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Gadolinium Poison Solubility Testing for the Downstream Impacts from Accelerated Basin De-Inventory

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March 2021

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EXECUTIVE SUMMARY

The Accelerated Basin Deinventory (ABD) Program at the Savannah River Site (SRS) is designed to accelerate the deinventory of L-Basin and accelerate the Spent Nuclear Fuel (SNF) Disposition mission. Spent fuel will be dissolved in H-Canyon without recovery of uranium. The dissolver solutions will be temporarily stored, pH-adjusted to excess hydroxide (which will facilitate precipitation of metal oxides/hydroxides), transferred to the Concentration, Storage, and Transfer Facility (CSTF), and subsequently immobilized in the Defense Waste Processing Facility (DWPF) during planned sludge batch campaigns. ABD accelerates basin closure, significantly reduces programmatic risk, and greatly reduces the lifecycle budget requirements for the site by eliminating the need for a SNF drying and packaging capability. The ABD approach represents a significant change to the clean-up approach for the SRS. However, the increased fissile loading in sludge batches, due to the dissolver solutions, requires investigation to ensure fissile limits are efficiently and safely managed; higher fissile loadings in the glass are projected to be two to three times higher than the current fissile concentration limit of 897 g/m^3 and will be addressed in a future report.

H-Canyon currently credits gadolinium (Gd) as a neutron poison, whereas the CSTF and DWPF credit only manganese (Mn) and iron (Fe) for ^{235}U. There is evidence that Gd can be an effective poison for uranium at a lower volume than Mn and Fe based on the neutron capture cross section as well as previous dissolution and precipitation solubility data. Current calculations for H-Canyon protect to a Gd:$^{235}U(eq_{SLU})$ mass ratio of approximately 0.11:1. For Gd to perform effectively as a neutron poison for uranium in the solid phase of the High-Level Waste (HLW) during processing, it must maintain adequate insolubility at all process steps within DWPF under the conditions found within the Nitric Glycolic Acid (NGA) flowsheet. Previous testing data has shown that Gd has similar pH-relative solubility as U over a majority of operating ranges, but with the transition to a higher fissile concentration target in the glass wasteform, additional testing was required to evaluate solubility under the DWPF conditions.

Savannah River National Laboratory (SRNL) was tasked to evaluate Gd as an alternative poison for use in the CSTF and DWPF to minimize the additional volume required to poison the additional amount of fissile species from the ABD program, while maintaining criticality safety and processability of the material. An aliquot of Tank 51 (Sludge Batch 10) material was combined with Gd-poisoned (via gadolinium nitrate solution) H-Canyon blended dissolver (Tank 10.2) material to produce a feed representing proposed future additions to DWPF. The targeted SB10/10.2 ratio was such that vitrified glass from the feed would contain approximately 2500 grams of fissile material per cubic meter of glass. This mixture represents the relatively low solubility conditions in the CSTF. Six samples received NGA flowsheet SRAT-like acid additions of nitric and glycolic acids followed by being heated for 10 hours at 95 °C; three of the samples received additional pH adjustment after cooling to represent pH conditions throughout DWPF locations (ex. process vessels, sumps, etc.). The following are the key results and observations.

- Uranium percent soluble values exceeded the percent soluble values for gadolinium over the entire range tested, indicating that gadolinium poisoning in the solid phase will always be maintained. Thus, any increase in gadolinium solubility due to the presence of additional acids in various process steps in DWPF will not negatively influence the Nuclear Criticality Safety Evaluation (NCSE)[1] criticality control for gadolinium poisoning of equivalent uranium-235 in the solid phase.

- Gadolinium percent solubility values were 15%, 80%, and 94% at the 70%, 100%, and 130% Koopman Minimum Acid (KMA) stoichiometries and 80%, 79%, and 88% at the pH 3, pH 2, and pH 0.7 adjustments of the 100% acid stoichiometry, respectively. Though the gadolinium did display >80% solubility at some lower pH conditions, the uranium solubility during this testing was always greater under the same conditions ensuring that the poisoning ratio is only positively influenced in the solid phase as the pH decreases.

- In only one condition of one testing scenario was the Gd:$^{235}U(eq_{SLU})$ ratio below the target 0.55:1. The only phase/scenario that produced a Gd:$^{235}U(eq_{SLU})$ ratio below the target was in the aqueous phase of the 70% KMA scenario with a ratio of 0.28:1 (92.8 mg/L $^{235}U(eq_{SLU})$). Although the ratio is below the target 0.55:1, it is still above the required protection limit of 0.11:1.

The results of this solubility testing should be applied to an NCSE evaluation for using gadolinium as a neutron poison in DWPF for SB11 and beyond. This could be in replacement of or in addition to the current use of manganese as a neutron poison for equivalent uranium-235. The NCSE should also evaluate whether gadolinium can be used as a neutron poison for equivalent plutonium-239 for feeds where the enriched uranium-235 is the major contributor to the overall equivalent plutonium-239.

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LIST OF ABBREVIATIONS

ABD	Accelerated Basin Deinventory
ANS	American Nuclear Society
CFD	Chemical Flowsheet Development
CPC	Chemical Processing Cell
CSTF	Concentration, Storage, and Transfer Facility
DI	de-ionized
DWPF	Defense Waste Processing Facility
HLW	High-Level Waste
ICP-ES	Inductively Coupled Plasma—Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma—Mass Spectroscopy
KMA	Koopman Minimum Acid
MDE	Material Disposition Engineering
NCSE	Nuclear Criticality Safety Evaluation
NFA	Nitric-Formic Acid
NFGA	Nitric-Formic-Glycolic Acid
NGA	Nitric-Glycolic Acid
OGCT	Off-Gas Condensate Tank
RSD	relative standard deviation
SB	Sludge Batch
SME	Slurry Mix Evaporator
SMECT	Slurry Mix Evaporator Condensate Tank
SNF	Spent Nuclear Fuel
SRAT	Sludge Receipt and Adjustment Tank
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SRE	Sodium Reactor Experiment
SRR	Savannah River Remediation
SRS	Savannah River Site
TIC	Total Inorganic Carbon
TTQAP	Task Technical and Quality Assurance Plan
TS	Total Solids
RCT	Recycle Collection Tank
REDOX	Reduction/Oxidation
TTR	Technical Task Request
WAC	Waste Acceptance Criteria

1.0 Introduction

1.1 Background

The Accelerated Basin Deinventory (ABD) Program at the Savannah River Site (SRS) is designed to accelerate the deinventory of L-Basin and accelerate the Spent Nuclear Fuel (SNF) disposition mission. Spent fuel will be dissolved in H-Canyon without recovery of uranium. The dissolver solutions will be temporarily stored, pH-adjusted to excess hydroxide (which will facilitate precipitation of metal oxides/hydroxides), transferred to the Concentration, Storage, and Transfer Facility (CSTF), and subsequently immobilized in the Defense Waste Processing Facility (DWPF) during planned sludge batch campaigns. ABD accelerates basin closure, significantly reduces programmatic risk, and greatly reduces the lifecycle budget requirements of the site by eliminating the need for a SNF drying and packaging capability. The ABD approach represents a significant change to the clean-up approach for the SRS. However, the increased fissile loading in sludge batches due to the dissolver solutions requires investigation to ensure fissile limits are efficiently and safely managed; higher fissile loadings in glass are projected to be two to three times higher than the current fissile concentration limit of 897 g/m^3 and will be addressed in a future report.

H-Canyon currently credits gadolinium (Gd) as a neutron poison, whereas the CSTF and DWPF credits only manganese (Mn) and iron (Fe).[1] It should be noted that both Mn and Fe require significant mass equivalents added per mass of fissile material (160:1 Fe:^{239}Pu(eq), 70:1 Mn:^{235}U(eq_{SLU}) for DWPF) in comparison to a neutron poison with a larger neutron capture cross section like Gd. This causes relatively large volumes of both poisons to be added. The following two equations define the equivalent ^{239}Pu and equivalent ^{235}U for sludge, respectively.[1,2]

$$^{239}\text{Pu(eq)} = {}^{239}\text{Pu} + {}^{241}\text{Pu} + {}^{244}\text{Cm} + 15({}^{245}\text{Cm}) + 35({}^{242m}\text{Am}) + 0.65({}^{235}\text{U}(\text{eq}_{\text{SLU}})) \quad [1]$$

$$^{235}\text{U}(\text{eq}_{\text{SLU}}) = {}^{235}\text{U} + 1.4({}^{233}\text{U}) \quad [2]$$

There is evidence that Gd can be an effective poison and reduce the volume of future transfers to both the CSTF and the DWPF based on the neutron capture cross section as well as previous dissolution and precipitation solubility data, as referenced below. Current calculations protect to a Gd:^{235}U(eq_{SLU}) mass ratio of approximately 0.11:1 in an infinite medium;[3] to provide testing at higher relative Gd concentration, a Gd:^{235}U(eq_{SLU}) mass ratio of 0.55:1 was targeted.

For Gd to perform effectively, it must adequately partition between the solid and aqueous phases at all process steps within the CSTF and DWPF. In addition to the DWPF SRAT and SME process vessels that handle sludge slurries, offgas vapor condensation tanks from the SRAT, SME, and melter vessels can also receive solids during normal operations due to various carryover mechanisms (i.e. foamover, blow-through, etc.). As future sludge batches will be processed in DWPF utilizing the Nitric-Glycolic Acid (NGA) flowsheet, the concern was raised as to the partitioning of Gd along with fissile material at these various process locations within the new flowsheet. The various condensate tanks can reside at different pH conditions from the typical process vessels in the CPC and Salt Process Cell. The DWPF Nuclear Criticality Safety Evaluation (NCSE) will need to be updated to reflect the targeted Gd:^{235}U(eq_{SLU}) under these various conditions if Gd is to be credited as a neutron poison.

Previous NCSE analyses based their conclusions on the following.[4-7]

- Pu equivalent was conservatively determined to be 100% Pu-239.
- At H:Pu ratios ≥ 30:1, a Gd:Pu ratio of 1:1 was sufficient to protect criticality.
- As the H:Pu ratio increased, the Gd:Pu ratio may decrease and maintain the same level of criticality protection.
- At particle sizes ≤ 70µm, heterogeneous effects did not enhance the reactivity of Pu-Gd systems through self-shielding by either PuO_2 or Gd_2O_3.
- In U/Pu/Gd solutions at a U:Pu ratio of ≤4.3:1, nearly 100% of the U, Pu, and Gd precipitated at pH values >14 (i.e. excess OH^-) and the Gd was uniformly distributed throughout the solids; however, if a neutralization process was interrupted during processing, less than 5% of the Gd precipitated with greater than 90% of the U and Pu at pH values from 3 to 4.5.

The previous data detailed above has shown that Gd has similar pH-relative solid-aqueous partitioning as U over a majority of operating ranges, but with the intention to increase the fissile loading of uranium in the wasteform glass, additional testing was required to evaluate for potential additional impacts to solubility within the various process steps and pH conditions.[8] Savannah River National Laboratory (SRNL) was tasked to evaluate Gd as an alternative poison for use in the CSTF and DWPF to minimize the additional volume required to poison the fissile species, while maintaining criticality safety and processability of the material.

1.2 Gadolinium Dissolution and Precipitation Studies

Previous evaluations of the solubility of Gd in the presence of fissile materials, as referenced below, have provided positive support for the use of Gd as a poison within DWPF conditions. Evidence, as detailed in these previous reports, suggests that both the Gd and the fissile material will partition to similar degrees between the solid and aqueous phases at the various process pH conditions and, due to the hygroscopic nature of precipitating components, sufficient water should be present to provide hydrogen for criticality protection where the Gd-to-fissile ratio fails due to incongruent partitioning. As the species precipitate, the solids were shown to form as relatively homogeneous mixtures of fine particles that do not detrimentally agglomerate over time and that maintain sufficient spheres of hydration to prevent criticality concerns.

Supporting conclusions from previous investigations include the following.

- Gd, from a solution of gadolinium nitrate, was combined with acidic solutions from Pu storage tanks and evaluated for immediate effects without additional treatment, stability after one month, precipitation with NaOH at varying bounding Gd:Pu mass ratios, and partitioning after pH adjustments from pH 3 up to >14 (i.e. excess OH^-). The Gd and Pu were shown to comparably partition between the solid and aqueous phases at all ratios and pH ranges except for pH 3, where only approximately 5% Gd precipitated as compared to greater than 94% Pu. However, the H:Pu:Gd ratio was sufficient to poison the neutrons at failed Gd conditions due to the hygroscopic nature of the precipitates. After centrifuging, solids were shown to still contain a H:Pu atom ratio of 75:1; more than two times the limit expressed in the then-current NCSE.[9, 10]

- Experimentation evaluating HB-Line conditions with the addition of U to the acidic Pu/Gd solution at mass ratios up to 4.3:1 U:Pu resulted in the formation of solids beginning at pH 4.5 and complete solids precipitation by pH 7. Similar partitioning results were observed as testing without the uranium with the failing condition for the Gd solubility to be at the initial onset of solids formation, approximately pH 4.5. The hygroscopic nature of the precipitated species provided sufficient hydrogen as long as the solids remained hydrated, as was demonstrated in a proposed accident scenario involving a pump box agitator failure resulting in the solids drying out.[11-14]

- Testing performed with solutions from high-aluminum dissolution processes resulted in partitioning that did not fail for the solids fraction in the low pH range where the previous testing had been out-of-range for the targeted Gd:U ratio[15]; aluminum is shown to aid in the dissolution and precipitation of Gd.[16]

These observations lend credence to the proposed use of Gd within CSTF and DWPF but also support the need for the testing reported here that accounted for the incorporation of the change to the NGA flowsheet and increased fissile concentration in the glass wasteform.

1.3 Gadolinium DWPF Solubility Studies

In 2008, Reboul published a review of gadolinium solubility behavior within the DWPF CPC.[17] The focus of the review was in support of disposition of excess plutonium. Testing related to CPC acid additions were based on the Nitric Formic Acid (NFA) DWPF flowsheet.[18-23] Additionally, it would be expected that the complexing power in the Nitric Glycolic Acid (NGA) DWPF flowsheet could lead to higher solubilities of many metals, and thus those previous results would not be directly applicable to the new flowsheet conditions. Observations showed that inclusion of oxalate during Sludge Receipt and Adjustment Tank (SRAT) testing influenced gadolinium solubility, but ultimately should have a smaller effect than the large amount of glycolate in the NGA flowsheet. A key conclusion of the review was that the solubility of Gd was relatively high when the Fe:Gd mass ratios were less than 20:1 and was much lower where much of the CPC-related testing was performed, at Fe:Gd mass ratios above 300. The review concluded that testing should be conducted where the Fe:Gd ratio varies from 50 to 150.

Subsequently, Reboul *et al.* completed experimental studies that focused on the use of gadolinium as a poison for introduction of excess plutonium in CPC processing.[24] Amongst the tests were beaker tests using nitric acid and SRAT simulant tests using the NFA flowsheet and the Nitric-Formic-Glycolic Acid (NFGA) flowsheet. While data and analysis in that study is valid for use of gadolinium as a poison, the conclusions drawn were in relation to the investigation of the disposition of excess plutonium.[24] Due to the great solubility difference between plutonium and uranium in testing, conclusions that were made with regards to excess plutonium disposition are not directly applicable to excess uranium disposition. The testing in this report follows up on the recommendation of Reboul to look at a wider range of acid addition scenarios and with compositions more related to future sludge batches where, in this case, ABD is being considered.

Two radioactive waste qualification tests, one with Sludge Batch (SB) 5 and the NFGA flowsheet and another with the SB9 and the NGA flowsheet, provide gadolinium solubility data.[25-27] Soluble and insoluble gadolinium were present in the sludge. Testing included performing a SRAT qualification run, followed by additional pH adjustment of the SRAT or Slurry Mix Evaporator (SME) product to pH of 3, 2 and 1. Figure 1-1 and Figure 1-2 contain depictions of the partitioning between insoluble and soluble phases, cast in terms of percent soluble, for the two glycolic acid related demonstrations of the DWPF CPC flowsheet.

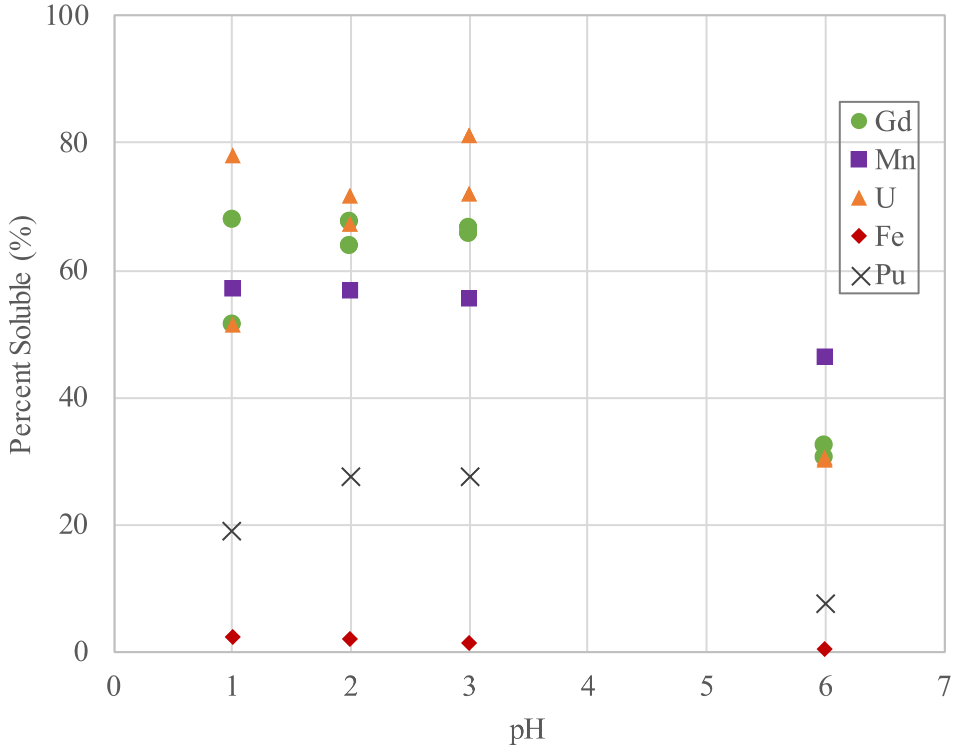

Figure 1-1. Partitioning of fissile and neutron poison components between solid and liquid phases for DWPF NFGA flowsheet testing of radioactive SB5 material and additional pH adjustment

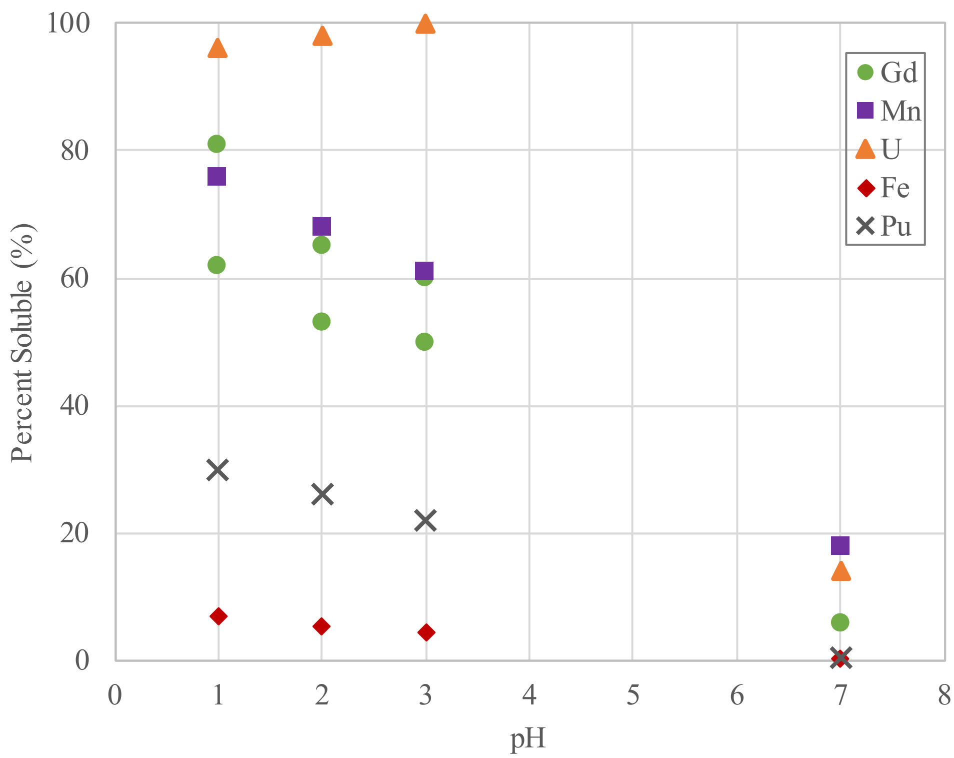

Figure 1-2. Partitioning of fissile and neutron poison components between solid and liquid phases for DWPF NGA flowsheet testing of radioactive SB9 material and additional pH adjustment

In these CPC demonstrations with additional pH adjustments, the gadolinium partitioning between liquid and solid phases approximately mimicked that of uranium and manganese. These observations showed that gadolinium holds promise as a replacement for excess manganese in poisoning enriched uranium.

