	0.12	2.46	8.9E-04	0.04	0.029	1.5E-04	0.019	0.066	1.1E-02	4.1	0.11	7.2	3.7	5.1	0.54	1.3	28.8	100
VES-WS6-154	2	593	1.4E-03	23.6	1.1E-03	0.80	0.019	15.6	1.31	0.12	0.014	0.63	2.5E-03	0.53	1.29	0.12	2.31	7.0E-04	0.03	0.029	4.6E-04	0.137	0.097	2.0E-02	6.1	0.13	8.5	2.8	4.7	1.12	2.1	27.9	100
VES-WS6-154	1	76	3.2E-07	21.6	3.2E-05	0.60	0.000	17.2	0.79	0.27	0.000	0.30	3.7E-05	0.39	4.09	0.04	1.84	9.7E-06		2.9E-04	2.6E-06	0.136	0.076	7.1E-05	4.8	0.12	6.2	10.5	3.7		0.4	26.9	100
Bin Totals		4724	1.4E-03	32.1	4.2E-04	0.45	0.005	7.2	0.57	0.13	0.004	0.65	3.3E-03	1.50	0.69	0.18	5.62	6.8E-04	0.06	0.067	1.3E-04	0.027	0.028	2.5E-02	1.7	0.21	3.0	1.7	9.8	0.24	1.0	33.1	100
VES-WS6-155	52																																
VES-WS6-155	51																																
VES-WS6-155	50																																
VES-WS6-155	49																																
VES-WS6-155	48																																
VES-WS6-155	47																																
VES-WS6-155	46	150	1.9E-03	37.5	3.9E-04	0.12	0.003	3.2	0.21	0.09	0.002	0.56	4.1E-03	1.77	0.32	0.23	8.21	4.6E-04	0.04	0.086	5.4E-05	0.016	0.020	2.1E-02	1.3	0.34	1.7	0.8	5.8	0.01	0.3	37.4	100
VES-WS6-155	45	608	1.5E-03	36.6	3.0E-04	0.29	0.002	3.8	0.13	0.07	0.001	0.42	2.9E-03	1.55	0.83	0.21	7.02	4.2E-04	0.03	0.079	4.2E-05	0.018	0.013	1.8E-02	0.81	0.29	1.2	2.1	7.6	0.12	0.4	36.4	100
VES-WS6-155	44	607	1.2E-03	35.6	2.5E-04	0.43	0.002	3.9	0.08	0.06	0.001	0.34	2.2E-03	1.49	0.60	0.22	6.65	4.2E-04	0.03	0.079	3.5E-05	0.025	0.008	1.6E-02	0.53	0.27	0.9	1.5	11.2	0.21	0.6	35.2	100
VES-WS6-155	43	605	1.5E-03	33.7	3.0E-04	0.44	0.004	4.6	0.27	0.18	0.004	0.84	4.2E-03	1.97	0.02	0.21	6.56	8.1E-04	0.09	0.084	1.1E-04	0.006	0.010	3.5E-02	0.65	0.21	1.6		13.7	0.10	1.1	33.6	100
VES-WS6-155	42	604	1.6E-03	33.2	3.2E-04	0.43	0.005	5.3	0.34	0.22	0.004	0.99	4.9E-03	2.01	0.18	0.19	6.17	8.9E-04	0.10	0.078	1.3E-04	0.004	0.012	4.0E-02	0.77	0.17	1.9	0.4	13.1	0.01	1.1	33.3	100
VES-WS6-155	41	602	1.2E-03	26.9	5.7E-04	0.57	0.006	13.7	1.68	0.11	0.004	0.54	2.2E-03	0.98	1.12	0.14	3.33	9.0E-04	0.05	0.041	1.3E-04	0.015	0.053	1.7E-02	3.3	0.12	6.0	2.7	7.0	0.41	1.2	30.1	100
VES-WS6-155	40	593	1.4E-03	22.7	1.0E-03	0.77	0.018	16.6	1.60	0.11	0.013	0.58	2.3E-03	0.51	1.49	0.12	2.19	7.6E-04	0.03	0.027	4.3E-04	0.112	0.095	1.8E-02	6.0	0.12	8.7	3.4	4.4	1.05	2.1	27.3	100
VES-WS6-155	39	76	6.9E-07	24.9	6.9E-05	0.12	0.001	15.5	2.8E-06		0.000				8.70			2.1E-05		6.2E-04	5.5E-06	0.028	0.000	1.5E-04	0.001				22.4			28.4	100
Bin Totals		3845	1.4E-03	31.9	4.2E-04	0.46	0.006	7.5	0.61	0.13	0.004	0.62	3.2E-03	1.46	0.76	0.18	5.46	6.9E-04	0.06	0.066	1.3E-04	0.025	0.028	2.5E-02	1.7	0.20	3.0	1.8	9.7	0.26	1.0	32.9	100
VES-WS6-156	90																																

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Table A13. Calcine chemical content by bin segment (weight percent) (continued).

	TC Point	Vol. (ft3)	Chemical Content of Calcine (weight percent)																														
			Ag	Al	As	B	Ba	Ca	Cd	Cr	Cs	Fe	Hg	K	Mg	Mn	Na	Nb	Ni	Pb	Se	Sr	Sn	U	Zr	Cl	F	CO ₃	NO ₃	PO ₄	SO ₄	O	Total
VES-WS6-157	128																																
VES-WS6-157	127																																
VES-WS6-157	126																																
VES-WS6-157	125																																
VES-WS6-157	124																																
VES-WS6-157	123																																
VES-WS6-157	122	340	2.0E-03	37.6	3.9E-04	0.12	0.003	3.0	0.22	0.09	0.002	0.57	4.1E-03	1.80	0.20	0.23	8.37	4.6E-04	0.05	0.087	5.5E-05	0.016	0.021	2.2E-02	1.3	0.35	1.7	0.5	5.9	0.01	0.3	37.5	100
VES-WS6-157	121	608	1.3E-03	36.3	2.7E-04	0.33	0.002	3.7	0.08	0.07	0.001	0.36	2.3E-03	1.62	0.67	0.24	7.19	4.5E-04	0.03	0.087	3.8E-05	0.021	0.008	1.8E-02	0.53	0.30	1.0	1.7	8.8	0.24	0.7	36.0	100
VES-WS6-157	120	607	1.2E-03	35.3	2.5E-04	0.46	0.002	4.2	0.10	0.06	0.001	0.35	2.3E-03	1.37	0.80	0.19	6.17	3.7E-04	0.03	0.071	3.5E-05	0.025	0.010	1.5E-02	0.62	0.25	1.0	2.0	11.3	0.15	0.5	35.0	100
VES-WS6-157	119	605	1.5E-03	33.7	3.0E-04	0.44	0.004	4.6	0.27	0.19	0.004	0.85	4.2E-03	1.97	0.02	0.21	6.52	8.1E-04	0.09	0.083	1.1E-04	0.006	0.010	3.6E-02	0.66	0.20	1.7		13.7	0.09	1.1	33.6	100
VES-WS6-157	118	604	1.6E-03	33.1	3.2E-04	0.44	0.005	5.1	0.34	0.22	0.004	0.99	4.9E-03	2.02	0.17	0.19	6.21	9.0E-04	0.10	0.079	1.3E-04	0.004	0.012	4.0E-02	0.77	0.18	1.9	0.4	13.2	0.01	1.1	33.3	100
VES-WS6-157	117	602	1.1E-03	25.9	6.3E-04	0.58	0.007	15.4	1.87	0.08	0.005	0.44	1.6E-03	0.69	1.56	0.12	2.52	8.4E-04	0.04	0.030	1.4E-04	0.018	0.059	1.2E-02	3.7	0.11	6.5	3.8	5.2	0.51	1.2	29.6	100
VES-WS6-157	116	593	1.4E-03	21.6	1.0E-03	0.82	0.018	17.3	1.74	0.12	0.014	0.59	2.4E-03	0.55	1.17	0.13	2.38	8.3E-04	0.04	0.029	4.3E-04	0.121	0.104	1.9E-02	6.5	0.13	9.5	2.5	4.8	1.08	2.1	26.6	100
VES-WS6-157	115	76	6.9E-07	24.8	6.9E-05	0.12	0.001	15.6	2.8E-06		0.000				8.72			2.1E-05		6.2E-04	5.5E-06	0.028	0.000	1.5E-04	0.001			22.4				28.3	100
Bin Totals		4035	1.4E-03	31.9	4.2E-04	0.46	0.005	7.6	0.62	0.12	0.004	0.60	3.1E-03	1.44	0.77	0.18	5.46	6.7E-04	0.05	0.066	1.2E-04	0.026	0.028	2.4E-02	1.8	0.20	3.0	1.9	9.6	0.27	1.0	32.9	100
VES-WS6-158	166																																
VES-WS6-158	165																																
VES-WS6-158	164																																
VES-WS6-158	163																																
VES-WS6-158	162																																
VES-WS6-158	161																																
VES-WS6-158	160																																
VES-WS6-158	159																																
VES-WS6-158	158	560	1.5E-03	36.8	3.1E-04	0.28	0.002	3.5	0.14	0.07	0.001	0.43	2.9E-03	1.58	0.63	0.22	7.19	4.3E-04	0.03	0.081	4.3E-05	0.018	0.013	1.8E-02	0.84	0.30	1.2	1.6	7.8	0.12	0.4	36.5	100
VES-WS6-158	157	605	1.3E-03	35.3	2.5E-04	0.44	0.002	3.9	0.10	0.08	0.001	0.39	2.3E-03	1.57	0.47	0.22	6.70	4.7E-04	0.03	0.081	4.3E-05	0.021	0.008	1.9E-02	0.51	0.27	1.0	1.2	11.9	0.22	0.7	34.9	100
VES-WS6-158	156	604	1.6E-03	33.0	3.2E-04	0.43	0.005	5.2	0.35	0.22	0.004	1.00	5.0E-03	2.05	0.12	0.20	6.29	9.1E-04	0.10	0.080	1.3E-04	0.004	0.012	4.1E-02	0.78	0.18	1.9	0.2	13.3	0.01	1.2	33.2	100
VES-WS6-158	155	602	1.3E-03	28.2	5.3E-04	0.55	0.006	12.3	1.41	0.12	0.004	0.60	2.5E-03	1.10	1.06	0.14	3.65	8.6E-04	0.06	0.045	1.2E-04	0.014	0.045	2.0E-02	2.8	0.13	5.1	2.6	7.6	0.35	1.1	30.9	100
VES-WS6-158	154	593	1.4E-03	21.9	1.0E-03	0.76	0.018	17.3	1.83	0.11	0.013	0.56	2.3E-03	0.51	1.39	0.12	2.21	8.3E-04	0.03	0.027	4.2E-04	0.105	0.098	1.8E-02	6.2	0.12	9.2	3.1	4.5	1.04	2.1	26.7	100
VES-WS6-158	153	76	6.9E-07	24.9	6.9E-05	0.12	0.001	15.5	2.8E-06		0.000				8.69			2.1E-05		6.2E-04	5.5E-06	0.028	0.000	1.5E-04	0.001			22.3				28.4	100
Bin Totals		3040	1.4E-03	31.3	4.5E-04	0.48	0.006	8.2	0.70	0.12	0.004	0.60	3.0E-03	1.39	0.85	0.18	5.21	6.9E-04	0.05	0.063	1.4E-04	0.028	0.031	2.3E-02	2.0	0.19	3.3	2.0	9.4	0.30	1.1	32.5	100
VES-WS6-159	204																																
VES-WS6-159	203																																
VES-WS6-159	202																																
VES-WS6-159	201																																
VES-WS6-159	200																																
VES-WS6-159	199																																
VES-WS6-159	198																																
VES-WS6-159	197																			</													

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Table A13. Calcine chemical content by bin segment (weight percent) (continued).

	TC Point	Vol. (ft3)	Chemical Content of Calcine (weight percent)																														
			Ag	Al	As	B	Ba	Ca	Cd	Cr	Cs	Fe	Hg	K	Mg	Mn	Na	Nb	Ni	Pb	Se	Sr	Sn	U	Zr	Cl	F	CO ₃	NO ₃	PO ₄	SO ₄	O	Total
VES-WS6-160	242																																
VES-WS6-160	241																																
VES-WS6-160	240																																
VES-WS6-160	239																																
VES-WS6-160	238																																
VES-WS6-160	237																																
VES-WS6-160	236																																
VES-WS6-160	235	330	1.9E-03	37.6	3.9E-04	0.15	0.003	2.9	0.22	0.09	0.002	0.57	4.1E-03	1.80	0.13	0.23	8.34	4.6E-04	0.05	0.087	5.5E-05	0.016	0.021	2.2E-02	1.3	0.35	1.7	0.3	6.3	0.01	0.3	37.5	100
VES-WS6-160	234	607	1.3E-03	36.1	2.6E-04	0.42	0.002	3.8	0.09	0.07	0.001	0.36	2.3E-03	1.50	0.52	0.22	6.69	4.1E-04	0.03	0.079	3.6E-05	0.024	0.009	1.7E-02	0.57	0.28	1.0	1.3	10.5	0.20	0.6	35.7	100
VES-WS6-160	233	605	1.4E-03	33.7	2.7E-04	0.44	0.004	4.7	0.21	0.15	0.003	0.70	3.5E-03	1.81	0.43	0.21	6.36	7.1E-04	0.07	0.081	8.6E-05	0.010	0.009	3.0E-02	0.54	0.21	1.4	1.1	13.2	0.15	1.0	33.5	100
VES-WS6-160	232	604	1.6E-03	33.1	3.2E-04	0.43	0.005	5.3	0.34	0.22	0.004	0.99	4.9E-03	2.01	0.17	0.19	6.19	9.0E-04	0.10	0.079	1.3E-04	0.004	0.012	4.0E-02	0.77	0.17	1.9	0.4	13.1	0.01	1.1	33.3	100
VES-WS6-160	231	602	1.2E-03	27.0	5.6E-04	0.57	0.006	13.6	1.66	0.11	0.004	0.55	2.3E-03	0.99	1.10	0.14	3.37	9.0E-04	0.05	0.041	1.3E-04	0.015	0.053	1.7E-02	3.3	0.13	5.9	2.7	7.0	0.40	1.2	30.1	100
VES-WS6-160	230	593	1.4E-03	22.7	1.0E-03	0.77	0.018	16.6	1.60	0.11	0.013	0.58	2.3E-03	0.51	1.49	0.12	2.19	7.6E-04	0.03	0.027	4.3E-04	0.112	0.095	1.8E-02	6.0	0.12	8.7	3.4	4.4	1.05	2.1	27.3	100
VES-WS6-160	229	76	6.9E-07	24.9	6.9E-05	0.12	0.001	15.5	2.8E-06		0.000				8.70			2.1E-05		6.2E-04	5.5E-06	0.028	0.000	1.5E-04	0.001			22.4			28.4	100	
Bin Totals		3417	1.4E-03	31.5	4.3E-04	0.47	0.006	7.9	0.66	0.13	0.004	0.63	3.2E-03	1.44	0.79	0.18	5.32	7.0E-04	0.06	0.065	1.3E-04	0.026	0.029	2.5E-02	1.8	0.19	3.2	1.9	9.7	0.28	1.1	32.6	100
CSSF VI Totals		25,181	1.4E-03	31.6	4.3E-04	0.47	0.006	7.8	0.64	0.13	0.004	0.62	3.2E-03	1.45	0.78	0.18	5.39	6.9E-04	0.06	0.065	1.3E-04	0.027	0.029	2.4E-02	1.8	0.20	3.1	1.9	9.6	0.27	1.0	32.7	100

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Table A14. Total calcine radioactivity decayed to January 1 for selected years.

	2003	2010	2012	2016	2022	2032	2116	3016	3110	12000
Radionuclide	Curies	Curies	Curies	Curies	Curies	Curies	Curies	Curies	Curies	Curies
⁶⁰ Co	5.1E+03	2.0E+03	1.6E+03	9.2E+02	4.2E+02	1.1E+02	1.8E-03			
⁶³ Ni	1.0E+04	9.8E+03	9.7E+03	9.4E+03	9.1E+03	8.5E+03	4.7E+03	9.3E+00	4.9E+00	
⁷⁹ Se	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.4E+01	2.3E+01
⁹⁰ Sr	1.0E+07	8.6E+06	8.2E+06	7.4E+06	6.4E+06	5.0E+06	6.3E+05	1.5E-04	1.5E-05	
⁹⁰ Y	1.0E+07	8.6E+06	8.2E+06	7.4E+06	6.4E+06	5.0E+06	6.3E+05	1.5E-04	1.5E-05	
⁹⁹ Tc	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.5E+03	3.4E+03
¹⁰⁶ Ru	3.9E+00	3.3E-02	8.4E-03	5.5E-04	9.2E-06	1.0E-08				
¹²⁵ Sb	1.7E+03	2.9E+02	1.8E+02	6.4E+01	1.4E+01	1.1E+00	6.0E-10			
¹²⁶ Sn	9.5E+01	9.5E+01	9.5E+01	9.5E+01	9.5E+01	9.5E+01	9.5E+01	9.5E+01	9.5E+01	8.9E+01
¹²⁹ I	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02
¹³⁴ Cs	3.9E+03	3.7E+02	1.9E+02	5.0E+01	6.6E+00	2.3E-01	1.3E-13			
¹³⁵ Cs	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02
^{137m} Ba	1.1E+07	9.1E+06	8.6E+06	7.9E+06	6.9E+06	5.4E+06	7.8E+05	7.3E-04	8.3E-05	
¹³⁷ Cs	1.1E+07	9.6E+06	9.1E+06	8.3E+06	7.3E+06	5.8E+06	8.3E+05	7.7E-04	8.8E-05	
¹⁴⁴ Ce	1.4E+00	2.9E-03	4.9E-04	1.4E-05	6.7E-08	9.3E-12				
¹⁴⁴ Pr	1.4E+00	2.9E-03	4.9E-04	1.4E-05	6.7E-08	9.3E-12				
¹⁴⁷ Pm	9.3E+03	1.5E+03	8.6E+02	3.0E+02	6.1E+01	4.3E+00	9.9E-10			
¹⁵¹ Sm	9.5E+04	9.0E+04	8.9E+04	8.6E+04	8.2E+04	7.6E+04	4.0E+04	3.9E+01	1.9E+01	
¹⁵² Eu	5.0E+02	3.5E+02	3.1E+02	2.5E+02	1.9E+02	1.1E+02	1.4E+00			
¹⁵⁴ Eu	4.3E+04	2.4E+04	2.1E+04	1.5E+04	9.2E+03	4.1E+03	4.7E+00			
¹⁵⁵ Eu	7.4E+03	2.6E+03	2.0E+03	1.1E+03	4.5E+02	1.0E+02	4.0E-04			
²³⁰ Th	3.3E-01	3.3E-01	3.3E-01	3.3E-01	3.3E-01	3.3E-01	3.6E-01	6.2E-01	6.5E-01	3.1E+00
²³¹ Th	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01
²³³ Pa	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.4E+01	7.4E+01	7.4E+01
²³² U	3.2E-01	3.0E-01	3.0E-01	2.9E-01	2.7E-01	2.4E-01	1.1E-01	1.2E-04	1.1E-04	1.0E-04
²³³ U	6.7E-03	8.9E-03	9.6E-03	1.1E-02	1.3E-02	1.6E-02	4.3E-02	3.4E-01	3.7E-01	3.2E+00
²³⁴ U	2.3E+01	2.3E+01	2.3E+01	2.4E+01	2.4E+01	2.5E+01	2.9E+01	3.3E+01	3.3E+01	3.2E+01
²³⁵ U	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01	2.6E-01
²³⁶ U	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01
²³⁷ U	1.7E+00	1.2E+00	1.1E+00	8.9E-01	6.7E-01	4.1E-01	7.1E-03	4.8E-08	4.7E-08	2.3E-08
²³⁸ U	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01
²³⁷ Np	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.3E+01	7.4E+01	7.4E+01	7.4E+01
²³⁸ Pu	8.7E+04	8.3E+04	8.1E+04	7.9E+04	7.5E+04	6.9E+04	3.6E+04	2.9E+01	1.4E+01	
²³⁹ Pu	2.4E+03	2.4E+03	2.4E+03	2.4E+03	2.4E+03	2.4E+03	2.4E+03	2.3E+03	2.3E+03	1.8E+03
²⁴⁰ Pu	1.6E+03	1.6E+03	1.6E+03	1.6E+03	1.6E+03	1.6E+03	1.6E+03	1.5E+03	1.4E+03	5.6E+02
²⁴¹ Pu	7.6E+04	5.4E+04	4.9E+04	4.1E+04	3.1E+04	1.9E+04	3.3E+02	2.1E-03	2.1E-03	1.0E-03
²⁴² Pu	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.9E+00	3.8E+00
²⁴¹ Am	7.7E+03	8.2E+03	8.4E+03	8.5E+03	8.8E+03	9.0E+03	8.3E+03	2.0E+03	1.7E+03	2.0E-03
²⁴³ Am	1.1E+00	1.1E+00	1.1E+00	1.1E+00	1.1E+00	1.1E+00	1.0E+00	9.6E-01	9.6E-01	4.1E-01
²⁴² Cm	2.0E+00	1.9E+00	1.9E+00	1.8E+00	1.8E+00	1.7E+00	1.1E+00	1.3E-02	8.5E-03	
²⁴⁴ Cm	1.4E+01	1.1E+01	9.9E+00	8.5E+00	6.7E+00	4.6E+00	1.8E-01	2.0E-16	5.4E-18	
Total	4.3E+07	3.6E+07	3.4E+07	3.1E+07	2.7E+07	2.1E+07	3.0E+06	9.8E+03	9.5E+03	6.3E+03

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Table A15. Calcline radioactivity in each of the six CSSFs decayed to January 1, 2016.