Subsequent testing of SB10 slurry with Sodium Reactor Experiment (SRE) material at DWPF SRAT conditions also showed that gadolinium partitioning into the liquid phase was similar to that of manganese and always less than that of uranium.[28] Figure 1-3 contains a graphical representation of the percent soluble data. The highest concentration of gadolinium in that testing was 65 mg/L. As seen in Table 1-1, the total Gd:^{235}U(eq$_{SLU}$) for that testing was approximately 1.5:1, with only the lowest acid addition yielding a phase of <0.11:1. Because this was the soluble phase and for the lowest acid addition, the ^{235}U(eq$_{SLU}$) in solution was too low for this to be a concern. Note that the acid addition values in Figure 1-3 and Table 1-1 are based on the Hsu acid stoichiometry. The highest gadolinium supernate concentration in the SB10 /SRE testing was approximately 65 mg/L, which was encountered for the 140% Hsu acid addition.

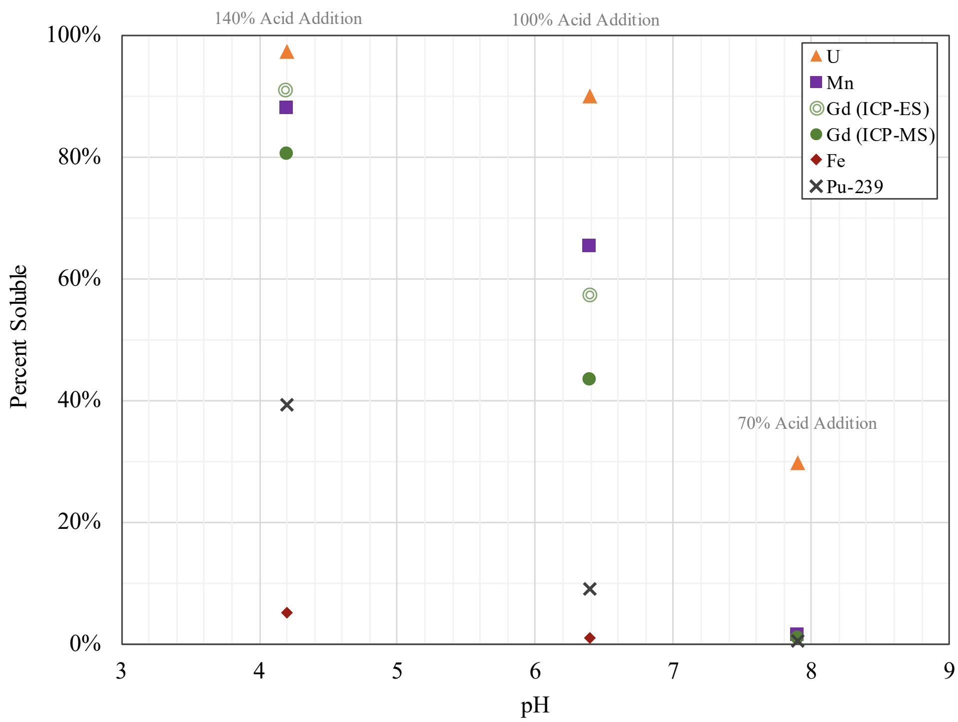

Figure 1-3. Partitioning of fissile and neutron poison components between solid and liquid phases for solubility tests of SB10 with SRE material.

Table 1-1. Mass ratio of Gd:^{235}U(eq$_{SLU}$) in total, insoluble, and soluble portions from SB10 with SRE solubility tests.

Gd:^{235}U(eq$_{SLU}$)	Feed	70% Acid Addition			100% Acid Addition			140% Acid Addition		
	Total	Total	Solid	Liquid	Total	Solid	Liquid	Total	Solid	Liquid
Gd by ICP-ES	1.29:1	1.50:1	--	--	1.48:1	5.0:1	0.97:1	1.52:1	2.7:1	1.46:1
Gd by ICP-MS	1.42:1	1.51:1	2.2:1	0.055:1	1.50:1	6.7:1	0.75:1	1.53:1	5.8:1	1.30:1

1.4 Solubility Test Process Background

The basis of the NCSE control on the DWPF feed was an initial solubility test with nitric and formic acids prior to DWPF radioactive processing,[7] and was backed up with data collected during qualification testing for early sludge batches. The initial metals solubility test involved adding fixed amounts of acid to washed sludge, heating the mixtures to 95 °C for 6 hours, and measuring the pH and soluble metals in the filtrate.[29] A portion of the previous testing was performed with simulants, where acid would be added to washed sludge simulant at 85 °C until the target pH is achieved.[22] There is a variation of this simulant testing where acid is added at 25 °C followed by heating to 85 °C. More recently, metals solubility testing for the NGA flowsheet started with SRAT product from a qualification test and involved adding additional glycolic acid at room temperature until a pH of 3 was reached, followed by adding nitric acid at room temperature to reach pH 2 and 1.[27, 30] Through measuring the soluble metals in the filtrate, the tests covered bounding conditions in other portions of the DWPF process, such as the offgas condensate tanks, where the pH is routinely lower than that of the SRAT.

The general process for SRAT-like acid additions for this test follow a recent test of metals solubility and manganese poisoning of uranium for the addition of SRE material to SB10. The testing was a hybrid of the previous test protocols used as the basis for determining the effectiveness of manganese poisoning of uranium-235.[29] Small subsamples of washed sludge/SRE were blended with nitric and glycolic acid quantities corresponding to a range of plausible acid additions for the NGA flowsheet and heated to 95 °C for a specified period. This is similar to the other small-scale metals solubility testing where acid additions and a heating were performed without replicating a full SRAT cycle.[29] For this testing, three acid addition cases were utilized based on the NGA flowsheet acid calculation. The acid additions were approximately representative of low, moderate/nominal, and high regions of the expected processing range (for example, 70%, 100%, and 130 to 150% excess acid). The low and high excess acid cases were designed to bracket potential conditions and are expected to be outside of the optimal processing window. This acid addition range was not confirmed with simulant testing prior to the solubility test. Likewise, determination of the acid window for DWPF processing of this material is outside of the scope of this solubility test. Monosodium titanate was not included in this testing because it is considered separately in the existing NCSE.[1]

2.0 Experimental

2.1 ABD and Sludge Blend Feed Preparation

ABD material was prepared similarly to how SRE material was prepared during prior testing with the change from manganese to gadolinium as the poison.[28] A solution of gadolinium nitrate was added to a sample of H-Canyon Tank dissolver (dissolver blend tank Tank 10.2) material targeting a Gd:^{235}U(eq$_{SLU}$) ratio of 0.55:1 (including Gd already present in all feed components), followed by pH adjustment targeting a free hydroxide molarity of 1.2 M. The pH-adjusted Tank 10.2 material was then blended with Tank 51 (SB10) material to an approximate concentration of 2500 grams of fissile material per cubic meter of glass once vitrified; the ^{235}U enrichment was not adjusted to any targeted value. Adjustment of enrichment would not increase the ^{235}U significantly, and, therefore, would not affect the amount of prescribed Gd. Appendix B describes the method and information used for creating a mixture of Tank 10.2 and Tank 51 that was analogous to a fissile content of 2500 g/m^3 in glass. The blended material was washed with a solution of sodium nitrite and excess water targeting a concentration of 0.85M sodium, capped and inverted to thoroughly mix, and set aside to allow to settle. The solution was allowed to settle for approximately three days before an initial decant to remove ~90% of the supernate and transfer to a smaller vessel for additional settling; a second decant to the final slurry volume was completed after one additional day of settling. The excess supernate was decanted to produce a blended slurry of Tank 51, ABD material (Tank 10.2), and gadolinium as would be expected to enter the DWPF CPC.

2.2 Solubility Test

Six 30-gram portions of the blended, washed, and decanted slurry feed were aliquoted into 50 mL polypropylene centrifuge tubes to provide starting samples for each set of test conditions. The first three aliquots received additions of nitric and glycolic acid according to the Koopman Minimum Acid (KMA)[31] calculations for what would be required during a typical SRAT/SME process operated according to the NGA flowsheet and targeting their respective acid stoichiometries and targeting a predicted REDOX value of 0.1 Fe^{2+}/Total Fe . Acid stoichiometries equal to 70%, 100%, and 130% KMA were targeted. For the other three aliquots being utilized for the expanded pH testing, nitric and glycolic acid were added to reach 100% KMA stoichiometry with additional acids added after heating and cooling to bring the pH values of the respective test aliquots to approximately pH 3, 2, and 1. Only glycolic acid was required to bring the slurry in the range of pH 3 while both glycolic and nitric acid were utilized to achieve pH 2 and pH 1. Each testing vessel was then capped with a vented covering by utilizing a cap with a small hole present; this was to prevent over-pressurization during heating while minimizing the potential for loss of material. Heating was performed based on the previous described testing by placing the vented vessels into an oven pre-heated to 95 °C and holding for a cumulative 10 hours split over two typical day shifts (the oven was turned off between shifts). Once the cumulative 10 hours spent at 95 °C was completed, each tube was removed from the oven and allowed to cool. Testing with the varying stoichiometries was complete at this point and the slurry and supernates were sampled. For testing at expanded pH values, once cool, the additional 70 wt.% glycolic acid and 50 wt.% nitric acid were utilized to bring the respective pH values to target while monitoring with a probe. Once pH-adjusted, the samples were mixed and allowed to sit for approximately 1 hour at room temperature before being sampled, in the same manner as the stoichiometry tests, for analyses.

2.3 Analytical

2.3.1 Sample Processing

Samples were processed within the SRNL Shielded Cells. Some analyses required dilution and removal of aliquots from the Shielded Cells.

Aqua regia digestion preparation was used for test feed and product slurry elemental and isotopic analyses. Previous SB10 sample characterization that compared aqua regia and peroxide fusion digestions showed aqua regia to be adequate for the key components of interest in this study, including manganese, uranium, and gadolinium.[32] No remaining solids were noted after aqua regia digestion. Digested feed and product slurries were analyzed by Inductively Coupled Plasma—Emission Spectroscopy (ICP-ES) and Inductively Coupled Plasma—Mass Spectroscopy (ICP-MS). Digested feed slurry was additionally analyzed by radiochemistry techniques, Liquid Scintillation Analysis and pulse height analyses, for the detection of ^{238}Pu, $^{239}Pu + ^{240}Pu$, ^{241}Pu, and several americium (Am) and curium (Cm) isotopes.

Preparation of the soluble fraction of test products was by filtration through a 0.45-micron nylon membrane. Product filtrates were diluted approximately 25-fold with 2 M nitric acid and analyzed by ICP-ES, ICP-MS, and radiochemistry techniques. Feed supernate was prepared by decanting (not filtering), removed from the Shielded Cells without dilution, and analyzed by the same methods as the product filtrates.

Test feed and product slurries and supernatant or filtrate densities were determined gravimetrically from sample weights in vessels of known volume. Aliquots of slurry and supernate or filtrate were dried to a constant weight at 110 °C for determination of weight percent total solids (TS) in the slurry and weight percent dissolved solids in the supernate or filtrate. Dissolved solids in the slurry were calculated from the difference of measured total solids in the slurry and the dissolved solids in the filtrate.

Additional analysis of the feed material was needed to provide information for the DWPF NGA flowsheet acid calculation. Supernate was diluted with deionized (DI) water and analyzed by Ion Chromatography (IC) for anions and by Total Inorganic Carbon (TIC) for carbonate. Slurry was diluted with DI water and analyzed by titration for total base and carbonate by TIC.

Test product slurries were measured for pH within the Shielded Cells using a pH probe.

Averages and relative standard deviations (RSD) are reported for many of the analyses. RSD is not reported when the reported result average is below the detection limit. Appendix A contains the individual results that were used in determining the averages and standard deviations. Individual results and averages are preceded by "<" when reporting below detection limit. Percent soluble results are preceded by "<" when the slurry concentration is a measured value and the supernate concentration is below detection limit. Percent soluble results are preceded by ">" when the slurry concentration is below detection limit and the supernate concentration is a measured value. Average values are preceded by "≤" when results are a combination of above and below detection limit values. The ≤ values typically include the below detection limit values when calculating the average and RSD. In cases where the below detection limit values are outliers, the ≤ values exclude the below detection limit values when calculating the average and RSD. In either case, the ≤ values should be considered qualitative.

Analyses by ICP-ES and ICP-MS nominally have 1-sigma method uncertainties of 10%. Radiochemical analytical methods have 1-sigma uncertainties that vary by analyte and replicate. Typical 1-sigma uncertainties for ^{238}Pu, ^{239}Pu + ^{240}Pu, and ^{241}Am are 5 to 10%, for ^{241}Pu are 15%, for ^{244}Cm are 20%, and for ^{242m}Am and ^{242}Cm are >20%. These uncertainties apply to the measurements of the total concentration (slurry) and the liquid phase concentration (filtrate or supernate). Solid phase concentrations are calculated as the difference between the total and liquid phase concentrations. For conditions of high partitioning into the liquid phase, the resulting propagated uncertainties for the solid phase concentrations, on a relative basis, are larger than the uncertainties for the total and liquid phases.

2.3.2 ICP-MS Interpretation

In some ICP-MS tables, the analytes are reported as "m/z" or "mass." The mass spectroscopy nomenclature "m/z" is the mass divided by the charge number, which for ICP-MS is usually reflective of the atomic weight of one or more isotopes. Various isotope and elemental concentrations can be attributed to individual, summed, or subtracted masses.[28, 33, 34] Often, the attribution of elemental concentrations requires an assumption to be made about the source of the material to disambiguate results from potential interfering isotopes. Depending on the element, the isotopic distribution is typically either considered as the natural abundance or the distribution resulting from the fission of ^{235}U. Table 2-1 contains a description of how isotope and elemental concentrations were determined from ICP-MS data and a summary of the assumptions made when necessary.[33]

Table 2-1. Interpretation and assumptions for converting ICP-MS data to element concentrations.

Cobalt is mass 59. This ignores the relatively smaller concentrations of radioactive cobalt isotopes.
Arsenic is mass 75 and potentially includes a minor interference from argon chloride.
Mass 88 is attributable to non-radioactive strontium but does not account for the entire strontium element concentration.
Technetium is mass 99.
Ruthenium is the sum of masses 101, 102, and 104.
Rhodium is mass 103.
Palladium is mass 105 multiplied by 1.663 to compensate for isotopes of other masses that cannot be disambiguated from other components in the mixture. Palladium isotopic distribution assumed as that of ^{235}U fission products.
Silver is taken as the sum of masses 107 and 109 and potentially includes a minor interference from palladium.
Antimony is the sum of masses 121 and 123.
Tin is the sum of masses 117 through 120, 122, and 124.
Mass 133 is attributable to non-radioactive cesium but does not account for the entire cesium element concentration due to the presence of cesium-137. Cesium-135 and 137 cannot be disambiguated from barium-135 and 137 in the slurry.
Lanthanum is mass 139.
Cerium is the sum of masses 140 and 142.
Praseodymium is mass 141.
Neodymium is the sum of masses 143 through 146, 148, and 150.
Europium is taken as the sum of masses 151 and 152.
Gadolinium is the sum of masses 155 through 158 and 160.
Terbium is mass 159.
Masses 161 and 162 can be used as isotopes of dysprosium, although the identification is questionable. The sum of these masses may not be the entire mass of dysprosium.
Mass 174 can be used as an isotope of ytterbium, although the identification is questionable. This mass may not be the entire mass of ytterbium.
Tantalum is mass 181.
Lead is the sum of masses 204, 206, 207, and 208.
Thorium is mass 232. Contributions from other Th isotopes are insignificant for this evaluation.
Uranium is the sum of masses 233, 234, 235, 236 and 238. This ignores the very small fraction of mass 238 attributable to Plutonium-238.
Neptunium is mass 237.
Masses 239 and 240 are due to plutonium but do not account for the entire plutonium element concentration.
Masses 241 and 242 are a combination of plutonium and americium and were not disambiguated.

2.4 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60.[35] This document, including all calculations, was reviewed by Design Verification by Document Review. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.[36] Data are recorded in the electronic laboratory notebook system as experiments I7770-00338-10 and A6583-00142-28, and associated experiments. All work, analysis, and documentation were performed with quality assurance methods commensurate with the Safety Class data requirements.

3.0 Results and Discussion

3.1 Feed Slurry Blend

Table 3-1 details the materials blended to produce the Tank 51/ABD feed slurry utilized during solubility testing. The ABD material was prepared by blending a target amount of Tank 10.2 material with a pre-weighed portion of additional H-Canyon gadolinium nitrate solution and 50 wt.% sodium hydroxide solution; each addition bottle was rinsed into the ABD material bottle utilizing small amounts of a dilute sodium nitrite / sodium hydroxide solution that was later used as the wash solution for the blended material. The poisoned- and pH-adjusted ABD material was mixed with a vortex mixer and added to a pre-weighed portion of Tank 51 (Sludge Batch 10) material. The bottle containing the ABD material was rinsed thoroughly with another portion of the wash solution before adding the remainder of the wash solution to the Tank 51/ABD combined bottle. The blended feed was mixed by inversion and allowed to settle to segregate the slurry from the supernate.

The blended material settled well over three days (Figure 3-1). A majority of the supernate to be removed was done by using a peristaltic pump down to a level just above the settled solids line without disturbing the settled solids. The remaining supernate and solids were then transferred to a smaller bottle and allowed to settle again overnight before removing the remainder of the target supernate amount by pipette. This settled slurry was then shaken and sampled for compositional analysis. A summary of elemental and radioisotope results for the slurry is shown in Table 3-2. Anion results for both slurry and supernate are shown in and Table 3-3. Additional test feed analytical results are included in Section 3.2 and Appendix A Table A-1 through Table A-13. The analyzed composition was utilized in acid calculations to determine the target additions of nitric and glycolic acid to achieve the desired stoichiometry percentages and theoretical Reduction/Oxidation (REDOX) ratio. Sodium concentration in the feed slurry and feed supernate were measured as 0.92 M and 0.91 M, respectively.

Table 3-1. Parameters for blending the feed slurry

ABD Slurry	
Tank 10.2 sample	55.099 g
50 wt% $Gd(NO_3)_3$	0.379 g
50 wt% NaOH	29.999 g
Unwashed Feed Slurry	
ABD slurry	82.215 g
SB10 Tank 51 slurry	405.29 g
Wash Solution	
50 wt% NaOH	50.2 g
$NaNO_2$	58.7 g
DI H_2O	3060.6 g
Washed Feed Slurry	
After supernate decant	297.80 g

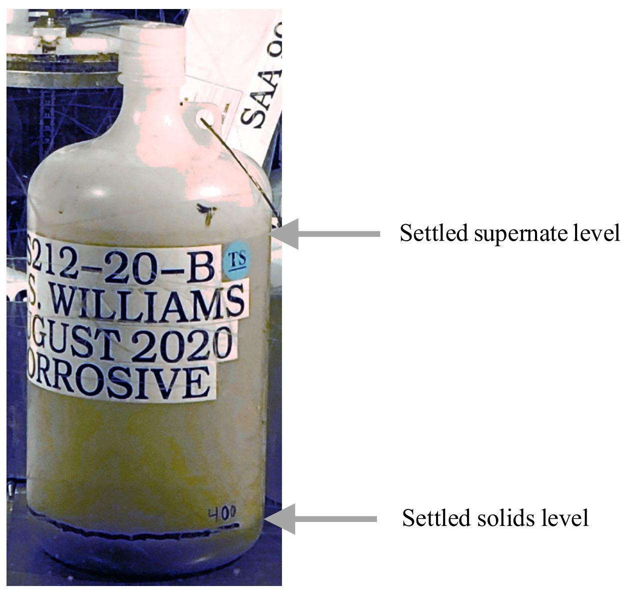

Figure 3-1. Washed Blended Tank 51/Tank10.2 Material After Settling Before Decanting

Table 3-2. Solubility test feed slurry analysis

Analyte	wt% slurry	wt% TS	RSD
Al	1.46E+00	1.08E+01	12%
Ba	8.03E-03	5.94E-02	4.2%
Ca	8.92E-02	6.60E-01	2.0%
Ce	1.76E-02	1.30E-01	6.7%
Cr	2.44E-02	1.80E-01	3.9%
Cu	6.23E-03	4.60E-02	26%
Fe	1.23E+00	9.12E+00	4.0%
Gd	1.62E-02	1.20E-01	4.9%
La	4.37E-03	3.23E-02	3.9%
Mg	3.52E-02	2.60E-01	3.7%
Mn	2.45E-01	1.81E+00	4.2%
Na	1.93E+00	1.43E+01	4.5%
Ni	4.30E-02	3.18E-01	4.4%
Si	4.36E-02	3.23E-01	16%
Sr	3.68E-03	2.72E-02	6.0%
Th	2.24E-01	1.66E+00	4.0%
Ti	1.92E-03	1.42E-02	5.0%
U	3.82E-01	2.83E+00	3.6%
Zn	3.12E-03	2.30E-02	1.3%
Zr	1.68E-02	1.24E-01	5.1%
^{232}Th	2.11E-01	1.56E+00	4.8%
^{234}U	3.52E-04	2.60E-03	7.3%
^{235}U	2.45E-02	1.81E-01	7.5%
^{236}U	2.26E-03	1.67E-02	4.8%
^{237}Np	2.39E-04	1.77E-03	5.1%
^{238}U	3.39E-01	2.50E+00	4.9%
Analyte	**wt% slurry**	**dpm/g slurry**	**RSD**
^{238}Pu	6.12E-05	2.33E+07	2.7%
^{239}Pu	2.36E-03	3.26E+06	5.3%
^{240}Pu	2.01E-04	1.02E+06	6.3%
^{239}Pu + ^{240}Pu	--	4.63E+06	3.0%
^{241}Pu	7.08E-06	1.62E+07	10%
^{241}Am	5.14E-05	3.92E+06	5.8%
^{242m}Am	≤2.44E-08	≤5.25E+03	4.1%
^{242}Cm	≤5.92E-11	≤4.34E+03	4.1%
^{244}Cm	2.66E-07	4.77E+05	22%

Table 3-3. Other results for the feed supernate and slurry for acid calculation

	mg/L	M	RSD
Nitrate in supernate	8.72E+03	1.41E-01	1.3%
Nitrite in supernate	1.41E+04	3.06E-01	2.1%
Carbonate in supernate	1.04E+03	1.73E-02	--
Sulfate in supernate	1.01E+03	1.05E-02	0.2%
Oxalate in supernate	<5.6E+02	<5.9E-03	--
Carbonate in slurry	2.11E+03	3.52E-02	--
Total base in slurry	7.38E+03	4.34E-01	--

3.2 Solubility Test Results

Table 3-4 summarizes the acid additions performed and reports the analogous Hsu stoichiometries for the target KMA values, but subsequent tables in this report and in the appendix identify only the KMA acid stoichiometries. Acid additions were prepared for 70, 100, and 130% KMA stoichiometries while targeting a nitric-to-glycolic ratio to produce a theoretical REDOX ratio of 0.1. The net water gain or loss indicated in the table is needed to complete a mass balance, and was calculated from the total mass of DI water used for rinsing the acid addition bottles minus the apparent mass of water evaporated during the heated test.