1/1/2016	CSSF I	CSSF II	CSSF III	CSSF IV	CSSF V	CSSF VI	Total
Radionuclide	Curies	Curies	Curies	Curies	Curies	Curies	Curies
⁶⁰ Co	3.82E-01	2.24E+01	4.05E+01	3.48E+01	7.10E+02	1.09E+02	9.18E+02
⁶³ Ni		1.09E+03	2.79E+03	1.83E+03	3.19E+03	5.52E+02	9.45E+03
⁷⁹ Se	2.72E+00	5.02E+00	5.00E+00	2.91E+00	6.27E+00	1.67E+00	2.36E+01
⁹⁰ Sr	6.72E+05	1.49E+06	1.58E+06	9.94E+05	2.13E+06	5.35E+05	7.40E+06
⁹⁰ Y	6.72E+05	1.49E+06	1.58E+06	9.94E+05	2.13E+06	5.35E+05	7.40E+06
⁹⁹ Tc	4.25E+02	7.68E+02	7.41E+02	4.28E+02	9.33E+02	2.49E+02	3.54E+03
¹⁰⁶ Ru	1.48E-10	9.20E-09	5.50E-07	5.16E-06	3.61E-04	1.84E-04	5.51E-04
¹²⁵ Sb	1.11E-01	7.23E+00	3.39E+00	6.05E+00	3.48E+01	1.22E+01	6.38E+01
¹²⁶ Sn	1.10E+01	2.02E+01	2.02E+01	1.17E+01	2.53E+01	6.76E+00	9.51E+01
¹²⁹ I	6.88E-03	1.25E-02	1.22E-02	7.08E-03	1.54E-02	4.11E-03	5.82E-02
¹³⁴ Cs	5.04E-03	3.73E-01	8.35E-01	2.52E+00	3.68E+01	9.10E+00	4.96E+01
¹³⁵ Cs	1.07E+01	2.61E+01	3.51E+01	2.12E+01	4.26E+01	1.07E+01	1.46E+02
^{137m} Ba	7.66E+05	1.59E+06	1.74E+06	1.01E+06	2.18E+06	5.86E+05	7.88E+06
¹³⁷ Cs	8.09E+05	1.68E+06	1.84E+06	1.07E+06	2.30E+06	6.19E+05	8.33E+06
¹⁴⁴ Ce	4.13E-14	8.14E-12	1.53E-09	2.49E-08	9.59E-06	4.31E-06	1.39E-05
¹⁴⁴ Pr	4.13E-14	8.14E-12	1.53E-09	2.49E-08	9.59E-06	4.31E-06	1.39E-05
¹⁴⁷ Pm	2.96E+00	5.16E+01	7.26E+01	3.85E+01	9.59E+01	3.64E+01	2.98E+02
¹⁵¹ Sm	1.64E+04	2.43E+04	1.35E+04	6.85E+03	1.90E+04	5.94E+03	8.60E+04
¹⁵² Eu	6.92E+00	3.95E+01	6.62E+01	3.97E+01	8.06E+01	2.14E+01	2.54E+02
¹⁵⁴ Eu	4.31E+02	2.39E+03	2.14E+03	1.99E+03	6.62E+03	1.42E+03	1.50E+04
¹⁵⁵ Eu	2.13E+01	1.14E+02	1.26E+02	1.31E+02	5.41E+02	1.53E+02	1.09E+03
²³⁰ Th	1.01E-01	1.22E-01	6.15E-03	1.17E-03	7.24E-02	2.90E-02	3.31E-01
²³¹ Th	2.06E-02	3.97E-02	1.95E-02	1.61E-02	8.72E-02	7.31E-02	2.56E-01
²³³ Pa	1.09E+00	1.76E+00	7.83E+00	1.95E+01	3.70E+01	5.43E+00	7.26E+01
²³² U	8.02E-05	8.82E-03	9.80E-02	6.93E-02	9.68E-02	1.35E-02	2.86E-01
²³³ U	1.57E-04	2.37E-04	1.27E-03	3.12E-03	5.35E-03	7.29E-04	1.09E-02
²³⁴ U	2.96E+00	6.67E+00	2.00E+00	1.81E+00	7.10E+00	3.00E+00	2.35E+01
²³⁵ U	2.06E-02	3.97E-02	1.95E-02	1.61E-02	8.72E-02	7.31E-02	2.56E-01
²³⁶ U	4.78E-02	1.01E-01	5.02E-02	4.38E-02	2.70E-01	1.63E-01	6.76E-01
²³⁷ U	3.79E-03	1.19E-01	2.47E-01	1.50E-01	2.95E-01	7.83E-02	8.93E-01
²³⁸ U	1.17E-03	2.26E-03	2.37E-03	8.68E-03	4.72E-02	5.74E-02	1.19E-01
²³⁷ Np	1.09E+00	1.76E+00	7.83E+00	1.95E+01	3.70E+01	5.43E+00	7.26E+01
²³⁸ Pu	3.16E+02	8.10E+03	1.66E+04	1.65E+04	3.23E+04	4.99E+03	7.88E+04
²³⁹ Pu	4.27E+01	1.82E+02	4.41E+02	5.09E+02	8.87E+02	3.34E+02	2.40E+03
²⁴⁰ Pu	1.71E+01	1.44E+02	3.21E+02	3.30E+02	6.24E+02	1.80E+02	1.62E+03
²⁴¹ Pu	1.19E+02	4.05E+03	8.57E+03	6.01E+03	1.71E+04	4.90E+03	4.07E+04
²⁴² Pu	9.86E-03	3.35E-01	8.18E-01	8.69E-01	1.48E+00	3.76E-01	3.89E+00
²⁴¹ Am	1.22E+02	1.13E+03	2.48E+03	1.54E+03	2.87E+03	4.01E+02	8.55E+03
²⁴³ Am	8.65E-03	8.38E-02	3.12E-01	1.96E-01	3.43E-01	1.12E-01	1.06E+00
²⁴² Cm	7.22E-03	2.37E-01	5.09E-01	3.07E-01	6.06E-01	1.74E-01	1.84E+00
²⁴⁴ Cm	1.28E-02	8.87E-01	2.43E+00	1.49E+00	2.79E+00	8.44E-01	8.45E+00
Total	2.94E+06	6.29E+06	6.79E+06	4.11E+06	8.83E+06	2.29E+06	3.13E+07

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Table A16. Chemical inventory in each of the six CSSFs.

1/1/2016	CSSF I	CSSF II	CSSF III	CSSF IV	CSSF V	CSSF VI	Total
Element	kg	kg	kg	kg	kg	kg	kg
Al	8.68E+04	2.28E+05	1.54E+05	6.29E+04	1.52E+05	2.77E+05	9.60E+05
B	2.29E+02	5.62E+03	1.09E+04	5.57E+03	1.17E+04	4.10E+03	3.82E+04
Ca		1.84E+05	3.81E+05	1.88E+05	3.46E+05	6.79E+04	1.17E+06
Cd	4.91E-01	9.33E-01	9.81E-01	5.72E-01	4.06E+04	5.60E+03	4.62E+04
Cr	1.14E+02	2.00E+03	3.71E+03	1.90E+03	1.94E+03	1.12E+03	1.08E+04
Cs	5.61E+01	1.09E+02	1.15E+02	6.74E+01	1.44E+02	3.79E+01	5.30E+02
Fe	1.54E+03	2.59E+03	3.79E+03	3.00E+03	5.90E+03	5.46E+03	2.23E+04
Hg	3.43E+03	7.19E+03	1.74E+01	1.15E+01	2.78E+01	2.77E+01	1.07E+04
K	4.00E+02	1.46E+03	3.27E+03	2.50E+03	8.57E+03	1.26E+04	2.88E+04
Mg	6.02E+02	5.94E+03	1.25E+04	3.00E+03	9.84E+03	6.80E+03	3.86E+04
Mn	5.07E+01	6.27E+02	1.51E+03	6.37E+02	1.78E+03	1.58E+03	6.19E+03
Mo	1.01E+02	1.96E+02	2.11E+02	1.24E+02	2.61E+02	6.83E+01	9.61E+02
Na	2.41E+03	9.24E+03	1.41E+04	1.02E+04	3.63E+04	4.71E+04	1.19E+05
Nb	6.71E-04	7.57E+00	1.97E+01	1.23E+01	2.86E+03	6.06E+00	2.90E+03
Nd	1.26E+02	2.33E+02	2.33E+02	1.35E+02	2.92E+02	7.76E+01	1.10E+03
Ni		2.16E+02	6.14E+02	4.80E+02	7.81E+02	4.98E+02	2.59E+03
Sn	1.02E+00	1.75E+03	3.13E+03	1.38E+03	2.27E+03	2.55E+02	8.79E+03
Sr	1.84E+01	1.95E+03	3.90E+03	1.93E+03	3.60E+03	2.32E+02	1.16E+04
Zr	1.38E+02	1.11E+05	1.98E+05	8.73E+04	1.43E+05	1.60E+04	5.55E+05
Cl	6.88E+01	3.86E+02	9.24E+02	7.36E+02	1.95E+03	1.73E+03	5.80E+03
F		1.62E+05	2.77E+05	1.27E+05	2.17E+05	2.75E+04	8.11E+05
CO3		1.08E+04	2.53E+04	4.56E+03	1.85E+04	1.64E+04	7.56E+04
NO3	4.70E+03	1.80E+04	2.86E+04	2.07E+04	7.35E+04	8.43E+04	2.30E+05
PO4	2.81E+03	9.97E+03	2.39E+04	5.07E+03	1.23E+04	2.39E+03	5.65E+04
SO4	3.42E+03	2.10E+04	3.12E+04	1.39E+04	3.94E+04	9.01E+03	1.18E+05
Trace FP	6.15E+02	1.08E+03	1.04E+03	5.69E+02	1.37E+03	5.34E+02	5.21E+03
U	1.42E+01	2.79E+01	1.69E+01	3.42E+01	1.84E+02	2.14E+02	4.91E+02
O	7.82E+04	2.59E+05	2.63E+05	1.22E+05	2.67E+05	2.86E+05	1.28E+06
Total	1.86E+05	1.04E+06	1.44E+06	6.63E+05	1.40E+06	8.75E+05	5.61E+06

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Table A17. RCRA metal mass and concentration in each of the six CSSFs.

Metal	CSSF I (kg)	CSSF II (kg)	CSSF III (kg)	CSSF IV (kg)	CSSF V (kg)	CSSF VI (kg)	Total (kg)
Ag	3	14	16	7	19	12	71
As	3	12	13	6	13	4	49
Ba	67	154	186	103	215	50	775
Cd	0	1	1	1	40,609	5,605	46,217
Cr	114	2,004	3,707	1,900	1,940	1,122	10,788
Hg	3,425	7,185	17	11	28	28	10,695
Ni ¹	0	216	614	480	781	498	2,588
Pb	12	23	78	79	270	571	1,033
Se	2	3	3	2	4	1	16
¹ Ni is not a RCRA metal but is included on this list because it is a "California List" waste.							

Metal	CSSF I (ppm)	CSSF II (ppm)	CSSF III (ppm)	CSSF IV (ppm)	CSSF V (ppm)	CSSF VI (ppm)	Average ² (ppm)
Ag	17	14	11	11	13	17	13
As	16	11	9	9	9	4	9
Ba	360	148	130	156	154	57	138
Cd	3	1	1	1	29,117	6,412	8,250
Cr	614	1,924	2,577	2,873	1,391	1,284	1,926
Hg	18,444	6,896	12	17	20	32	1,909
Ni ¹	0	207	427	725	560	570	462
Pb	63	22	54	119	194	653	184
Se	10	3	2	3	3	1	3
² Average value is mass weighted average of all CSSFs							

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Table A18. Calcine mass, volume, and calculated bulk density in each CSSF bin.

CSSF I	Bin					
	115-I-A	115-I-B	115-I-C	115-II-A	115-II-B	115-II-C
Volume (L)	4.80E+03	1.90E+04	3.43E+04	4.80E+03	1.90E+04	3.43E+04
Mass (kg)	5.52E+03	1.67E+04	2.62E+04	5.57E+03	1.54E+04	2.63E+04
BD (g/cc)	1.15	0.88	0.76	1.16	0.81	0.77

CSSF I (Cont)	Bin						
	115-III-A	115-III-B	115-III-C	115-IV-A	115-IV-B	115-IV-C	Total
Volume (L)	4.80E+03	1.90E+04	3.43E+04	4.62E+03	1.90E+04	2.20E+04	2.20E+05
Mass (kg)	4.34E+03	1.51E+04	2.74E+04	4.30E+03	1.74E+04	2.09E+04	1.85E+05
BD (g/cc)	0.91	0.79	0.80	0.93	0.91	0.95	0.84

CSSF II	Bin							
	136-1	136-2	136-3	136-4	136-5	136-6	136-7	Total
Volume (L)	1.21E+05	1.21E+05	1.21E+05	1.21E+05	1.21E+05	1.21E+05	1.21E+05	8.50E+05
Mass (kg)	1.57E+05	1.50E+05	1.37E+05	1.30E+05	1.59E+05	1.54E+05	1.56E+05	1.04E+06
BD (g/cc)	1.30	1.24	1.13	1.07	1.31	1.27	1.28	1.23

CSSF III	Bin							
	139	140-1	140-2	140-3	140-4	140-5	140-6	Total
Volume (L)	1.82E+05	1.56E+05	1.56E+05	1.56E+05	1.56E+05	1.56E+05	1.56E+05	1.12E+06
Mass (kg)	2.30E+05	1.93E+05	2.13E+05	2.01E+05	2.09E+05	1.95E+05	2.00E+05	1.44E+06
BD (g/cc)	1.27	1.24	1.36	1.29	1.33	1.25	1.28	1.29

CSSF IV	Bin			
	142	143	144	Total
Volume (L)	1.62E+05	1.62E+05	1.62E+05	4.86E+05
Mass (kg)	2.14E+05	2.27E+05	2.22E+05	6.63E+05
BD (g/cc)	1.32	1.40	1.37	1.36

CSSF V	Bin							
	146	147	148	149	150	151	152	Total
Volume (L)	1.44E+05	1.44E+05	1.44E+05	1.44E+05	1.44E+05	1.44E+05	1.44E+05	1.01E+06
Mass (kg)	2.00E+05	1.99E+05	1.98E+05	1.97E+05	2.03E+05	1.99E+05	2.01E+05	1.40E+06
BD (g/cc)	1.39	1.38	1.38	1.37	1.40	1.38	1.39	1.38

CSSF VI	Bin							
	154	155	156	157	158	159	160	Total
Volume (L)	1.34E+05	1.09E+05	8.72E+04	1.14E+05	8.61E+04	8.61E+04	9.67E+04	7.13E+05
Mass (kg)	1.64E+05	1.33E+05	1.07E+05	1.40E+05	1.04E+05	1.06E+05	1.19E+05	8.74E+05
BD (g/cc)	1.23	1.22	1.23	1.22	1.21	1.24	1.23	1.23

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Table A19. Historical fuel reprocessing and waste disposition summary.

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
1	2-53 to 8-53	Hanford slugs	275.33	WM-180	WM-181	WM-181
2	10-53 to 12-53	MTR	52.30	WM-180	WM-181	WM-181
		LITR	3.26	WM-180	WM-181	WM-181
		NRX	2.44	WM-180	WM-181	WM-181
		ORNL Shielding	5.65	WM-180	WM-181	WM-181
	7-54 to 7-54	EBR-I Core 1	7.95	WM-180	WM-181	WM-181
3	7-54 to 2-55	EBR-I Core 1	60.47	WM-180	WM-181	WM-181
		NP Cold Run	24.97	WM-180	WM-181	WM-181
		MTR	31.78	WM-180	WM-181	WM-181
		LITR	1.62	WM-180	WM-181	WM-181
		BORAX	1.12	WM-180	WM-181	WM-181
		BORAX	0.23	WM-180	WM-181	WM-181
		Hanford slugs	40.36	WM-180	WM-181	WM-181
		Hanford slugs	484.80	WM-180	WM-181	WM-181
4	3-55 to 7-55	Hanford slugs	403.00	WM-180	WM-181	WM-181
		MTR	27.08	WM-180	WM-181	WM-181
		BORAX	12.30	WM-180	WM-181	WM-181
		BORAX	0.38	WM-180	WM-181	WM-181
		LITR	0.68	WM-180	WM-181	WM-181
	9-55 to 11-55	X	223.90	No waste stored due to cold startup	WM-181	WM-181
5	12-55 to 3-56	Hanford slugs	581.00	WM-182	WM-181	WM-181
		Hanford slugs		WM-182	WM-181	WM-181
		X	0.13	WM-182	WM-181	WM-181
6	3-56 to 5-56	MTR	22.07	WM-182	WM-181	WM-181
		LITR	1.89	WM-182	WM-181	WM-181
		CP-3	4.15	WM-182	WM-181	WM-181
		CR	0.82	WM-182	WM-181	WM-181
		BORAX	1.90	WM-182	WM-181	WM-181
7	5-56 to 3-57	Hanford slugs	93.90	WM-182	WM-181	WM-181
		Hanford slugs	125.10	WM-182	WM-181	WM-181
		CR	0.30	WM-180/182	WM-181	WM-181
		MTR	23.60	WM-180	WM-181	WM-181
		BORAX	14.30	WM-180	WM-181	WM-181
		LITR	2.00	WM-180	WM-181	WM-181
		ANL plates	14.20	WM-180	WM-181	WM-181
		X	460.80	WM-180	WM-181	WM-181
		STR	11.57	WM-103	WM-181	WM-181
		Rala MTR	2.61	WM -182	WM-181	WM-181
	8-57 to 9-57	CPM Cold Start w/ LM Slugs (cold), MTR (depleted & /normal), and "dummy" J	222.00	PTR -301 indicates that no waste stored due to cold startup		
8	10-57 to 12-57	X	467.00	WM -182	WM-181	WM-181
		W				
		Rala MTR	0.20	WM -182	WM-181	WM-181
9	12-57 to 1-58	STR	15.00	WM-103	WM-181	WM-181
10	1-58 to 2-58	Hanford slugs	68.10	WM -182	WM-181	WM-181
		Rala MTR	0.70	WM -182	WM-181	WM-181
		X	208.40	WM -182	WM-181	WM-181
11	5-58 to 12-58	X	458.60	WM-182/183	WM-181/184	WM-181/184
		W	10.00	WM-182	WM-181	WM-181
		MTR	42.60	WM-183	WM-181	WM-181
		Rala MTR	2.17	WM-183	WM-181	WM-181
		NRX	0.90	WM-182/183	WM-181/184	WM-181/184
		W	1714.00	WM-182/183	WM-181/184	WM-181/184
12	12-58 to 4-59	X	93.10	WM-183/185	WM-184	WM-184
		W	559.10	WM-183/185	WM-184	WM-184
		NRX	0.95	WM-183/185	WM-184	WM-184

Table A19. Historical fuel reprocessing and waste disposition summary (continued).

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
13	4-59 to 8-59	Rala MTR	0.84	WM-183/185	WM-184	WM-184
		W	966.20	WM-185	WM-184	WM-184
		X	171.80	WM-185	WM-184	WM-184
		W	33.80	WM-185	WM-184	WM-184
		W	1.54	WM-185	WM-184	WM-184
14	7-59 to 12-59	NRX	1.65	WM-185	WM-184	WM-184
		SIR	58.30	WM-106	WM-184	WM-184
		OMRE	27.30	WM-106	WM-184	WM-184
		BMI	1.20	WM-106	WM-184	WM-184
		Rala MTR	1.84	WM-185	WM-184	WM-184
15	12-59 to 2-60	MTR	59.90	WM-185/186/187/188	WM-184	WM-184
		Rala MTR	0.33	WM-185/186/187/188	WM-184	WM-184
		ETR	260.50	WM-185/186/187/188	WM-184	WM-184
		LITR	18.00	WM-185/186/187/188	WM-184	WM-184
		ASTR	6.20	WM-185	WM-184	WM-184
		Hanford slugs	100.90	WM-187/186	WM-184	WM-184
		Hanford slugs	1.50	WM-187/186	WM-184	WM-184
		Hanford slugs	6.80	WM-187/186	WM-184	WM-184
		X	35.78	WM-187/186	WM-184	WM-184
		SIR	48.00	WM-106	WM-184	WM-184
16	2-60 to 3-60	Rala MTR	0.50	WM-187/186	WM-184	WM-184
		STR	27.00	WM-103/104	WM-184	WM-184
		Rala MTR	0.17	WM-187/186	WM-184	WM-184
18	1-61 to 2-61	ETR	45.10	WM-187/186	WM-184	WM-184
19	12-61 to 2-62	MTR	142.50	WM-187/186	WM-184	WM-184
		ETR	462.40	WM-187/186	WM-184	WM-184
		BORAX IV	21.50	WM-187/186	WM-184	WM-184
		Rala MTR	4.51	WM-187/186	WM-184	WM-184
		Hanford slugs	0.10	WM-187/186	WM-184	WM-184
		Hanford slugs	0.60	WM-187/186	WM-184	WM-184
		LITR	44.20	WM-187/186	WM-184	WM-184
		NRX	7.10	WM-187/186	WM-184	WM-184
		CP-5	5.50	WM-187/186	WM-184	WM-184
		LPTR	2.20	WM-187/186	WM-184	WM-184
		GTR	3.60	WM-187/186	WM-184	WM-184
		OWR	0.70	WM-187/186	WM-184	WM-184
		SL-1	1.18	WM-187	WM-184	WM-184
20	6-63 to 9-63	MTR	69.60	WM-187	WM-181	WM-181
		ETR	359.60	WM-187	WM-181	WM-181
		Rala MTR	1.67	WM-187	WM-181	WM-181
		SPERT-1	11.20	WM-187	WM-181	WM-181
		GETR	82.60	WM-187	WM-181	WM-181
		BRR	17.30	WM-187	WM-181	WM-181
		SL-1	14.90	WM-187	WM-181	WM-181
		BGRR	39.60	WM-187	WM-181	WM-181
		LITR	49.80	WM-187	WM-181	WM-181
		CP-5	3.70	WM-187	WM-181	WM-181
		LPTR	2.70	WM-187	WM-181	WM-181
		GTR	9.40	WM-187	WM-181	WM-181
		OWR	5.50	WM-187	WM-181	WM-181
		WTR	77.00	WM-187	WM-181	WM-181
		BORAX	0.40	WM-187	WM-181	WM-181
		SUSIE	9.10	WM-187	WM-181	WM-181
		Hanford slugs	1.70	WM-187	WM-181	WM-181
		Hanford slugs	0.30	WM-187	WM-181	WM-181
		NRU	2.85	WM-187	WM-181	WM-181
		BGRR	13.28	WM-187	WM-187	WM-181
		NRX	6.82	WM-187	WM-187	WM-181

Table A19. Historical fuel reprocessing and waste disposition summary (continued).

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
		MNR	1.48	WM-187	WM-187	WM-181
		NRU	3.52	WM-187	WM-187	WM-181
		NRL	4.82	WM-187	WM-187	WM-181
		SWE	25.17	WM-187	WM-187	WM-181
		IRL	3.96	WM-187	WM-187	WM-181
		FNR	3.23	WM-187	WM-187	WM-181
		GTR	3.31	WM-187	WM-187	WM-181
		MTR	37.29	WM-187	WM-187	WM-181
		OWR	3.61	WM-187	WM-187	WM-181
		LPTR	3.80	WM-187	WM-187	WM-181
		LITR	35.50	WM-187	WM-187	WM-181
		UF	0.78	WM-187	WM-187	WM-181
		ETR	304.10	WM-187	WM-187	WM-181
		CP-5				
		STR				
		SPERT-1	26.10	WM-187	WM-187	WM-181
		NASA	28.70	WM-187	WM-187	WM-181
	1-65	Cold Zr	0.00	WM-103/187	NA	NA
		Unirradiated Zr Scrap	32.26	WM-187	WM-181	WM-181
		PWR Core I Seed I	168.10	WM-187	WM-181	WM-181
		Zr	450.50	WM-187/188	WM-181	WM-181
		EBR-I Core 3 Codissolution	16.00	WM-188/189	WM-181	WM-181
		EBR-I Core 3	53.00	WM-188/189	WM-181	WM-181
		SNAPTRAN 2/10A-3 Core debris	3.98	WM-188/189	WM-181	WM-181
		SNAPTRAN 2/10A-3 Fines	0.37			
22	4-65 to 6-65	VBWR	37.00	WM-103	WM-181	WM-181
		Atomics International UO ₂ SO ₄	7.60	WM-103	WM-181	WM-181
23	12-65 to 1-66	MTR	60.31	WM-185	WM-181	WM-181
		MTR	63.92	WM-185	WM-185	WM-181
		ETR	195.15	WM-185	WM-185	WM-181
		LITR	32.99	WM-185	WM-185	WM-181
		LPTR	2.07	WM-185	WM-185	WM-181
		OWR	5.06	WM-185	WM-185	WM-181
		SPERT-1	14.80	WM-185	WM-185	WM-181
		GTR	5.51	WM-185	WM-185	WM-181
		ASTR	5.10	WM-185	WM-185	WM-181
		GETR	41.71	WM-185	WM-185	WM-181
24	3-67 to 9-67	EBR-II vycor glass	18.70	WM-185	WM-181	WM-181
		EBR-I Mark 2	65.83	WM-185	WM-181	WM-181
		EBR-II vycor glass	13.24	WM-185	WM-181	WM-181
		Plastic Coated Al fuel plates	2.40	WM-185	WM-181	WM-181
		JRR-2	21.61	WM-183/187	WM-181	WM-181
		NRX	4.12	WM-185	WM-181	WM-181
		NRU	3.10	WM-185	WM-181	WM-181
		BGRR	3.71	WM-185	WM-181	WM-181
		EBR-II vycor glass	12.47	WM-185	WM-181	WM-181
		JRR-2	8.25	WM-185	WM-186	WM-186
		EBR-II vycor glass	9.56	WM-183	WM-186	WM-186
25	4-68 to 6-68	MTR	110.70	WM-183	WM-185	WM-186
		ETR	385.54	WM-183	WM-185	WM-186
		LITR	53.39	WM-183	WM-185	WM-186
		LPTR	5.37	WM-183	WM-185	WM-186
		OWR	10.08	WM-183	WM-185	WM-186
		GTR	3.20	WM-183	WM-185	WM-186
		CP-5	6.54	WM-183	WM-185	WM-186
		SER-Sandia	1.76	WM-183	WM-185	WM-186
		IRL	3.37	WM-183	WM-185	WM-186

Table A19. Historical fuel reprocessing and waste disposition summary (continued).