The measured pH values after the conclusion of the heated testing were as expected, with the low acid addition being approximately neutral, the high acid addition at a pH of 4, and the moderate acid addition falling in-between the other values. This testing reasonably brackets the potential NGA flowsheet conditions. Separately prepared aliquots initially utilizing 100% KMA additions followed by heating to 95 °C for 10 hours were subsequently titrated to pH 3 with glycolic acid. Two of the pH 3 aliquots were further adjusted to either pH 2 or 1 with nitric acid. For the pH 1 condition, the actual pH attained was 0.7. These lower pH aliquots reasonably represent conditions in locations where potential upsets may deposit slurry material (i.e., condensate tanks). The acid stoichiometry and REDOX target values in Table 3-4 includes only the initial acid additions and not the subsequent acid additions to reach the lower pH conditions.

The densities and solid content of the feed and product slurries are reported in Table 3-5 and Table 3-6. Slurry densities and total solids contents increase with increasing SRAT acid additions, even without significant dewater. Supernate densities and soluble solids concentrations also increase with increasing acid stoichiometry, which is consistent with the dissolution of a portion of the solids in the original SB10/ABD mixture. The insoluble solids concentrations decrease with increasing acid stoichiometry, consistent with the other data indicating additional solids dissolution at high SRAT acid additions and additional pH adjustments. For the increasing acid additions for pH adjustment of the 100% KMA product, the insoluble solids continues to decrease, but the soluble solids also decrease at pH 2 and pH 0.7 after reaching a maximum at pH 3.

Table 3-4. Acid addition details and pH results

	Feed	Low Acid	Moderate Acid	High Acid	pH 3 Adjustment	pH 2 Adjustment	pH 1 Adjustment
KMA Stoichiometry	0%	70%	100%	130%	100%	100%	100%
Hsu Acid Stoichiometry	0%	78%	112%	145%	112%	112%	112%
REDOX Target	--	0.10	0.10	0.10	0.10	0.10	0.10
Feed Slurry	--	29.996 g	29.997 g	29.999 g	30.002 g	30.007 g	29.997 g
50 wt% Nitric Acid for SRAT	--	0.640 g	1.223 g	1.852 g	1.214 g	1.210 g	1.217 g
70 wt% Glycolic Acid for SRAT	--	1.248 g	1.597 g	1.890 g	1.598 g	1.577 g	1.600 g
Water Gain or Loss	--	0.246 g	-0.094 g	-0.145 g	0.127 g	0.199 g	0.100 g
70 wt% Glycolic Acid for pH adjustment	--	--	--	--	3.633 g	3.153 g	3.634 g
50 wt% Nitric Acid for pH adjustment	--	--	--	--	--	1.705 g	3.735 g
Dilution Factor	1.000	0.934	0.917	0.893	0.820	0.793	0.745
pH Measurement	13.0	7.0	5.0	4.0	3.0	2.0	0.7

Table 3-5. Physical results from the feed slurry and SRAT acid addition heated solubility tests

	Feed		70% Acid Additon		100% Acid Additon		130% Acid Additon	
	Average	RSD	Average	RSD	Average	RSD	Average	RSD
Slurry Density (g/mL slurry)	1.094	0.7%	1.129	0.8%	1.140	0.9%	1.144	0.8%
Supernate Density (g/mL supernate)	1.038	0.6%	1.046	0.1%	1.061	0.1%	1.071	0.2%
Total Solids (wt% slurry)	13.5	0.6%	14.7	0.4%	15.7	0.9%	16.5	0.3%
Dissolved Solids (wt% supernate)	5.3	1.6%	7.9	1.6%	9.5	1.5%	10.7	0.9%
Insoluble Solids (wt% slurry)	8.7	--	7.4	--	6.8	--	6.4	--
Soluble Solids (wt% slurry)	4.8	--	7.3	--	8.9	--	10.1	--

Table 3-6. Physical results from the additional pH adjustment solubility tests

	pH 3 Adjustment		pH 2 Adjustment		pH 0.7 Adjustment	
	Average	RSD	Average	RSD	Average	RSD
Slurry Density (g/mL slurry)	1.147	0.7%	1.146	0.4%	1.161	0.3%
Supernate Density (g/mL supernate)	1.081	0.3%	1.090	0.2%	1.105	0.1%
Total Solds (wt% slurry)	17.3	0.9%	16.1	0.8%	15.2	1.2%
Dissolved Solids (wt% supernate)	11.4	2.3%	10.7	2.7%	10.4	3.0%
Insoluble Solids (wt% slurry)	6.6	--	6.0	--	5.4	--
Soluble Solids (wt% slurry)	10.7	--	10.0	--	9.8	--

The ICP-ES and ICP-MS results of the test feed and SRAT acid addition product slurries are reported in Table 3-7 and Table 3-8. Radiochemistry results calculated by mass balance from the feed are contained in Table 3-9. Additional results for product slurries, including all replicates and detection limits, are available in Table A-14 through Table A-18.

The ICP-ES, ICP-MS, and radiochemistry results of the supernate from the test feed and the filtrate from the SRAT acid addition tests are reported in Table 3-10 through Table 3-12. Additional results for product filtrates, including all replicates and detection limits, are available in Table A-19 through Table A-25. Along with the test product slurry results, the test product filtrate results are used to calculate the percent soluble for each component.

The ICP-ES and ICP-MS results of the additional pH adjustment product slurries are reported in Table 3-13 and Table 3-14. Radiochemistry results calculated by mass balance from the feed are contained in Table 3-15. Additional results for product slurries, including all replicates and detection limits, are available in Table A-14 through Table A-18.

The ICP-ES, ICP-MS, and radiochemistry results of the filtrate from the additional pH adjustment tests are reported in Table 3-16 through Table 3-18. Additional results for product filtrates, including all replicates and detection limits, are available in Table A-19 through Table A-25.

The tables of results contain values for $^{235}U(eq_{SLU})$ and $^{239}Pu(eq)$ that were calculated using Equations 1 and 2, respectively. For cases where isotopes were below the detection limit, those isotopes were omitted from the calculations.

Table 3-7. ICP-ES results for the feed and product slurries from the SRAT acid addition heated solubility tests

Analyte	Feed		70% KMA		100% KMA		130% KMA	
	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD
Ag	<1.0E-03	--	<1.7E-03	--	<1.7E-03	--	<1.7E-03	--
Al	1.46E+00	12.5%	1.44E+00	6.3%	1.44E+00	4.2%	1.45E+00	6.0%
B	<2.5E-03	--	<2.5E-03	--	<2.5E-03	--	<2.5E-03	--
Ba	8.03E-03	4.2%	8.02E-03	0.4%	8.10E-03	1.4%	7.81E-03	0.4%
Be	<4.6E-05	--	<8.5E-05	--	<8.5E-05	--	<8.5E-05	--
Ca	8.92E-02	2.0%	8.23E-02	1.7%	8.40E-02	1.0%	8.24E-02	0.4%
Cd	<1.2E-03	--	<1.2E-03	--	<1.2E-03	--	<1.2E-03	--
Ce	1.76E-02	6.7%	<1.4E-02	--	<1.4E-02	--	<1.4E-02	--
Co	<1.5E-03	--	<1.8E-03	--	<1.8E-03	--	<1.8E-03	--
Cr	2.44E-02	3.9%	2.41E-02	1.2%	2.46E-02	2.0%	2.35E-02	0.9%
Cu	6.23E-03	25.8%	<5.8E-03	--	<5.8E-03	--	<5.8E-03	--
Fe	1.23E+00	4.0%	1.25E+00	0.8%	1.28E+00	1.2%	1.22E+00	0.5%
Gd	1.62E-02	4.9%	1.60E-02	1.2%	1.56E-02	0.4%	1.56E-02	0.4%
K	<2.4E-02	--	<2.8E-02	--	<2.8E-02	--	<2.8E-02	--
La	4.37E-03	3.9%	<4.5E-03	--	<4.5E-03	--	<4.5E-03	--
Li	<1.9E-03	--	<2.3E-03	--	<2.3E-03	--	<2.3E-03	--
Mg	3.52E-02	3.7%	3.50E-02	0.9%	3.47E-02	0.8%	3.40E-02	0.3%
Mn	2.45E-01	4.2%	2.39E-01	0.4%	2.37E-01	0.9%	2.32E-01	0.2%
Mo	<4.9E-03	--	<5.7E-03	--	<5.7E-03	--	<5.7E-03	--
Na	1.93E+00	4.5%	1.90E+00	0.9%	1.86E+00	0.8%	1.83E+00	0.3%
Ni	4.30E-02	4.4%	4.27E-02	0.3%	4.30E-02	2.4%	4.10E-02	0.6%
P	<9.1E-03	--	<1.1E-02	--	<1.1E-02	--	<1.1E-02	--
Pb	<1.0E-02	--	<1.2E-02	--	<1.2E-02	--	<1.2E-02	--
Sb	<2.0E-02	--	<2.3E-02	--	<2.3E-02	--	<2.3E-02	--
Si	4.36E-02	15.7%	4.18E-02	11.3%	4.11E-02	2.0%	4.23E-02	3.3%
Sn	<9.2E-03	--	<1.1E-02	--	<1.1E-02	--	<1.1E-02	--
Sr	3.68E-03	6.0%	<4.3E-03	--	<4.3E-03	--	<4.3E-03	--
Th	2.24E-01	4.0%	1.98E-01	6.9%	2.30E-01	4.4%	2.05E-01	1.3%
Ti	1.92E-03	5.0%	1.75E-03	1.2%	1.76E-03	2.2%	1.70E-03	2.2%
U	3.82E-01	3.6%	3.37E-01	0.7%	3.35E-01	1.2%	3.25E-01	0.2%
V	<8.3E-04	--	<9.6E-04	--	<9.6E-04	--	<9.6E-04	--
Zn	3.12E-03	1.3%	2.82E-03	5.9%	2.79E-03	3.1%	2.75E-03	2.6%
Zr	1.68E-02	5.1%	1.57E-02	1.7%	1.60E-02	1.7%	1.53E-02	1.0%

Table 3-8. ICP-MS results for the feed and product slurries from the SRAT acid addition heated solubility tests

Analyte	Feed		70% KMA		100% KMA		130% KMA	
	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD
Co	4.05E-04	6.1%	3.63E-04	2.5%	3.59E-04	1.9%	3.49E-04	2.4%
As	--	--	4.41E-04	3.9%	4.57E-04	2.2%	4.23E-04	4.5%
^{88}Sr	2.42E-03	4.9%	2.30E-03	1.1%	2.32E-03	1.7%	2.27E-03	1.6%
^{99}Tc	2.50E-04	6.9%	2.21E-04	3.6%	2.23E-04	1.6%	2.15E-04	0.7%
Ru	6.22E-03	5.1%	5.97E-03	1.1%	5.94E-03	1.1%	5.80E-03	0.9%
Rh	1.34E-03	4.5%	1.29E-03	1.1%	1.27E-03	1.0%	1.24E-03	0.5%
Pd	2.30E-04	8.3%	2.13E-04	5.2%	2.22E-04	2.8%	2.10E-04	2.8%
Ag	9.39E-04	12.1%	9.22E-04	1.3%	9.29E-04	1.7%	9.03E-04	1.5%
Sb	<1.7E-04	--	3.89E-05	2.6%	3.81E-05	3.6%	3.80E-05	9.3%
^{133}Cs	1.25E-04	7.5%	1.31E-04	3.6%	1.27E-04	1.5%	1.32E-04	4.9%
La	5.60E-03	5.9%	5.51E-03	1.1%	5.52E-03	1.1%	5.36E-03	0.5%
Ce	1.61E-02	5.6%	1.65E-02	1.3%	1.64E-02	1.4%	1.60E-02	0.5%
Pr	4.73E-03	6.2%	4.68E-03	0.9%	4.66E-03	0.6%	4.55E-03	0.6%
Nd	1.82E-02	5.7%	1.81E-02	1.3%	1.80E-02	0.9%	1.75E-02	0.7%
Eu	--	--	2.67E-04	0.6%	2.66E-04	1.6%	2.61E-04	1.5%
Gd	1.56E-02	5.4%	1.61E-02	1.2%	1.59E-02	0.7%	1.56E-02	0.3%
Dy*	<8.6E-05	--	1.58E-05	0.8%	1.60E-05	1.9%	1.56E-05	2.1%
Yb*	<8.6E-05	--	1.17E-05	4.1%	1.19E-05	2.8%	1.18E-05	1.7%
Ta	<8.6E-05	--	2.08E-05	6.5%	2.02E-05	21.0%	2.48E-05	6.9%
Pb	1.50E-03	3.6%	1.23E-02	1.1%	1.24E-02	1.8%	1.20E-02	0.6%
^{232}Th	2.11E-01	4.8%	1.95E-01	6.8%	2.25E-01	4.9%	2.03E-01	2.0%
^{233}U	<8.6E-05	--	5.13E-05	3.4%	5.40E-05	3.8%	5.05E-05	2.0%
^{234}U	3.52E-04	7.3%	3.74E-04	1.5%	3.63E-04	1.3%	3.57E-04	1.6%
^{235}U	2.45E-02	7.5%	2.35E-02	0.8%	2.29E-02	0.9%	2.23E-02	0.5%
^{236}U	2.26E-03	4.8%	2.11E-03	0.8%	2.06E-03	0.4%	2.03E-03	0.7%
^{237}Np	2.39E-04	5.1%	2.21E-04	1.5%	2.20E-04	0.7%	2.14E-04	1.2%
^{238}U	3.39E-01	4.9%	3.42E-01	0.7%	3.35E-01	1.2%	3.29E-01	0.1%
^{239}Pu	2.36E-03	5.3%	2.07E-03	1.9%	2.15E-03	2.0%	2.05E-03	0.6%
^{240}Pu	2.01E-04	6.3%	1.79E-04	2.1%	1.84E-04	1.8%	1.78E-04	0.1%
mass 241	<8.6E-05	--	5.18E-05	1.2%	5.17E-05	0.8%	5.03E-05	2.3%
mass 242	<8.6E-05	--	1.72E-05	1.4%	1.65E-05	1.9%	1.64E-05	4.3%
mass 243	<8.6E-05	--	<1.0E-05	--	<1.0E-05	--	<1.0E-05	--
mass 244	<8.6E-05	--	<1.0E-05	--	<1.0E-05	--	<1.0E-05	--
U	3.66E-01	4.9%	3.68E-01	0.7%	3.60E-01	1.2%	3.53E-01	0.1%
$^{235}U(eq_{SLU})$	2.45E-02	7.5%	2.36E-02	0.8%	2.30E-02	0.9%	2.23E-02	0.5%

* partial mass and tentative identification, see Table 2-1 for details

Table 3-9. Rad. chemistry results for the feed and calculated values for product slurries from the SRAT acid addition heated solubility tests

Analyte	Feed		70% KMA		100% KMA		130% KMA	
	Average (wt% slurry)	RSD	Calculated (wt% slurry)	RSD	Calculated (wt% slurry)	RSD	Calculated (wt% slurry)	RSD
^{238}Pu	6.12E-05	3%	5.71E-05	--	5.61E-05	--	5.46E-05	--
^{241}Pu	7.08E-06	10%	6.61E-06	--	6.49E-06	--	6.33E-06	--
^{241}Am	5.14E-05	6%	4.80E-05	--	4.71E-05	--	4.59E-05	--
^{243}Am	<3.6E-05	--	<3.3E-05	--	<3.3E-05	--	<3.2E-05	--
^{242m}Am	≤2.44E-08	4%	≤2.27E-08	--	≤2.23E-08	--	≤2.17E-08	--
^{243}Cm	<1.2E-07	--	<1.1E-07	--	<1.1E-07	--	<1.0E-07	--
^{245}Cm	<3.4E-07	--	<3.2E-07	--	<3.1E-07	--	<3.0E-07	--
^{247}Cm	<1.2E-02	--	<1.1E-02	--	<1.1E-02	--	<1.0E-02	--
^{242}Cm	≤5.92E-11	4%	≤5.52E-11	--	≤5.42E-11	--	≤5.28E-11	--
^{244}Cm	2.66E-07	22%	2.48E-07	--	2.43E-07	--	2.37E-07	--
Pu	2.63E-03	5.2%	2.31E-03	--	2.39E-03	--	2.29E-03	--
^{239}Pu(eq)	1.83E-02	7.0%	1.74E-02	--	1.71E-02	--	1.66E-02	--

Table 3-10. ICP-ES results for the feed supernate and product filtrates from the SRAT acid addition heated solubility tests

Analyte	Feed Supernate		70% KMA Supernate		100% KMA Supernate		130% KMA Supernate	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
Ag	<2.4E-01	--	<4.5E+00	--	<4.5E+00	--	<4.5E+00	--
Al	1.09E+03	0.7%	1.42E+02	0.7%	1.23E+03	0.5%	1.64E+03	0.7%
B	2.43E+00	0.6%	<6.5E+00	--	<6.4E+00	--	<6.5E+00	--
Ba	<1.7E-01	--	2.53E+00	5.6%	3.03E+00	2.4%	2.74E+00	10.1%
Be	<1.1E-02	--	<1.4E-01	--	<1.4E-01	--	<1.4E-01	--
Ca	4.03E-01	1.8%	4.05E+02	0.7%	7.55E+02	0.3%	8.13E+02	0.5%
Cd	<2.9E-01	--	<3.8E+00	--	<3.7E+00	--	<3.8E+00	--
Ce	<7.7E-01	--	<5.3E+01	--	<5.3E+01	--	<5.3E+01	--
Co	<3.6E-01	--	<4.7E+00	--	<4.6E+00	--	<4.7E+00	--
Cr	1.81E+01	0.0%	5.22E+01	1.2%	1.43E+02	0.4%	1.62E+02	0.9%
Cu	<8.7E-02	--	<1.0E+01	--	2.39E+01	3.3%	3.41E+01	1.0%
Fe	<3.9E-01	--	1.96E+01	2.1%	3.55E+02	0.3%	7.77E+02	0.6%
Gd	<2.4E-01	--	2.98E+01	0.4%	1.45E+02	0.0%	1.68E+02	0.6%
K	3.41E+01	2.9%	<7.3E+01	--	<7.2E+01	--	<7.3E+01	--
La	<2.2E-01	--	<1.2E+00	--	1.65E+01	1.3%	2.75E+01	0.8%
Li	<3.7E-01	--	<1.3E+01	--	<1.3E+01	--	<1.3E+01	--
Mg	<1.7E-02	--	1.98E+02	0.3%	3.00E+02	0.4%	3.40E+02	0.7%
Mn	<9.7E-02	--	7.20E+02	0.3%	2.00E+03	0.3%	2.28E+03	0.7%
Mo	<2.4E+00	--	<1.5E+01	--	<1.5E+01	--	<1.5E+01	--
Na	2.10E+04	0.7%	2.07E+04	0.3%	2.06E+04	0.3%	2.05E+04	0.0%
Ni	<5.0E-01	--	2.08E+01	4.6%	1.92E+02	0.5%	2.70E+02	0.6%
P	<4.0E+00	--	<2.8E+01	--	<2.7E+01	--	<2.8E+01	--
Pb	<2.4E+00	--	<3.2E+01	--	<3.1E+01	--	<3.2E+01	--
Sb	<4.6E+00	--	<6.0E+01	--	<6.0E+01	--	<6.0E+01	--
Si	<1.1E+00	--	<3.9E+01	--	2.70E+02	0.8%	2.40E+02	1.2%
Sn	<2.1E+00	--	<2.8E+01	--	<2.7E+01	--	<2.8E+01	--
Sr	<2.8E-02	--	1.12E+01	0.5%	1.70E+01	0.3%	1.94E+01	0.6%
Th	<9.3E-01	--	<1.3E+02	--	<1.3E+02	--	<1.3E+02	--
Ti	<7.4E-02	--	<3.3E+00	--	<3.3E+00	--	<3.3E+00	--
U	<9.3E+00	--	1.33E+03	0.4%	3.95E+03	0.4%	3.98E+03	0.1%
V	<1.9E-01	--	<2.5E+00	--	<2.5E+00	--	<2.5E+00	--
Zn	<2.0E-01	--	<1.0E+01	--	<1.0E+01	--	<1.0E+01	--
Zr	<1.0E-01	--	<3.5E+01	--	<3.5E+01	--	<3.5E+01	--

Table 3-11. ICP-MS results for the feed supernate and product filtrates from the SRAT acid addition heated solubility tests

Analyte	Feed Supernate		70% KMA Supernate		100% KMA Supernate		130% KMA Supernate	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
Co	<1.0E-02	--	8.59E-02	6.8%	1.86E+00	1.4%	2.59E+00	1.1%
As	--	--	1.85E-01	9.2%	1.71E+00	2.7%	2.42E+00	0.1%
^{88}Sr	<1.0E-02	--	7.89E+00	1.0%	1.20E+01	0.5%	1.36E+01	0.2%
^{99}Tc	4.94E-01	2.6%	7.28E-01	0.3%	9.17E-01	0.9%	9.67E-01	1.2%
Ru	1.93E-01	0.9%	1.59E+01	0.6%	2.85E+01	0.4%	3.57E+01	0.5%
Rh	2.97E-02	7.9%	5.75E+00	0.8%	9.08E+00	0.4%	1.04E+01	0.5%
Pd	7.82E-02	0.6%	<4.5E-02	--	1.74E-01	4.5%	<4.4E-02	--
Ag	≤3.51E-02	14%	<5.2E-02	--	1.44E-01	7.2%	6.10E-01	2.3%
Sb	<2.0E-02	--	<5.2E-02	--	1.45E-01	1.9%	1.83E-01	3.7%
^{133}Cs	7.01E-01	1.2%	1.14E+00	5.0%	1.28E+00	2.7%	1.25E+00	1.6%
La	<1.0E-02	--	1.51E+00	2.0%	1.87E+01	0.2%	3.10E+01	0.3%
Ce	<2.0E-02	--	1.12E+00	1.7%	1.50E+01	0.5%	3.00E+01	2.0%
Pr	<1.0E-02	--	1.51E+00	0.5%	1.60E+01	0.2%	2.58E+01	0.3%
Nd	<6.0E-02	--	8.03E+00	0.4%	7.07E+01	0.2%	1.05E+02	0.1%
Eu	0.00E+00	0.0%	1.66E-01	1.9%	1.21E+00	0.9%	1.62E+00	0.8%
Gd	<5.0E-02	--	2.63E+01	0.6%	1.43E+02	0.3%	1.67E+02	0.3%
Dy*	<1.0E-02	--	<2.6E-02	--	6.53E-02	1.8%	9.14E-02	1.9%
Yb*	<1.0E-02	--	<2.6E-02	--	1.01E-01	2.4%	1.17E-01	2.6%
Ta	<1.0E-02	--	<2.6E-02	--	4.25E-02	5.7%	1.12E-01	3.8%
Pb	<3.0E-02	--	≤8.95E-02	--	≤8.02E-02	--	≤8.14E-02	--
^{232}Th	1.00E-02	--	1.10E+00	0.6%	5.15E+01	0.6%	7.76E+01	0.3%
^{233}U	1.00E-02	--	6.85E-02	1.9%	2.45E-01	0.8%	2.49E-01	0.4%
^{234}U	4.53E-02	0.0%	1.41E+00	0.7%	3.74E+00	2.3%	3.82E+00	3.0%
^{235}U	3.44E+00	0.8%	9.27E+01	2.5%	2.47E+02	0.8%	2.47E+02	0.2%
^{236}U	3.39E-01	2.3%	8.94E+00	0.4%	2.54E+01	0.4%	2.54E+01	0.6%
^{237}Np	1.00E-02	--	9.08E-01	0.7%	1.90E+00	0.6%	1.98E+00	0.3%
^{238}U	3.42E+00	2.5%	1.27E+03	3.2%	3.63E+03	2.3%	3.68E+03	0.4%
^{239}Pu	<1.0E-02	--	2.97E-01	1.6%	6.07E+00	0.6%	9.70E+00	0.9%
^{240}Pu	<1.0E-02	--	<2.6E-02	--	5.19E-01	0.5%	8.34E-01	1.4%
mass 241	<1.0E-02	--	<2.6E-02	--	1.63E-01	1.9%	2.64E-01	1.1%
mass 242	<1.0E-02	--	<2.6E-02	--	4.04E-02	2.9%	6.24E-02	1.9%
mass 243	<1.0E-02	--	<2.6E-02	--	<2.6E-02	--	<2.6E-02	--
mass 244	<1.0E-02	--	<2.6E-02	--	<2.6E-02	--	<2.6E-02	--
U	7.24E+00	0.9%	1.37E+03	2.8%	3.90E+03	2.2%	3.96E+03	0.3%
$^{235}U(eq_{SLU})$	3.44E+00	0.8%	9.28E+01	2.5%	2.47E+02	0.8%	2.47E+02	0.2%

* partial mass and tentative identification, see Table 2-1 for details

Table 3-12. Rad. chemistry results for the feed supernate and product filtrates from the SRAT acid addition heated solubility tests

Analyte	Feed Supernate		70% KMA Supernate		100% KMA Supernate		130% KMA Supernate	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
^{238}Pu	6.84E-06	5.4%	3.37E-03	15%	8.43E-02	6.0%	1.42E-01	12%
^{241}Pu	6.12E-06	23%	1.68E-03	14%	3.68E-02	4.0%	7.11E-02	21%
^{241}Am	<3.0E-05	--	<6.5E-04	--	5.39E-03	5.1%	7.12E-03	26%
^{243}Am	<2.0E-04	--	<4.7E-05	--	<3.3E-04	--	<5.0E-04	--
^{242m}Am	<1.6E-05	--	<7.4E-06	--	<4.8E-06	--	<1.2E-06	--
^{243}Cm	<3.0E-06	--	<2.2E-05	--	<2.3E-05	--	<9.3E-06	--
^{245}Cm	<8.9E-06	--	<5.4E-05	--	<5.7E-05	--	<2.3E-05	--
^{247}Cm	<1.7E+00	--	<1.4E+01	--	<1.3E+01	--	<4.4E+00	--
^{242}Cm	<3.8E-08	--	<1.8E-08	--	<1.2E-08	--	<2.9E-09	--
^{244}Cm	<1.1E-06	--	<9.5E-06	--	7.22E-05	18%	7.49E-05	26%
Pu	1.30E-05	8.1%	3.02E-01	1.7%	6.71E+00	0.4%	1.07E+01	1.1%
^{239}Pu(eq)	2.24E+00	0.8%	6.06E+01	2.5%	1.67E+02	0.7%	1.70E+02	0.2%

Table 3-13. ICP-ES results for the feed and product slurries from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD
Ag	<1.7E-03	--	<1.7E-03	--	<1.7E-03	--
Al	1.43E+00	3.5%	1.45E+00	2.4%	1.39E+00	0.7%
B	<2.5E-03	--	<2.5E-03	--	<2.5E-03	--
Ba	7.15E-03	0.7%	6.92E-03	0.6%	6.63E-03	1.7%
Be	<8.4E-05	--	<8.5E-05	--	<8.5E-05	--
Ca	7.96E-02	0.5%	7.98E-02	0.8%	7.28E-02	0.5%
Cd	<1.2E-03	--	<1.2E-03	--	<1.2E-03	--
Ce	<1.2E-02	--	<1.2E-02	--	<1.2E-02	--
Co	<1.8E-03	--	<1.8E-03	--	<1.8E-03	--
Cr	2.24E-02	1.2%	2.19E-02	1.6%	2.03E-02	1.2%
Cu	<5.3E-03	--	<5.4E-03	--	<5.4E-03	--
Fe	1.14E+00	0.0%	1.12E+00	0.0%	1.06E+00	0.9%
Gd	1.50E-02	0.4%	1.51E-02	1.0%	1.37E-02	1.5%
K	<2.8E-02	--	<2.8E-02	--	<2.8E-02	--
La	<4.9E-03	--	<4.9E-03	--	<5.0E-03	--
Li	<2.1E-03	--	<2.1E-03	--	<2.1E-03	--
Mg	3.21E-02	0.5%	3.22E-02	0.6%	2.97E-02	0.5%
Mn	2.18E-01	0.3%	2.16E-01	0.5%	1.99E-01	0.3%
Mo	<6.5E-03	--	<6.5E-03	--	<6.5E-03	--
Na	1.73E+00	0.0%	1.71E+00	0.7%	1.58E+00	0.4%
Ni	3.90E-02	1.4%	3.82E-02	2.0%	3.61E-02	1.0%
P	<1.1E-02	--	<1.1E-02	--	<1.1E-02	--
Pb	<1.2E-02	--	<1.2E-02	--	<1.2E-02	--
Sb	<2.3E-02	--	<2.3E-02	--	<2.3E-02	--
Si	3.16E-02	4.6%	3.42E-02	4.5%	3.28E-02	4.6%
Sn	<1.1E-02	--	<1.1E-02	--	<1.1E-02	--
Sr	<7.4E-03	--	<7.4E-03	--	<7.4E-03	--
Th	1.91E-01	2.4%	1.98E-01	1.5%	1.80E-01	1.9%
Ti	1.68E-03	1.4%	1.68E-03	0.7%	1.60E-03	1.7%
U	3.06E-01	2.0%	3.02E-01	0.7%	2.81E-01	0.2%
V	<9.5E-04	--	<9.5E-04	--	<9.6E-04	--
Zn	2.61E-03	2.0%	2.53E-03	2.9%	2.35E-03	4.2%
Zr	<1.6E-02	--	<1.6E-02	--	<1.6E-02	--

Table 3-14. ICP-MS results for the feed and product slurries from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD	Average (wt% slurry)	RSD
Co	3.22E-04	1.6%	3.08E-04	0.8%	3.01E-04	2.4%
As	3.94E-04	5.1%	4.00E-04	6.1%	3.69E-04	3.5%
^{88}Sr	2.10E-03	0.9%	2.08E-03	0.4%	1.94E-03	1.9%
^{99}Tc	2.14E-04	1.7%	2.09E-04	0.5%	1.96E-04	0.3%
Ru	5.52E-03	0.9%	5.37E-03	1.0%	5.07E-03	1.2%
Rh	1.19E-03	0.4%	1.16E-03	1.3%	1.08E-03	0.3%
Pd	1.79E-04	1.3%	1.66E-04	2.8%	1.61E-04	2.2%
Ag	8.63E-04	1.0%	8.43E-04	1.0%	7.97E-04	0.5%
Sb	3.60E-05	3.2%	3.70E-05	7.6%	3.48E-05	7.9%
^{133}Cs	1.15E-04	0.9%	1.15E-04	4.3%	1.04E-04	2.1%
La	5.05E-03	0.3%	4.91E-03	1.0%	4.59E-03	0.6%
Ce	1.52E-02	0.4%	1.46E-02	0.4%	1.40E-02	0.7%
Pr	4.28E-03	0.4%	4.17E-03	0.8%	3.92E-03	0.6%
Nd	1.67E-02	0.3%	1.62E-02	0.7%	1.53E-02	0.5%
Eu	2.44E-04	0.8%	2.41E-04	0.6%	2.24E-04	1.0%
Gd	1.50E-02	0.1%	1.47E-02	0.7%	1.36E-02	0.3%
Dy*	1.33E-05	2.3%	1.31E-05	1.3%	1.26E-05	3.9%
Yb*	1.03E-05	5.1%	1.03E-05	2.5%	1.01E-05	1.6%
Ta	2.06E-05	4.8%	2.18E-05	7.1%	1.94E-05	2.9%
Pb	1.09E-02	2.0%	1.06E-02	0.3%	1.01E-02	0.4%
^{232}Th	1.75E-01	2.0%	1.78E-01	2.1%	1.65E-01	1.2%
^{233}U	4.87E-05	1.3%	4.77E-05	0.7%	4.43E-05	0.8%
^{234}U	3.17E-04	0.3%	3.11E-04	0.1%	2.90E-04	1.0%
^{235}U	2.14E-02	0.3%	2.11E-02	1.1%	1.94E-02	1.2%
^{236}U	1.92E-03	0.3%	1.88E-03	0.4%	1.75E-03	0.5%
^{237}Np	2.05E-04	1.2%	1.99E-04	0.4%	1.86E-04	0.9%
^{238}U	2.85E-01	0.6%	2.81E-01	0.4%	2.60E-01	0.3%
^{239}Pu	1.95E-03	1.0%	1.91E-03	1.1%	1.78E-03	0.5%
^{240}Pu	1.68E-04	2.0%	1.64E-04	0.6%	1.55E-04	0.3%
mass 241	4.79E-05	1.8%	4.68E-05	1.4%	4.37E-05	1.8%
mass 242	1.58E-05	2.2%	1.52E-05	2.4%	1.46E-05	1.0%
mass 243	<9.9E-06	--	<1.0E-05	--	<1.0E-05	--
mass 244	<9.9E-06	--	<1.0E-05	--	<1.0E-05	--
U	3.09E-01	0.6%	3.05E-01	0.3%	2.82E-01	0.3%
$^{235}U(eq_{SLU})$	2.15E-02	0.3%	2.12E-02	1.1%	1.94E-02	1.2%

* partial mass and tentative identification, see Table 2-1 for details

Table 3-15. Rad. chemistry results for the feed and calculated values for product slurries from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Calculated (wt% slurry)	RSD	Calculated (wt% slurry)	RSD	Calculated (wt% slurry)	RSD
^{238}Pu	5.02E-05	--	4.85E-05	--	4.56E-05	--
^{241}Pu	5.81E-06	--	5.62E-06	--	5.28E-06	--
^{241}Am	4.22E-05	--	4.08E-05	--	3.83E-05	--
^{243}Am	<2.9E-05	--	<2.8E-05	--	<2.7E-05	--
^{242m}Am	≤2.00E-08	--	≤1.93E-08	--	≤1.81E-08	--
^{243}Cm	<9.6E-08	--	<9.2E-08	--	<8.7E-08	--
^{245}Cm	<2.8E-07	--	<2.7E-07	--	<2.5E-07	--
^{247}Cm	<9.4E-03	--	<9.1E-03	--	<8.6E-03	--
^{242}Cm	≤4.85E-11	--	≤4.69E-11	--	≤4.41E-11	--
^{244}Cm	2.18E-07	--	2.11E-07	--	1.98E-07	--
Pu	2.18E-03	--	2.13E-03	--	1.99E-03	--
^{239}Pu(eq)	1.59E-02	--	1.57E-02	--	1.44E-02	--

Table 3-16. ICP-ES results for the feed supernate and product filtrates from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
Ag	<4.5E+00	--	<4.5E+00	--	<4.6E+00	--
Al	1.23E+03	2.2%	1.26E+03	0.9%	1.32E+03	0.4%
B	<6.4E+00	--	<6.4E+00	--	<6.5E+00	--
Ba	4.02E+00	2.3%	4.24E+00	0.5%	7.41E+00	0.4%
Be	<1.4E-01	--	<1.4E-01	--	<1.4E-01	--
Ca	7.75E+02	2.0%	7.91E+02	1.1%	7.40E+02	0.9%
Cd	<3.7E+00	--	<3.7E+00	--	<3.8E+00	--
Ce	<4.2E+01	--	<4.2E+01	--	<4.3E+01	--
Co	<4.6E+00	--	<4.6E+00	--	<4.7E+00	--
Cr	1.34E+02	2.0%	1.36E+02	0.4%	1.41E+02	0.4%
Cu	<2.9E+01	--	<2.9E+01	--	<3.0E+01	--
Fe	3.98E+02	2.0%	4.85E+02	0.2%	1.03E+03	0.6%
Gd	1.39E+02	1.5%	1.37E+02	1.5%	1.40E+02	1.5%
K	<7.2E+01	--	<7.2E+01	--	<7.4E+01	--
La	2.13E+01	2.4%	2.17E+01	4.2%	2.59E+01	2.9%
Li	<9.7E+00	--	<9.7E+00	--	<9.9E+00	--
Mg	2.75E+02	1.9%	2.78E+02	0.6%	2.68E+02	0.6%
Mn	1.88E+03	1.8%	1.90E+03	0.3%	1.83E+03	0.3%
Mo	<1.5E+01	--	<1.5E+01	--	<1.5E+01	--
Na	1.91E+04	2.0%	1.90E+04	0.5%	1.79E+04	0.3%
Ni	1.76E+02	1.3%	1.83E+02	0.8%	1.89E+02	0.5%
P	<2.7E+01	--	<2.7E+01	--	<2.8E+01	--
Pb	<3.1E+01	--	<3.1E+01	--	<3.2E+01	--
Sb	<5.9E+01	--	<6.0E+01	--	<6.1E+01	--
Si	2.87E+02	1.4%	3.01E+02	0.5%	3.25E+02	0.5%
Sn	<2.7E+01	--	<2.7E+01	--	<2.8E+01	--
Sr	1.91E+01	2.0%	2.02E+01	0.5%	1.92E+01	0.8%
Th	<1.3E+02	--	<1.3E+02	--	<1.3E+02	--
Ti	<2.7E+00	--	<2.7E+00	--	<2.8E+00	--
U	3.53E+03	1.8%	3.52E+03	0.5%	3.38E+03	0.5%
V	<2.5E+00	--	<2.5E+00	--	<2.5E+00	--
Zn	<6.1E+00	--	<6.2E+00	--	<6.2E+00	--
Zr	1.87E+01	1.4%	1.86E+01	0.8%	1.84E+01	1.3%

Table 3-17. ICP-MS results for the feed supernate and product filtrates from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
Co	1.78E+00	2.5%	1.83E+00	1.6%	1.95E+00	1.4%
As	1.83E+00	4.1%	1.91E+00	4.4%	2.05E+00	3.3%
^{88}Sr	1.32E+01	2.2%	1.39E+01	0.8%	1.31E+01	0.5%
^{99}Tc	7.74E-01	2.5%	7.75E-01	1.6%	7.72E-01	0.3%
Ru	2.58E+01	1.6%	2.63E+01	0.3%	2.58E+01	0.6%
Rh	8.23E+00	0.9%	8.25E+00	0.5%	7.91E+00	0.5%
Pd	1.52E-01	8.2%	7.92E-02	15%	7.76E-02	6.2%
Ag	7.11E-01	3.3%	1.35E+00	1.4%	3.82E+00	0.6%
Sb	1.36E-01	1.2%	1.39E-01	9.4%	1.58E-01	4.8%
^{133}Cs	1.25E+00	0.9%	1.31E+00	1.6%	1.19E+00	1.4%
La	2.20E+01	1.7%	2.30E+01	0.3%	2.92E+01	0.4%
Ce	1.59E+01	1.9%	1.69E+01	0.6%	2.08E+01	0.3%
Pr	1.82E+01	1.4%	1.87E+01	0.4%	2.33E+01	1.4%
Nd	7.76E+01	2.5%	7.92E+01	0.8%	9.09E+01	0.4%
Eu	1.24E+00	1.4%	1.25E+00	0.7%	1.36E+00	0.4%
Gd	1.38E+02	1.3%	1.36E+02	0.9%	1.40E+02	0.6%
Dy*	6.80E-02	0.2%	7.23E-02	3.6%	7.96E-02	2.4%
Yb*	9.69E-02	3.2%	9.47E-02	1.6%	9.70E-02	5.7%
Ta	5.45E-02	1.5%	4.50E-02	2.1%	5.34E-02	5.2%
Pb	<8.7E-02	--	3.00E-01	63%	2.00E+00	4.5%
^{232}Th	3.84E+01	1.8%	4.04E+01	0.5%	4.09E+01	0.4%
^{233}U	2.22E-01	0.4%	2.21E-01	0.9%	2.11E-01	1.1%
^{234}U	3.92E+00	2.1%	3.72E+00	1.9%	3.45E+00	4.5%
^{235}U	2.45E+02	1.6%	2.38E+02	0.5%	2.27E+02	1.4%
^{236}U	2.35E+01	0.9%	2.32E+01	0.2%	2.22E+01	0.6%
^{237}Np	1.77E+00	1.3%	1.75E+00	0.2%	1.71E+00	0.9%
^{238}U	3.42E+03	1.4%	3.29E+03	1.0%	3.16E+03	1.2%
^{239}Pu	6.08E+00	1.3%	6.21E+00	0.5%	6.65E+00	0.1%
^{240}Pu	5.27E-01	1.5%	5.38E-01	0.9%	5.73E-01	1.2%
mass 241	1.86E-01	1.0%	1.92E-01	1.6%	2.42E-01	1.2%
mass 242	4.10E-02	4.1%	4.22E-02	0.5%	4.55E-02	2.2%
mass 243	<2.6E-02	--	<2.6E-02	--	<2.6E-02	--
mass 244	<2.6E-02	--	<2.6E-02	--	<2.6E-02	--
U	3.69E+03	1.4%	3.56E+03	0.9%	3.41E+03	1.2%
$^{235}U(eq_{SLU})$	2.46E+02	1.6%	2.38E+02	0.5%	2.27E+02	1.4%

* partial mass and tentative identification, see Table 2-1 for details

Table 3-18. Rad. chemistry results for the feed supernate and product filtrates from the additional pH adjustment solubility tests

Analyte	Adjusted to pH 3		Adjusted to pH 2		Adjusted to pH 0.7	
	Average (mg/L)	RSD	Average (mg/L)	RSD	Average (mg/L)	RSD
^{238}Pu	8.55E-02	7.6%	9.40E-02	7.6%	9.01E-02	4.0%
^{241}Pu	4.01E-02	10%	3.04E-02	71%	4.41E-02	6.2%
^{241}Am	6.30E-03	1.7%	6.52E-03	5.3%	1.09E-02	41%
^{243}Am	<4.8E-04	--	<6.3E-04	--	<8.4E-04	--
^{242m}Am	≤3.22E-06	33%	1.83E-06	41%	≤6.77E-06	83%
^{243}Cm	<8.7E-06	--	<1.2E-05	--	<1.1E-05	--
^{245}Cm	<2.1E-05	--	<2.9E-05	--	<2.8E-05	--
^{247}Cm	<4.2E+00	--	<4.6E+00	--	<5.6E+00	--
^{242}Cm	≤7.83E-09	33%	4.45E-09	41%	≤1.65E-08	84%
^{244}Cm	6.37E-05	20%	7.26E-05	8.1%	9.82E-05	49%
Pu	6.73E+00	1.3%	6.88E+00	0.6%	7.36E+00	0.2%
^{239}Pu(eq)	1.66E+02	1.6%	1.61E+02	0.5%	1.54E+02	1.3%

Figure 3-2 displays the soluble gadolinium concentrations observed in this testing as determined from the ICP-ES and ICP-MS analyses. As gadolinium was largely soluble at the 100% KMA addition and above, this should not be considered the overall highest gadolinium concentrations possible in the supernate at these conditions. The gadolinium concentration was higher in the supernate for increasing heated acid additions, increasing from the 70% to 100% KMA test and the 100% to 130% KMA test. However, the additional pH adjustment of the 100% KMA test product to lower pH values of 3, 2, and 0.7 did not significantly increase the soluble gadolinium concentration from that at the end of the heated acid addition.