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
		GETR	85.89	WM-183	WM-185	WM-186
		NRL	3.98	WM-183	WM-185	WM-186
		Graphite leaching	9.95	WM-183	WM-186	WM-186
		Zr	17.25	WM-189	WM-186	WM-186
		EBR-II vycor glass	13.80		WM-186	WM-186
		EBR-II vycor glass	4.80		WM-186	WM-186
26	8-69 to 4-70 Zr	Zr	466.34	WM-185/188	WM-188	WM-186
	3-70 to 4-70 Al	MTR	420.00	WM-183	WM-186	WM-186
		ETR	227.00	WM-183	WM-186	WM-186
		GETR	140.00	WM-183	WM-186	WM-186
		KOREAN	16.00	WM-183	WM-186	WM-186
		SER-Sandia	1.76	WM-183	WM-186	WM-186
		LITR	267.00	WM-183	WM-186	WM-186
		AF-NETR	28.00	WM-183	WM-186	WM-186
		JRR-2	71.00	WM-183	WM-186	WM-186
		KUR	28.00	WM-183	WM-186	WM-186
		LPTR	40.00	WM-183	WM-186	WM-186
		OWR	60.00	WM-183	WM-186	WM-186
		ATR	27.40	WM-183	WM-186	WM-186
		SPERT-1		WM-183	WM-186	WM-186
		ZPR-III	92.70			
		SNAPTRAN-2/10-2 debris	2.22			
27	2-71 to 7-71 Zr	Zr	804.00	WM-185/187/189	WM-186/187	WM-186
	6-71 to 7-71 Al	JRR-2	3.90	WM-187	WM-186/182	WM-186
		EBR-II Scrap	32.20	WM-183		
		WADCO	0.60	WM-183		
28	6-72 to 8-72	Zr	206.00	WM-183/182	WM-186/182	WM-186
		ETR	150.00	WM-183/182	WM-183	WM-186
		Custom miscellaneous	5.56			
29	1-73 to 5-73	EBR-II	1543.60	WM-183	WM-183	WM-181/184/186
		EBR-II slurry and Denitrator Product	3.00			
		Zr	0.00	WM-182		
30	2-74 to 5-74	Zr	637.20	WM-182/188	WM-183	WM-181/183
		GETR	87.00	WM-182/188	WM-183	WM-181
		ATR	508.10	WM-182/188	WM-183	WM-181
		MTR	0.70	WM-182/188	WM-183	WM-181
		MTR	1.00	WM-182/188	WM-183	WM-181
		ATR	0.80	WM-182/188	WM-183	WM-181
		JRR-2	10.90	WM-182/188	WM-183	WM-183
		ETR	351.50	WM-182/188	WM-183	WM-181
		CP-5	11.10	WM-182/188	WM-183	WM-183
		OWR	20.90	WM-182/188	WM-183	WM-181
		JMTR	8.20	WM-182/188	WM-183	WM-181
		Juggernaut	4.40	WM-182/188	WM-183	WM-181
		KUR	9.80	WM-182/188	WM-183	WM-181
		UM	0.80	WM-182/188	WM-183	WM-181
		SER-Sandia	7.80	WM-182/188	WM-183	WM-183
		LPTR	9.50	WM-182/188	WM-183	WM-183
		EBR-II vycor glass	0.77			
		EBR-II vycor glass	1.54			
		G.G.A. Thermionic				
		EBR-II vycor glass	1.15			
		ETRC plates				
		Univ of Wyoming	1.33			
		EBR-II vycor glass	0.77			
		Atomics Internation Fission Disc	8.00			

Table A19. Historical fuel reprocessing and waste disposition summary (continued).

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
		HTRE scrap	0.50			
		Walter Reed Army Hosp	1.25			
		Nuclear Test Gauge / Split Table Reactor	5.00			
		HTGR secondary burner ash leaching				
		BML fission disc	1.67			
		EBR-II vycor glass	1.03			
		EBR-II vycor glass	0.21			
		EBR-II vycor glass	0.67			
31	2-75 to 5-76	EBR-II	3139.80	WM-100/102/183	WM-183	WM-183
		APPR cold fuel scrap				
32	5-76 to 9-76	Zr	77.50	WM-189	WM-189	WM-181
		PWR	38.90	WM-189	WM-189	WM-181
33	3-77 to 6-77	Zr	448.20	WM-187	WM-187	WM-181
		EBR-II vycor glass??	75.00			
		HTRE				
		Stanford University	4.00			
		ATR	347.00	WM-187	WM-187	WM-181
		MTR		WM-187	WM-187	WM-181
		ASTR	5.90			
		KUR	7.20			
		JRR-2	12.70			
		GTR	24.90			
		LPT	1.69	WM-187	WM-187	WM-181
		ETR	46.30	WM-187	WM-187	WM-181
		GETR	172.62	WM-187	WM-187	WM-181
34	8-77 to 9-77	EBR-II	390.60	WM-180	WM-180	WM-181
		OMRE	2.39	WM-180	WM-180	WM-181
		SPERT-3	0.59	WM-180	WM-180	WM-181
		ORNL-17-1	0.23	WM-180	WM-180	WM-181
		BMI-2	2.48	WM-180	WM-180	WM-181
		Kinglet	52.69	WM-180	WM-180	WM-181
		Sandia	140.86	WM-180	WM-180	WM-181
		PBF metallurgical samples				
35	7-78 to 3-79	Zr	342.40	WM-185	WM-185	WM-181
		Custom	34.60			
36	9-80 to 3-81	Zr	515.90	WM-182/185/187	WM-185	WM-181
		Zr	190.20	WM-185	WM-185	WM-181
		Rocky Flats U ₃ O ₈	84.50	WM-185	WM-185	WM-181
		GETR	29.59	WM-185	WM-185	WM-181
		OWR	5.26	WM-185	WM-185	WM-181
		STIR	3.84	WM-185	WM-185	WM-181
		LPTR	9.52	WM-185	WM-185	WM-181
		UCLA R-1	0.79	WM-185	WM-185	WM-181
		ATR	250.63	WM-185	WM-185	WM-181
37	8-81 to 11-81	EBR-II	826.00	WM-100	WM-100/183	WM-183/180/181
		other site??	20.00			
		Los Alamos metal fuel scrap	81.00			
		Rocky Flats U ₃ O ₈	54.00			
		ROVER				
38	9-82 to 11-82	ETR	177.63	WM-183	WM-183	WM-183
		BSR-1	0.62	WM-183	WM-183	WM-183
		ATR	99.37	WM-183	WM-183	WM-183
		OWR	5.49	WM-183	WM-183	WM-183
		ORR	9.94	WM-183	WM-183	WM-183
		HFR-PETTEN	20.65	WM-183	WM-183	WM-183

Table A19. Historical fuel reprocessing and waste disposition summary (continued).

Run	Date	Fuel	Uranium (kg)	Waste Destination (Tank Farm Vessel)		
				1st Cycle	2nd Cycle	3rd Cycle
		SAPHIRE	6.79	WM-183	WM-183	WM-183
		GETR	71.50	WM-183	WM-183	WM-183
		FRG	11.85	WM-183	WM-183	WM-183
		FRM	1.54	WM-183	WM-183	WM-183
		FRJ-1	3.86	WM-183	WM-183	WM-183
		FRJ-2	4.08	WM-183	WM-183	WM-183
		SFR	2.94	WM-183	WM-183	WM-183
		UO ₂ SO ₄	0.90			
39	4-83 to 6-84	ROVER	3027.60	WM-100/101/102	WM-183	WM-183
		Sandia	147.40			
		Rocky Flats	72.10			
		FLUORINEL	3.90	WM-187		
		FLUORINEL	60.00	WM-187		
40	8-85 to 1-86	ITAL	3.90	WM-182	WM-182	WM-182
		FRG	15.04	WM-182	WM-182	WM-182
		DR-3	16.53	WM-182	WM-182	WM-182
		UCLA R-1	3.80	WM-182	WM-182	WM-182
		MURR	43.17	WM-182	WM-182	WM-182
		OWR	6.69	WM-182	WM-182	WM-182
		HFBR	137.97	WM-182	WM-182	WM-182
		LPTR	0.62	WM-182	WM-182	WM-182
		TR-1	4.64	WM-182	WM-182	WM-182
		ATR	162.64	WM-182	WM-182	WM-182
		BSR-1	2.34	WM-182	WM-182	WM-182
		ORR	33.74	WM-182	WM-182	WM-182
		HMI	5.41	WM-182	WM-182	WM-182
		TRITON	10.29	WM-182	WM-182	WM-182
		FRJ-1	4.86	WM-182	WM-182	WM-182
		FRJ-2	24.87	WM-182	WM-182	WM-182
		FRM	4.99	WM-182	WM-182	WM-182
		HFR-PETTEN	42.75	WM-182	WM-182	WM-182
		BR-2	9.53	WM-182	WM-182	WM-182
		ORPHEE	14.90	WM-182	WM-182	WM-182
		ASTRA	3.64	WM-182	WM-182	WM-182
		SFR	9.07	WM-182	WM-182	WM-182
		R-2	45.83	WM-182	WM-182	WM-182
		JUNTA	3.31	WM-182	WM-182	WM-182
		MNR	3.30	WM-182	WM-182	WM-182
		JRR-2	11.30	WM-182	WM-182	WM-182
		JMTR	54.37	WM-182	WM-182	WM-182
		JANUS	2.73	WM-182	WM-182	WM-182
		UCSB	1.30			
		FLUORINEL	0.00	WM-187		
		FLUORINEL	2.20			
41	10-86 to 10-87	FLUORINEL	809.70	WM-188 WM-189	WM-182	WM-182
42	12-87 to 7-88	FLUORINEL	670.70	WM-189 WM-188	WM-182	WM-182
		EBR-II vycor glass	216.90		WM100/101	WM100/101
		BYU	7.60		WM100/101	WM100/101
		EBR-II	57.00		WM100/101	WM100/101
		ANL-E fuel scrap	8.00		WM100/101	WM100/101

Appendix B

Calcination Campaign Data Plots

Appendix B

Calcination Campaign Data Plots

Figures

B1.	WCF Campaign 1 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-5
B2.	WCF Campaign 2 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-6
B3.	WCF Campaign 3 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-7
B4.	WCF Campaign 4 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-8
B5.	WCF Campaign 5 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-9
B6.	WCF Campaign 6 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-10
B7.	WCF Campaign 7 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-11
B8.	WCF Campaign 8 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-12
B9.	WCF Campaign 9 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-13
B10.	NWCF Campaign 1 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-14
B11.	NWCF Campaign 2 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-15
B12.	NWCF Campaign 3 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-16
B13.	NWCF Campaign 4 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.....	B-17
B14.	Tank WM-180 historical operation showing volumes and types of waste stored	B-18
B15.	Tank WM-181 historical operation showing volumes and types of waste stored	B-19
B16.	Tank WM-182 historical operation showing volumes and types of waste stored	B-20
B17.	Tank WM-183 historical operation showing volumes and types of waste stored	B-21
B18.	Tank WM-184 historical operation showing volumes and types of waste stored	B-22
B19.	Tank WM-185 historical operation showing volumes and types of waste stored	B-23
B20.	Tank WM-186 historical operation showing volumes and types of waste stored	B-24
B21.	Tank WM-187 historical operation showing volumes and types of waste stored	B-25

B22. Tank WM-188 historical operation showing volumes and types of waste stored	B-26
B23. Tank WM-189 historical operation showing volumes and types of waste stored	B-27
B24. Tank WM-190 historical operation showing volumes and types of waste stored	B-28
B25. Time line showing the filling of CSSF I.....	B-29
B26. Time line showing the filling of CSSF II	B-30
B27. Time line showing the filling of CSSF III.....	B-31
B28. Time line showing the filling of CSSF IV	B-32
B29. Time line showing the filling of CSSF V	B-33
B30. Time line showing the filling of CSSF VI.....	B-34

Figure B-1. WCF Campaign 1 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-2. WCF Campaign 2 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-3. WCF Campaign 3 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-4. WCF Campaign 4 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-5. WCF Campaign 5 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-6. WCF Campaign 6 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-7. WCF Campaign 7 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-8. WCF Campaign 8 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-9. WCF Campaign 9 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-10. NWCF Campaign 1 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-11. NWCF Campaign 2 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-12. NWCF Campaign 3 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-13. NWCF Campaign 4 time line showing source of calcined waste (Tank Farm vessel number) and HPM waste stream number.

Figure B-14. Tank WM-180 historical operation showing volumes and types of waste stored.

Figure B-15. Tank WM-181 historical operation showing volumes and types of waste stored.

Figure B-16. Tank WM-182 historical operation showing volumes and types of waste stored.

Figure B-17. Tank WM-183 historical operation showing volumes and types of waste stored.

Figure B-18. Tank WM-184 historical operation showing volumes and types of waste stored.

Figure B-19. Tank WM-185 historical operation showing volumes and types of waste stored.

Figure B-20. Tank WM-186 historical operation showing volumes and types of waste stored.

Figure B-21. Tank WM-187 historical operation showing volumes and types of waste stored.

Figure B-22. Tank WM-188 historical operation showing volumes and types of waste stored.

Figure B-23. Tank WM-189 historical operation showing volumes and types of waste stored.

Figure B-24. Tank WM-190 historical operation showing volumes and types of waste stored.

Figure B25. Time line showing the filling of CSSF I.

Figure B26. Time line showing the filling of CSSF II.

Figure B27. Time line showing the filling of CSSF III.

Figure B28. Time line showing the filling of CSSF IV.

Figure B29. Time line showing the filling of CSSF V.

Figure B30. Time line showing the filling of CSSF VI.

Appendix C

Calcine Composition Data Plots

Appendix C

Calcine Composition Data Plots

Figures

C1.	Concentration of aluminum in calcine by bin segment	C-5
C2.	Concentration of arsenic in calcine by bin segment	C-6
C3.	Concentration of barium in calcine by bin segment	C-7
C4.	Concentration of boron in calcine by bin segment	C-8
C5.	Concentration of cadmium in calcine by bin segment.....	C-9
C6.	Concentration of calcium in calcine by bin segment.....	C-10
C7.	Concentration of carbonate in calcine by bin segment	C-11
C8.	Concentration of cesium in calcine by bin segment	C-12
C9.	Concentration of chloride in calcine by bin segment	C-13
C10.	Concentration of chromium in calcine by bin segment.....	C-14
C11.	Concentration of fluoride in calcine by bin segment.....	C-15
C12.	Concentration of iron in calcine by bin segment	C-16
C13.	Concentration of lead in calcine by bin segment.....	C-17
C14.	Concentration of magnesium in calcine by bin segment	C-18
C15.	Concentration of manganese in calcine by bin segment.....	C-19
C16.	Concentration of mercury in calcine by bin segment	C-20
C17.	Concentration of nickel in calcine by bin segment.....	C-21
C18.	Concentration of nitrate in calcine by bin segment	C-22
C19.	Concentration of oxide in calcine by bin segment.....	C-23
C20.	Concentration of phosphate in calcine by bin segment	C-24
C21.	Concentration of potassium in calcine by bin segment	C-25
C22.	Concentration of selenium in calcine by bin segment.....	C-26
C23.	Concentration of silver in calcine by bin segment.....	C-27
C24.	Concentration of sodium in calcine by bin segment.....	C-28
C25.	Concentration of strontium in calcine by bin segment	C-29
C26.	Concentration of sulfate in calcine by bin segment.....	C-30
C27.	Concentration of tin in calcine by bin segment	C-31
C28.	Concentration of uranium in calcine by bin segment	C-32
C29.	Concentration of zirconium in calcine by bin segment	C-33

C30. Activity of Co-60 in calcine by bin segment decayed to January 1, 2016	C-34
C31. Activity of Ni-63 in calcine by bin segment decayed to January 1, 2016	C-35
C32. Activity of Se-79 in calcine by bin segment decayed to January 1, 2016	C-36
C33. Activity of Sr-90 in calcine by bin segment decayed to January 1, 2016	C-37
C34. Activity of Y-90 in calcine by bin segment decayed to January 1, 2016	C-38
C35. Activity of Tc-99 in calcine by bin segment decayed to January 1, 2016	C-39
C36. Activity of Sn-126 in calcine by bin segment decayed to January 1, 2016	C-40
C37. Activity of I-129 in calcine by bin segment decayed to January 1, 2016	C-41
C38. Activity of Cs-137 in calcine by bin segment decayed to January 1, 2016	C-42
C39. Activity of Ba-137m in calcine by bin segment decayed to January 1, 2016	C-43
C40. Activity of Np-237 in calcine by bin segment decayed to January 1, 2016	C-44
C41. Activity of Pu-238 in calcine by bin segment decayed to January 1, 2016	C-45
C42. Activity of Pu-239 in calcine by bin segment decayed to January 1, 2016	C-46
C43. Activity of Pu-240 in calcine by bin segment decayed to January 1, 2016	C-47
C44. Activity of Pu-241 in calcine by bin segment decayed to January 1, 2016	C-48
C45. Activity of Am-241 in calcine by bin segment decayed to January 1, 2016	C-49
C46. Activity of Cm-242 in calcine by bin segment decayed to January 1, 2016	C-50

Aluminum (Al)

Figure C-1. Concentration of aluminum in calcine by bin segment.

Arsenic (As)

Figure C-2. Concentration of arsenic in calcine by bin segment.

Barium (Ba)

Figure C-3. Concentration of barium in calcine by bin segment.

Boron (B)

Figure C-4. Concenetration of boron in calcine by bin segment.

Cadmium (Cd)

Figure C-5. Concentration of cadmium in calcine by bin segment.

Calcium (Ca)

Figure C-6. Concentration of calcium in calcine by bin segment.

Carbonate (CO₃)

Figure C-7. Concentration of carbonate in calcine by bin segment.

Cesium (Cs)

Figure C-8. Concentraiton of cesium in calcine by bin segment.

Chloride (Cl)

Figure C-9. Concentration of chloride in calcine by bin segment.

Chromium (Cr)

Figure C-10. Concentration of chromium in calcine by bin segment.

Fluoride (F)

Figure C-11. Concentration of fluoride in calcine by bin segment.

Figure C-12. Concentration of iron in calcine by bin segment.

Lead (Pb)

Figure C-13. Concentration of lead in calcine by bin segment.

Magnesium (Mg)

Figure C-14. Concentration of magnesium in calcine by bin segment.

Manganese (Mn)

Figure C-15. Concentration of manganese in calcine by bin segment.

Mercury (Hg)

Figure C-16. Concentration of mercury in calcine by bin segment.

Nickel (Ni)

Figure C-17. Concentration of nickel in calcine by bin segment.

Nitrate (NO₃)

Figure C-18. Concentration of nitrate in calcine by bin segment.

Oxygen (O)

Figure C-19. Concentration of oxide in calcine by bin segment.

Phosphate (PO₄)

Figure C-20. Concentration of phosphate in calcine by bin segment.

Potassium (K)

Figure C-21. Concentration of potassium in calcine by bin segment.

Selenium (Se)

Figure C-22. Concentration of selenium in calcine by bin segment.

Silver (Ag)

Figure C-23. Concentration of silver in calcine by bin segment.

Sodium (Na)

Figure C-24. Concentration of sodium in calcine by bin segment.

Strontium (Sr)

Figure C-25. Concentration of strontium in calcine by bin segment.

Sulfate (SO₄)

Figure C-26. Concentration of sulfate in calcilne by bin segment.

Figure C-27. Concentration of tin in calcine by bin segment.

Uranium (U)

Figure C-28. Concentration of uranium in calcine by bin segment.

Zirconium (Zr)

Figure C-29. Concentration of zirconium in calcine by bin segment.

Figure C-30. Activity of Co-60 in calcine by bin segment decayed to January 1, 2016.

Figure C-31. Activity of Ni-63 in calcine by bin segment decayed to January 1, 2016.

Selenium (Se)-79

Figure C-32. Activity of Se-79 in calcine by segment decayed to January 1, 2016.

Strontium (Sr)-90

Figure C-33. Activity of Sr-90 in calicne by bin segment decayed to January 1, 2016.

Figure C-34. Activity of Y-90 in calcine by bin segment decayed to January 1, 2016.

Technetium (Tc)-99

Figure C-35. Activity of Tc-99 in calcine by bin segment decayed to January 1, 2016.

Figure C-36. Activity of Sn-126 in calcine by bin segment decayed to January 1, 2016.

Figure C-37. Activity of I-129 in calcine by bin segment decayed to January 1, 2016.

Cesium (Cs)-137

Figure C-38. Activity of Cs-137 in in calcine by bin segment decayed to January 1, 2016.

Barium (Ba)-137m

Figure C-39. Activity of Ba-137m in calcine by bin segment decayed to January 1, 2016.

Neptunium (Np)-237

Figure C-40. Activity of Np-237 in calcine by bin segment decayed to January 1, 2016.

Plutonium (Pu)-238

Figure C-41. Activity of Pu-238 in calcine by bin segment decayed to January 1, 2016.

Plutonium (Pu)-239

Figure C-42. Activity of Pu-239 in calcine by bin segment decayed to January 1, 2016.

Plutonium (Pu)-240

Figure C-43. Activity of Pu-240 in calcine by bin segment decayed to January 1, 2016.

Plutonium (Pu)-241

Figure C-44. Activity of Pu-241 in calcine by bin segment decayed to January 1, 2016.

Americium (Am)-241

Figure C-45. Activity of Am-241 in calcine by bin segment decayed to January 1, 2016.

Figure C-46. Activity of Cm-242 in calcine by bin segment decayed to January 1, 2016.

Appendix D

Internal INTEC Documentation Referenced in Report

Appendix D

Internal Documentation Referenced in Report

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HLW-100 833

LTS

Bod-06-92

From: S. S. Bodner
Phone: 6-3089/MS 5219
Date: May 22, 1992
Subject: Water Ingression to Bin Set Vaults

To: M. B. Heiser, Staff Engineer
Waste Processing

cc:	F. D. Bench	M. R. Johnson	P. I. Nelson
	J. G. Burton	L. P. Mickelsen	G. K. Oswald
	H. G. Deede	W. A. Mickelson	R. R. Smith
	A. P. Hoskins	R. F. Mozes	S. S. Bodner-2

Per your request, I have contacted the people listed in the distribution concerning information on water ingression to bin set vaults. The following information may be helpful for obtaining an LDR permit case by case exemption.