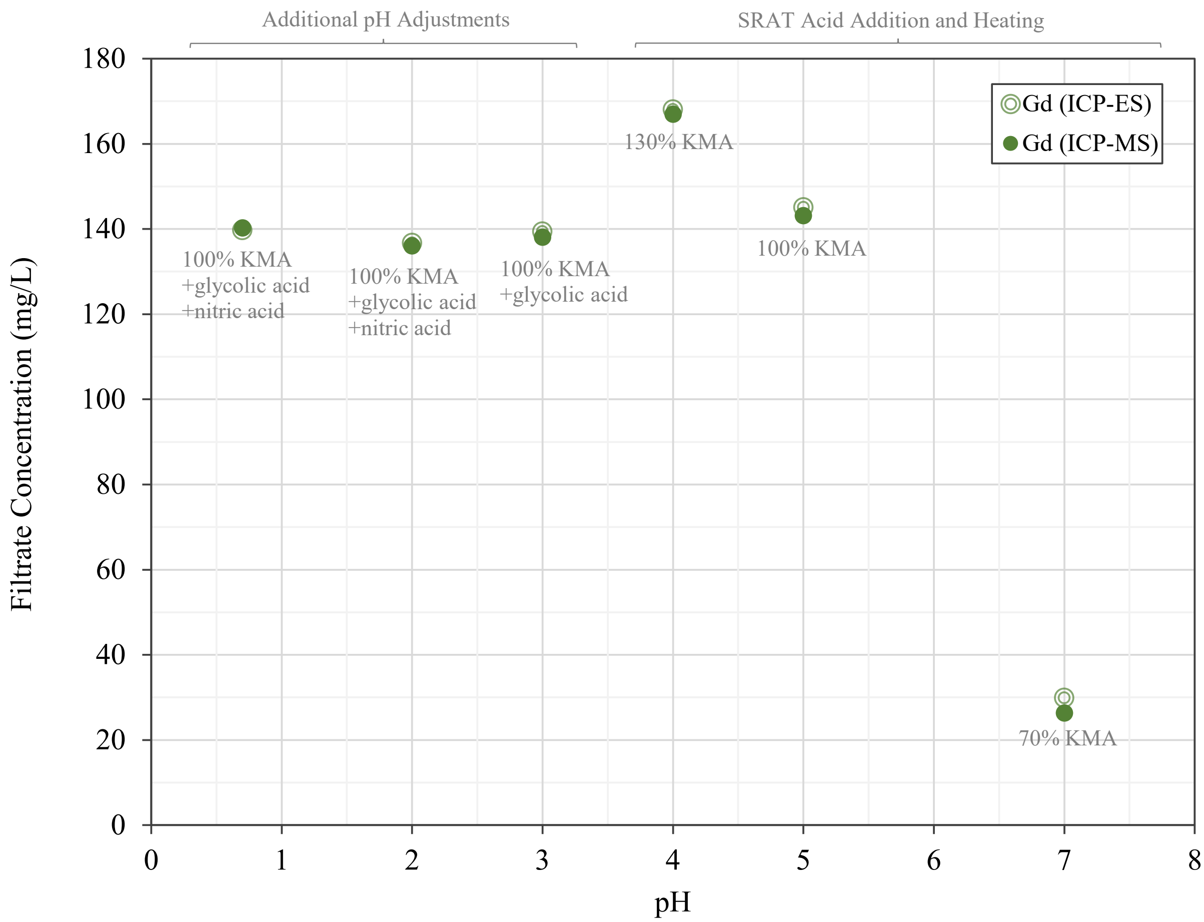

Figure 3-2. Gadolinium concentration in the filtrate during solubility testing

3.3 Partitioning, Mass Ratios, and Discussion

The concentration of each element in the feed and each testing aliquot along with the calculated percent soluble are shown in Table 3-19 through Table 3-24. The concentration in the solid phase is calculated as the difference between the total concentration in the slurry minus the concentration in the liquid phase. For components that are nearly completely soluble, occasionally the measured liquid concentration exceeds the total concentration in the slurry due to analytical uncertainty, which leads to negative calculated concentrations in the solid phase. For those cases, the calculated percent soluble, or partitioning into the liquid phase, is calculated to be >100%.

When compared to the feed solubility, most species show an increase in solubility as the pH goes from basic to acidic, with few exceptions displaying brief excursions around neutral pH before rejoining the trend. For the specific species of interest in this study, mainly Gd, other poisons, and fissile components, the trends are visually depicted in Figure 3-3. Based on these results, the Gd poison follows a similar solubility trend of the fissile components suggesting it should adequately partition into the solid and aqueous phases at the same conditions as the fissile components; poisons were at too low of concentration to be measured in the pH 13 feed.

Table 3-19. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the feed slurry, elements and non-radioactive isotopes.

Analyte	Method	Feed (pH 13.0)			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	ICP-MS	9.39E-04	9.36E-04	≤3.09E-06	0.3%
Al	ICP-ES	1.46E+00	1.36E+00	9.55E-02	6.5%
B	ICP-ES	<2.5E-03	--	2.14E-04	--
Ba	ICP-ES	8.03E-03	8.01E-03	<1.5E-05	<0.2%
Ca	ICP-ES	8.92E-02	8.91E-02	3.55E-05	0.04%
Ce	ICP-ES	1.76E-02	1.75E-02	<6.8E-05	<0.4%
	ICP-MS	1.61E-02	1.61E-02	<1.8E-06	<0.01%
Co	ICP-MS	4.05E-04	4.04E-04	<8.8E-07	<0.2%
Cr	ICP-ES	2.44E-02	2.28E-02	1.59E-03	6.5%
^{133}Cs	ICP-MS	1.25E-04	6.33E-05	6.17E-05	49%
Cu	ICP-ES	6.23E-03	6.22E-03	<7.7E-06	<0.1%
Fe	ICP-ES	1.23E+00	1.23E+00	<3.4E-05	<0.003%
Gd	ICP-ES	1.62E-02	1.62E-02	<2.1E-05	<0.1%
	ICP-MS	1.56E-02	1.56E-02	<4.4E-06	<0.03%
K	ICP-ES	<2.4E-02	--	3.00E-03	--
La	ICP-ES	4.37E-03	4.35E-03	<1.9E-05	<0.4%
	ICP-MS	5.60E-03	5.60E-03	<8.8E-07	<0.02%
Mg	ICP-ES	3.52E-02	3.51E-02	<1.5E-06	<0.004%
Mn	ICP-ES	2.45E-01	2.45E-01	<8.5E-06	<0.003%
Na	ICP-ES	1.93E+00	8.22E-02	1.85E+00	96%
Nd	ICP-MS	1.82E-02	1.82E-02	<5.3E-06	<0.03%
Ni	ICP-ES	4.30E-02	4.30E-02	<4.4E-05	<0.1%
Pb	ICP-MS	1.50E-03	1.50E-03	<2.6E-06	<0.2%
Pd	ICP-MS	2.30E-04	2.23E-04	6.88E-06	3.0%
Pr	ICP-MS	4.73E-03	4.73E-03	<8.8E-07	<0.02%
Pu	multiple	2.63E-03	2.63E-03	1.14E-09	0.0%
Rh	ICP-MS	1.34E-03	1.34E-03	2.61E-06	0.2%
Ru	ICP-MS	6.22E-03	6.20E-03	1.70E-05	0.3%
Si	ICP-ES	4.36E-02	4.35E-02	<9.7E-05	<0.2%
Sr	ICP-ES	3.68E-03	3.68E-03	<2.5E-06	<0.1%
^{88}Sr	ICP-MS	2.42E-03	2.41E-03	<8.8E-07	<0.04%
Th	ICP-ES	2.24E-01	2.24E-01	<8.1E-05	<0.04%
Ti	ICP-ES	1.92E-03	1.91E-03	<6.5E-06	<0.3%
U	ICP-ES	3.82E-01	3.81E-01	<8.2E-04	<0.2%
	ICP-MS	3.66E-01	3.65E-01	6.37E-04	0.2%
Zn	ICP-ES	3.12E-03	3.10E-03	<1.8E-05	<0.6%
Zr	ICP-ES	1.68E-02	1.68E-02	<9.1E-06	<0.05%

Table 3-20. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the feed slurry, radioactive isotopes.

Analyte	Method	Feed (pH 13.0)			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{99}Tc	ICP-MS	2.50E-04	2.06E-04	4.35E-05	17%
^{232}Th	ICP-MS	2.11E-01	2.11E-01	<8.8E-07	<0.0004%
^{233}U	ICP-MS	<8.6E-05	--	<8.8E-07	--
^{234}U	ICP-MS	3.52E-04	3.48E-04	3.99E-06	1.1%
^{235}U	ICP-MS	2.45E-02	2.42E-02	3.03E-04	1.2%
^{236}U	ICP-MS	2.26E-03	2.23E-03	2.98E-05	1.3%
^{237}Np	ICP-MS	2.39E-04	2.38E-04	<8.8E-07	<0.4%
^{238}U	ICP-MS	3.39E-01	3.38E-01	3.01E-04	0.09%
^{238}Pu	radchem	6.12E-05	6.12E-05	6.02E-10	0.001%
^{241}Pu	radchem	7.08E-06	7.08E-06	5.39E-10	0.008%
^{239}Pu	ICP-MS	2.36E-03	2.36E-03	<8.8E-07	<0.04%
^{240}Pu	ICP-MS	2.01E-04	2.01E-04	<8.8E-07	<0.4%
^{241}Am	radchem	5.14E-05	5.14E-05	<2.6E-09	<0.005%
^{244}Cm	radchem	2.66E-07	2.66E-07	<9.3E-11	<0.03%
^{235}U(eq$_{SLU}$)	ICP-MS	2.45E-02	2.42E-02	3.03E-04	1.2%
^{239}Pu(eq)	multiple	1.83E-02	1.81E-02	1.97E-04	1.1%

Table 3-21. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the SRAT acid addition heated solubility tests, elements and non-radioactive isotopes.

Analyte	Method	70% KMA (pH 7.0)				100% KMA (pH 5.0)				130% KMA (pH 4.0)			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	ICP-MS	9.22E-04	--	<4.6E-06	<0.5%	9.29E-04	9.17E-04	1.26E-05	1.4%	9.03E-04	8.50E-04	5.33E-05	5.9%
Al	ICP-ES	1.44E+00	1.42E+00	1.26E-02	0.9%	1.44E+00	1.34E+00	1.08E-01	7.5%	1.45E+00	1.30E+00	1.44E-01	9.9%
As	ICP-MS	4.41E-04	4.24E-04	1.63E-05	3.7%	4.57E-04	3.07E-04	1.50E-04	33%	4.23E-04	2.11E-04	2.12E-04	50%
Ba	ICP-ES	8.02E-03	7.80E-03	2.24E-04	2.8%	8.10E-03	7.84E-03	2.66E-04	3.3%	7.81E-03	7.57E-03	2.40E-04	3.1%
Ca	ICP-ES	8.23E-02	4.65E-02	3.58E-02	44%	8.40E-02	1.77E-02	6.63E-02	79%	8.24E-02	1.13E-02	7.11E-02	86%
Ce	ICP-MS	1.65E-02	1.64E-02	9.94E-05	1%	1.64E-02	1.51E-02	1.31E-03	8%	1.60E-02	1.34E-02	2.62E-03	16%
Co	ICP-MS	3.63E-04	3.55E-04	7.60E-06	2.1%	3.59E-04	1.96E-04	1.63E-04	45%	3.49E-04	1.22E-04	2.26E-04	65%
Cr	ICP-ES	2.41E-02	1.95E-02	4.62E-03	19%	2.46E-02	1.21E-02	1.25E-02	51%	2.35E-02	9.37E-03	1.41E-02	60%
^{133}Cs	ICP-MS	1.31E-04	2.98E-05	1.01E-04	77%	1.27E-04	1.50E-05	1.12E-04	88%	1.32E-04	2.30E-05	1.09E-04	83%
Cu	ICP-ES	<5.8E-03	--	<9.2E-04	--	<5.8E-03	--	2.10E-03	>36%	<5.8E-03	--	2.98E-03	>51%
Dy*	ICP-MS	1.58E-05	--	<2.3E-06	<15%	1.60E-05	1.03E-05	5.73E-06	36%	1.56E-05	7.65E-06	7.99E-06	51%
Eu	ICP-MS	2.67E-04	2.52E-04	1.46E-05	5%	2.66E-04	1.59E-04	1.07E-04	40%	2.61E-04	1.20E-04	1.41E-04	54%
Fe	ICP-ES	1.25E+00	1.25E+00	1.73E-03	0.1%	1.28E+00	1.25E+00	3.12E-02	2.4%	1.22E+00	1.15E+00	6.79E-02	5.6%
Gd	ICP-ES	1.60E-02	1.34E-02	2.64E-03	16%	1.56E-02	2.90E-03	1.27E-02	81%	1.56E-02	8.81E-04	1.47E-02	94%
	ICP-MS	1.61E-02	1.37E-02	2.33E-03	14%	1.59E-02	3.31E-03	1.26E-02	79%	1.56E-02	9.66E-04	1.46E-02	94%
La	ICP-ES	<4.5E-03	--	<1.0E-04	--	<4.5E-03	--	1.45E-03	>32%	<4.5E-03	--	2.41E-03	>54%
	ICP-MS	5.51E-03	5.38E-03	1.34E-04	2%	5.52E-03	3.88E-03	1.64E-03	30%	5.36E-03	2.65E-03	2.71E-03	51%
Mg	ICP-ES	3.50E-02	1.75E-02	1.75E-02	50%	3.47E-02	8.29E-03	2.64E-02	76%	3.40E-02	4.27E-03	2.97E-02	87%
Mn	ICP-ES	2.39E-01	1.75E-01	6.37E-02	27%	2.37E-01	6.13E-02	1.75E-01	74%	2.32E-01	3.26E-02	1.99E-01	86%
Na	ICP-ES	1.90E+00	6.53E-02	1.83E+00	97%	1.86E+00	5.72E-02	1.81E+00	97%	1.83E+00	3.46E-02	1.79E+00	98%
Nd	ICP-MS	1.81E-02	1.74E-02	7.11E-04	4%	1.80E-02	1.18E-02	6.21E-03	35%	1.75E-02	8.36E-03	9.15E-03	52%
Ni	ICP-ES	4.27E-02	4.08E-02	1.84E-03	4.3%	4.30E-02	2.62E-02	1.69E-02	39%	4.10E-02	1.74E-02	2.36E-02	58%
Pb	ICP-MS	1.23E-02	1.23E-02	≤7.92E-06	0.06%	1.24E-02	1.24E-02	≤7.04E-06	0.06%	1.20E-02	1.20E-02	≤7.1E-06	0.06%
Pd	ICP-MS	2.13E-04	2.09E-04	3.99E-06	1.9%	2.22E-04	2.06E-04	1.53E-05	6.9%	2.10E-04	2.07E-04	3.81E-06	1.8%
Pr	ICP-MS	4.68E-03	4.55E-03	1.33E-04	2.9%	4.66E-03	3.25E-03	1.41E-03	30%	4.55E-03	2.29E-03	2.26E-03	50%
Pu	multiple	2.31E-03	2.29E-03	2.67E-05	1.2%	2.39E-03	1.80E-03	5.89E-04	25%	2.29E-03	1.35E-03	9.39E-04	41%
Rh	ICP-MS	1.29E-03	7.78E-04	5.09E-04	40%	1.27E-03	4.76E-04	7.97E-04	63%	1.24E-03	3.29E-04	9.10E-04	73%
Ru	ICP-MS	5.97E-03	4.56E-03	1.41E-03	24%	5.94E-03	3.44E-03	2.50E-03	42%	5.80E-03	2.68E-03	3.12E-03	54%
Sb	ICP-MS	3.89E-05	--	<4.6E-06	12%	3.81E-05	2.53E-05	1.28E-05	34%	3.80E-05	2.20E-05	1.60E-05	42%
Si	ICP-ES	4.18E-02	--	<3.5E-03	<8%	4.11E-02	1.74E-02	2.37E-02	58%	4.23E-02	2.13E-02	2.10E-02	50%
Sr	ICP-ES	<4.3E-03	--	9.88E-04	>23%	<4.3E-03	--	1.49E-03	>34%	<4.3E-03	--	1.70E-03	>39%
^{88}Sr	ICP-MS	2.30E-03	1.60E-03	6.99E-04	30%	2.32E-03	1.27E-03	1.05E-03	45%	2.27E-03	1.08E-03	1.19E-03	52%
Ta	ICP-MS	2.08E-05	--	<2.3E-06	<11%	2.02E-05	1.65E-05	3.73E-06	18%	2.48E-05	1.50E-05	9.78E-06	39%
Tb	ICP-MS	2.29E-05	--	<2.3E-06	<10%	2.33E-05	1.56E-05	7.65E-06	33%	2.33E-05	1.25E-05	1.08E-05	46%
Th	ICP-ES	1.98E-01	--	<1.1E-02	<6%	2.30E-01	--	<1.1E-02	<5%	2.05E-01	--	<1.1E-02	<5%
Ti	ICP-ES	1.75E-03	--	<2.9E-04	<17%	1.76E-03	--	<2.9E-04	<16%	1.70E-03	--	<2.9E-04	<17%
U	ICP-ES	3.37E-01	2.19E-01	1.18E-01	35%	3.35E-01	-1.15E-02	3.47E-01	103%	3.25E-01	-2.29E-02	3.48E-01	107%
	ICP-MS	3.68E-01	2.46E-01	1.21E-01	33%	3.60E-01	1.74E-02	3.43E-01	95%	3.53E-01	7.37E-03	3.46E-01	98%
Yb*	ICP-MS	1.17E-05	--	<2.3E-06	<20%	1.19E-05	3.01E-06	8.85E-06	75%	1.18E-05	1.56E-06	1.02E-05	87%
Zn	ICP-ES	2.82E-03	--	<9.1E-04	<32%	2.79E-03	--	<9.0E-04	<32%	2.75E-03	--	<9.0E-04	<33%
Zr	ICP-ES	1.57E-02	--	<3.1E-03	<20%	1.60E-02	--	<3.0E-03	<19%	1.53E-02	--	<3.1E-03	<20%

* partial mass and tentative identification, see Table 2-1 for details

Table 3-22. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the SRAT acid addition heated solubility tests, radioactive isotopes.