Water was detected in the CPP-729 Bin Set 1 vault sump on April 4, 1979, (SOOR No. 79-10). The water supply valve to CPP-729 was then closed, and the water level based on reading (LIA-WC-115) appeared to recede slowly. No other information was found in the microfiche Series 400 Reel 06, Supervisors and Operation Log Books. The sump was then jetted with difficulty followed by evaporation to remove the water. The specific point of the water ingression source was not determined. The source may have been underground outside the vault but more likely was from the blower cooler apparatus above the vault.

Documentation of water ingression to the Bin Set 4 vault although suspected during construction could not be obtained. However, water was jetted from the interior of a bin vessel as a result of transport air valve leakage during performance of a hydrostatic test on the TA line.

Recollections indicated that no other bin set vaults were ever suspected of containing water. I believe that surface water ingression or egression for the bin set vaults is unlikely since water stops were installed between the bin floor slabs and walls, and no evidence of surface water ingression was ever determined.

S. S. Bodner, Fellow Engineer
Waste Processing Development

\mc

Westinghouse Idaho Nuclear Company, Inc.

Box 4000 - Idaho Falls, Idaho 83415

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HLW-REF 6442

Tully

EPL

IDAHO CHEMICAL PROGRAMS - OPERATIONS OFFICE

May 26, 1978

550 Second Street

Idaho Falls, Idaho 83401

Dropping of Corrosion Coupons
into Bin Set #2
JSS-11-78

B. C. Musgrave
CPP 637

At approximately 10:30 AM on May 26, 1978, the retrieval end of the corrosion coupon sample train to be removed after ten years of storage in bin #1 of Bin Set #2 was dropped down the retrieval riser. Attempts will be made to recover it in about a month, but it is doubtful at present whether this can be done without a considerable expenditure of money, time, and exposure.

Figure 1 is a sketch of the existing flanged riser cap above bin #1. Figure 2 is a sketch of the riser and top of the bin. The riser flange was being temporarily replaced with a HEPA filter and blower unit for use in providing a vacuum during the calcine bin sampling activities in bins #7 and #3. Work was being done by Waste Management personnel with an HP in attendance. Maintenance personnel were not used as their radiation exposure is very high already this year, and the general field around the open riser was ~ 3 R/hr, β and γ .

The riser flange was unbolted and turned upside down next to the open riser for removal of the corrosion sample cables attached underneath. These cables were also to be held on hooks about a foot down inside the riser (see Figure 1), but two of the cables weren't attached to these hooks. This wasn't noticed, however, until after the cable was dropped, as we refrained from looking directly down the open riser. Whether the two cables were unhooked during retrieval of the 5 year sample train in 1973, or when the flange was removed two days ago is unknown.

Each sample train was unbolted, one at a time, and reclamped onto the special flange plate we had made up for this purpose shown in Figure 3. This plate fits between the riser flange and the flange on the bottom of the HEPA installed above the riser. The first two sample trains were transferred with no problems, but upon unbolting the third the cable slipped loose and fell down the bin. The fourth sample train was transferred without incident.

It is believed the sample train fell all the way into the bin as it was heard to fall for about two or three seconds. There is a possibility it is still hung up on the riser, but I doubt it.

The filter and blower were installed on the riser and the area cleaned up. There was considerable calcine dust under the flange; the activity was mostly β . Contamination levels approached 250,000 dpm/100 cm² around the riser apron, but these were subsequently cleaned up.

I take full responsibility for dropping the corrosion string. The work was being done under my direction, but I failed to check down the riser to see if the sample train was attached on the hook inside. No safety problems were involved with the incident, but loss of the coupons will reduce by 25% our remaining ability to monitor corrosion by zirconia calcine in Bin Set #2. This would be a problem if it is decided to store calcine in the existing bins indefinitely. A plan will be worked out for retrieving the coupons within the next month and discussed with all concerned prior to attempting retrieval.

J. S. Schofield

rls

Attachment

cc: J. R. Berreth
J. R. Bower
R. D. Boyer
R. D. Bradley
O. L. Cordes
B. R. Dickey
P. Fineman
W. A. Freeby *WAF*
J. A. Hendricks
T. L. Hoffman
H. Lawroski
R. E. Mizia
B. L. Rich
J. A. Rindfleisch
K. L. Rohde
B. A. Staples
E. L. Wade
J. S. Schofield - 2

Fig. 1. Bldg #4 Nicer Cap

1001 DWG. NO.

Fig. 3 Coupon cable retainer flange

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WBP

ALLIED CHEMICAL CORPORATION
IDAHO CHEMICAL PROGRAMS - OPERATIONS OFFICE

INTEROFFICE CORRESPONDENCE

August 9, 1972

HLW-100-2642

LTS

Gas Sampling of
Solids Storage Bins
WBP-1-72

CPP 637

Mr. G. E. Lohse *ML*

In order to show that there is no chance of explosion or other hazard resulting from the accumulation of radiolytic decomposition gases in the vapor space of the waste calcine storage bins, samples were taken of the gas above the stored solids in bin WC-136-2. The procedures by which the sampling apparatus was installed, the samples taken, and the apparatus removed from the bin are given in Wlr-69-72. All three phases were done with Safeguards Committee approval, a safe work permit, and an HP in attendance. No problems were encountered, and no contamination was released from the bin.

The sampling apparatus was installed by Maintenance, Friday, July 21. Samples 1 and 2 were taken immediately. Samples 3 and 4 were taken the following Monday morning, and then Maintenance removed the sampling equipment from the bin.

The gas analysis from Analytical Chemistry is given in Table I. As the table shows, there are no hazardous gases accumulating in the bin.

TABLE I
(mole%)

Sample	H ₂	N ₂	O ₂	Ar	CO ₂	NO _x	CO	Total
1	<0.01	78.1	19.8	0.95	0.79	<0.01	0.30	99.9
2	<0.01	78.1	19.9	0.95	0.80	<0.01	0.25	100.0
3	<0.01	77.9	20.4	0.95	0.44	<0.01	0.25	99.9
4	<0.01	77.9	20.5	0.95	0.46	<0.01	0.23	100.0

There was a 0.5 psi vacuum inside the bin during all phases of the gas sampling. This vacuum apparently is caused by leaking valves between one or more of the solid storage bin cyclones and the solids transport lines, which are kept under a vacuum by the WCF equipment vent blower. Three weeks prior to this sampling, a bypass valve was closed which had been allowing air to flow from the stack, through the bins and the leaking transport line valves, and then into the WCF equipment vent system. If this bypass valve is not leaking, then there is no flow through the bins, and the analyses given in Table I are representative of three weeks' accumulation of decomposition gases. If the bypass valve leaks, then there is a continual flow of air through the bins, and the gas analysis does not show the gases which would be present if the valves were ever completely sealed.

Mr. G. E. Lohse

WBP-1-72

Page 2

It would be advisable to determine if the bypass valve leaks; if so, either it should be sealed and the bin resampled later, or another set of bins, which do not have air flow through them, should be sampled.

WBP:bb

W. B. Palmer

W. B. Palmer

cc: R. D. Bradley
L. T. Lakey *ITL/361*
R. E. Schindler
B. R. Wheeler
W. B. Palmer - 2

EXXON NUCLEAR IDAHO COMPANY, Inc.

Internal Correspondence

Distribution:

A. G. Westra
J. R. Berreth
W. A. Freeby (2)

Date: September 6, 1979

To: G. L. Ritter

From: W. A. Freeby *WAF*

Subject: Possibility of Additional Space in the Second
Calcined Solids Storage Facility (CSSF)
WAF-45-79

We have investigated the current status of empty storage space in bins of the CSSF #2 for possible future calcine storage. Based on results from (1) sampling bins #3 and #7, (2) thermocouple data, and (3) calculated calcine production, all bins except #3, #4, and #5 are full. Bins #3, #4, and #5 may have 5-6 ft of void space at the top based on sampling of bin #3. Settling of the calcine does not appear to have occurred as evidenced from bin #7 being full. The empty space in the bins is probably due to incomplete filling.

It would be difficult to fill bins #3, #4, and #5, as the bins are filled sequentially based on vertical spacing of fill lines on the distributor pipe. The filling sequence is 1, 2, 4, 3, 5, 7, 6 (See Figure 1).

Another problem that strongly influences the use of Bin Set #2 is the leak in the transport system within the equipment vault. Calcine in the vault due to the leak would need to be removed, the vault decontaminated, and the leaks repaired.

sk

FIG. 1 SECOND CALCINE
SOLIDS STORAGE BINS

IDAHO NUCLEAR CORPORATION

INTEROFFICE CORRESPONDENCE

April 8, 1971

Solids Storage Bin
Solids Level Detector Connection
Jobe- 2 -71

Mr. G. V. Markham
CF-633

This will confirm our telephone conversation concerning the use of the (former) capacitance probe (B) nozzle at the top of the new solids storage bin VES-WCS-139. We recommend that this nozzle be capped and the misaligned hole in the concrete roof slab be plugged.

The following factors have caused us to abandon the former capacitance probe nozzle as a location for a possible Time Domain Reflectometry level probe.

1. The pipe extension from the top of the vessel should be straight and preferably vertical, which would require boring a new hole in the roof slab.
2. The top of this pipe would be inside the equipment vault (rather than the instrument room) and therefore would be in a radioactively hot area so that the terminal of the probe could not be serviced.
3. Special design considerations would be required to utilize this one-inch pipe nozzle.

We will plan to utilize the 6 inch riser for any solids level measuring system that may be recommended for this bin.

LAJ:ls

cc: J.A. Buckham
G.L. Booman
R.H. Halstead
K.W. Moore

B.C. Musgrave
N.J. Rigstad
B.R. Wheeler
L.A. Jobe (2)
File 6.3

L. A. Jobe
L. A. Jobe

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INTEROFFICE MEMORANDUM

Date: March 19, 2002

To: K. F. Childs MS 3920 6-3261
M. D. Staiger MS 3211 6-3122

From: I. R. Thomas *IR Thomas* MS 5102 6-3774

Subject: MEASUREMENT ERROR ANALYSIS FOR CALCINE VERIFICATION STUDY

References: (a) W. F. Boyer e-mail message to I. R. Thomas, DCS Volume Measurements, November 7, 2001
(b) J. P. Henscheid notegram to K. F. Childs, Estimates of Error Associated With the Analytical Data for the Calcline Feed Tank Analysis, October 25, 2001
(c) I. R. Thomas interoffice memorandum to A. P. Poloski, Verification Sampling of Calcline Batches, September 17, 2001

This memorandum summarizes the analysis for bounding the error in an arbitrary constituent of stored calcine. Based on this analysis, a relative bound for the error in a calcine constituent processed during a waste campaign is conservatively estimated to be 14%, meaning that the error bound is obtained by multiplying the stated quantity of the constituent by 0.14. The result, when added to, and subtracted from the quantity of the calcine constituent, gives an interval in which the actual quantity of the calcine constituent is believed to lie, with approximately 95% confidence. For instance, if 42,250 kilograms of aluminum were reported to have been processed in 500 waste batches, then with approximately 95% confidence, the actual value of aluminum would lie somewhere between 36,335 and 48,165 kilograms.

The overall error in a stated quantity of a calcine constituent is a function of the errors in the determination of bulk volume, errors due to inadequate mixing or sampling of the bulk solution, and errors in the analysis of the sampled solution. All errors perturb a measurement to some extent, but some errors have more of an impact on the uncertainty in the stated result, either because they assume a wider range of values (have a bigger error bound) or because they produce a greater change in the measurement for an fixed change in error value (have a larger partial derivative with respect to the error). Thus, the bound for the composite error depends on the magnitude of the bounds for the individual error components and on the magnitude of the corresponding partial derivatives. Both factors are considered in the ensuing error analysis in which the bound for the overall error was obtained via error propagation, sometimes called variance propagation. The objective of error propagation is to compute the contribution (often expressed as a percentage) that each error bound makes to the composite (or overall) bound. This bound is computed by mathematically expressing the measurement result as a function of all identified errors, by estimating a bound for each component of error, and by approximating the change in the measurement result with respect to a fixed change in each error (the partial derivative). The total bound is then computed as a function of the sum of the products of the squared error bounds and the corresponding squared partial derivatives.

The following caveats concerning this error analysis are noted.

1. The vessel measurement techniques and analytical methods changed over the 30-year history of calcining waste at the Idaho Nuclear Technology and Engineering Center (INTEC), formerly the Idaho Chemical Processing Plant. The techniques and representative values of later years are emphasized in this analysis because more data are available.
2. This report is only a synopsis of the measurement methods, and the results are approximate. In fact, some of the assessments are unavoidably subjective, and different experts could dispute the assumed values. The stated values are on the conservative side, but a balance between excessive conservatism and unsubstantiated optimism is attempted. Furthermore, due to the large number of batch transfers made during a given waste processing campaign, this analysis was developed under the assumption that for each batch, the volume of the transferred waste and the chemical concentration of a given calcine constituent are adequately approximated by an average or nominal value. Under this assumption, the batch sizes and the corresponding concentrations are treated as being fixed for all batches, even though they actually varied. The estimated bounds for the identified measurement errors are also expressed using representative values. A more detailed analysis will require significantly more effort.
3. Each error was quantified in terms of a relative bound, that is, as a fixed proportion (or percentage) of the assumed nominal or average value. The relative bound was estimated by dividing the stated tolerance for the error (often obtained from expert opinion) by the nominal or average value. Thus, if an error were believed to lie within some tolerance of a given value, the relative bound for the error was estimated by dividing the stated tolerance by the representative (or nominal) value, yielding an estimated relative bound. For example, if 1000 gallons represents the nominal value of a transferred quantity of liquid waste per batch, and if the error in a transferred volume is believed to be ± 75 gallons, then the relative error bound is expressed as 0.075 (or 7.5%). In some cases, the errors are expressed in relative terms at the outset. For example, the analytical error might be categorically stated as 5% of the analytical result. Some error bounds are more appropriately expressed in absolute terms because their value is independent of the measurement result, but an approximation in relative terms was attempted in an effort to simplify the analysis and to provide a more direct means of comparing the effect of measurement errors.
4. Each measurement error was placed into one of two dichotomous classes, namely, systematic or random. In general, a systematic error, such as an error in the calibration of an instrument or an error due to inadequate instrument adjustment, is a constant perturbation that persists (both in sign and magnitude) through repeated measurement determinations. Random errors, on the other hand, are chance deviations that are unique for each measurement and generally result from uncontrolled fluctuations in the measurement environment. In repeated measurements, random errors are more "forgiving" than systematic errors because they tend to compensate for each other, in the sense that positive errors are generally negated by negative errors. Thus, in the long run, the effect of random errors is reduced in repeated measurements, and for a campaign of approximately 500 batches, the effect of random error in sequential measurements is virtually nullified, while the effect of systematic errors is not diminished. Consequently, systematic errors generally play a more dominant role in error analyses.

For a typical waste campaign, the measurement methods and the bounds for all identified sources of error in the calcine measurements are summarized below. The mathematical details are omitted, but the results of the error propagation are summarized in two tables. One table is for measurements made in the vessels of the tank farm and the other table is for measurements made in the receiving tanks of either the Waste Calcining Facility (WCF) or the New Waste Calcining Facility (NWCF). These tables list the sources of error, the error types (whether systematic or random), the estimated relative bound for each error, and the contribution that each bound makes, as a percentage, to the overall error bound.

Measurement Overview

Liquid waste was transferred via steam jet (or in a few cases, by air lift) from a selected vessel in the tank farm to one of two calibrated feed tanks in either the WCF or the NWCF. These feed tanks are Vessels WC-100 and WC-101 of the WCF and Vessels NCC-102 and NCC-103 of the NWCF. (Note:

sodium waste was specifically feed to NCC-101 of the NWCF. NCC-101 is similar to NCC-102 and NCC-103 but was reserved for measuring sodium waste, which had to be ratioed with the other forms of process waste because the correct blend ratio was necessary for avoiding a sticky consistency in the calcine.)

For most batches, the volumes of the transferred waste were measured at both the tank farm and the WCF or NWCF. The decrease in the sending volume of the tank farm was compared against the increase in the receiving volume of the WCF or the NWCF, both as a check for leaks in the transfer system and for verifying measurement consistency. The volumes of both the sending and the receiving vessels were listed on the batch transfer sheets, but the recorded values for the batch transfer sometimes came from the tank farm and sometimes came from one of the feed tanks at WCF or NWCF. Consequently, this error analysis considers the errors in both tank types.

The transferred solutions were not always sampled for chemical analysis; but when they were, the samples were drawn from one of the feed tanks (WCF or NWCF), after the solution was thoroughly mixed via an air sparge. The air sparge produced homogeneous mixtures by agitating the solutions with large volumes of air. The drawn samples were then analyzed for multiple constituents, and the results of the analysis were listed on the analytical final report. These values were recorded with the accompanying volumes of the batch transfers. For each constituent of the calcine, the product of the batch transfer (in "volume" units) and the result of the chemical analysis (in "quantity of analyte per unit volume," after adjusting for steam jet dilution, if necessary) gave the total quantity of the analyte in the calcined batch. These products were then summed, giving the total analyte (calcine constituent) in the number of waste batches.

Liquid Height

For most process vessels, the volume of contained liquid is derived from the height of the liquid surface (sometimes called the liquid level) above a fixed reference point. The measured height is then entered into a calibration equation (or some other computational algorithm) for computing the volume corresponding to the measured height of solution. Thus, an error in the liquid height can be a major contributor to the error in the volume determination. The tank farm vessels are very large (containing about 1224 gallons per inch of liquid), while the feed vessels of the NWCF are considerably smaller (containing about 31 gallons per inch). Both types of vessels employ bubbler probe systems (sometimes called dip tubes) for making liquid level/ density measurements. A bubbler probe is a long, thin tube that penetrates the vessel from the top and extends to near the vessel bottom. (The reference probe is an exception because it terminates near the vessel top.) A metered supply of air is purged through the bubbler probes, and the escaping air bubbles from the tip of the submerged probe to the liquid surface and then exits the vessel via the off-gas system. The greater the height of liquid above the tip of the submerged dip tube, the greater the pressure required for maintaining the constant flow of air. Pressure measuring instruments (such as liquid manometers or pressure transducers) are connected to the dip tubes for registering the differential pressure between the submerged probe and the reference probe. The observed pressure is then converted to the height of solution above the tip of the submerged probe.

Over the 30-year history of calcining waste at the INTEC, the tank farm used multiple pressure measuring devices, including liquid manometers and differential pressure transducers. But due to the excessive height of the tank farm vessels, the bubbler probes were too long to allow for a precise measurement of liquid height. Due to the massive volume of solution represented by a small change in

liquid height, the errors in the height measurement seriously distorted the volume determinations. Thus, prior to 1979, a 25-inch "range elevation kit" was used for refining the pressure measurement. This system effectively magnified the region near the liquid surface to a 25-inch of water column. The error in the pressure measurement was 3% of full scale, that is, 0.03×25 inches of water pressure, or 0.75 inches of water pressure. Due to the very small difference in height between the before-transfer and the after-transfer measurements, most of this error, on the order of 95%, is considered to be systematic (constant) and therefore subtracts out in the difference between the before and after transfer measurements. The remainder is attributed to random error, but because the random error is unique for each measurement, it does not subtract out in the before and after-transfer measurements but perturbs both measurements. After 1979, a radio frequency (RF) probe was used for improving the liquid height determinations in the tank farm vessels. With this system, the reference point changed from the tip of a bubbler probe to a point above the liquid level, and the height of liquid was determined by measuring the fundamental frequency of a resonating cavity and consequently the cavity length from the reference point to the liquid surface. Both the range elevation kit and the RF probe systems gave fairly accurate measures of liquid volume despite the large quantities of volume involved. The error in the RF probe is expressed in terms of volume (rather than height) and is discussed below.

Pneumatic bubbler probes (dip tubes) were the primary means of determining liquid density and liquid level (the height of the liquid surface above the tip of a bubbler probe) in the WCF and NWCF feed tanks. The NWCF vessels have a capacity of approximately 3,500 gallons. For these tanks, the error in the liquid level is a function of the random and systematic errors in the level and density transmitters. The error in the measured separation between the tips of the level and density probes also contributes to the error in the density/ height determination. For the WCF (and for the NWCF prior to the installation of the Distributive Control System (DCS)), the errors in the level and density determinations included the error in the accompanying strip chart recorders and the error in the operator's inability to read the strip chart values. The error in the level transmitter is stated to be ± 3 inches of water pressure for a maximum range of 142 inches of water pressure. For a full vessel, the effect of this error is much less (about $\pm 2\%$) than for a nearly empty vessel, but assuming a nominal volume of 1000 gallons, this error was conservatively assigned $\pm 8\%$. The error in the density transmitter is stated to be $\pm 4\%$. For conservatism, the majority of the error in the level and density transmitter is assumed to be systematic. The error in the measured probe separation is also systematic and is conservatively assigned a value of 2%.

Liquid Volume

As noted above, the volume of solution in a process vessel is generally computed as a function of the liquid height. The volume-versus-height relationship for any vessel can be approximated from the tank dimensions, but a more accurate relationship is acquired via a vessel calibration. A vessel is calibrated by adding known increments of calibration liquid (generally de-mineralized water) to a vessel that is initially empty. The incremental additions are added via a volumetric standard (commonly called a prover), and for each incremental addition, the cumulative volume of the calibration liquid is computed as the sum of the current and the preceding incremental additions. Also for each addition, the corresponding height of liquid is measured via the vessel instrumentation—such as the liquid/ level bubbler probes. From the acquired volume/ height data, a calibration equation (giving volume of contained solution as a function of liquid height) is obtained by statistically fitting (such as the method of least-squares) a mathematical equation to the observed data. Deviations between the observed data points and the fitted values of the calibration equation are called errors due to "lack of fit." These errors

are primarily systematic because for a given height, the deviation between the actual volume and the volume predicted by the calibration equation, is fixed.

Each set of the makeup/feed tanks at the WCF and NWCF have nominally the same dimensions, and both sets had the same quality of physical calibration. Tank calibration data for the NWCF vessels (NCC-102 and NCC-103) were acquired in 1980. These data were used for assessing the "lack of fit" in the common volume-versus-height algorithm that is programmed into the DCS for computing the volume of solution in both of the NWCF vessels. This algorithm, given in Reference (a), tends to understate the volume of Vessel 103 and to overstate the volume of Vessel 102. Prior to the DCS algorithm, volumes for the NWCF vessels (and the WCF vessels) were obtained via a calibration curve that was plotted on graph paper. An operator used the calibration curve for obtaining the volume of solution corresponding to a measured liquid height, and the random error in the volume determination included the operator's inability to accurately read the calibration curve. For this study, the "lack of fit" error was estimated by comparing the DCS algorithm against the observed calibration data of 1980. For a fixed height, the error in the corresponding volume (due to the lack of fit) in the programmed algorithm (or the plotted curve) is obviously systematic. However, the liquid heights of the smaller WCF and NWCF vessels probably varied considerably between the before and after measurements, and these before and after heights also fluctuated between transfers. Thus, in reality, the estimated "lack of fit" error for the WCF and NWCF vessels was probably more random than systematic, but for additional conservatism, the error was treated as systematic. For the majority of the calibration data, the error due to lack-of-fit seemed to be less than 50 gallons, so for a typical 1000-gallon measurement, a relative bound of 0.05 was conservatively assigned.

The massive tank farm vessels were too large to be physically calibrated, so the volume of solution per unit height had to be calculated from the vessel dimensions. Thus, the systematic error in a transferred volume was partly due to the error in the tank dimensions and partly due to the inaccuracy in the calibration of the RF probe (or the range elevation kit). The height of solution in these tanks would decrease very gradually as the vessel emptied, and the transferred volume was calculated from the small change in height between the before and after transfer measurements. For a small change in height, these errors in volume are mostly systematic and nearly all of the error would subtract out in the difference between the before and after measurements. The remaining error in the transfer volumes would be caused primarily by fluctuations in the probe readings, but these errors are unique for each measurement and do not subtract out. Consequently, the contribution of the random errors in the before and after measurements must be accounted for in each batch transfer; but over the long run, the random errors would tend to negate each other. Numerically, the total error in an individual volume measurement (both systematic and random components) is conservatively believed to be within ± 100 gallons. This bound is further increased by assessing the bounds for both the systematic and the random errors to ± 75 gallons, meaning that for a typical transferred volume of 1000 gallons, the relative bounds for both the systematic and random errors are assigned the value 0.075.

Volume Dilution (Steam Jet Transfer)

As noted, liquid waste was transferred via steam jet (or in a few cases, by air lift) from a selected vessel in the tank farm to one of two calibrated feed tanks in either the WCF or the NWCF. The volumes measured in the tank farm were increased by 5% to account for the dilution by the steam jet. Thus, a measured tank farm transfer of 1000 gallons would be inflated to 1050 gallons, prior to comparing it with the volume received in the WCF or NWCF. The extent of the dilution depended upon the height of

the solution in the sending tank. The closer the liquid was to the top of the tank, the less steam was required for making the jet transfer. Consequently, the error in the dilution would likewise depend on the height of liquid in the tank; and would fluctuate slightly, as the liquid level of the tank farm vessel decreased. The actual dilution was estimated to be $5\% \pm 2\%$ (i.e., between 3% to 7%), so an estimated error bound of 0.02 was assigned to the error in the dilution value. For conservatism, this error was assumed to be systematic.

Mixing/Sampling Error

The transferred solutions were not always sampled; but when they were, the samples were drawn from the WCF/ NWCF feed vessels, after the contained solutions were thoroughly mixed via an air sparge. Empirical mixing data are not available for evaluating the error in the mixing and sampling mechanisms. However, the vessel contents were believed to have been homogeneous, so the nature and extent of the sampling error is probably not a major issue. The sampling error, if present, is most likely systematic, and a relative bound of 0.02 is assumed. For conservatism, a systematic mixing error, also having a bound of 0.02, is assumed.

Analytical Error

Although calcine is comprised of several chemical and isotopic constituents, the specific composition of the calcine processed during a given campaign depends upon the type of waste. Aluminum, zirconium, calcium, and sodium accounted for about 98% of all calcine, so the waste—when sampled—was routinely analyzed for these constituents. (Cesium-137 was also measured because the trace radio nuclides were ratioed to it.) Aluminum is common to all calcined waste, while the presence or proportions of the other elements are specific to the type of calcine. For this reason, the variability in the aluminum concentration is considered to be typical (or representative) of the variability in all calcine constituents. Fortunately, the error in the analytical results were probably equivalent for most elements, and per Reference (b), the estimated error in the analytical methods is assumed to be within $\pm 5\%$ of the reported value. Most of this error is attributed to random error (often called the precision in the analytical method) because the laboratory corrected all reported results for analytical bias. (Two exceptions were sodium and potassium analyses via spectrochem.) Even if bias corrected, however, an analytical result contained a small systematic error due to the error in the estimated bias correction.

Another “analytical” error that was considered in this study was not actually an error in measurement but was treated as such in the variance propagation. This error resulted from a lack of analyzed samples and was called “non sampling” error because it represented the inability to definitively characterize the calcine in those batches that were not sampled. Of necessity, the results of prior analytical determinations (from the samples that were analyzed) were used for characterizing the calcine in the batches that were not sampled. A bound for this error is difficult to quantify, but its magnitude is probably not excessive because, as noted, the tank farm solutions were believed to be homogeneous. The majority of the non-sampling error would likely be random because the concentrations of the non-sampled batches would tend to fluctuate above and below the average of the available values. However, the deviation between the nominal concentration (the average of the available values) and the overall (or long-term) concentration for an entire waste campaign must also be considered. Based upon the spread of the latest available aluminum concentrations (in molarity units), a relative bound for the random error due to “non-sampling” was assigned the value of 0.142, and a relative bound for the systematic error was assigned the value of 0.048.

Data Entry Errors

Another non-measurement error is the error due to incorrect data entry. As noted in Reference (c), however, only one entry error was found in a random sample of 100 batch sheets. Thus, with 95% confidence, the inferred proportion of all batches containing data-entry errors is at most 5%. This low proportion gives high assurance that the vast majority of the recorded values are accurate. However, the impact of incorrect entries on the uncertainty in the stated value of a calcine constituent cannot be quantified via error propagation. Nonetheless, the presence of a few data-entry errors is inconsequential to the overall error bound because representative or nominal values (of the transferred volumes and their corresponding concentrations) were used in place of actual values.

Propagated Error Bound

The following tables each give estimated relative bounds (computed via variance propagation) for the overall error in the total quantity of a calcine constituent processed from a waste campaign consisting of approximately 500 batches. One table is for volume measurements made in the Tank Farm and the other is for volumes measured in the WCF/ NWCF. These bounds are 12% and 14%, respectively, so a representative value of 0.14 is assigned as a conservative relative bound for the overall error.

These tables list the estimated relative bound for each identified error component, together with its error type (whether systematic or random), and the contribution that each bound makes, as a percentage, to the overall (or propagated) error bound. (Actually, the stated contribution is the percentage that each error's variance makes to the total variance, but error bounds were used in this study because they were thought to be more familiar to the reader. Also, the propagated error bound does not equal the sum of the individual error bounds.)

For the tank farm vessels, the long-term error due to the lack of analytical samples, is a major contributor to the overall error, but the biggest contributor is the systematic error in the calibration of the radio frequency probe. (This error could also include the systematic error in the calculated volume due to incorrect tank dimensions.) As noted, most of this systematic error would actually subtract out in the difference between the before and after transfer measurements. However, data were unavailable for assessing the extent of the systematic error, so for conservatism, the systematic error was assumed not to subtract out. The resulting bound is probably overly conservative, but the extent of the conservatism is unknown. (Note: if the bound for this error [that is, the systematic error in the calibration of the RF probe] were halved, the relative bound would reduce from 12% to 8%.)

The biggest contributor to the overall error for the WCF/NWCF vessel measurements is the systematic error in the calibration of the level transmitter. Again, for some measurements, the bound for this error might have been overly conservative, but a worst case was assumed. The systematic error due to the lack-of-fit in the vessel calibration curve is the next biggest contributor, and the long-term error due to the lack of analytical samples is the third biggest contributor. All other errors make minor or trivial contributions. (Note: if the bound for the systematic error in the calibration of the liquid level transmitter were halved, the relative bound would reduce from 14% to 11%.)

Tank Farm	Source of Error	Error Type	Bound	% Cont
Volume	Radio Frequency Probe (Calibration)	Systematic	0.075	74.615
	Radio Frequency Probe (Reading)	Random	0.075	0.149
	Steam Jet Dilution	Systematic	0.020	2.653
Sampling	Mixing (Sparging)	Systematic	0.020	2.653
	Sampler System	Systematic	0.020	2.653
Analytical	Bias	Systematic	0.016	1.698
	Precision	Random	0.048	0.031
	Non-sampling (long-term)	Systematic	0.048	15.281
	Non-sampling	Random	0.142	0.267
			Total	100.000
		Prop. Bound	0.12	

WCF / NWCF	Source of Error	Error Type	Bound	% Cont
Height	Liquid Level Transmitter (Calibration)	Systematic	0.086	54.016
	Liquid Level Transmitter (Reading)	Random	0.028	0.012
	Density Transmitter (Calibration)	Systematic	0.038	0.422
	Density Transmitter (Reading)	Random	0.012	0.000
	Bubbler Probe Separation	Systematic	0.020	2.921
Volume	Calibration Equation	Systematic	0.050	25.359
Sampling	Mixing (Sparging)	Systematic	0.020	2.029
	Sampler System	Systematic	0.020	2.029
Analytical	Bias	Systematic	0.016	1.298
	Precision	Random	0.048	0.023
	Non-sampling (long-term)	Systematic	0.048	11.686
	Non-sampling	Random	0.142	0.205
			Total	100.000
		Prop. Bound	0.14	

vg

cc: J. P. Henscheid, MS 3114
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K. F. Childs
March 19, 2002
Page 9

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INTEROFFICE MEMORANDUM

Date: February 14, 2000

To: K. B. Farmer MS 5111 6-3995

From: R. A. Wood *R. A. Wood* MS 5218 6-2273

Subject: UPDATED ALUMINUM NITRATE/WM-189 BLEND CALCULATIONS FOR 500°C AND 600°C OPERATION DURING NWCF RUN H4

Blend calculations for NWCF Run H4 were previously released in December of 1999. Since that time, a successful 15-cm calciner pilot plant trial has been completed using simulated WM-189 waste with an Al/Na+K mole ratio of 2.5:1. Based upon the success of this trial, NWCF blend calculations have been updated and are attached for your use. Specifically, Table 3, Table 4A, and Table 5 have been updated.

In addition to updating the range of acceptable blends for use at the NWCF, one precautionary measure is also recommended to prevent fouling in the piping and equipment downstream of the calciner. Because ANN/Na calcine exhibits greater hygroscopicity than other calcines, it is recommended that at least 2 cold feed batches be processed at the conclusion of the run. This will help to flush the system, as well as ensure that the top layer of calcine or fines that remain in the system is not excessively hygroscopic.

The composition of WM-189 is provided in Table 1, and is based on analysis of four tank samples. The calculated heat generation rate for WM-189 liquid is provided in Table 2. Table 3 provides a summary of feed blend ratios, and indicates the appropriate operating temperature(s) for each blend. For clarity, feed blend recipes suitable for operation at either 500°C or 600°C are provided in Table 4A, while those blends only suitable for 600°C operation are provided in Table 4B. Note that boric acid addition is the key difference between the blends shown in Tables 4A and 4B. Blended waste compositions and chemical usage estimates are provided in Table 5.

Table 1 Process Waste Composition, December 1999

Species		WM-189 Waste*
Specific Gravity		1.3070
Acid	(H+, M)	2.5700
Nitrate	(NO ₃ , M)	6.2300
Aluminum	(Al, M)	0.8884
Boron	(B, M)	0.0250
Cadmium	(Cd, M)	0.0048
Calcium	(Ca, M)	0.0840
Chloride	(Cl, M)	0.0241
Chromium	(Cr, M)	0.0046
Flouride	(F, M)	0.2357
Iron	(Fe, M)	0.0250
Lead	(Pb, M)	0.0011
Manganese	(Mn, M)	0.0116
Mercury	(Hg, M)	0.0156
Molybdenum	(Mo, M)	
Nickel	(Ni, M)	< 0.0020
Phosphate	(PO ₄ , M)	0.0003
Potassium	(K, M)	0.1141
Sodium	(Na, M)	0.9013
Sulfate	(SO ₄ , M)	0.0067
Zirconium	(Zr, M)	0.0357
Undissolved Solids	(UDS, g/l)	1.1000
Americium 241	(Am-241, mCi/l)	
Antimony 125	(Sb-125, mCi/l)	
Cerium 144	(Ce-144, mCi/l)	
Cesium 134	(Cs-134, mCi/l)	0.2100
Cesium 137	(Cs-137, mCi/l)	122.0000
Cobalt 60	(Co-60, mCi/l)	
Europium-154	(Eu-154, mCi/l)	0.4100
Europium-155	(Eu-155, mCi/l)	
Iodine-129	(I-129, mCi/l)	
Neptunium-237	(Np-237, mCi/l)	
Nickel-63	(Ni-63, mCi/l)	
Plutonium-238	(Pu-238, mCi/l)	
Plutonium-239	(Pu-239, mCi/l)	
Plutonium	(Total Pu, mCi/l)	
Ruthenium-106	(Ru-106, mCi/l)	
Strontium-90	(Sr-90, mCi/l)	111.0000
Technetium-99	(Tc-99, mCi/l)	
Tritium	(H-3, mCi/l)	0.0230
Uranium	(U, mg/l)	55
Heat Generation Rate	(W/m ³)	1.3640

* Values from Schi-25-98. ** Mercury value is from 990311-1 only.

NOTE: Radionuclide values are not corrected for decay for conservatism.

Table 2 Heat Generation

Species	Absorbable Energy (W/Ci)	WM-189 Decay Heat (W/m ³)
Americium 241 (Am-241)		
Antimony 125 (Sb-125)		
Cerium 144 (Ce-144)		
Cesium 134 (Cs-134)	1.02E-2	2.14E-3
Cesium 137 (Cs-137)	5.03E-3	6.14E-1
Cobalt 60 (Co-60)		
Eropium-154 (Eu-154)	8.95E-3	3.67E-3
Europium-155 (Eu-155)		
Iodine-129 (I-129)		
Neptunium-237 (Np-237)		
Nickel-63 (Ni-63)		
Plutonium-238 (Pu-238)		
Plutonium-239 (Pu-239)		
Plutonium (Total Pu)		
Ruthenium-106 (Ru-106)		
Strontium-90 (Sr-90)	6.70E-3	7.44E-1
Technetium-99 (Tc-99, mCi/l)		
Tritium (H-3)		
Heat Generation Rate (W/m ³)	1.364E+00	

Minimum/Maximum Blend Recommendations

The range of feed blends calculated for WM-189 waste at 500°C are shown as the first five entries in Table 3. Corresponding blend recipes are listed in Table 4A. Sodium plus potassium mole percent for these blends ranges from 5.33 to 9.39 mol%. In order to minimize the likelihood of agglomeration, plugging, and/or the inability to build bed level, the aluminum to sodium plus potassium ratio for the blended feed should be greater than 3.20 moles Al/mole Na+K for 500°C operation.

A WM-189:ANN ratio of 1:1.45 is recommended as the initial blend for 500°C calcination. This blend was calcined successfully during NWCF operation on WM-189 feed in January to March of 1999. This blend has: 1) a blend ratio of 1 volume of WM-189 to 1.45 volumes of ANN, 2) an aluminum to sodium plus potassium mole ratio of 4.03, 3) 40% excess calcium nitrate for all fluoride, chloride, sulfate, and phosphate (Ca/F ratio of 0.81), and 4) an assumed scrub recycle rate of 15%.

Note that all blends that can be calcined at 500°C can also be calcined at 600°C. However, the final six blends in Table 3 do not include boric acid addition, and should therefore be used only during operation at 600°C. Corresponding blend recipes for 600°C are listed in Table 4B.

Sodium plus potassium mole percent for these blends range from 5.37 to 11.59 mol%. Pilot plant trials using WM-189 simulants at 600°C with Al/Na+K mole ratios of 3.1 and 2.5 were successfully completed without encountering bed agglomeration or severe plugging. However, pilot plant trials using Al/Na+K mole ratios of 1.5 and 1.8 resulted in bed agglomeration. Therefore, it is recommended that blend ratios at the NWCF be limited to an Al/Na+K mole ratio greater than 2.5. For high-temperature blend calculations, a value of 0.233 mol NO₃/mol Na+K in the calcine was used, which corresponds to results obtained during 15-cm high-temperature pilot plant runs.

If feed with an Al/Na+K mole ratio greater than 4.0 is used during high-temperature operation, and boric acid is not added to the feed batch, UDS in the scrub should be closely monitored. If UDS in the scrub increases significantly, boric acid should be added to subsequent blends.

Comparison With WM-189 Blends Previously Run At NWCF

WM-189 blends have previously been run at NWCF at 500°C. Based on this experience, similar performance during the upcoming run of WM-189 at 500°C is anticipated. At 600°C, it is probable that NAR will need to be increased slightly to maintain the desired particle size. Other differences at high-temperature include a slight increase in fines production, and a lower fines density. Also, pilot plant studies indicate that fines produced at 600°C tend to absorb more moisture than fines produced at 500°C.^b Therefore, off-gas down-flow in the fines column should be minimized during high-temperature operation.

Table 3 Feed Blend Ratios Using Variable Molarity Calcium Nitrate for Minimum Addition of 75 Gal¹

Waste	Operation Mode	Calcine Na+K Mole %	ANN (L/L Waste)	Aluminum to Na+K Ratio	Boron in Feed Blend (M)	Boric Acid (L/L Waste)	Ca(NO ₃) ₂ (L/L Waste)	Ca(NO ₃) ₂ Solution Recommended Molarity (M)	Volume Reduction Factor (L Waste/L Calcine)	Calcine Solids (g/L Blend)	Feed Nitrate ² (M)	Heat Gen. Rate (W/m ³)	Vol Waste at Max Feedrate (gal Waste/hr)	Approx. Max Feedrate for 450 lb/hr NO _x (Gal/hr)
WM-189	500/600°C	5.33%	2.60	6.50	0.022	0.080	0.111	0.968	3.694	108.1	6.45	5.04	41	181
WM-189	500/600°C	5.98%	2.22	5.68	0.026	0.085	0.100	1.078	4.123	107.9	6.41	5.62	45	182
WM-189	500/600°C	6.81%	1.83	4.85	0.034	0.107	0.089	1.210	4.658	107.2	6.32	6.35	52	184
WM-189	500/600°C	7.89%	1.45	4.03	0.045	0.130	0.078	1.377	5.351	106.2	6.21	7.30	60	187
WM-189	500/600°C	9.39%	1.07	3.20	0.060	0.153	0.067	1.599	6.289	104.9	6.06	8.58	71	191
WM-189	600°C	5.37%	2.60	6.50	0.007	0.000	0.109	0.990	3.713	110.0	6.59	5.06	41	178
WM-189	600°C	6.04%	2.22	5.68	0.008	0.000	0.097	1.107	4.147	110.1	6.58	5.66	46	178
WM-189	600°C	6.90%	1.83	4.85	0.009	0.000	0.086	1.256	4.697	110.3	6.56	6.41	52	178
WM-189	600°C	8.04%	1.45	4.03	0.010	0.000	0.074	1.450	5.415	110.5	6.54	7.39	60	179
WM-189	600°C	9.64%	1.07	3.20	0.012	0.000	0.063	1.717	6.392	110.8	6.51	8.72	71	179
WM-189	600°C	11.59%	0.75	2.50	0.014	0.000	0.053	2.034	7.547	111.2	6.47	10.29	85	180

¹Basis:

Scrub Recycle = 15.0% at 6.50 M NO₃

Calcine Mixture Bulk Density = 1.513 g/cm₃ at 600°C

ANN Concentration = 2.2 M Al

Boric Acid Concentration = 0.73 M B

Calcine product contains 0.233 mol NO₃/mol (Na+K) (i.e., 600°C calcination assumed for the 500/600°C blends)

²Feed nitrate does not include scrub recycle.

Table 4A Feed Blend Recipes That May be Run at 500°C or 600°C¹

	189:ANN (Min Na+K)		189:ANN		189:ANN		189:ANN (Initial)		189:ANN (Max Na+K) ⁴	
	Ratio	Volume (gal)	Ratio	Volume (gal)	Ratio	Volume (gal)	Ratio	Volume (gal)	Ratio	Volume (gal)
ANN (2.20 M)	0.583	1748	0.554	1662	0.514	1543	0.464	1393	0.398	1193
WM-189	0.224	673	0.250	750	0.280	841	0.319	958	0.371	1112
Boric Acid (0.733 M)	0.018	54	0.021	64	0.030	90	0.042	125	0.057	170
Calcium Nitrate	0.025	75	0.025	75	0.025	75	0.025	75	0.025	75
Calcium Nitrate: Molarity or dilute to 75gal:	0.97		1.08		1.21		1.38		1.60	
Scrub Recycle	15.0%	450	15.0%	450	15.0%	450	15.0%	450	15.0%	450
Total	1.000	3000	1.000	3000	1.000	3000	1.000	3000	1.000	3000
Boron Molarity (Min)	0.022		0.026		0.034		0.045		0.060	
Ca:F Ratio ³	0.81		0.81		0.81		0.81		0.81	
Na+K mol%	5.33%		5.98%		6.81%		7.89%		9.39%	
Al/Na+K Ratio	6.50		5.68		4.85		4.03		3.20	
Heat Generation (W/m ³)	5.04		5.62		6.35		7.30		8.58	
Approx. Max Feedrate for 450 lb/hr NOx (Gal/hr) ²	181		182		184		187		191	

¹Al/Na+K ratio and calcine bulk density values for this table are based on 600°C operation.

²Implementation of the hourly NO_x limit is based on the stack NO_x monitor measured value.

³Minimum Ca:F Ratio is 0.81 (500°C and 600°C operation); maximum recommended Ca:F Ratio is 1.10 (600°C operation only).

⁴Minimum recommended Al/Na+K mole ratio is 3.2 mol/mol.

Table 4B Feed Blend Recipes That May be Run Only at 600°C

	189:ANN 5.37 Mol% Na+K			189:ANN 6.04 Mol% Na+K			189:ANN 6.90 Mol% Na+K			189:ANN (Initial) 8.04 Mol% Na+K			189:ANN 9.64 Mol% Na+K			189:ANN (Max Na+K) ³ 11.59 Mol% Na+K		
	Ratio	Volume (gal)		Ratio	Volume (gal)		Ratio	Volume (gal)		Ratio	Volume (gal)		Ratio	Volume (gal)		Ratio	Volume (gal)	
ANN (2.20 M)	0.596	1787		0.568	1705		0.534	1602		0.489	1466		0.427	1281		0.354	1061	
WM-189	0.229	688		0.257	770		0.291	873		0.336	1009		0.398	1194		0.471	1414	
Boric Acid (0.733 M)	0.000	0		0.000	0		0.000	0		0.000	0		0.000	0		0.000	0	
Calcium Nitrate	0.025	75		0.025	75		0.025	75		0.025	75		0.025	75		0.025	75	
Calcium Nitrate: Molarity or dilute to 75gal:	0.99			1.11			1.26			1.45			1.72			2.03		
Scrub Recycle	15.0%	450		15.0%	450		15.0%	450		15.0%	450		15.0%	450		15.0%	450	
Total	1.000	3000		1.000	3000		1.000	3000		1.000	3000		1.000	3000		1.000	3000	
Boron Molarity (Min)	0.007			0.008			0.009			0.010			0.012			0.014		
Ca:F Ratio ²	0.81			0.81			0.81			0.81			0.81			0.81		
Na+K mol%	5.37%			6.04%			6.90%			8.04%			9.64%			11.59%		
Al/Na+K Ratio	6.50			5.68			4.85			4.03			3.20			2.50		
Heat Generation (W/m ³)	5.06			5.66			6.41			7.39			8.72			10.29		
Approx. Max Feedrate for 450 lb/hr NOx (Gal/hr) ¹	178			178			178			179			179			180		

¹Implementation of the hourly NO_x limit is based on the stack NO_x monitor measured value.

²Minimum Ca:F Ratio is 0.81; maximum Ca:F Ratio is 1.10.