Analyte	Method	70% KMA (pH 7.0)				100% KMA (pH 5.0)				130% KMA (pH 4.0)			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{99}Tc	ICP-MS	2.21E-04	1.57E-04	6.44E-05	29%	2.23E-04	1.42E-04	8.05E-05	36%	2.15E-04	1.31E-04	8.45E-05	39%
^{232}Th	ICP-MS	1.95E-01	1.95E-01	9.77E-05	0.05%	2.25E-01	2.21E-01	4.53E-03	2.0%	2.03E-01	1.96E-01	6.78E-03	3.3%
^{233}U	ICP-MS	5.13E-05	4.52E-05	6.06E-06	12%	5.40E-05	3.24E-05	2.15E-05	40%	5.05E-05	2.87E-05	2.18E-05	43%
^{234}U	ICP-MS	3.74E-04	2.50E-04	1.25E-04	33%	3.63E-04	3.54E-05	3.28E-04	90%	3.57E-04	2.32E-05	3.34E-04	93%
^{235}U	ICP-MS	2.35E-02	1.53E-02	8.20E-03	35%	2.29E-02	1.19E-03	2.17E-02	95%	2.23E-02	7.09E-04	2.16E-02	97%
^{236}U	ICP-MS	2.11E-03	1.32E-03	7.91E-04	37%	2.06E-03	-1.70E-04	2.23E-03	108%	2.03E-03	-1.88E-04	2.22E-03	109%
^{237}Np	ICP-MS	2.21E-04	1.41E-04	8.03E-05	36%	2.20E-04	5.39E-05	1.67E-04	76%	2.14E-04	4.07E-05	1.73E-04	81%
^{238}U	ICP-MS	3.42E-01	2.29E-01	1.12E-01	33%	3.35E-01	1.63E-02	3.18E-01	95%	3.29E-01	6.79E-03	3.22E-01	98%
^{238}Pu	radchem	5.71E-05	5.68E-05	2.98E-07	0.5%	5.61E-05	4.87E-05	7.40E-06	13%	5.46E-05	4.22E-05	1.24E-05	23%
^{239}Pu	ICP-MS	2.07E-03	2.04E-03	2.63E-05	1.3%	2.15E-03	1.61E-03	5.33E-04	25%	2.05E-03	1.20E-03	8.48E-04	41%
^{240}Pu	ICP-MS	1.79E-04	--	<2.3E-06	<1%	1.84E-04	1.38E-04	4.56E-05	25%	1.78E-04	1.05E-04	7.29E-05	41%
^{241}Pu	radchem	6.61E-06	6.47E-06	1.49E-07	2.2%	6.49E-06	3.26E-06	3.24E-06	50%	6.33E-06	1.07E-07	6.22E-06	98%
^{241}Am	radchem	4.80E-05	4.794E-05	<5.8E-08	<0.1%	4.71E-05	4.67E-05	4.73E-07	1%	4.59E-05	4.53E-05	6.22E-07	1%
^{242m}Am	radchem	≤2.27E-08	--	<6.6E-10	<2.9%	≤2.23E-08	--	<4.2E-10	<1.9%	≤2.17E-08	--	<1.0E-10	<0.5%
^{242}Cm	radchem	≤5.52E-11	--	<1.6E-12	<2.9%	≤5.42E-11	--	<1.0E-12	<1.9%	≤5.28E-11	--	<2.5E-13	<0.5%
^{244}Cm	radchem	2.48E-07	2.471E-07	<8.4E-10	<0.3%	2.43E-07	2.37E-07	6.34E-09	2.6%	2.37E-07	2.31E-07	6.55E-09	2.8%
mass 241	ICP-MS	5.18E-05	--	<2.3E-06	<4%	5.17E-05	3.74E-05	1.44E-05	28%	5.03E-05	2.73E-05	2.31E-05	46%
mass 242	ICP-MS	1.72E-05	--	<2.3E-06	<13%	1.65E-05	1.30E-05	3.55E-06	21%	1.64E-05	1.10E-05	5.46E-06	33%
^{235}U(eq$_{SLU}$)	ICP-MS	2.36E-02	1.54E-02	8.21E-03	35%	2.30E-02	1.23E-03	2.17E-02	95%	2.23E-02	7.49E-04	2.16E-02	97%
^{239}Pu(eq)	multiple	1.74E-02	1.20E-02	5.36E-03	31%	1.71E-02	2.42E-03	1.47E-02	86%	1.66E-02	1.69E-03	1.49E-02	90%

Table 3-23. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the additional pH adjustment solubility tests, elements and non-radioactive isotopes.

Analyte	Method	100% KMA Adjusted to pH 3				100% KMA Adjusted to pH 2				100% KMA Adjusted to pH 0.7			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	ICP-MS	8.63E-04	8.02E-04	6.15E-05	7.1%	8.43E-04	7.27E-04	1.16E-04	14%	7.97E-04	4.71E-04	3.27E-04	41%
Al	ICP-ES	1.43E+00	1.32E+00	1.06E-01	7.5%	1.45E+00	1.34E+00	1.08E-01	7.5%	1.39E+00	1.28E+00	1.13E-01	8.1%
As	ICP-MS	3.94E-04	2.36E-04	1.58E-04	40%	4.00E-04	2.36E-04	1.64E-04	41%	3.69E-04	1.93E-04	1.75E-04	48%
Ba	ICP-ES	7.15E-03	6.80E-03	3.48E-04	4.9%	6.92E-03	6.56E-03	3.66E-04	5.3%	6.63E-03	6.00E-03	6.35E-04	9.6%
Ca	ICP-ES	7.96E-02	1.26E-02	6.70E-02	84%	7.98E-02	1.16E-02	6.82E-02	85%	7.28E-02	9.41E-03	6.34E-02	87%
Ce	ICP-MS	1.52E-02	1.38E-02	1.38E-03	9.1%	1.46E-02	1.32E-02	1.46E-03	10.0%	1.40E-02	1.22E-02	1.78E-03	13%
Co	ICP-MS	3.22E-04	1.68E-04	1.54E-04	48%	3.08E-04	1.50E-04	1.58E-04	51%	3.01E-04	1.34E-04	1.67E-04	55%
Cr	ICP-ES	2.24E-02	1.08E-02	1.16E-02	52%	2.19E-02	1.02E-02	1.17E-02	53%	2.03E-02	8.22E-03	1.20E-02	59%
^{133}Cs	ICP-MS	1.15E-04	6.68E-06	1.08E-04	94%	1.15E-04	2.07E-06	1.13E-04	98%	1.04E-04	1.80E-06	1.02E-04	98%
Dy*	ICP-MS	1.33E-05	7.45E-06	5.88E-06	44%	1.31E-05	6.84E-06	6.24E-06	48%	1.26E-05	5.75E-06	6.81E-06	54%
Eu	ICP-MS	2.44E-04	1.37E-04	1.08E-04	44%	2.41E-04	1.33E-04	1.07E-04	45%	2.24E-04	1.08E-04	1.17E-04	52%
Fe	ICP-ES	1.14E+00	1.11E+00	3.44E-02	3.0%	1.12E+00	1.08E+00	4.18E-02	3.7%	1.06E+00	9.72E-01	8.79E-02	8.3%
Gd	ICP-ES	1.50E-02	2.92E-03	1.20E-02	80%	1.51E-02	3.29E-03	1.18E-02	78%	1.37E-02	1.71E-03	1.20E-02	88%
	ICP-MS	1.50E-02	3.07E-03	1.19E-02	80%	1.47E-02	2.93E-03	1.17E-02	80%	1.36E-02	1.60E-03	1.20E-02	88%
La	ICP-ES	<4.9E-03	--	1.84E-03	--	<4.9E-03	--	1.87E-03	--	<5.0E-03	--	2.22E-03	--
	ICP-MS	5.05E-03	3.14E-03	1.90E-03	38%	4.91E-03	2.93E-03	1.98E-03	40%	4.59E-03	2.09E-03	2.50E-03	55%
Mg	ICP-ES	3.21E-02	8.36E-03	2.38E-02	74%	3.22E-02	8.20E-03	2.40E-02	75%	2.97E-02	6.72E-03	2.29E-02	77%
Mn	ICP-ES	2.18E-01	5.51E-02	1.63E-01	75%	2.16E-01	5.23E-02	1.64E-01	76%	1.99E-01	4.24E-02	1.57E-01	79%
Na	ICP-ES	1.73E+00	7.58E-02	1.65E+00	96%	1.71E+00	6.88E-02	1.64E+00	96%	1.58E+00	4.69E-02	1.53E+00	97%
Nd	ICP-MS	1.67E-02	9.96E-03	6.71E-03	40%	1.62E-02	9.36E-03	6.83E-03	42%	1.53E-02	7.49E-03	7.78E-03	51%
Ni	ICP-ES	3.90E-02	2.38E-02	1.52E-02	39%	3.82E-02	2.24E-02	1.58E-02	41%	3.61E-02	1.99E-02	1.62E-02	45%
Pb	ICP-MS	1.09E-02	--	<7.6E-06	<0.07%	1.06E-02	1.05E-02	2.59E-05	0.2%	1.01E-02	9.89E-03	1.71E-04	1.7%
Pd	ICP-MS	1.79E-04	1.66E-04	1.32E-05	7.4%	1.66E-04	1.60E-04	6.83E-06	4.1%	1.61E-04	1.54E-04	6.65E-06	4.1%
Pr	ICP-MS	4.28E-03	2.71E-03	1.57E-03	37%	4.17E-03	2.56E-03	1.61E-03	39%	3.92E-03	1.93E-03	1.99E-03	51%
Pu	multiple	2.18E-03	1.59E-03	5.82E-04	27%	2.13E-03	1.54E-03	5.93E-04	28%	1.99E-03	1.36E-03	6.30E-04	32%
Rh	ICP-MS	1.19E-03	4.80E-04	7.11E-04	60%	1.16E-03	4.51E-04	7.11E-04	61%	1.08E-03	4.05E-04	6.78E-04	63%
Ru	ICP-MS	5.52E-03	3.29E-03	2.23E-03	40%	5.37E-03	3.11E-03	2.26E-03	42%	5.07E-03	2.86E-03	2.21E-03	44%
Sb	ICP-MS	3.60E-05	2.42E-05	1.17E-05	33%	3.70E-05	2.50E-05	1.19E-05	32%	3.48E-05	2.13E-05	1.35E-05	39%
Si	ICP-ES	3.16E-02	6.72E-03	2.48E-02	79%	3.42E-02	8.25E-03	2.59E-02	76%	3.28E-02	4.97E-03	2.78E-02	85%
Sr	ICP-ES	<7.4E-03	--	1.65E-03	--	<7.4E-03	--	1.74E-03	--	<7.4E-03	--	1.64E-03	--
^{88}Sr	ICP-MS	2.10E-03	9.66E-04	1.14E-03	54%	2.08E-03	8.86E-04	1.20E-03	57%	1.94E-03	8.15E-04	1.12E-03	58%
Ta	ICP-MS	2.06E-05	1.59E-05	4.71E-06	23%	2.18E-05	1.79E-05	3.88E-06	18%	1.94E-05	1.48E-05	4.57E-06	24%
Tb	ICP-MS	2.10E-05	1.30E-05	7.97E-06	38%	2.00E-05	1.21E-05	7.91E-06	40%	1.83E-05	9.25E-06	9.07E-06	50%
Th	ICP-ES	1.91E-01	--	<1.1E-02	<6%	1.98E-01	--	<1.1E-02	<5%	1.80E-01	--	<1.1E-02	<6%
Ti	ICP-ES	1.68E-03	--	<2.4E-04	<14%	1.68E-03	--	<2.4E-04	<14%	1.60E-03	--	<2.4E-04	<15%
U	ICP-ES	3.06E-01	8.03E-04	3.05E-01	100%	3.02E-01	-1.10E-03	3.03E-01	100%	2.81E-01	-8.46E-03	2.89E-01	103%
	ICP-MS	3.09E-01	-9.97E-03	3.19E-01	103%	3.05E-01	-2.23E-03	3.07E-01	101%	2.82E-01	-1.01E-02	2.92E-01	104%
Yb*	ICP-MS	≤1.03E-05	1.93E-06	8.38E-06	81%	≤1.03E-05	2.11E-06	8.16E-06	79%	≤1.01E-05	1.77E-06	8.31E-06	82%
Zn	ICP-ES	2.61E-03	--	<5.3E-04	<20%	2.53E-03	--	<5.4E-04	<21%	2.35E-03	--	<5.3E-04	<23%
Zr	ICP-ES	<1.6E-02	--	1.62E-03	--	<1.6E-02	--	1.61E-03	--	<1.6E-02	--	1.57E-03	--

* partial mass and tentative identification, see Table 2-1 for details

Table 3-24. Total, insoluble, and soluble concentrations and the corresponding percent soluble for the additional pH adjustment solubility tests, radioactive isotopes.

Analyte	Method	100% KMA Adjusted to pH 3				100% KMA Adjusted to pH 2				100% KMA Adjusted to pH 0.7			
		Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{99}Tc	ICP-MS	2.14E-04	1.47E-04	6.69E-05	31%	2.09E-04	1.42E-04	6.68E-05	32%	1.96E-04	1.30E-04	6.61E-05	34%
^{232}Th	ICP-MS	1.75E-01	1.72E-01	3.32E-03	1.9%	1.78E-01	1.74E-01	3.49E-03	2.0%	1.65E-01	1.62E-01	3.50E-03	2.1%
^{233}U	ICP-MS	4.87E-05	2.95E-05	1.92E-05	39%	4.77E-05	2.87E-05	1.91E-05	40%	4.43E-05	2.63E-05	1.81E-05	41%
^{234}U	ICP-MS	3.17E-04	-2.19E-05	3.39E-04	107%	3.11E-04	-9.74E-06	3.21E-04	103%	2.90E-04	-4.92E-06	2.95E-04	102%
^{235}U	ICP-MS	2.14E-02	1.96E-04	2.12E-02	99%	2.11E-02	6.03E-04	2.05E-02	97%	1.94E-02	-3.20E-05	1.94E-02	100%
^{236}U	ICP-MS	1.92E-03	-1.13E-04	2.04E-03	106%	1.88E-03	-1.23E-04	2.00E-03	107%	1.75E-03	-1.54E-04	1.90E-03	109%
^{237}Np	ICP-MS	2.05E-04	5.21E-05	1.53E-04	75%	1.99E-04	4.80E-05	1.50E-04	76%	1.86E-04	3.93E-05	1.46E-04	79%
^{238}U	ICP-MS	2.85E-01	-1.01E-02	2.95E-01	104%	2.81E-01	-2.72E-03	2.84E-01	101%	2.60E-01	-9.91E-03	2.70E-01	104%
^{238}Pu	radchem	5.02E-05	4.28E-05	7.39E-06	15%	4.85E-05	4.04E-05	8.10E-06	17%	4.56E-05	3.78E-05	7.71E-06	17%
^{239}Pu	ICP-MS	1.95E-03	1.43E-03	5.25E-04	27%	1.91E-03	1.38E-03	5.36E-04	28%	1.78E-03	1.21E-03	5.70E-04	32%
^{240}Pu	ICP-MS	1.68E-04	1.22E-04	4.56E-05	27%	1.64E-04	1.18E-04	4.63E-05	28%	1.55E-04	1.06E-04	4.91E-05	32%
^{241}Pu	radchem	5.81E-06	2.34E-06	3.47E-06	60%	5.62E-06	3.00E-06	2.62E-06	47%	5.28E-06	1.50E-06	3.78E-06	72%
^{241}Am	radchem	4.22E-05	4.16E-05	5.45E-07	1.3%	4.08E-05	4.02E-05	5.62E-07	1.4%	3.83E-05	3.74E-05	9.29E-07	2.4%
^{242m}Am	radchem	≤2.00E-08	1.97E-08	≤2.78E-10	1.4%	≤1.93E-08	1.91E-08	1.58E-10	0.8%	≤1.81E-08	1.76E-08	≤5.80E-10	3.2%
^{242}Cm	radchem	≤4.85E-11	4.79E-11	≤6.77E-13	1.4%	≤4.69E-11	4.65E-11	3.84E-13	0.8%	≤4.41E-11	4.27E-11	≤1.41E-12	3.2%
^{244}Cm	radchem	2.18E-07	2.12E-07	5.50E-09	2.5%	2.11E-07	2.04E-07	6.26E-09	3.0%	1.98E-07	1.89E-07	8.41E-09	4.3%
mass 241	ICP-MS	4.79E-05	3.18E-05	1.61E-05	34%	4.68E-05	3.02E-05	1.66E-05	35%	4.37E-05	2.30E-05	2.07E-05	47%
mass 242	ICP-MS	1.58E-05	1.23E-05	3.54E-06	22%	1.52E-05	1.15E-05	3.64E-06	24%	1.46E-05	1.07E-05	3.90E-06	27%
$^{235}U(eq_{SLU})$	ICP-MS	2.15E-02	2.37E-04	2.13E-02	99%	2.12E-02	6.43E-04	2.05E-02	97%	1.94E-02	4.75E-06	1.94E-02	100%
$^{239}Pu(eq)$	multiple	1.59E-02	1.58E-03	1.43E-02	90%	1.57E-02	1.80E-03	1.39E-02	89%	1.44E-02	1.22E-03	1.32E-02	92%

Figure 3-3 shows the percent soluble for many of the important elements for poisoning of fissile components, including several elements that have been credited as neutron poisons (gadolinium, iron, and manganese) and the elements that are partially fissile (uranium and plutonium). Seven of the results are from the testing in this report. The additional three results, indicated by asterisks at the top and bottom borders of the plot in Figure 3-3, are from the previous study of SB10 with SRE material presented in Figure 1-3.[28] The previous SB10 with SRE tests were performed at 65%, 92%, and 129% KMA, leading to product pH of 7.9, 6.4, and 4.2, respectively. The percent soluble from the two data sets mesh well to complete the observed trends of increasing solubility with decreasing pH until a limit of diminishing returns is reached for each species. Additionally, this data compares well to previous solubility data for SB5 and SB9 as represented in Figure 1-1 and Figure 1-2.

The partitioning of uranium into the liquid phase remains higher than that of gadolinium across the range of measured pH values. This suggests that a portion of the gadolinium should remain in the associated phases with the uranium during HLW processing in DWPF as well as in corresponding process condensate tanks if material is carried through the offgas lines.

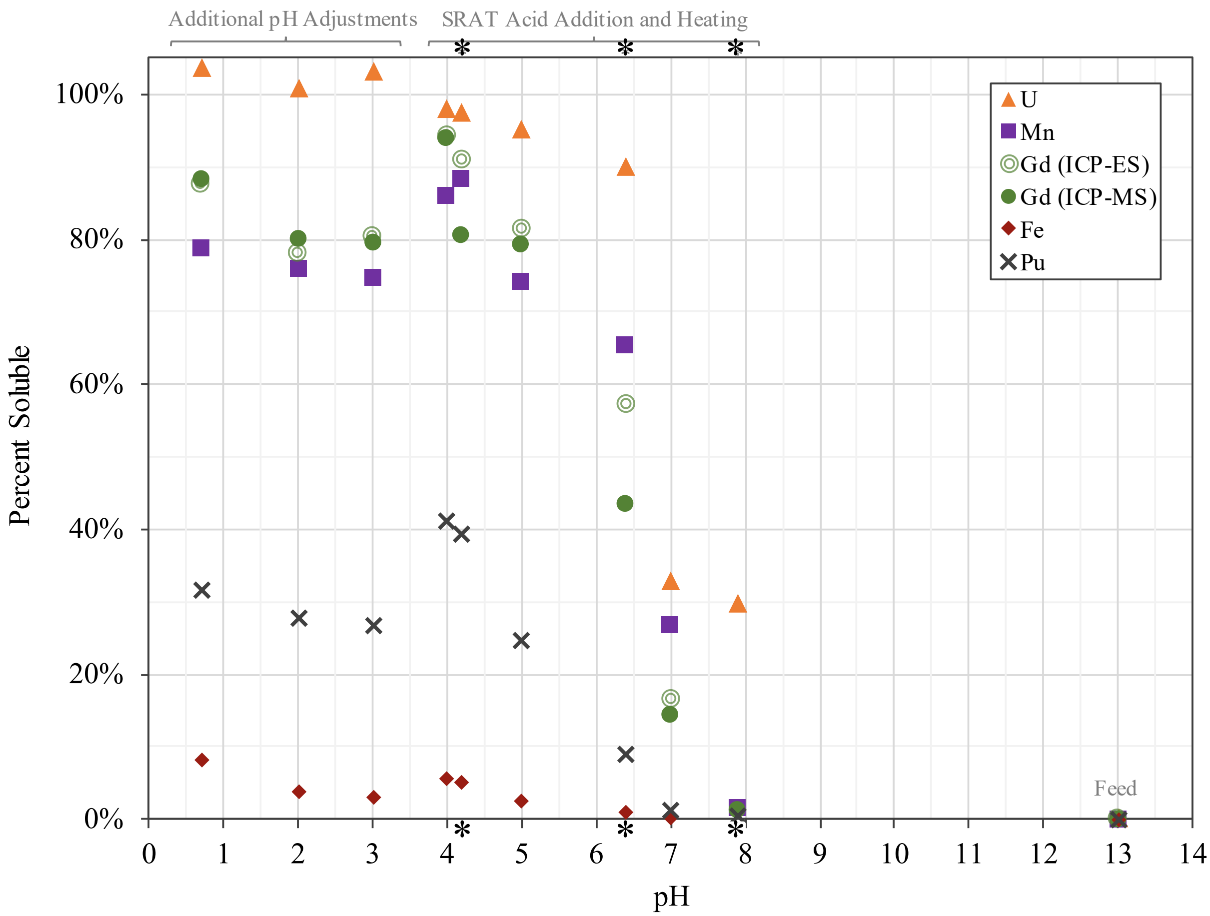

Figure 3-3. Comparison of percent solubilities of key metals for the present tests and the prior SB10/SRE solubility tests.