³Minimum recommended Al/Na+K mole ratio is 2.5 mol/mol.

High-Temperature Considerations

A separate test procedure has been written for use during high-temperature operation (Temporary Procedure 1-00). The schedule suggested in 1-00 is flexible, and high-temperature blend recipes will need to be adjusted based on performance at the NWCF. The State of Idaho DEQ has indicated that high-temperature operation is within the current permit (PTC #023-00001). Therefore, the NO_x limit of 472 lb/hr must continue to be observed during high-temperature operation^c.

The NWCF has previously been operated at 600°C using WM-185 feed without significant operational problems^d. However, if difficulties are encountered, corrective actions other than changing the operating temperature should first be considered. Suggested corrective actions for some common potential problems are briefly outlined below:

High Scrub UDS Due To α -Alumina Formation – Pilot plant tests indicate that α -alumina formation is not significant at 600°C operation. Therefore, boric acid has been omitted from the high-temperature feed blends to maximize net waste throughput and minimize final waste form volume. If unusually high UDS results are observed while processing blends at the elevated temperature, boric acid should be added to subsequent blends. If desired, the maximum amount to add should be calculated using the standard 500°C correlation:

$$B = 1.1 * (0.2149 * (Na + K) - 0.0409)$$

where:

B is the suggested maximum molarity of boron in the feed

Na and K are the molarities of sodium and potassium in the feed blend, respectively

However, boric acid is fairly dilute. Addition of large quantities of boric acid will dilute the blend, which may increase fines generation and/or decrease bed building.

Excessive Cl⁻ Buildup In The Scrub – If excessive chloride buildup in the scrub is observed, an attempt should be made to identify the cause of this problem. If excessive fines carryover (as indicated by high aluminum and low acidity of the scrub) does not adequately explain the chloride buildup, it may be necessary to increase the amount of calcium in the feed blend. All blends listed in the tables of this letter are based on adding 40% excess calcium (molar basis) to chemically combine with all fluoride, chloride, sulfate, and phosphate in the feed. This value was selected based upon experience with WM-185 waste processing at 600°C at the NWCF, previous calcination experience, and process modeling which indicates that fluoride and chloride will be chemically bound with other components. However, if chloride buildup in the scrub solution is unacceptable, the calcium in the feed blend may be increased as required to alleviate this problem. Although increasing calcium in the blend is an acceptable means of controlling excessive chloride buildup in the scrub, discretion should be used when adding additional calcium. It has been speculated that large amounts of calcium in the blend may potentially contribute to plugging of the offgas line. In a previous high-temperature run at the NWCF, 90% excess calcium was added to the blend. Based on this experience, 90% excess calcium should be considered the recommended maximum amount for any feed blend. For WM-189 feed, a 90% excess of calcium is equivalent to a Ca:F value of 1.10. As an alternative to increasing the

amount of calcium in the blend, consideration should also be given to performing a deep recycle of the scrub back to the tank farm.

Unacceptable Calcine Particle Size – Previous high-temperature experience at the NWCF indicates that with more concentrated feed blends, the calcine particle size may increase to an unacceptable value. Preventative measures should be taken to keep particle size under control. These include: 1) increase the NAR by 5-10% when transitioning to high-temperature, and 2) change the feed blend in small steps, and allow several days run time between changes to let particle size stabilize. If particle size does not stabilize at an acceptable value, adjustments to the NAR and/or fluidizing air flowrate should first be considered. If particle size cannot be adequately controlled with these adjustments, the feed blend should be modified to correct this problem.

Inability To Build Bed Level – If operation at 600°C results in the inability to build bed level, it may be necessary to increase the aluminum to sodium plus potassium ratio for subsequent feed blend batches. Adjusting the recycle rate could also be considered. Previous experience at 600°C also indicates that bed level should be maintained at or slightly above levels typically targeted during 500°C operation. Operating with a low bed level at 600°C may result in the inability to build bed level.

Offgas Line Plugging – In the previous high-temperature trial at NWCF, plugging was experienced shortly after the transition from 600°C to 500°C due to renitration of the high-temperature fines. Once operation is commenced at 600°C on ANN/Na blends, the temperature should not be lowered to 500°C without taking the appropriate measures as specified in the S.O. test procedure and applicable operating procedures.

Tests indicate that ANN/Na calcines exhibit an increased hygroscopicity compared to other calcines. Therefore, as a precautionary measure, it is recommended that at least 2 cold feed batches be processed at the conclusion of the run or prior to placing the calciner in standby mode. This will help to flush the system, as well as ensure that the top layer of calcine or fines that remain in the system is not excessively hygroscopic.

Table 5 lists the blended waste feed composition for each 500°C/600°C blend, as well as for each 600°C-only blend. Also, chemical usage has been estimated for each blend, based on a calcinable waste volume for WM-189 of 86,000 gallons. Note that the usage given for $\text{Ca}(\text{NO}_3)_2$ is for stock 4.3 M Ca solution, and does not reflect the actual amount of diluted $\text{Ca}(\text{NO}_3)_2$ solution that will be used (i.e., diluted to assure a minimum of 75 gallons per 3000 gallon batch).

Table 5 Blended Waste Feed Composition & Chemical Usage

Species		500/ 600°C	500/ 600°C	500/ 600°C	500/ 600°C	500/ 600°C	600°C	600°C	600°C	600°C	600°C	600°C
Na+K, Calcine	(Mole %)	5.33%	5.98%	6.81%	7.89%	9.39%	5.37%	6.04%	6.90%	8.04%	9.64%	11.59%
Al/Na+K	(Ratio)	6.50	5.68	4.85	4.03	3.20	6.50	5.68	4.85	4.03	3.20	2.50
ANN	(L/L Waste)	2.60	2.22	1.83	1.45	1.07	2.60	2.22	1.83	1.45	1.07	0.75
Ca($\frac{1}{2}$ F + $\frac{1}{2}$ Cl + SO ₄ + $\frac{3}{2}$ PO ₄)	(Ratio)	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Ca:F	(Ratio)	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Ca(NO ₃) ₂ Solution	(L/L Waste)	0.111	0.100	0.089	0.078	0.067	0.109	0.097	0.086	0.074	0.063	0.053
Ca(NO ₃) ₂ Solution Molarity	(Ca(NO ₃) ₂ , M)	0.968	1.078	1.210	1.377	1.599	0.990	1.107	1.256	1.450	1.717	2.034
Boron Factor	(times minimum)	1.10	1.10	1.10	1.10	1.10	0.00	0.00	0.00	0.00	0.00	0.00
H ₃ BO ₃	(L/L Waste)	0.080	0.085	0.107	0.130	0.153	0.000	0.000	0.000	0.000	0.000	0.000
Chemical Usage												
Waste	(gal)	86,000	86,000	86,000	86,000	86,000	86,000	86,000	86,000	86,000	86,000	86,000
ANN	(gal)	223,256	190,533	157,767	125,044	92,278	223,256	190,533	157,767	125,044	92,278	64,500
4.3 M Ca(NO ₃) ₂ Equivalent	(gal)	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157
Ca(NO ₃) ₂ Variable M Soln.	(gal)	9,579	8,600	7,667	6,734	5,800	9,371	8,380	7,387	6,395	5,402	4,561
H ₃ BO ₃	(gal)	6,843	7,283	9,232	11,179	13,128	0	0	0	0	0	0
Acid	(H+, M)	0.8157	0.8862	0.9690	1.0746	1.2143	0.8338	0.9095	1.0057	1.1315	1.3038	1.5086
Nitrate	(NO ₃ , M)	6.4480	6.4071	6.3201	6.2093	6.0625	6.5886	6.5758	6.5595	6.5382	6.5090	6.4742
Aluminum	(Al, M)	1.7427	1.6948	1.6247	1.5352	1.4169	1.7813	1.7394	1.6862	1.6165	1.5212	1.4079
Boron	(B, M)	0.0220	0.0256	0.0342	0.0452	0.0597	0.0067	0.0075	0.0086	0.0099	0.0117	0.0139
Cadmium	(Cd, M)	0.0013	0.0014	0.0016	0.0018	0.0021	0.0013	0.0014	0.0016	0.0019	0.0022	0.0026
Calcium	(Ca, M)	0.0507	0.0564	0.0633	0.0721	0.0837	0.0518	0.0579	0.0657	0.0759	0.0898	0.1064
Chloride	(Cl, M)	0.0064	0.0071	0.0080	0.0091	0.0105	0.0065	0.0073	0.0083	0.0095	0.0113	0.0134
Chromium	(Cr, M)	0.0012	0.0014	0.0015	0.0017	0.0020	0.0012	0.0014	0.0016	0.0018	0.0022	0.0026
Fluoride	(F, M)	0.0622	0.0693	0.0778	0.0885	0.1028	0.0636	0.0711	0.0807	0.0932	0.1104	0.1307
Iron	(Fe, M)	0.0066	0.0074	0.0082	0.0094	0.0109	0.0067	0.0075	0.0086	0.0099	0.0117	0.0139
Lead	(Pb, M)	0.0003	0.0003	0.0004	0.0004	0.0005	0.0003	0.0003	0.0004	0.0004	0.0005	0.0006
Manganese	(Mn, M)	0.0031	0.0034	0.0038	0.0044	0.0051	0.0031	0.0035	0.0040	0.0046	0.0054	0.0064
Mercury	(Hg, M)	0.0041	0.0046	0.0052	0.0059	0.0068	0.0042	0.0047	0.0054	0.0062	0.0073	0.0087
Molybdenum	(Mo, M)											
Nickel	(Ni, M)	0.0005	0.0006	0.0007	0.0007	0.0009	0.0005	0.0006	0.0007	0.0008	0.0009	0.0011
Phosphate	(PO ₄ , M)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
Potassium	(K, M)	0.0301	0.0335	0.0376	0.0428	0.0497	0.0308	0.0344	0.0391	0.0451	0.0534	0.0633
Sodium	(Na, M)	0.2380	0.2651	0.2974	0.3386	0.3931	0.2433	0.2721	0.3086	0.3565	0.4220	0.4999
Sulfate	(SO ₄ , M)	0.0018	0.0020	0.0022	0.0025	0.0029	0.0018	0.0020	0.0023	0.0026	0.0031	0.0037
Zirconium	(Zr, M)	0.0094	0.0105	0.0118	0.0134	0.0156	0.0096	0.0108	0.0122	0.0141	0.0167	0.0198
Uranium	(U, mg/l)	14.4575	16.1021	18.0634	20.5650	23.8760	14.7774	16.5261	18.7475	21.6543	25.6342	30.3655
Undissolved Solids	(UDS, g/l)	0.2905	0.3235	0.3629	0.4132	0.4797	0.2969	0.3320	0.3767	0.4351	0.5150	0.6101
Americium 241	(Am-241, mCi/l)											
Antimony 125	(Sb-125, mCi/l)											
Cerium 144	(Ce-144, mCi/l)											
Cesium 134	(Cs-134, mCi/l)	0.0555	0.0618	0.0693	0.0789	0.0916	0.0567	0.0634	0.0719	0.0831	0.0983	0.1165
Cesium 137	(Cs-137, mCi/l)	32.2159	35.8804	40.2508	45.8253	53.2032	32.9287	36.8253	41.7752	48.2526	57.1210	67.6639
Cobalt 60	(Co-60, mCi/l)											
Europium-154	(Eu-154, mCi/l)	0.1083	0.1206	0.1353	0.1540	0.1788	0.1107	0.1238	0.1404	0.1622	0.1920	0.2274
Europium-155	(Eu-155, mCi/l)											
Iodine-129	(I-129, mCi/l)											
Neptunium-237	(Np-237, mCi/l)											
Nickel-63	(Ni-63, mCi/l)											
Plutonium-238	(Pu-238, mCi/l)											
Plutonium-239	(Pu-239, mCi/l)											
Plutonium	(Total Pu, mCi/l)											
Ruthenium-106	(Ru-106, mCi/l)											
Strontium-90	(Sr-90, mCi/l)	29.3111	32.6453	36.6216	41.6935	48.4062	29.9598	33.5050	38.0086	43.9019	51.9707	61.5630
Technetium-99	(Tc-99, mCi/l)											
Tritium	(H-3, mCi/l)	0.0061	0.0068	0.0076	0.0086	0.0100	0.0062	0.0069	0.0079	0.0091	0.0108	0.0128
Heat Generation Rate	(W/m ³)	0.36	0.40	0.45	0.51	0.59	0.37	0.41	0.47	0.54	0.64	0.76
Activity	(Ci/l)	0.06	0.07	0.08	0.10	0.11	0.06	0.07	0.08	0.10	0.11	0.13

Blend calculations for 500°C operation were previously verified, and are documented in a prior letter.^a Additionally, blend calculations for the recommended starting blend (7.89% mol % Na+K) have also been verified and documented previously.^c Therefore, verification of only one 600°C blend ratio (9.64 mol % Na+K) was necessary before issuance of this letter. Verification was performed by J. P. Law using the NWCF DCS feed batch program to calculate heat generation rate and mol % Na+K. During verification, slight differences were observed (8.72 W/m³ vs. 7.21 W/m³ for heat generation of solids, and 9.64 mol % vs. 9.45 mol % for Na+K content of the solids). Therefore, a recalculation of the spreadsheet was performed using the same values as the NWCF DCS feed batch program (1.37 g/ml for calcined solids density, and 0.66 for the ratio of nitrate mol % to Na+K mol % in the calcined solids). These changes resulted in agreement with the NWCF DCS feed batch program (7.18 W/m³ vs. 7.21 W/m³ for heat generation of solids, and 9.45 mol % vs. 9.45 mol % for Na+K content of the solids). Copies of the DCS batch program printouts are included as Attachment 1. For future reference, a spreadsheet printout with blended feed concentrations before scrub addition is also included as Attachment 2. If you have any questions, please contact me at 6-2273, or you may contact either B. H. O'Brien at 6-3120 or J. P. Law at 6-3091.

Attachments

cc: R. D. Boardman, MS 5218
R. R. Bone, MS 5117
R. R. Chase, MS 5108
D. V. Croson, MS 5218
R. H. Davis, MS 5233
W. B. DeBow, MS 5224
W. M. Ison, MS 5111
W. E. Landon, MS 5220
J. P. Law**, MS 5111 *JPL*
C. B. Millet, MS 3211
J. A. Nenni, MS 5218
B. H. O'Brien*, MS 5218 *BHO*

R. E. Schindler, MS 5218
M. D. Staiger, MS 3211
M. C. Swensen, MS 5218
F. S. Ward, MS 5111
J. M. White, MS 5111
H. C. Wood, MS 5218
T. S. Yoder, MS 5218
R. A. Wood File* (RAW-01-00)
UFC: RCRA/6153*
* w/Attachments
** w/Attachments and electronic copy for inclusion in Run Plan

References:

- (a) B. H. O'Brien letter to K. B. Farmer, BHO-11-98, WM-189/Aluminum Nitrate Blend Calculations For NWCF Run H4, dated October 6, 1998.
- (b) J. A. Nenni and D. R. Marshall letter to D. V. Croson, JAN-08-98/DRM-05-98, Calcination of WM-185 Waste, dated September 30, 1998.
- (c) S. J. Richards to R. C. Cullison, P-990027, *Idaho National Engineering and Environmental Laboratory (INEEL), New Waste Calcine Facility (NWCF), Idaho Falls (Permit to Construct Applicability Determination)*, dated March 16, 1999.
- (d) R. A. Wood letter to D. W. Marshall, RAW-08-99, Transmittal of NWCF High-Temperature Trial Report for FY-1999, dated September 30, 1999.
- (e) R. A. Wood letter to K. B. Farmer, RAW-09-99, Aluminum Nitrate/WM-189 Blend Calculations for 500°C and 600°C Operation During NWCF Run H4, dated December 16, 1999.

NWCF HOT FEED MAKE-UP DCS REPORT

Batch Number: 4-101-H
Completion Time: 13:55:50 08 FEB 00
Make-up Vessel: VES-NCC-102

Recycle Added: 450 gallons received from VES-NCC-108
Raw Feed #1 Added: XXXXXXXX gallons received from XXXXXXXXXXXX
Raw Feed #2 Added: XXXXXXXX gallons received from XXXXXXXXXXXX

Blend Added 1194 gallons received from VES-NCC-101
Al. Nitrate Added: 1281 gallons received from CPP601 PM AR
Special Added: XXXXXXXX gallons received from XXXXXXXXXXXX

Sld Boric Acid Added XXXXXXXX kgs
Liq Boric Acid Added XXXXXXXX gallons received from XXXXXXXXXXXX
Solid Ca(NO3)2 Added 0 lbs.
Liq. Ca(NO3)2 Added: 75 gallons received from VES-NCM-120

Final Batch Volume: 3000 gallons
Final Batch Density: 1.100 Sp. Gr.
Final Ca / F Ratio: 0.8148 (ORM 7.5.1.4)

		Raw #1	Raw #2	Blend	Spcl	FINAL FEED
		-----	-----	-----	-----	=====
ACID (H+)	Molar	XXXXXXX	XXXXXXX	2.5700	XXXXXXX	1.2034
ALUMINUM (Al)	Molar	XXXXXXX	XXXXXXX	0.8884	XXXXXXX	1.5212
BORON (B)	Molar	XXXXXXX	XXXXXXX	0.0250	XXXXXXX	0.0117
CADMIUM (Cd)	Molar	XXXXXXX	XXXXXXX	0.0048	XXXXXXX	0.0022
CALCIUM (Ca)	Molar	XXXXXXX	XXXXXXX	0.0840	XXXXXXX	0.0899
CHLORIDE (Cl)	Molar	XXXXXXX	XXXXXXX	0.0241	XXXXXXX	0.0113
CHROMIUM (Cr)	Molar	XXXXXXX	XXXXXXX	0.0046	XXXXXXX	0.0022
FLUORIDE (F)	Molar	XXXXXXX	XXXXXXX	0.2357	XXXXXXX	0.1104
IRON (Fe)	Molar	XXXXXXX	XXXXXXX	0.0250	XXXXXXX	0.0117
LEAD (Pb)	Molar	XXXXXXX	XXXXXXX	0.0011	XXXXXXX	0.0005
NITRATE (NO3)	Molar	XXXXXXX	XXXXXXX	6.2300	XXXXXXX	6.3338
PHOSPHATE (PO4)	Molar	XXXXXXX	XXXXXXX	0.0003	XXXXXXX	0.0001
POTASSIUM (K)	Molar	XXXXXXX	XXXXXXX	0.1141	XXXXXXX	0.0534
SODIUM (Na)	Molar	XXXXXXX	XXXXXXX	0.9013	XXXXXXX	0.4220
SULFATE (SO4)	Molar	XXXXXXX	XXXXXXX	0.0067	XXXXXXX	0.0031
URANIUM (U)	Molar	XXXXXXX	XXXXXXX	0.0002	XXXXXXX	0.0001
ZIRCONIUM (Zr)	Molar	XXXXXXX	XXXXXXX	0.0357	XXXXXXX	0.0167
Undiss. Solids	g/L	XXXXXXX	XXXXXXX	1.10	XXXXXXX	0.52
Heat Generation	W/m3	XXXXXXX	XXXXXXX	1.36	XXXXXXX	0.639

(XXXXXXX's indicate data not applicable for this batch)

NWCF HOT FEED MAKE-UP DCS REPORT

Page 2 of 2

Batch Number: 4-101-H

ESTIMATED CALCINE COMPOSITION (per liter of feed)

Al ₂ O ₃	0.6885	moles	KNO ₃	0.0353	moles
B ₂ O ₃	0.0059	moles	K ₃ PO ₄	0.0000	moles
CaCl ₂	0.0000	moles	KF	0.0000	moles
CaF ₂	0.0552	moles	KAlO ₂	0.0006	moles
CaO	0.0345	moles	K ₂ SO ₄	0.0031	moles
Ca ₃ (PO ₄) ₂	0.0001	moles	KCl	0.0113	moles
CaSO ₄	0.0000	moles	K ₂ O	0.0000	moles
CdO	0.0022	moles	NaNO ₃	0.2785	moles
CdSO ₄	0.0000	moles	Na ₃ PO ₄	0.0000	moles
Cr ₂ O ₃	0.0011	moles	NaF	0.0000	moles
Fe ₂ O ₃	0.0059	moles	NaAlO ₂	0.1435	moles
PbO	0.0005	moles	Na ₂ SO ₄	0.0000	moles
UO ₃	0.0001	moles	NaCl	0.0000	moles
ZrO ₂	0.0167	moles	Na ₂ O	0.0000	moles

CALCINED WASTE GENERATION DATA (this batch only)

Volume Reduction Factor: 11.284

Density Calcined Solids: 1.37 g/ml

Volume Calcined Solids: 0.8554 m³

Heat Generation of Solids: 7.2070 W/m³

Na + K content of Solids: 9.4456 mol %

SIXTH BIN SET WASTE STORAGE DATA (40 BATCH AVERAGE)

Heat Generation of Solids: 6.3548 W/m³

Na + K content of Solids: 8.3722 mol %

[illegible]

Letter file

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: December 7, 1998

To: M. D. Staiger MS 3211 6-3122

From: R. S. Herbst *RSH* MS 5218 6-6836

Subject: MERCURY AND CHLORIDE ANALYSES IN CALCINES PRODUCED IN NWCF
CAMPAIGN H-4 – RSH-07-98

The Long Term Waste Treatment Group in Technology Development prepared several solutions of dissolved radioactive calcines produced during the H-4 campaign at NWCF. The calcine dissolutions were performed to prepare feed materials for separations technology development activities (solvent extraction and ion exchange) during treatability studies conducted during FY-97. Analysis of these aqueous solutions provides some insight into the composition of the H-4 calcine. The purpose of this letter is to formally transmit the results of these analyses and provide data relative to the content of mercury and chloride in the H-4 calcine.

Three separate dissolutions of H-4 calcines were performed in the Remote Analytical Laboratory. In all cases the dissolution ratio was 10 mL of nitric acid per gram of calcine and boiling the solution for >1 hour with constant reflux. Two of the dissolutions were performed with H-4 calcines produced from tank WM-188/ANN. The third dissolution was performed with a mixture of H-4 calcines produced from both WM-188/ANN and WM-185/ANN. The analytical results for Hg and Cl are tabulated below and converted to solid phase composition:

H-4 Calcine	Approx. Date Calcine Produced	Calcine Mass Dissolved (g)	Solution Analysis	Solid Composition
WM-188/ANN	2/3/97 – 2/19/97	190.9	5.72 µg/mL Hg <48.6 µg/mL Cl	57.2 µg/g Hg <486 µg/g Cl
WM-188/ANN	3/17/97	106.9	<1.76 µg/mL Hg	<17.6 µg/g Hg
WM-185/ANN	4/7/97	59.15	283 µg/mL Cl	2830 µg/g Cl
WM-188/ANN	3/17/97	39.15	4.34 µg/mL Hg <24.38 µg/mL Cl	43.4 µg/g Hg <243.8 µg/g Cl

Note that the above solid phase compositions are per gram of calcine and assume all of the mercury and chloride dissolved and remained in solution – these components did not remain in the undissolved solids (UDS), nor were they volatilized during the dissolution process. Limited analyses have been performed on UDS from radioactive H-4 calcine and to a larger extent on pilot plant calcines, in no case has mercury ever been observed in the UDS. Finally, the use of a total condenser and temperatures of ~100°C during dissolution is not expected to result in Hg or Cl volatilization during the dissolution process.

RSH/sm

cc: C. M. Barnes, MS 3625
J. D. Law, MS 5218
A. L. Olson, MS 5218
J. A. Rindfleisch, MS 5218

R. E. Schindler, MS 5218
M. C. Swenson, MS 1504
T. A. Todd, MS 5218
R. S. Herbst, file

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Lockheed Martin Idaho Technologies Company**INTERDEPARTMENTAL COMMUNICATION**

Date: October 16, 1997

To: B. H. O'Brien *pho* MS 5218 6-3120

From: R. E. Schindler *R. E. Schindler* MS 5218 6-3111

Subject: MERCURY BEHAVIOR DURING NWCF RUN H-4 OPERATION – SCHI-25-97

References: (a) R. E. Schindler, Schi-17-97 to B. H. O'Brien, NWCF Atomspheric Mercury Emission, dated October 8, 1997.

The behavior of mercury during calcination in the NWCF is an issue for modeling the NWCF and estimating emissions. A particular concern is the extent to which mercury accumulates in the scrub solution and is transferred to the tank farm as a result of deep recycles of the scrub solution.

The recent NWCF shutdown with draining of scrub solution to NCC-119 provides an opportunity to do a material balance on the mercury fed to NWCF and determine where the mercury goes. The material balance of the attachment indicates of the mercury in the NWCF feed during the first three months of operation: 84 % was collected in the scrub solution, 0.76 % was discharged to the atmosphere^a 0.05 % drained to NCC-122, and 15 % was not found. Likely dispositions of the mercury not found are 1) residuals in the unrinsed process vessels, equipment and piping, 2) retention in the calcined solids fines, and 3) sorption in the silica gel.

rmg

Attachment

cc: R. D. Boardman, MS 5218
D. V. Croson, MS 5218
J. A. DelDebbio, MS 5218
M. M. Dumas, MS 5111
K. B. Farmer, MS 5111
J. P. Law, MS 5111
C. M. Mohr, MS 3625
M. C. Swenson, MS 5104
D. D. Taylor, MS 3625
F. S. Ward, MS 5111
R. E. Schindler file

MERCURY BEHAVIOR IN THE NWCF DURING INITIAL THREE MONTHS OF RUN H-4 HOT OPERATION

The September 27 NWCF shutdown offers a good opportunity for a material balance on the Hg fed to the NWCF during the first 3 1/3 months (June 17 through September 27) of NWCF operation. The blended feed tanks were emptied and the scrub solution was drained to NCC-119 so there are no large unsampled inventories in the process.

Material balance on mercury

The mercury inputs, outputs, and heel for NWCF operation from June 17 through September 27 are summarized in Table 1. The total net waste volume received¹ in the blend tanks for feed batches H-1 through H-147 is 141,149 gal. (which is greater than the WM-188 depletion because of jet dilution). The waste in the feed (as sampled from NCC-101 contains² 1.48 g Hg/l. The total Hg fed to the NWCF is then 791 kg.

Table 1. Mercury inputs, outputs, and heel for NWCF operation through September 27.

Date	Transfer	Vol ^a , gal	Spl. log #	[Hg], g/l	Hg, kg
	Feed to NCC-101	141,149	Ref. 2	1.48	791
7/18	NCC-119 ^b to WM-187	3533	0714-3	2.76	37
9/12	NCC-119 to WM-189	3145	0907-2	26.6	317
9/30	NCC-119 to WM-189	2255	0929-4	28.6	244
9/30	NCC-119 heel	600	0929-4	28.6	65
6/25	NCC-122 to PEW	2750	0621-1	0.0032	0.033
10/2	NCC-122 to PEW	2825	0930-5	0.0368	0.4

a. Volumes from the WPCS measured in NCC-119, -122 or -101.

b. This tank of liquid contained feed, not included in the 141,149 gal. of feed, from a batch of feed inadvertently drained to the air-lift pit.

The Hg collected in the scrub solution is determined from volumes and concentrations in NCC-119 (which also received miscellaneous flushes and absorber drainage). There were several partial drains of scrub solution to NCC-119 during operation followed by a complete drain from NCC-108 following shutdown. There were three transfers, with sampling, from NCC-119 to WM-189 or -187 whose particulars are given in Table 1. The total Hg collected in NCC-119 is 663 Kg (84 % of the Hg in the feed) of which 598 kg were transferred to WM-189 or -187 (and 65 kg remained in the NCC-119 heel).

A small amount of Hg is collected in NCC-122 from condensate draining from the intercoolers. The Hg concentrations in NCC-122 were small and the total Hg in NCC-122 amounted to only about 0.05 % of the Hg in the NWCF feed.

The Hg emitted to the atmosphere from the stack was determined³ to be about 0.76 % of the Hg in the NWCF feed.

Discussion

The total Hg found is about 85 % of the Hg in the NWCF feed. Although a material balance deficit of 15 % could be an experimental error, the deficit has appeared⁴ persistantly throughout the run. Potential fates of the 15 % of the Hg not found in the scrub solution are:

- Process residuals

The process vessels and piping were drained but not rinsed (which is not needed for a temporary break in processing). Additional Hg is present in minimum vessel heels (e. g., in NCC-108), in pumps, other equipment and lines, and on vessel walls (and the off-gas cell floor). This residual Hg may be a significant share of the Hg not found.

- Fines

Samples⁵ of the NWCF bed solids (calcined at 500°C) have had Hg concentrations below detection limits. However, the fines, which cannot be sampled, might contain more Hg because of a lower residence time (especially of spray dried feed) at the high temperature. Pilot-plant calcining tests⁶ with Hg showed higher Hg concentrations on the fines samples. Note that an increase in calcining temperature to 600°C will decrease any Hg retention in the fines.

- Down-stream off-gas system

A study⁷ of Hg behavior in the WCF found that most of the Hg that got through the scrub system was retained in the down-stream sections of the off-gas system, probably in the absorbers and filters. Similar behavior can be expected in the NWCF. The (about 25 m³ of) Si-gel in the absorber vessel is likely to absorb a major fraction of any high-boiling vapor in the off gas.

Conclusion

1. About 84 % of the Hg in the first 147 batches of NWCF feed was collected in the scrub solution.
2. Continuing Hg accumulation in the NWCF scrub solution should be expected during NWCF operation. The Hg accumulated in the scrub solution will return to the tank farm in deep recycles and end-of-campaign flushes.

3. The conservative assumption for emissions estimates⁸ that all of the Hg in the feed is collected in the scrub system does not appear unreasonable especially when the calcination temperature may increase to 600°C.

References

1. M. M. Dumas, Spreadsheet "Hot Feed Batch Data", October, 1997.
2. R. J. Rivard, RJR-02-97 to K. B. Farmer, Aluminum Nitrate/WM-188 Blend Calculations For NWCF Run H-4, dated April 7, 1997.
3. R. E. Schindler, Schi-23-97 to J. P. Law, NWCF Atmospheric Mercury Emission, dated October 8, 1997.
4. R. E. Schindler, Schi-17-97 to B. H. O'Brien, Mercury Behavior During Initial NWCF RUN H4 Operation, dated July 23, 1997.
5. R. S. Garcia, Waste Inventories/Characterization Study, INEL/EXT-97-00600, July 1997, Table 7.
6. B. J. Newby, CALCINATION OF DILUTE ZIRCONIUM WASTE, ENICO-1042, November, 1980, App. D.
7. A. K. Herbst, MERCURY CONCENTRATIONS IN THE EFFLUENT STREAMS OF THE IDAHO CHEMICAL PROCESSING PLANT, ACI-378, May, 1979, Figure 8.
8. R. E. Schindler, Schi-14-97 to B. W. Brown, Independent Validation Of Upper-Level NWCF Emissions For Screening-Level Risk Analysis, dated June 25, 1997.

PHILLIPS PETROLEUM COMPANY
Atomic Energy Division
Idaho Falls, Idaho
December 22, 1964

INTER-OFFICE CORRESPONDENCE / SUBJECT

Temperatures in Present Solids
Storage Facilities
JWG-94-64A

L. J. Weber

Attached are temperature data from the existing WCF storage bins for transmittal to Norman Engineering. Considerable information is included because we feel that evaluation of the data should not be attempted without adequate history of the operation.

Phillips is planning to analyze the temperature data obtained from the present solids storage bins in conjunction with data obtained from the new bins and data obtained from a fuel burial study. We doubt that Norman Engineering will be able to complete an analysis of the attached data in time to utilize the results in the design of the new storage bins and, considering our planned study, feel that their detailed analysis of the data is unnecessary.

If you have any questions concerning the attached information, please let us know.

JWGarner:emh/GEL

GEL

JW Garner

Attachment

cc: A. L. Ayers
J. A. Buckham *3/2/21*
R. I. Kuehl
N. J. Rigstad
B. M. Legler
G. E. Lohse *GL*
K. W. Richardson (11)
J. W. Garner
File

TEMPERATURE INFORMATION ON PRESENT SOLIDS STORAGE FACILITIES

The WCF was started up on November 30, 1963, with non-radioactive, simulated waste solution. Operation with the "cold" feed continued until December 8, 1963, at which time feed from WM-185 liquid storage tank was introduced into the calciner. Consequently almost the entire volume of the inner chamber of bin WC-115-1 was filled with non-radioactive solids.

Feed from WM-185 was introduced from December 8, 1963, until March 29, 1964. Approximately 170,000 gallons (containing 3.3×10^6 curies) of waste from this tank was converted to solids which were transferred to the storage bins. The calculated heat generation rate, as of March, 1964, based on the radiochemical analysis of these solids was $0.34 \text{ Btu}/(\text{hr})(\text{lb})$. The estimated volume reduction factor was 9.6. The middle and outside chambers of bin WC-115-1, the inner chamber and one-half of the middle chamber of WC-115-2 were filled with solids from calcination of WM-185 feed.

On March 29, feed from the second liquid storage tank, WM-187, was introduced into the calciner. Operation with this feed continued until July 24, 1964. Approximately 208,000 gallons of waste (containing 5.8×10^6 curies) were converted to solids which were transferred to the storage bins. The calculated heat generation rate, as of August, 1964, for these solids was $0.86 \text{ Btu}/(\text{hr})(\text{lb})$. The estimated volume reduction factor was 8.8. One-half of the middle chamber and all of the outer chamber of WC-115-2 and all of the middle chamber and one-half of the outer chamber of WC-115-3 were filled with solids from calcination of WM-187 waste. The inner chamber of WC-115-3 contains solids from the calcination of both WM-185 and WM-187 wastes. The proportions of each are not known with certainty.

On July 24, feed from the third liquid waste tank, WM-183, was introduced into the calciner. Until calciner shutdown on October 15, approximately 129,000 gallons of waste (containing 2.2×10^6 curies) were converted to solids which were transferred to the storage bins. The calculated heat generation rate, as of August, 1964, for these solids was $0.28 \text{ Btu}/(\text{hr})(\text{lb})$. The estimated volume reduction factor was 9.9. One-half of the outer chamber of WC-115-3 and the middle chamber and approximately two-thirds of the outer chamber of WC-115-4 were filled with solids from calcination of WM-183 waste. The inner chamber of WC-115-4 contains solids from calcination of wastes from all three liquid storage tanks, but the proportions of each are not known with certainty.

Cooling of the solids storage bins until September 16 was accomplished by radiation to the vault wall and by convection of air flowing through cooling air annuli in the bins. On September 14, the air flow rate and air temperature differential were measured for determining the amount of convective heat transfer. The air flow was measured with a vane anemometer and then with a hot-wire anemometer. Both instruments indicated very close agreement. The

velocity *ft/min in a 36" dia stack (centerline)*
measured air rate was 230 ~~cfm~~ and the temperature differential was 39.6°F. These data indicated that only 34 percent of the calculated heat generation was removed by the cooling air stream. On September 16, the cooling air inlet valves were closed and heat transfer since that date has been by radiation to and conduction in the surrounding soil. In order to confirm the closure of the inlet valves, measurements were again taken on September 17. The cooling air stack temperature had dropped to ambient and no measurable air flow could be detected with the hot-wire anemometer. Obviously the above air flow rate and temperature differential are applicable to only a brief time increment because of the increasing amount of solids, hence heat generation and temperature, as the operation progressed.

Temperatures in the WCF storage bins and in the air annuli at various times during and subsequent to the recent processing campaign are shown in Tables 1 and 2. Though these tables summarize the temperatures in all of the storage bins on the various dates shown, they do not indicate when a specific chamber was filled nor show the transients which occurred during the filling. In order to help clarify the above two points as well as to provide additional information which may be useful to Norman Engineering in their heat transfer evaluation, we have included temperature profiles for six of the twelve chambers. Temperatures shown on Figures 1 to 6 were obtained from thermocouples located as shown on Fluor Drawing 5775-CPP-729-P-3 which has been furnished to the Architect previously. Generally, the temperatures shown are an average of two readings at the indicated thermocouple height.

Figure 1 shows the temperatures in the outer chamber of the first bin filled, WC-115-1. This chamber contains solids from WM-185 processing only. Figure 2 shows the temperatures in the middle chamber of WC-115-2. This bin contains solids from WM-185 processing and from WM-187 processing. The greater heat generation of the WM-187 material is amply demonstrated by the large difference in temperature of the 10.5 foot and the 15.5 foot levels. The temperatures in this chamber are the second highest observed in the existing storage bins.

Figure 3 shows the temperatures in the middle chamber of WC-115-3. These temperatures are the highest observed thus far. This chamber contains solids from WM-187 processing only. Figure 4 shows temperatures in the outer chamber of the same bin. The transition from the "hot" WM-187 solids to the "cooler", WM-183 solids is shown by the lower temperature at the 15.5-foot level than at the 10.5-foot level. The lower slope of the 15.5-foot parameter also indicates the lower heat generation.

Figure 5 shows the temperatures for the inner chamber of WC-115-4. This chamber contains solids from the processing of all three liquid wastes. Again these temperatures at least indicate the relative magnitudes of the heat generation of solids from processing the contents of various waste tanks. Figure 6 shows temperatures for the middle chamber of WC-115-4 which is filled essentially from WM-183 material. The slopes of the parameters when filling past the various bin levels are almost identical.

As was mentioned previously, the cooling air inlet valves were closed on September 16, 1964. A sharp rise in the temperatures is indicated on all bins during the following week. Thereafter the temperatures have increased slowly, but at a decreasing weekly rate, until late November. Excavation for the new storage bins have exposed about one-eighth of the south vault wall and ambient outside air temperatures continue to drop. The apparent decrease in the bin temperatures as of December 7 possibly may be attributed to the above occurrences, but it may be some time before we can say with certainty that maximum temperatures have been attained.

On November 4, just as excavation reached the roof slab of the existing bin vault, temperatures were obtained by submerging thermometers about six inches into the soil and right against the concrete surface. The hot earth provided constant temperature readings within ten minutes. These were as follows:

1. 30 inches from southeast edge of roof slab - 135°F
2. 8 feet from east edge - 142°F
3. Above the cooling air inlet - 131°F
4. East edge of stack foundation - 124°F
5. 30 inches from southwest edge - 122°F.

TABLE 1: TEMPERATURES IN WCF STORAGE BINS

CENTERLINE TEMPERATURES* BIN AND CHAMBER	DATE							D. 21	D. 70
	FEB 17	MAY 11	JUNE 4	SEPT 14	NOV 2	NOV 30	DEC 7		
WC-115-1 INNER	33	67 ^{23'}	82 ^{23'}	98 ^{23'}	131	132	134		132
MIDDLE "	100	113	125	142	187	192	193		191
OUTER	94 ^{5.5'}	107	114	131	171	181	181		178
WC-115-2 INNER	84 ^{55'}	114	130	146	194	198	195		193
MIDDLE	19	161	176	176	217	221	218		213
OUTER	30 ^{17.5'}	116 ^{10.5'}	159 ^{10.5'}	160 ^{17.5'}	197 ^{10.5'}	208 ^{10.5'}	205 ^{10.5'}		198
WC-115-3 INNER	88 ^{10.5'}	107	121	156	202	207	202		200
MIDDLE	20 ^{19.0'}	31 ^{19.0'}	105	178	217	224	219		215
OUTER	25 ^{19.5'}	32 ^{19.5'}	43	160 ^{10.5'}	197 ^{10.5'}	207 ^{10.5'}	202 ^{10.5'}		198
WC-115-4 INNER	26 ^{0.5'}	104 ^{5.5'}	157	176	214	215	215		210
MIDDLE	21 ^{19.5'}	31 ^{19.5'}	45 ^{19'}	133	185	193	190		188
OUTER	25 ^{17.5'}	33 ^{19'}	45 ^{19'}	67 ^{19.0'}	177 ^{10.5'}	188	184		182

SPECIAL PROFILE TEMPERATURES

* Maximum temperature in chamber
Elevation is at 15.5' except as noted

WC-115-2 OUTER

Centerline at 17.5'	30	46	142	150	184	197	193		189
One Foot at 17.5'	30	47	110	124	165.5	180	177		172
1/2" from Wall at 17.5'	30	54	75	97	145.5	162	158		163

WC-115-4 MIDDLE

Centerline at 17.5'	NA	NA	NA	NA	175.5	NA	184		
One Foot at 17.5'	NA	NA	NA	NA	148.2	NA	162.5		
1/2" from Wall at 17.5'	NA	NA	NA	NA	136.5	NA	150		

TABLE 2: TEMPERATURES IN THE AIR ANNULI OF WCF STORAGE BINS

		DATE							DATE					12/28
<u>WC-115-1</u>		Feb 17, 1964	May 11, 1964	Sept 14, 1964	Nov 30, 1964	Dec 7, 1964	<u>WC-115-2</u>		Feb 17, 1964	May 11, 1964	Sept 14, 1964	Nov 30, 1964	Dec 7, 1964	
Air Duct	Elevation													
Inner	0'	19	23	34	114	114		19	23	38	114	113	111	
	10'	29	37	63	135	133		28	37	66	136	133	133	
	20'	38	48	80	131	130		29	52	84	147	144	138	
Middle	0'	20	23	35	115	115		20	23	39	114	112	112	
	10'	33	43	67	134	135		26	41	64	140	136	136	
	20'	34	44	74	137	135		29	44	79	141	137	137	
Outer	0'	19	23	38	118	118		19	23	35	119	116	115	
	10'	30	35	62	123	122		26	38	65	127	124	122	
	20'	31	40	66	125	119		28	39	72	125	121	118	

<u>WC-115-3</u>									<u>WC-115-4</u>					12/28
Air Duct	Elevation													
Inner	0'	19	25	36	113	110	114		19	21	32	106	105	
	10'	29	36	68	138	133	134		27	34	63	128	129	
	20'	29	39	87	144	142	140		28	34	75	133	132	
Middle	0'	22	26	38	114	111	112		20	22	32	106	105	
	10'	28	35	72	144	139	140		23	29	65	112	105	
	20'	30	37	76	145	132	129		31	34	65	124	122	
Outer	0'	22	27	40	119	115	115		20	23	36	111	109	
	10'	28	34	66	131	127	126		28	31	58	117	116	
	20'	30	37	71	127	123	121		31	34	63	117	115

FIGURE 7

FIGURE 4.
OUTSIDE C-ANALOG
WC-115-3

Parameters Are Bin Or Air Duct	Centerline Temperatures	At Elevations Shown
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HLW-100 908

TS

MMD-02-94

From : M. M. Dumas
Phone : 6-3290/PPP-663/MS 5230
Date : April 1, 1994
Subject: NWCF Campaign H-3 (1993 Portion) Feed Data

To : M. D. Staiger, Fellow Engineer
Calcine Retrieval

cc: J. G. Burton J. P. Law
C. M. Frazee W. B. Palmer

Reference: Letter HBE-6-86, H. B. Eldredge to S. S. Bodner,
"Disposal of Classified Calcine in the 6th Set Solid
Storage Facility," dated May 2, 1986.

Attached is feed data, compiled on a monthly basis, for all cold and hot batches fed to the calciner during the 1993 portion of NWCF Campaign H-3. All of the calcine produced during this portion of the campaign was transported to Solids Storage #6 (SS6). The data has been compiled based on quantities as reported by NWCF operations personnel on hot and cold feed makeup data sheets and the resultant Distributed Control System (DCS) feed batch makeup program calculations for volume reduction factor, calcine volume produced, and heat generation. In a few instances, the calculations were approximated because of problems with the DCS program.

In addition to the calcine produced during Campaign H-3, there is approximately 43 ft³ of cold pilot plant calcine at the bottom of Bin 154 (center bin) in SS6. This calcine was placed in the bin in April 1986, as documented in letter HBE-6-86.

The total volume of calcine transported to SS6 in 1993 as reported in Operations Department Monthly Reports to the DOE and in the Idaho Hazardous Waste Generator Report to the State of Idaho is 5284 ft³ (149.6 m³). Please contact me if you have any questions.

M. M. Dumas, Support Engineer
Calcination Facilities

Attachment

Westinghouse Idaho Nuclear Company, Inc.