Table 3-25, Table 3-26, and Table 3-27 are a series of summary tables for the ABD poison solubility test feed, SRAT acid additions, and additional pH adjustments, respectively. The first section of these tables summarizes the total, solid (insoluble), and liquid (soluble) concentrations of key fissile and poison elements, isotopes, and equivalents. The next section provides concentrations of three of the key ways to look at fissile concentration, the $^{235}U(eq_{SLU})$, ^{239}Pu, and $^{239}Pu(eq)$, in units of g/L for direct comparison with the single parameter concentration limit. The next section summarizes three terms that can be useful in understanding the fissile components, which are the percent ^{235}U enrichment, the percent of $^{239}Pu(eq)$ that is due to U, and the percent of $^{239}Pu(eq)$ that is due to Pu. The final section provides multiple potentially useful mass ratios of poisons to fissile component.

In cases where calculated values for uranium content in the solid phase was below or very near zero, enrichment in the solid phase is not listed.

Table 3-25. Calculation of ratios of poisons to equivalent fissile in the test feeds

	Feed		
	Total	Solid	Liquid
Concentrations (wt% slurry)			
Fe	1.23E+00	1.23E+00	<3.4E-05
Gd (ICP-ES)	1.62E-02	1.62E-02	<2.1E-05
Gd (ICP-MS)	1.56E-02	1.56E-02	<4.4E-06
Mn	2.45E-01	2.45E-01	<8.5E-06
U (ICP-ES)	3.82E-01	3.82E-01	<8.2E-04
U (ICP-MS)	3.66E-01	3.65E-01	6.37E-04
^{235}U	2.45E-02	2.42E-02	3.03E-04
$^{235}U(eq_{SLU})$	2.45E-02	2.42E-02	3.03E-04
^{239}Pu	2.36E-03	2.36E-03	<8.8E-07
$^{239}Pu(eq)$	1.83E-02	1.81E-02	1.97E-04
Concentrations (g/L)			
$^{235}U(eq_{SLU})$	2.68E-01	--	3.44E-03
^{239}Pu	2.58E-02	--	<1.0E-05
$^{239}Pu(eq)$	2.00E-01	--	2.24E-03
^{235}U Enrichment (%) and Contribution to ^{239}Pu(eq) (%)			
$^{235}U/U$	6.7%	6.6%	47.5%
U in $^{239}Pu(eq)$	87.1%	86.9%	100.0%
Pu in $^{239}Pu(eq)$	12.9%	13.1%	0.0%
Mass Ratios			
Fe:Gd	79:1	79:1	--
Gd:$^{235}U(eq_{SLU})$	0.63:1	0.64:1	--
Gd:$^{239}Pu(eq)$	0.85:1	0.86:1	--
Gd:^{239}Pu	6.6:1	6.6:1	--
Mn:$^{235}U(eq_{SLU})$	10.0:1	10.1:1	--
Mn:$^{239}Pu(eq)$	13.4:1	13.5:1	--
Fe:$^{239}Pu(eq)$	67:1	68:1	--
Fe:^{239}Pu	520:1	520:1	--

Table 3-26. Calculation of ratios of poisons to equivalent fissile in the products from the SRAT acid addition heated solubility tests

	70% KMA (pH 7.0)			100% KMA (pH 5.0)			130% KMA (pH 4.0)		
	Total	Solid	Liquid	Total	Solid	Liquid	Total	Solid	Liquid
Concentrations (wt% slurry)									
Fe	1.25E+00	1.25E+00	1.73E-03	1.28E+00	1.25E+00	3.12E-02	1.22E+00	1.15E+00	6.79E-02
Gd (ICP-ES)	1.60E-02	1.34E-02	2.64E-03	1.56E-02	2.90E-03	1.27E-02	1.56E-02	8.81E-04	1.47E-02
Gd (ICP-MS)	1.61E-02	1.37E-02	2.33E-03	1.59E-02	3.31E-03	1.26E-02	1.56E-02	9.66E-04	1.46E-02
Mn	2.39E-01	1.75E-01	6.37E-02	2.37E-01	6.13E-02	1.75E-01	2.32E-01	3.26E-02	1.99E-01
U (ICP-ES)	3.37E-01	2.19E-01	1.18E-01	3.35E-01	-1.15E-02	3.47E-01	3.25E-01	-2.29E-02	3.48E-01
U (ICP-MS)	3.68E-01	2.46E-01	1.21E-01	3.60E-01	1.74E-02	3.43E-01	3.53E-01	7.37E-03	3.46E-01
^{235}U	2.35E-02	1.53E-02	8.20E-03	2.29E-02	1.19E-03	2.17E-02	2.23E-02	7.09E-04	2.16E-02
$^{235}U(eq_{SLU})$	2.36E-02	1.54E-02	8.21E-03	2.30E-02	1.23E-03	2.17E-02	2.23E-02	7.49E-04	2.16E-02
^{239}Pu	2.07E-03	2.04E-03	2.63E-05	2.15E-03	1.61E-03	5.33E-04	2.05E-03	1.20E-03	8.48E-04
$^{239}Pu(eq)$	1.74E-02	1.20E-02	5.36E-03	1.71E-02	2.42E-03	1.47E-02	1.66E-02	1.69E-03	1.49E-02
Concentrations (g/L)									
$^{235}U(eq_{SLU})$	2.66E-01	--	9.28E-02	2.62E-01	--	2.47E-01	2.56E-01	--	2.47E-01
^{239}Pu	2.34E-02	--	2.97E-04	2.45E-02	--	6.07E-03	2.35E-02	--	9.70E-03
$^{239}Pu(eq)$	1.97E-01	--	6.06E-02	1.95E-01	--	1.67E-01	1.90E-01	--	1.70E-01
^{235}U Enrichment (%) and Contribution to $^{239}Pu(eq)$ (%)									
$^{235}U/U$	6.4%	6.2%	6.8%	6.4%	--	6.3%	6.3%	--	6.2%
U in $^{239}Pu(eq)$	88.1%	83.0%	99.5%	87.4%	33%	96.3%	87.6%	29%	94.3%
Pu in $^{239}Pu(eq)$	11.9%	17.0%	0.5%	12.6%	67%	3.7%	12.4%	71%	5.7%
Poison Mass Ratios (poison mass:fissile mass)									
Fe:Gd	78:1	91:1	0.74:1	80:1	380:1	2.5:1	78:1	1190:1	4.7:1
Gd:$^{235}U(eq_{SLU})$	0.68:1	0.89:1	0.28:1	0.69:1	2.7:1	0.58:1	0.70:1	1.29:1	0.68:1
Gd:$^{239}Pu(eq)$	0.92:1	1.14:1	0.43:1	0.93:1	1.37:1	0.86:1	0.94:1	0.57:1	0.98:1
Gd:^{239}Pu	7.8:1	6.7:1	89:1	7.4:1	2.1:1	24:1	7.6:1	0.80:1	17.2:1
Mn:$^{235}U(eq_{SLU})$	10.1:1	11.4:1	7.8:1	10.3:1	50:1	8.1:1	10.4:1	44:1	9.2:1
Mn:$^{239}Pu(eq)$	13.7:1	14.5:1	11.9:1	13.9:1	25:1	12.0:1	14.0:1	19.3:1	13.4:1
Fe:$^{239}Pu(eq)$	72:1	104:1	0.32:1	75:1	510:1	2.1:1	73:1	680:1	4.6:1
Fe:^{239}Pu	600:1	610:1	66:1	590:1	770:1	59:1	590:1	960:1	80:1

Table 3-27. Calculation of ratios of poisons to equivalent fissile in the products from the additional pH adjustment solubility tests

	100% KMA Adjusted to pH 3			100% KMA Adjusted to pH 2			100% KMA Adjusted to pH 0.7		
	Total	Solid	Liquid	Total	Solid	Liquid	Total	Solid	Liquid
Concentrations (wt% slurry)									
Fe	1.14E+00	1.11E+00	3.44E-02	1.12E+00	1.08E+00	4.18E-02	1.06E+00	9.72E-01	8.79E-02
Gd (ICP-ES)	1.50E-02	2.92E-03	1.20E-02	1.51E-02	3.29E-03	1.18E-02	1.37E-02	1.71E-03	1.20E-02
Gd (ICP-MS)	1.50E-02	3.07E-03	1.19E-02	1.47E-02	2.93E-03	1.17E-02	1.36E-02	1.60E-03	1.20E-02
Mn	2.18E-01	5.51E-02	1.63E-01	2.16E-01	5.23E-02	1.64E-01	1.99E-01	4.24E-02	1.57E-01
U (ICP-ES)	3.06E-01	8.03E-04	3.05E-01	3.02E-01	-1.10E-03	3.03E-01	2.81E-01	-8.46E-03	2.89E-01
U (ICP-MS)	3.09E-01	-9.97E-03	3.19E-01	3.05E-01	-2.23E-03	3.07E-01	2.82E-01	-1.01E-02	2.92E-01
^{235}U	2.14E-02	1.96E-04	2.12E-02	2.11E-02	6.03E-04	2.05E-02	1.94E-02	-3.20E-05	1.94E-02
$^{235}U(eq_{SLU})$	2.15E-02	2.37E-04	2.13E-02	2.12E-02	6.43E-04	2.05E-02	1.94E-02	4.75E-06	1.94E-02
^{239}Pu	1.95E-03	1.43E-03	5.25E-04	1.91E-03	1.38E-03	5.36E-04	1.78E-03	1.21E-03	5.70E-04
$^{239}Pu(eq)$	1.59E-02	1.58E-03	1.43E-02	1.57E-02	1.80E-03	1.39E-02	1.44E-02	1.22E-03	1.32E-02
Concentrations (g/L)									
$^{235}U(eq_{SLU})$	2.47E-01	--	2.46E-01	2.42E-01	--	2.38E-01	2.26E-01	--	2.27E-01
^{239}Pu	2.24E-02	--	6.08E-03	2.19E-02	--	6.21E-03	2.07E-02	--	6.65E-03
$^{239}Pu(eq)$	1.83E-01	--	1.66E-01	1.80E-01	--	1.61E-01	1.68E-01	--	1.54E-01
^{235}U Enrichment (%) and Contribution to $^{239}Pu(eq)$ (%)									
$^{235}U/U$	6.9%	--	6.7%	6.9%	--	6.7%	6.9%	--	6.7%
U in $^{239}Pu(eq)$	87.7%	10%	96.3%	87.7%	23%	96.1%	87.6%	0%	95.7%
Pu in $^{239}Pu(eq)$	12.3%	90%	3.7%	12.2%	77%	3.9%	12.4%	100%	4.3%
Poison Mass Ratios (poison mass:fissile mass)									
Fe:Gd	76:1	360:1	2.9:1	76:1	370:1	3.6:1	78:1	610:1	7.3:1
Gd:$^{235}U(eq_{SLU})$	0.70:1	12.9:1	0.56:1	0.69:1	4.6:1	0.57:1	0.70:1	340:1	0.62:1
Gd:$^{239}Pu(eq)$	0.94:1	1.94:1	0.83:1	0.94:1	1.63:1	0.85:1	0.94:1	1.31:1	0.91:1
Gd:^{239}Pu	7.7:1	2.2:1	23:1	7.7:1	2.1:1	22:1	7.6:1	1.32:1	21:1
Mn:$^{235}U(eq_{SLU})$	10.1:1	230:1	7.6:1	10.2:1	81:1	8.0:1	10.3:1	8900:1	8.1:1
Mn:$^{239}Pu(eq)$	13.7:1	35:1	11.3:1	13.8:1	29:1	11.8:1	13.8:1	35:1	11.9:1
Fe:$^{239}Pu(eq)$	72:1	700:1	2.4:1	71:1	600:1	3.0:1	73:1	800:1	6.7:1
Fe:^{239}Pu	580:1	780:1	65:1	590:1	780:1	78:1	590:1	800:1	154:1

Elemental gadolinium and uranium are included from both ICP-ES and ICP-MS. For all the cases, the results from ICP-ES and ICP-MS were within the experimental uncertainty and did not show a constant bias in one direction; in most of the cases the results from the two methods were within 5% of each other. In the subsequent calculation of fissile ratios, ICP-MS measurements were used for the gadolinium and uranium concentrations.

For the feed analysis, the soluble concentration of the three poisons compared here, Gd, Fe, and Mn, were all below the detection limits of ICP-ES and ICP-MS. The soluble concentrations of these poisons in the six solubility test products were all above the detectable level.

The percent ^{235}U enrichment of the overall slurry used in the solubility testing was measured to range from 6.7% in the feed slurry to 6.4% in the SRAT acid addition product slurries to 6.9% in the additional pH adjustment product slurries. These are three independent sets of measurements for what is essentially the same enriched uranium material and thus gives an indication of the analytical uncertainty in this value. The high percent ^{235}U enrichment of 47.5% for the feed supernate indicates that the primary contribution of uranium to the supernate of the feed mixture was from the pH adjusted Tank 10.2 and gadolinium nitrate material rather than from the Tank 51 sludge.

The average measurement of percent ^{235}U enrichment of 6.7% places the feed for this test outside of the current Waste Acceptance Criteria (WAC) for DWPF feed based on the downstream processing of DWPF Recycle in the 2H-Evaporator system. The TTQAP did not require addition of depleted uranium to adjust the material used in this testing and none was added. Addition of depleted uranium would have increased the amount of total uranium present in the solids phase without requiring a significant amount of additional gadolinium. For most of the test conditions, including 130% KMA and the additional pH adjustment tests, the percent solubility of uranium is so high that additional enriched uranium should not significantly influence the Gd:$^{235}U(eq_{SLU})$ ratio in the solids. For other test conditions, such as 70% to 100% KMA additions, a similar argument can be made that the uranium percent soluble is so much higher than the gadolinium percent soluble that the addition of depleted uranium could not influence the uranium solubility to the extent that the poison ratio in the solid phase would be reduced to unacceptable levels.

The poison ratios in the "Total" column for the feed and products reflects the feed mass ratio of poison-to-fissile in the slurry. Notably, the feed had Gd:$^{235}U(eq_{SLU})$ of 0.66:1 to 0.70:1, Mn:$^{235}U(eq_{SLU})$ of 10.1:1 to 10.4:1, and Fe:$^{239}Pu(eq)$ of 67:1 to 75:1. The ratios of both Mn:$^{235}U(eq_{SLU})$ and Fe:$^{239}Pu(eq)$ do not meet the current NCSE mass ratio requirements of 70:1 Mn:$^{235}U(eq_{SLU})$ and 160:1 Fe:$^{239}Pu(eq)$. Poison ratios in the feed supernate could not be established because the Gd, Mn, and Fe concentrations were all below the detectable level in the feed supernate.

Because the uranium percent solubility is higher than the gadolinium percent solubility for all acid addition cases, the Gd:$^{235}U(eq_{SLU})$ in the insoluble phase is always increased by the acid addition. As this is the main function of gadolinium as a poison in the CPC, it is a good sign for use as a neutron poison that gadolinium partitions similarly to uranium while staying slightly lower percent soluble to result in slightly higher Gd:$^{235}U(eq_{SLU})$ in the solids.

Even though Gd has a considerably higher percent soluble than Pu, Gd:$^{239}Pu(eq)$ also remains high in both phases. This is due to a large portion of the feed $^{239}Pu(eq)$ being from the $^{235}U(eq_{SLU})$ contribution. The average Gd:$^{239}Pu(eq)$ in the feed was 0.92:1. The lowest Gd:$^{239}Pu(eq)$ encountered during this testing was for the insoluble solid portion from the 130% KMA addition, which was 0.57:1. This demonstrates that even though a portion of the gadolinium can be dissolved from the plutonium solids, the Gd:$^{239}Pu(eq)$ remains high in the solid phase at all conditions for this mixture.

Iron was not added to this testing to maintain the Fe:$^{239}Pu(eq)$ of $\geq$160:1 in the feed. Because Fe always had a lower solubility than Pu and a much lower percent soluble than U, the Fe:$^{239}Pu(eq)$ was seen to increase in the insoluble phase during CPC testing. In fact, for all the tests other than the 70% KMA test, which had Fe:$^{239}Pu(eq)$ of 104:1 in the insoluble phase, the Fe:$^{239}Pu(eq)$ in the solid phase always exceeded 160:1. Likewise, manganese was not added to this testing to maintain the Mn:$^{235}U(eq_{SLU})$ of $\geq$70:1 in the feed (>14:1 in the individual phases). Similarly, because manganese had a lower percent soluble than uranium, the Mn:$^{235}U(eq_{SLU})$ mass ratio in the insoluble phase was always increased during testing. In many cases, however, Mn:$^{235}U(eq_{SLU})$ remained below the targeted protection limit in the individual phases of 14:1.

In general, the gadolinium solubility behavior was previously shown to be tied to the relative amount of iron in the sludge slurry.[17] In this case, the seven determinations of the mass ratio of Fe:Gd in the feed averaged 78:1. This is in the 50:1 to 150:1 range of Fe:Gd considered as representative by the previous gadolinium solubility study and much lower than the 300:1 Fe:Gd ratio that the previous study deemed as unrealistic for CPC related Gd solubility testing.

In Figure 3-3, gadolinium displayed a remarkable similarity to manganese percent solubility with the acid additions for the DWPF NGA flowsheet. This is consistent with what was seen from previous NGA qualification testing with SB5 and SB9 material and with results from recent testing with SB10 and SRE material. For the DWPF NGA flowsheet, the argument that manganese will remain between 20 and 80 percent soluble at all conditions does not hold, as you can have >80% manganese solubility at some high acid conditions. The same is true for gadolinium, which showed very similar percent solubilities to manganese. For these same scenarios, the uranium solubility was shown to be higher than both manganese and gadolinium, only serving to increase the poison-to-fissile ratio in the remaining solids and assuaging the concerns of increased solubility of the poisons.

In the lowest acid addition (70% KMA), the Gd:$^{235}U(eq_{SLU})$ mass ratio of 0.28:1 in the liquid phase was below the 0.5:1 target but was above the 0.11:1 level. The low Gd:$^{235}U(eq_{SLU})$ mass ratio in the liquid phase should not be a concern because the $^{235}U(eq_{SLU})$ concentration in the liquid of 92.8 mg/L is significantly lower than the applicable American Nuclear Society (ANS) 8.1 single parameter subcritical limit of 11600 mg/L.[37] Thus, the low $^{235}U(eq_{SLU})$ concentration in the liquid phase appears to offset the need to maintain the poison mass ratio in the liquid phase.

Am and Cm contribute to only approximately 0.006% of the $^{239}Pu(eq)$ value and generally show significantly lower solubilities than the other components with most species having concentrations below detection limits. For those species that do have measurable values, the solubilities are shown to trend upward with increasing acid stoichiometry and decreasing pH. As an indicator for Am, ^{241}Am goes from <0.1% to 1.0% soluble in the SRAT-like acid additions to a range of 1.3% to 2.4% soluble for the lower pH conditions; for Cm, ^{244}Cm ranges from <0.3% to 2.8% soluble in the SRAT-like acid additions to a range of 2.5% to 4.3% soluble for the lower pH conditions.

4.0 Conclusions

Under the conditions tested, results successfully show that Gd solubility trends with U solubility while remaining slightly more insoluble to ensure consistent protection in the solids phase. Test conditions consisted of acids consistent with the DWPF NGA flowsheet at 70, 100, and 130% KMA stoichiometries being added to three aliquots of Tank 51 (SB10) material blended with H-Canyon Tank 10.2 (ABD Dissolver) material. The mixtures were heated to 95 °C for 10 hours. Three additional aliquots, processed at 100% KMA, received additional acids upon cooling to adjust the pH values to pH 3, 2, and 1. Portions of all six were filtered to produce separate slurry and supernate samples for analyses. The following are the key results.

- Uranium percent soluble values exceeded the percent soluble values for gadolinium over the entire range tested, indicating that gadolinium poisoning in the solid phase will always be maintained. Thus, any increase in gadolinium solubility due to the presence of additional acids in various process steps in DWPF will not negatively impact the NCSE criticality control for gadolinium poisoning of equivalent uranium-235 in the solid phase.

- Gadolinium percent solubility values were 15%, 80%, and 94% at the 70%, 100%, and 130% acid stoichiometries and 80%, 79%, and 88% at the pH 3, pH 2, and pH 0.7 variations of the 100% acid stoichiometry, respectively. Though the gadolinium did display >80% solubility at some lower pH values, the uranium solubility was always greater under the same conditions ensuring that the poisoning ratio is only positively influenced in the solid phase as the pH decreases.

- In only one condition of one testing scenario was the Gd:$^{235}U(eq_{SLU})$ ratio below the target 0.55:1 in any phase. The only phase/scenario that produced a Gd:$^{235}U(eq_{SLU})$ ratio below the target was in the aqueous phase of the 70% KMA scenario with a mass ratio of 0.28:1 (92.8 mg/L $^{235}U(eq_{SLU})$). Although the ratio is below the target 0.55:1, it is still above the required protection limit of 0.11:1.

5.0 Path Forward

The results of this solubility testing with ABD material combined with Sludge Batch 10 Tank 51 sample material should be applied to an NCSE evaluation for using gadolinium as a neutron poison in DWPF for SB11 and beyond. Through testing a variety of conditions applicable to processing within DWPF with the NGA flowsheet, the mass ratio of gadolinium to equivalent uranium-235 would be maintained in the solid phase to a sufficient level that gadolinium could be credited as a neutron poison. This could be in replacement of or in addition to the current use of manganese as a neutron poison for equivalent uranium-235. The NCSE should also evaluate whether gadolinium can be used as a neutron poison for equivalent plutonium-239 for feeds where the enriched uranium-235 is the major contributor to the overall equivalent plutonium-239.