Box 4000 — Idaho Falls, Idaho 83403

MMD-02-94
 April 1, 1994
 Attachment 1
 Page 1 of 10

BATCH	TIME/DATE FEED START	ANN	RECYCLE ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-027C	1600/1-8	1,792	0	8.4	2,145	19.17	14.96	0.0
3-028C	1610/1-8	1,845	0	8.4	2,192	19.20	15.26	0.0 *
3-029C	2350/1-9	1,773	403	10.2	2,346	18.77	16.71	0.0
3-030C	1805/1-26	1,680	480	10.1	2,741	19.38	18.91	0.0
3-031C	1724/1-27	1,743	667	11.3	2,530	18.85	17.94	0.0
3-032C	0750/1-28	946	683	10.2	2,666	18.99	18.77	0.0
Jan Totals		9,779	2,233	58.6	14,620		102.55 ft ³	

BATCH	TIME/DATE FEED START	ANN	RECYCLE ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-033C	2224/3-14	1,726	328	11.8	2,657	17.98	19.75	0.0
3-034C	1315/3-16	1,878	199	9.7	2,659	17.17	20.70	0.0
3-035C	0410/3-18	1,620	608	10.4	2,686	14.56	24.67	0.0
MAR TOTAL		5,224	1,135	31.9	8,002		65.12 ft ³	

Calcine produced from cold feed = 167.67 ft³

BATCH	TIME/DATE FEED START	BLEND	SODIUM BLEND	182	187	185	RECYCLE ADDED	Ca(NO ₃) ₂ ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-247H	0224/3-20	7:4.2:1.3	1,070	1,369	817	253	411	233	36.0	3,328	12.15	36.62	85.43
3-248H	2229/3-20		914	1,173	698	216	394	215	31.3	2,871	12.65	30.35	57.83
3-249H	1411/3-21		979	1,240	748	231	527	23	34.6	3,233	12.25	35.28	52.77
3-250H	0910/3-22		892	1,083	681	211	516	21	32.6	3,033	7.66	52.92	31.29
3-251H	0150/3-23		878	1,107	670	208	555	21	32.0	3,077	7.93	51.85	32.33
3-252H	1738/3-24		881	1,119	673	208	506	21	20.5	2,933	13.37	29.33	62.31
3-253H	0120/3-24		870	1,111	664	206	295	21	28.7	2,691	14.47	24.86	62.47
3-254H	0955/3-25		731	935	558	173	407	17	26.1	2,438	14.27	22.84	61.75
3-255H	2318/3-25		906	1,149	692	214	465	21	31.8	3,020	14.91	27.08	63.87
3-256H	1520/3-26		890	1,172	680	210	462	21	31.8	2,987	13.42	29.75	58.73
3-257H	0740/3-27		894	1,133	683	211	373	21	30.3	2,906	14.19	27.37	62.53
3-258H	?		705	917	538	167	168	16	22.5	2,145	14.23	20.15	68.00
3-259H	1207/3-28		883	1,117	674	209	394	21	30.2	2,850	14.45	26.38	64.17
3-260H	0410/3-29		889	1,117	679	210	265	21	28.6	2,696	13.64	26.42	64.18
3-261H	2102/3-29		876	1,164	669	207	285	21	29.3	2,102	13.95	20.14	65.06
3-262H	1220/3-30		856	1,145	654	202	251	20	28.4	2,808	14.48	25.93	65.22
3-263H	0348/3-31		868	1,105	663	205	398	20	29.9	2,822	14.09	26.77	62.28
March Totals			14,982	19,156	11,441	3,541	6,672	*	504.6	47,940		514.03 ft ³	

* Calcium Nitrate Added (First two batches were liquid calcium nitrate)

liquid 448 gals
 solid 306 bags

24,448 lbs

BATCH	TIME/DATE FEED START	BLEND TYPE	SODIUM BLEND	182	187	185	ANN	RECYCLE ADDED	Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-264H	2255/3-31	7-4.2:1.3	854	1,097	652	202	0	459	20	30.4	2,882	15.68	24.57	67.21
3-265H	1727/4-1		868	1,096	663	205	0	0	20	24.7	2,363	15.12	20.90	79.32
3-266H	1315/4-2		788	1,010	602	186	0	507	19	29.0	2,738	17.11	21.39	70.97
3-267H	0518/4-3		877	1,113	670	207	0	396	20	30.1	2,830	16.62	22.76	73.94
3-268H	2024/4-3		883	1,115	674	209	0	415	21	30.4	2,911	17.25	22.55	74.91
3-269H	1315/4-4		820	1,039	626	194	0	306	19	30.0	2,828	16.78	22.53	69.71
3-270H	0420/4-5		786	1,030	600	186	0	297	19	30.0	2,793	17.06	21.88	69.74
3-271H	1939/4-5		861	1,099	657	204	0	229	20	27.6	2,639	15.45	22.83	72.65
3-272H	1007/4-6		888	1,146	678	210	0	399	21	31.0	2,909	15.92	24.43	70.71
3-273H	0200/4-7		918	1,168	701	217	0	206	21	28.9	2,760	16.33	22.60	78.06
3-274H	1932/4-7		1,012	1,288	773	239	0	257	24	29.0	2,768	15.57	23.76	81.84
3-275H	2110/4-8		909	1,158	694	215	0	318	21	29.3	2,819	16.09	23.43	75.08
3-276H	2146/4-9		883	1,124	674	209	0	119	21	29.3	2,779	16.75	22.18	76.39
3-277H	1745/4-10	.32:1.0	0	1,727	0	0	604	403	2	8.5	2,847	16.70	22.79	67.00 *
3-278H	1055/4-11		0	1,704	0	0	547	404	2	8.2	2,765	16.70	22.13	68.20 *
3-279H	0322/4-12	.45:1.0	0	1,856	0	0	835	318	2	9.6	3,116	16.58	25.12	63.90 *
3-280H	2218/4-12	1:1	0	987	0	0	1,008	191	2	7.9	2,301	14.38	21.40	50.56
3-281H	1417/4-13	7-4.2:1.3	886	1,120	677	209	0	507	21	31.7	3,006	15.53	25.88	65.71
3-282H	0840/4-14		880	1,116	672	208	0	519	21	32.0	2,980	14.92	26.69	63.58
3-283H	1903/4-15		880	1,119	672	208	0	529	21	31.9	3,009	14.77	27.23	62.09
3-284H	1710/4-17		894	1,141	683	211	0	413	21	30.8	2,917	15.73	24.80	69.44
3-285H	1125/4-18		886	1,172	677	209	0	410	21	31.0	2,972	15.35	25.89	67.62
3-286H	0452/4-19		598	738	457	141	0	500	15	23.0	2,237	16.11	18.56	60.56
3-287H	1813/4-19		891	1,135	680	211	0	306	21	29.4	2,799	16.91	22.13	77.58
3-288H	2022/4-20		886	1,121	677	209	0	208	21	28.0	2,660	16.44	21.62	78.85
3-289H	2124/4-21		893	1,123	682	211	0	399	21	30.4	2,890	15.96	24.21	70.69
3-290H	1941/4-22		845	1,086	645	200	0	324	20	28.5	2,670	15.32	23.30	70.90
3-291H	1154/4-23		893	1,123	682	211	0	315	21	29.4	2,788	15.55	23.97	70.19
3-292H	0535/4-24		873	1,119	667	206	0	306	20	28.9	2,750	14.93	24.63	68.40
3-293H	0044/4-25		879	1,121	671	208	0	257	21	28.4	2,737	15.70	19.74	72.67
3-294H	2238/4-25		730	959	557	173	0	523	20	27.9	2,653	17.97	19.74	72.67
3-295H	2125/4-26		895	1,160	683	212	0	216	21	29.0	2,697	16.76	21.51	81.08
3-296H	1408/4-27		858	1,100	655	203	0	308	21	28.6	2,705	18.00	20.09	82.60
3-297H	0005/4-29		901	1,132	688	213	0	385	21	30.5	2,869	18.38	20.87	81.61
3-298H	0920/4-29	1:1	0	1,313	0	0	1,278	0	16	9.3	2,700	15.35	23.51	61.17
April Totals			25,915	40,655	19,790	6,125	4,272	11,649	638	922.6	97,087		805.21 ft ³	
182/187/185 total			83,358											
AI/ANN total			13,729											
			97,087											

51,072 lbs

BATCH	TIME/DATE FEED START	BLEND TYPE	SODIUM BLEND	182	187	185	ANN	RECYCLE Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-299H	1620/4-30	.32:1.0	0	2,032	0	0	634	0	8.3	2,762	16.77	22.01	101.19
3-300H	0836/5-2	1.0:3.12	0	1,885	0	0	586	308	8.7	2,903	16.55	23.46	88.10
3-301H	1313/5-3		0	1,930	0	0	634	270	8.8	2,975	16.49	24.12	87.71
3-302H	1602/5-4	.45:1.0	0	1,870	0	0	833	350	9.8	3,194	16.58	25.75	79.72
3-303H	2313/5-5		0	1,764	0	0	750	475	9.5	3,137	17.37	24.15	80.08
3-304H	2215/5-6		0	1,861	0	0	819	296	9.5	3,085	16.07	25.66	79.50
3-305H	1310/5-8		0	1,724	0	0	776	495	9.6	3,121	15.80	26.40	71.57
3-306H	1329/5-9		0	1,816	0	0	812	0	8.4	2,692	15.97	22.54	88.31
3-307H	1011/5-11		0	1,682	0	0	768	306	8.9	2,902	16.32	23.78	77.54
3-308H	1515/5-13	7:4.2:1.3	601	714	459	142	0	350	21.0	1,911	13.64	18.73	58.82
3-309H	2324/5-14		841	1,023	642	199	0	496	29.7	2,810	13.96	26.91	58.12
3-310H	0448/5-17		835	1,069	638	197	0	417	29.3	2,829	15.24	24.82	64.93
3-311H	0043/5-18		769	978	587	182	0	504	28.4	2,644	15.43	22.90	64.34
3-312H	1945/5-18		856	1,086	654	202	0	505	30.8	2,926	14.62	26.76	61.33
3-313H	2032/5-19		843	1,063	644	199	0	499	30.3	2,827	15.62	24.19	66.51
3-314H	1550/5-20		868	1,101	663	205	0	399	29.8	2,854	16.47	23.17	71.44
3-315H	1417/5-21		878	1,100	670	208	0	414	30.1	2,886	16.79	22.98	72.19
3-316H	1235/5-22		846	1,071	646	200	0	446	29.8	2,844	16.91	22.48	71.65
3-317H	0125/5-23	.45:1.0	0	1,602	0	0	736	175	8.0	2,692	17.72	20.31	86.45
3-318H	0140/5-25		0	1,519	0	0	680	399	8.3	2,718	13.51	26.89	61.92
3-319H	0305/5-26		0	1,422	0	0	645	503	8.3	2,682	14.26	25.15	61.98
3-320H	1341/5-27	7:4.2:1.3	870	1,110	664	206	0	500	31.3	2,919	13.74	28.40	58.94
3-321H	0709/5-29		891	1,138	680	211	0	501	33.5	3,155	14.96	28.19	60.88
May Totals			9,098	32,560	6,948	2,150	8,673	8,608	430.1	65,468		559.76	ft ³

19,840 lbs

34,863

182/187/185 total

30,605

AI/ANN total

65,468

BATCH	TIME/DATE FEED START	BLEND TYPE	SODIUM BLEND	182	187	185	188	RECYCLE Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-322H	0219/5-31	7:4.2:1.3	877	1,101	670	207	0	501	21	31.4	2,965	16.57	23.92
3-323H	2027/6-2		658	762	502	156	0	500	16	24.2	2,311	16.68	18.52
3-324H	0456/6-6		884	1,116	675	209	0	392	21	30.1	2,850	14.59	26.11
3-325H	1740/6-8		886	1,116	677	209	0	205	21	27.8	2,626	14.42	24.35
3-326H	0505/6-10		893	1,147	682	211	0	359	21	30.2	2,846	15.51	24.54
3-327H	0606/6-11		584	745	446	138	0	601	14	24.3	2,255	16.99	17.74
3-328H	0159/6-12		890	1,134	680	210	0	463	21	31.3	3,000	17.30	23.19
3-329H	0600/6-13		769	1,124	587	182	0	210	19	26.5	2,577	16.28	21.16
3-330H	0947/6-14	4.8:1.0	0	0	1,809	367	0	319	51	4.0	3,088	11.51	35.85
3-331H	2314/6-15		0	0	1,396	267	0	402	41	31.0	3,068	13.77	29.79
3-332H	0403/6-17		0	0	1,205	248	0	309	412	25.9	2,633	13.54	25.99
3-333H	0509/6-18		0	0	1,222	251	0	400	426	28.1	2,858	14.07	27.16
3-334H	0239/6-20		0	0	1,367	280	0	236	468	29.9	3,075	14.44	28.47
3-335H	1300/6-22		0	0	1,303	241	0	301	449	28.5	2,872	14.99	25.61
3-336H	1755/6-23	6:1	0	0	0	248	1,493	420	584	0.0	3,114	14.49	28.73
3-337H	1813/6-24		0	0	0	234	1,513	217	588	0.0	3,044	15.07	27.00
3-338H	1440/6-25		0	0	0	261	1,565	218	545	0.0	2,949	14.95	26.37
3-339H	1105/6-26		0	0	0	243	1,494	207	486	0.0	2,734	14.30	25.55
3-340H	0858/6-27		0	0	0	357	1,985	290	624	0.0	3,260	14.18	30.73
3-341H	1123/6-28		0	0	0	307	1,832	254	576	0.0	2,958	13.34	29.64
3-342H	1157/6-29		0	0	0	325	1,829	311	585	0.0	3,054	13.54	30.15
3-343H	0910/6-30	4.8:1.0	0	0	697	135	0	303	196	0.0	1,333	16.51	10.80
June Totals			6,441	8,245	13,918	5,286	11,711	7,418	*	373.2	61,470		561.35

* Calcium Nitrate Added:

liquid	5,939 gals
solid	246 bags
	19,680 lbs

182/187/185 total	21,430
187/185 total	18,927
188/185 total	21,113
	61,470

BATCH	TIME/DATE	BLEND FEED START TYPE	182	ANN	185	188	RECYCLE Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-344H	2230/6-30	6:1			306	1,833	271	586	0.0	3,012	13.42	29.99
3-345H	0518/7-2	11.86:1.0		2,147	136		241	5	90.4	3,136	20.97	19.99
3-346H	1103/7-3	4.27:1.0		867	200		237	5	44.0	1,572	20.84	10.08
3-347H	0155/7-4	.45:1.0	1,765	785			404	30	16.5	3,095	23.85	17.35
3-348H	1144/7-5		1,779	804			411	29	16.8	3,168	23.58	17.96
3-349H	1629/7-6		1,678	730			208	30	16.4	3,085	14.16	29.13
3-350H	?		1,789	825			399	31	17.0	3,143	21.70	19.36
3-351H	1613/7-8	1:1	1,288	1,250			297	15	17.0	2,975	18.38	21.64
3-352H	1330/7-9		1,280	1,279			302	15	17.0	2,992	15.18	26.35
3-353H	1018/7-10		1,267	1,269			344	15	17.3	3,004	14.96	26.84
3-354H	1047/7-11		1,205	1,146			489	15	17.0	3,007	14.36	27.99
3-355H	1505/7-12		1,252	1,245			297	22	16.5	2,928	13.45	29.10
3-356H	1850/7-13		1,336	1,330			212	15	17.3	3,015	13.54	29.76
3-357H	2145/7-14	6:1			286	1,798	196	570	0.0	2,836	9.36	40.51
3-358H	0010/7-16				302	1,801	312	576	0.0	2,981	9.95	40.04
3-359H	0145/7-17				294	1,779	385	604	0.0	3,052	11.03	36.98
3-360H	0420/7-18				297	1,567	408	509	0.0	2,798	11.40	32.82
3-361H	0336/7-19				292	1,795	311	610	0.0	2,995	10.59	37.81
3-362H	1114/7-21				296	1,809	403	611	0.0	3,106	11.22	36.99
3-363H	1820/7-22				286	1,768	394	604	0.0	3,039	13.89	29.26
3-364H	2348/7-23				304	1,846	402	637	0.0	2,348	13.12	23.92
3-365H	1030/7-25				295	1,800	401	614	0.0	3,096	11.43	36.20
3-366H	2045/7-26				295	1,784	408	618	0.0	3,087	12.11	34.07
3-367H	0844/7-28				268	1,776	392	618	0.0	3,084	11.74	35.13
3-368H	0140/7-30				255	1,510	809	545	0.0	3,107	13.80	30.10
3-369H	0845/7-31				301	1,814	404	634	0.0	3,133	13.30	31.49
July Totals			14,639	13,677	4,413	24,680	9,337	8,563	303.3	76,794		750.87 ft ³

185/ANN total 4,708
 182/ANN total 30,412
 188/185 total 41,674

Gross Feed 76,794

BATCH	TIME/DATE FEED START TYPE	102	ANN	185	188	RECYCLE ADDED	Ca(NO3)2 ADDED *	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-370H	1725/8-1 0.9:1.0	1,066	965			611	5	18.5	2,869	22.25	17.24	0.84
3-371H	1815/8-2	1,083	990			610	6	18.8	2,876	21.87	17.58	0.84
3-372H	1941/8-3	1,109	1,009			505	68	18.4	2,822	23.38	16.14	0.94
3-373H	1815/8-4 1.86:1.0	818	1,514			153	58	17.4	2,674	18.56	19.26	0.58
3-374H	?	984	1,837			0	55	19.7	2,998	17.38	23.07	0.58
3-375H	0007/8-7 1.3:1.0	915	1,179			301	50	16.7	2,582	15.57	22.16	0.56
3-376H	2235/8-7 1.86:1.0	598	1,149			613	64	16.3	2,526	19.80	17.05	0.48
3-377H	2045/8-8 1.3:1.0	859	1,098			609	62	17.7	2,721	15.56	23.38	0.50
3-378H	2145/8-9	837	1,116			611	49	18.0	2,742	15.58	23.53	0.48
3-379H	2043/8-10 1.86:1.0	805	1,498			411	65	18.7	2,883	13.12	29.38	0.37
3-380H	2312/8-11	770	1,449			414	64	18.2	2,815	13.38	28.13	0.37
3-381H	2310/8-12	817	1,513			512	64	19.6	3,037	14.10	28.79	0.39
3-382H	0103/8-14 1.3:1.0	844	1,108			613	56	18.0	2,715	15.15	23.96	0.48
3-383H	2345/8-14 1.1:1.0	957	1,078			609	59	18.3	2,811	16.26	23.10	0.56
3-384H	0115/8-16	916	1,074			599	70	17.9	2,761	17.48	21.12	0.59
3-385H	0127/8-17	964	1,057			612	46	18.2	2,803	16.49	22.73	0.58
3-386H	0245/8-18	857	965			407	52	15.4	2,389	16.60	19.23	0.61
3-387H	0014/8-19 4.1:1.0			407	1,787	297	605	0.0	3,090	11.66	35.43	53.67
3-388H	0441/8-20			378	1,542	402	540	0.0	2,865	11.62	32.96	49.95
3-389H	0450/8-21 5.0:1.0			302	1,492	608	521	0.0	2,968	12.58	31.55	50.07
3-390H	0630/8-22			260	1,492	608	516	0.0	2,875	12.56	30.60	51.41
3-391H	0759/8-23			272	1,501	564	529	0.0	2,891	12.07	32.01	49.51
3-392H	1233/8-24			262	1,485	622	522	0.0	2,888	12.10	31.90	49.11
3-393H	1400/8-25			285	1,508	597	527	0.0	2,956	12.85	30.75	51.86
3-394H	1933/8-28			250	1,495	601	509	0.0	2,882	13.89	27.74	56.76
3-395H	1327/8-30			281	1,452	596	505	0.0	2,870	14.69	26.11	58.85
August totals		15,199	20,599	2,697	13,754	11,864	5,656	305.8	73,309		654.90 ft ³	
102/ANN total												
188/185 total												
Gross Feed												

880 lbs Ca(NO3)2 first two batches

47,024
 26,285

 73,309

BATCH	TIME/DATE FEED START TYPE	100	ANN	185	188	RECYCLE Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION	
3-396H	1903/8-31 5.0:1.0			268	1,490	595	557	0.0	2,897	13.19	29.36	53.58
3-397H	2010/9-1			269	1,488	606	527	0.0	2,918	11.76	33.18	47.35
3-398H	2120/9-2			318	1,496	618	559	0.0	3,008	11.10	36.24	43.84
3-399H	2205/9-3			272	1,485	601	511	0.0	2,902	12.20	31.80	49.32
3-400H	2155/9-4			307	1,483	625	552	0.0	2,960	12.05	32.84	47.91
3-401H	2129/9-5			270	1,479	606	533	0.0	2,862	12.22	31.31	49.88
3-402H	2051/9-6			305	1,479	606	538	0.0	2,916	13.50	28.88	54.33
3-403H	0627/9-8			299	1,477	597	520	0.0	2,875	14.00	27.45	57.04
3-404H	0742/9-9			289	1,495	608	543	0.0	2,932	13.64	28.73	55.07
3-405H	0853/9-10			298	1,471	601	465	0.0	2,904	12.73	30.51	51.11
3-406H	1115/9-11			306	1,482	398	529	0.0	2,702	11.82	30.56	51.44
3-407H	0245/9-13			200	982	402	348	0.0	1,907	13.66	18.66	55.80
3-408H	0403/9-14			289	1,891	398	658	0.0	3,216	12.34	34.83	56.14
3-409H	1100/9-15 0.45:1.0	1,811	833			307	33	21.0	3,168	17.54	24.14	0.89
3-410H	1426/9-16	1,470	794			305	53	19.0	3,194	18.25	23.40	0.92
3-411H	0305/9-17 2.6:1.0	740	1,927			332	78	22.0	3,196	13.16	32.46	0.27
3-412H	2003/9-18	760	1,919			326	48	21.4	3,174	12.89	32.91	0.27
3-413H	2054/9-19 5:1			322	902	612	524	0.0	2,968	13.60	29.17	46.24 *
3-414H	1805/9-20			202	957	1,006	365	0.0	2,531	13.60	24.88	41.20 *
3-415H	1015/9-22 2.6:1.0	745	1,988			296	7	21.4	3,175	13.25	32.04	0.27 *
3-416H	0533/9-24	667	1,715			615	247	21.2	3,265	16.67	26.18	0.27 *
3-417H	0354/9-25	661	1,752			603	69	21.4	3,244	14.67	29.56	0.27 *
3-418H	0127/9-26	531	1,390			1,011	63	21.0	3,112	12.92	32.20	0.27 *
3-419H	0219/9-28	517	1,380			1,012	81	20.6	3,104	18.33	22.64	0.27 *
3-420H	0945/9-29	615	1,511			798	58	21.0	3,095	14.70	28.15	0.27 *

September totals				8,517	15,209	4,214	21,057	14,484	*	210.0	74,225	732.09 ft ³

100/ANN total 31,727

188/185 total 42,498

Gross Feed 74,225

* Calcium Nitrate Added:

liquid 8,212 gals

solid 254 lbs

BATCH	TIME/DATE FEED START	BLEND TYPE	100	ANN	185	188	RECYCLE ADDED	Ca(NO3)2 ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-421H	1342/9-30	0.8:1.0	1,328	1,043			595	32	20.8	3,129	13.68	30.57	0.50 *
3-422H	1840/10-1	1.3:1.0	874	1,135			820	54	20.0	2,993	16.78	23.84	0.28 *
3-423H	2330/10-2		865	1,176			797	65	20.1	3,040	15.45	26.30	0.28 *
3-424H	0525/10-4		884	1,177			805	103	20.3	3,040	14.70	27.65	0.28 *
3-425H	0021/10-7	0.8:1.0	1,149	930			801	69	20.5	3,060	14.66	27.91	0.50 *
3-426H	1335/10-9		1,111	892			852	44	20.1	3,011	16.16	24.91	0.53
3-427H	0100/10-11	1.3:1.0	716	942			1,018	61	19.0	2,838	12.57	30.18	0.28
3-428H	1919/10-12	4.1:1.0		1,303	313		1,001	45	88.0	3,190	12.69	33.59	1.84
3-429H	2107/10-14			1,846	456		615	38	63.4	3,335	11.83	37.68	2.39
3-430H	2138/10-16			1,448	356		804	51	56.7	2,968	11.56	34.33	2.05
3-431H	1853/10-18			1,527	375		728	78	57.0	2,996	10.87	36.85	2.01
3-432H	1508/10-20			1,533	371		802	30	91.0	3,342	12.62	35.42	2.07
3-433H	1535/10-22			1,853	453		508	60	61.0	3,245	12.09	35.87	2.50
3-434H	1444/10-24			1,661	399		996	59	66.4	3,276	12.13	36.10	2.19
3-435H	1839/10-26			1,230	296		1,004	77	85.0	3,102	13.68	30.31	2.20
3-436H	2115/10-28			1,249	298		986	100	85.0	3,068	17.82	23.02	2.54
October totals			6,927	20,945	3,317	0	13,132	966	794	49,633		494.53 ft ³	
100/ANN total				21,111									
185/ANN total				28,522									
Gross Feed				49,633									

BATCH	TIME/DATE FEED START	ANN	WATER ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-036C	1754/10-30	903	320	4.0	1,251	15.02	11.13	0.0
3-037C	0510/10-31	915	274	4.3	1,233	14.61	11.28	0.0
October TOTAL		1,818	594	8	2,484		22.41 ft ³	

BATCH	TIME/DATE FEED START	ANN	WATER ADDED	BORIC ADDED	GROSS FEED	VRF	VOLUME CALCINE	HEAT GENERATION
3-038C	0420/11-1	821	231	3.8	1,100	14.41	10.21	0.0
3-039C	2314/11-1	906	254	4.2	1,199	14.23	11.26	0.0
November TOTAL		1,727	485	8	2,299		21.47 ft ³	

Volume calcine from cold feed = 43.88 ft³

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