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Appendix A. Reporting Replicate Analyses and Partitioning into Phases

Table A-1. Replicate analyses of the feed slurry by ICP-ES, in mg/kg.

Analyte	LW17985	LW17986	LW17987	LW17988	average	RSD
Ag	<9.9E+00	<1.1E+01	<1.0E+01	<9.9E+00	<1.0E+01	--
Al	1.26E+04	1.69E+04	1.39E+04	1.50E+04	1.46E+04	12%
B	<2.4E+01	<2.7E+01	<2.5E+01	<2.4E+01	<2.5E+01	--
Ba	7.53E+01	8.23E+01	8.25E+01	8.11E+01	8.03E+01	4.2%
Be	<4.4E-01	<4.9E-01	<4.5E-01	<4.4E-01	<4.6E-01	--
Ca	8.68E+02	8.95E+02	9.10E+02	8.94E+02	8.92E+02	2.0%
Cd	<1.2E+01	<1.4E+01	<1.2E+01	<1.2E+01	<1.2E+01	--
Ce	1.58E+02	1.83E+02	1.82E+02	1.79E+02	1.76E+02	6.7%
Co	<1.5E+01	<1.7E+01	<1.5E+01	<1.5E+01	<1.5E+01	--
Cr	2.30E+02	2.47E+02	2.51E+02	2.48E+02	2.44E+02	3.9%
Cu	8.63E+01	5.41E+01	5.52E+01	5.34E+01	6.23E+01	26%
Fe	1.16E+04	1.25E+04	1.27E+04	1.25E+04	1.23E+04	4.0%
Gd	1.50E+02	1.66E+02	1.66E+02	1.65E+02	1.62E+02	4.9%
K	<2.3E+02	<2.6E+02	<2.4E+02	<2.3E+02	<2.4E+02	--
La	4.13E+01	4.43E+01	4.53E+01	4.40E+01	4.37E+01	3.9%
Li	<1.8E+01	<2.1E+01	<1.9E+01	<1.8E+01	<1.9E+01	--
Mg	3.32E+02	3.57E+02	3.61E+02	3.56E+02	3.52E+02	3.7%
Mn	2.30E+03	2.49E+03	2.53E+03	2.49E+03	2.45E+03	4.2%
Mo	<4.8E+01	<5.3E+01	<4.9E+01	<4.8E+01	<4.9E+01	--
Na	1.80E+04	1.96E+04	1.98E+04	1.98E+04	1.93E+04	4.5%
Ni	4.02E+02	4.38E+02	4.45E+02	4.35E+02	4.30E+02	4.4%
P	<8.8E+01	<9.9E+01	<9.1E+01	<8.8E+01	<9.1E+01	--
Pb	<1.0E+02	<1.1E+02	<1.0E+02	<1.0E+02	<1.0E+02	--
Sb	<1.9E+02	<2.2E+02	<2.0E+02	<1.9E+02	<2.0E+02	--
Si	3.77E+02	4.37E+02	5.32E+02	3.99E+02	4.36E+02	16%
Sn	<8.8E+01	<9.9E+01	<9.1E+01	<8.8E+01	<9.2E+01	--
Sr	3.37E+01	3.79E+01	3.88E+01	3.67E+01	3.68E+01	6.0%
Th	2.11E+03	2.28E+03	2.31E+03	2.27E+03	2.24E+03	4.0%
Ti	1.79E+01	1.97E+01	2.01E+01	1.91E+01	1.92E+01	5.0%
U	3.62E+03	3.88E+03	3.92E+03	3.87E+03	3.82E+03	3.6%
V	<8.0E+00	<9.0E+00	<8.2E+00	<8.0E+00	<8.3E+00	--
Zn	3.08E+01	3.14E+01	3.16E+01	3.08E+01	3.12E+01	1.3%
Zr	1.55E+02	1.73E+02	1.73E+02	1.70E+02	1.68E+02	5.1%

Table A-2. Replicate analyses of the feed slurry by ICP-MS, in mg/kg, part 1 of 4.

m/z	LW17990	LW17991	LW17992	LW17993	average	RSD
59	3.74E+00	4.00E+00	4.32E+00	4.13E+00	4.05E+00	6.1%
82	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
84	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
85	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
86	<8.3E-01	1.07E+00	<8.6E-01	9.48E-01	≤9.27E-01	12%
87	<2.5E+00	<2.8E+00	<2.6E+00	<2.5E+00	<2.6E+00	--
88	2.24E+01	2.47E+01	2.47E+01	2.48E+01	2.42E+01	4.9%
89	2.16E+01	2.41E+01	2.52E+01	2.48E+01	2.39E+01	6.8%
90	2.06E+01	2.29E+01	2.41E+01	2.33E+01	2.27E+01	6.6%
91	2.60E+01	2.96E+01	2.92E+01	2.95E+01	2.86E+01	6.1%
92	2.28E+01	2.65E+01	2.64E+01	2.64E+01	2.55E+01	7.2%
93	3.06E+01	3.42E+01	3.48E+01	3.41E+01	3.34E+01	5.7%
94	2.65E+01	2.98E+01	3.03E+01	2.95E+01	2.90E+01	6.0%
95	1.21E+00	1.80E+00	1.45E+00	1.37E+00	1.46E+00	17%
96	2.23E+01	2.62E+01	2.58E+01	2.55E+01	2.50E+01	7.2%
97	1.12E+00	1.52E+00	1.29E+00	1.30E+00	1.31E+00	12%
98	1.03E+00	1.51E+00	1.36E+00	1.34E+00	1.31E+00	16%
99	2.24E+00	2.54E+00	2.61E+00	2.59E+00	2.50E+00	6.9%
100	2.18E+00	2.63E+00	2.32E+00	2.40E+00	2.38E+00	8.0%
101	2.50E+01	2.87E+01	2.79E+01	2.76E+01	2.73E+01	5.8%
102	2.19E+01	2.38E+01	2.43E+01	2.38E+01	2.34E+01	4.6%
103	1.25E+01	1.37E+01	1.38E+01	1.36E+01	1.34E+01	4.5%
104	1.06E+01	1.16E+01	1.20E+01	1.17E+01	1.15E+01	5.2%
105	1.23E+00	1.38E+00	1.43E+00	1.50E+00	1.38E+00	8.3%
106	1.42E+00	1.51E+00	1.69E+00	1.73E+00	1.59E+00	9.1%
107	4.22E+00	5.81E+00	4.97E+00	5.11E+00	5.03E+00	13%
108	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
109	3.71E+00	4.88E+00	4.31E+00	4.54E+00	4.36E+00	11%
110	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
111	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
112	1.05E+00	1.11E+00	1.30E+00	1.37E+00	1.21E+00	13%
113	<6.7E+00	<7.5E+00	<6.9E+00	<6.7E+00	<6.9E+00	--
114	1.20E+00	1.30E+00	1.27E+00	1.32E+00	1.27E+00	4.0%
116	5.67E+01	6.43E+01	6.55E+01	6.34E+01	6.25E+01	6.3%
117	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
118	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
119	5.45E+01	6.14E+01	6.18E+01	6.06E+01	5.96E+01	5.7%
120	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--

Table A-3. Replicate analyses of the feed slurry by ICP-MS, in mg/kg, part 2 of 4.

m/z	LW17990	LW17991	LW17992	LW17993	average	RSD
121	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
122	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
123	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
124	2.88E+00	2.96E+00	3.40E+00	3.02E+00	3.07E+00	7.5%
125	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
126	1.48E+00	1.27E+00	1.88E+00	1.70E+00	1.58E+00	17%
128	3.77E+00	4.40E+00	4.09E+00	3.68E+00	3.99E+00	8.2%
130	1.25E+01	1.41E+01	1.40E+01	1.42E+01	1.37E+01	5.7%
133	1.18E+00	1.20E+00	1.24E+00	1.39E+00	1.25E+00	7.5%
134	1.40E+00	1.55E+00	1.65E+00	1.54E+00	1.53E+00	6.6%
135	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
136	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
137	1.63E+01	1.78E+01	1.83E+01	1.82E+01	1.77E+01	5.3%
138	5.16E+01	5.87E+01	5.77E+01	5.74E+01	5.63E+01	5.7%
139	5.12E+01	5.81E+01	5.82E+01	5.66E+01	5.60E+01	5.9%
140	9.56E+01	1.07E+02	1.08E+02	1.07E+02	1.04E+02	5.7%
141	4.30E+01	4.90E+01	4.92E+01	4.80E+01	4.73E+01	6.2%
142	5.22E+01	5.87E+01	5.89E+01	5.82E+01	5.70E+01	5.6%
143	3.94E+01	4.48E+01	4.46E+01	4.39E+01	4.32E+01	5.9%
144	4.63E+01	5.23E+01	5.33E+01	5.19E+01	5.09E+01	6.2%
145	2.90E+01	3.25E+01	3.26E+01	3.20E+01	3.15E+01	5.3%
146	2.42E+01	2.71E+01	2.72E+01	2.67E+01	2.63E+01	5.4%
147	1.33E+01	1.47E+01	1.49E+01	1.50E+01	1.45E+01	5.3%
148	1.48E+01	1.64E+01	1.68E+01	1.64E+01	1.61E+01	5.4%
149	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
150	1.31E+01	1.45E+01	1.47E+01	1.46E+01	1.42E+01	5.2%
151	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
152	4.06E+00	4.69E+00	4.67E+00	4.69E+00	4.53E+00	6.8%
153	1.84E+00	2.13E+00	2.16E+00	2.15E+00	2.07E+00	7.3%
154	4.91E+00	5.42E+00	5.50E+00	5.39E+00	5.30E+00	5.1%
155	2.14E+01	2.38E+01	2.38E+01	2.32E+01	2.31E+01	4.9%
156	2.95E+01	3.26E+01	3.33E+01	3.30E+01	3.21E+01	5.4%
157	2.23E+01	2.48E+01	2.50E+01	2.46E+01	2.42E+01	5.2%
158	3.65E+01	4.10E+01	4.12E+01	4.05E+01	3.98E+01	5.5%
159	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
160	3.35E+01	3.72E+01	3.82E+01	3.72E+01	3.65E+01	5.7%
161	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
162	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--

Table A-4. Replicate analyses of the feed slurry by ICP-MS, in mg/kg, part 3 of 4.

m/z	LW17990	LW17991	LW17992	LW17993	average	RSD
163	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
164	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
165	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
166	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
167	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
168	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
169	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
170	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
171	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
172	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
173	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
174	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
175	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
176	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
177	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
178	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
179	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
180	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
181	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
182	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
183	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
184	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
185	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
186	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
187	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
191	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
193	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
194	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
195	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
196	2.92E+00	3.22E+00	3.38E+00	3.27E+00	3.20E+00	6.1%
198	1.73E+02	1.93E+02	1.94E+02	1.95E+02	1.89E+02	5.6%
203	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
204	1.06E+02	1.17E+02	1.18E+02	1.18E+02	1.15E+02	5.1%
205	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
206	3.56E+00	3.80E+00	3.79E+00	3.87E+00	3.76E+00	3.7%
207	3.13E+00	3.43E+00	3.38E+00	3.38E+00	3.33E+00	4.0%
208	7.51E+00	8.15E+00	8.04E+00	8.01E+00	7.93E+00	3.6%
230	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--

Table A-5. Replicate analyses of the feed slurry by ICP-MS, in mg/kg, part 4 of 4.

m/z	LW17990	LW17991	LW17992	LW17993	average	RSD
232	1.96E+03	2.16E+03	2.16E+03	2.16E+03	2.11E+03	4.8%
233	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
234	3.31E+00	3.89E+00	3.48E+00	3.39E+00	3.52E+00	7.3%
235	2.25E+02	2.69E+02	2.43E+02	2.41E+02	2.45E+02	7.5%
236	2.10E+01	2.31E+01	2.30E+01	2.35E+01	2.26E+01	4.8%
237	2.20E+00	2.44E+00	2.45E+00	2.46E+00	2.39E+00	5.1%
238	3.14E+03	3.45E+03	3.48E+03	3.48E+03	3.39E+03	4.9%
239	2.18E+01	2.40E+01	2.43E+01	2.43E+01	2.36E+01	5.3%
240	1.83E+00	2.06E+00	2.07E+00	2.11E+00	2.01E+00	6.3%
241	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
242	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
243	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--
244	<8.3E-01	<9.4E-01	<8.6E-01	<8.3E-01	<8.6E-01	--

Table A-6. Replicate analyses of the feed slurry by rad. chem. methods, in dpm/g.

Analyte	LW17994	LW17995	LW17996	LW17997	average	RSD
^{238}Pu	2.25E+07	2.40E+07	2.31E+07	2.34E+07	2.33E+07	2.7%
$^{239}Pu + ^{240}Pu$	4.47E+06	4.80E+06	4.65E+06	4.58E+06	4.63E+06	3.0%
^{241}Pu	1.85E+07	1.59E+07	1.52E+07	1.52E+07	1.62E+07	10%
^{241}Am	3.58E+06	4.02E+06	4.08E+06	3.99E+06	3.92E+06	5.8%
^{243}Am	<1.1E+05	<1.5E+05	<1.9E+05	<1.9E+05	<1.6E+05	--
^{242m}Am	5.14E+03	5.12E+03	<3.8E+03	5.50E+03	≤5.25E+03	4.1%
^{243}Cm	<1.2E+05	<1.4E+05	<1.4E+05	<1.3E+05	<1.3E+05	--
^{245}Cm	<1.2E+05	<1.4E+05	<1.3E+05	<1.3E+05	<1.3E+05	--
^{247}Cm	<2.2E+04	<2.5E+04	<2.5E+04	<2.3E+04	<2.4E+04	--
^{249}Cf	<2.4E+04	<2.7E+04	<2.7E+04	<2.6E+04	<2.6E+04	--
^{251}Cf	<1.3E+05	<1.4E+05	<1.4E+05	<1.3E+05	<1.3E+05	--
^{242}Cm	4.25E+03	4.23E+03	<3.1E+03	4.55E+03	≤4.34E+03	4.1%
^{244}Cm	5.71E+05	4.99E+05	5.11E+05	3.27E+05	4.77E+05	22%

Table A-7. Replicate analyses of the feed slurry by rad. chem. methods, in mg/kg.

Analyte	LW17994	LW17995	LW17996	LW17997	average	RSD
^{238}Pu	5.92E-01	6.31E-01	6.08E-01	6.16E-01	6.12E-01	2.7%
^{241}Pu	8.09E-02	6.95E-02	6.65E-02	6.65E-02	7.08E-02	10%
^{241}Am	4.70E-01	5.28E-01	5.36E-01	5.24E-01	5.14E-01	5.8%
^{243}Am	<2.4E-01	<3.3E-01	<4.2E-01	<4.4E-01	<3.6E-01	--
^{242m}Am	2.38E-04	2.37E-04	<1.7E-04	2.55E-04	≤2.44E-04	4.1%
^{243}Cm	<1.1E-03	<1.2E-03	<1.2E-03	<1.1E-03	<1.2E-03	--
^{245}Cm	<3.1E-03	<3.5E-03	<3.5E-03	<3.3E-03	<3.4E-03	--
^{247}Cm	<1.1E+02	<1.2E+02	<1.2E+02	<1.1E+02	<1.2E+02	--
^{242}Cm	5.79E-07	5.76E-07	<4.2E-07	6.20E-07	≤5.92E-07	4.1%
^{244}Cm	3.18E-03	2.78E-03	2.85E-03	1.82E-03	2.66E-03	22%

Table A-8. Replicate analyses of the feed supernate by ICP-ES, in mg/L.

Analyte	LW18014	LW18015	average	RSD
Ag	<2.4E-01	<2.4E-01	<2.4E-01	--
Al	1.08E+03	1.09E+03	1.09E+03	0.7%
B	2.42E+00	2.44E+00	2.43E+00	0.6%
Ba	<1.7E-01	<1.7E-01	<1.7E-01	--
Be	<1.1E-02	<1.1E-02	<1.1E-02	--
Ca	3.98E-01	4.08E-01	4.03E-01	1.8%
Cd	<2.9E-01	<2.9E-01	<2.9E-01	--
Ce	<7.7E-01	<7.7E-01	<7.7E-01	--
Co	<3.6E-01	<3.6E-01	<3.6E-01	--
Cr	1.81E+01	1.81E+01	1.81E+01	0%
Cu	<8.7E-02	<8.7E-02	<8.7E-02	--
Fe	<3.9E-01	<3.9E-01	<3.9E-01	--
Gd	<2.4E-01	<2.4E-01	<2.4E-01	--
K	3.34E+01	3.48E+01	3.41E+01	2.9%
La	<2.2E-01	<2.2E-01	<2.2E-01	--
Li	<3.7E-01	<3.7E-01	<3.7E-01	--
Mg	<1.7E-02	<1.7E-02	<1.7E-02	--
Mn	<9.7E-02	<9.7E-02	<9.7E-02	--
Mo	<2.4E+00	<2.4E+00	<2.4E+00	--
Na	2.11E+04	2.09E+04	2.10E+04	0.7%
Ni	<5.0E-01	<5.0E-01	<5.0E-01	--
P	<4.0E+00	<4.0E+00	<4.0E+00	--
Pb	<2.4E+00	<2.4E+00	<2.4E+00	--
Sb	<4.6E+00	<4.6E+00	<4.6E+00	--
Si	<1.1E+00	<1.1E+00	<1.1E+00	--
Sn	<2.1E+00	<2.1E+00	<2.1E+00	--
Sr	<2.8E-02	<2.8E-02	<2.8E-02	--
Th	<9.3E-01	<9.3E-01	<9.3E-01	--
Ti	<7.4E-02	<7.4E-02	<7.4E-02	--
U	<9.3E+00	<9.3E+00	<9.3E+00	--
V	<1.9E-01	<1.9E-01	<1.9E-01	--
Zn	<2.0E-01	<2.0E-01	<2.0E-01	--
Zr	<1.0E-01	<1.0E-01	<1.0E-01	--

Table A-9. Replicate analyses of the feed supernate by ICP-ES, in mg/L, part 1 of 4.

m/z	LW18016	LW18017	average	RSD
59	<1.0E-02	<1.0E-02	<1.0E-02	--
82	<1.0E-02	1.09E-02	≤1.05E-02	6.1%
84	<1.0E-02	<1.0E-02	<1.0E-02	--
85	8.98E-02	1.06E-01	9.79E-02	12%
86	<1.0E-02	<1.0E-02	<1.0E-02	--
87	1.85E-01	1.92E-01	1.89E-01	2.6%
88	<1.0E-02	<1.0E-02	<1.0E-02	--
89	<1.0E-02	<1.0E-02	<1.0E-02	--
90	<1.0E-02	<1.0E-02	<1.0E-02	--
91	<1.0E-02	<1.0E-02	<1.0E-02	--
92	8.38E-02	8.70E-02	8.54E-02	2.6%
93	<1.0E-02	<1.0E-02	<1.0E-02	--
94	5.69E-02	5.53E-02	5.61E-02	2.0%
95	4.89E-01	5.09E-01	4.99E-01	2.8%
96	9.44E-02	9.43E-02	9.44E-02	0.1%
97	4.41E-01	4.52E-01	4.47E-01	1.7%
98	5.05E-01	5.28E-01	5.17E-01	3.1%
99	4.85E-01	5.03E-01	4.94E-01	2.6%
100	4.46E-01	4.58E-01	4.52E-01	1.9%
101	7.62E-02	7.67E-02	7.65E-02	0.5%
102	6.87E-02	6.84E-02	6.86E-02	0.3%
103	3.13E-02	2.80E-02	2.97E-02	7.9%
104	4.67E-02	4.90E-02	4.79E-02	3.4%
105	4.68E-02	4.72E-02	4.70E-02	0.6%
106	4.30E-02	4.68E-02	4.49E-02	6.0%
107	2.78E-02	2.17E-02	2.48E-02	17%
108	1.04E-02	<1.0E-02	≤1.02E-02	2.8%
109	1.07E-02	<1.0E-02	≤1.04E-02	4.8%
110	<1.0E-02	<1.0E-02	<1.0E-02	--
111	<1.0E-02	<1.0E-02	<1.0E-02	--
112	<1.0E-02	<1.0E-02	<1.0E-02	--
113	<1.0E-02	<1.0E-02	<1.0E-02	--
114	<1.0E-02	<1.0E-02	<1.0E-02	--
116	<1.0E-02	<1.0E-02	<1.0E-02	--
117	<1.0E-02	<1.0E-02	<1.0E-02	--
118	2.78E-02	2.98E-02	2.88E-02	4.9%
119	6.73E-02	6.77E-02	6.75E-02	0.4%
120	2.88E-02	2.75E-02	2.82E-02	3.3%

Table A-10. Replicate analyses of the feed supernate by ICP-ES, in mg/L, part 2 of 4.

m/z	LW18016	LW18017	average	RSD
121	<1.0E-02	<1.0E-02	<1.0E-02	--
122	<1.0E-02	<1.0E-02	<1.0E-02	--
123	<1.0E-02	<1.0E-02	<1.0E-02	--
124	1.03E-02	1.09E-02	1.06E-02	4.0%
125	<1.0E-02	<1.0E-02	<1.0E-02	--
126	6.20E-02	6.62E-02	6.41E-02	4.6%
128	<1.0E-02	<1.0E-02	<1.0E-02	--
130	<1.0E-02	<1.0E-02	<1.0E-02	--
133	6.95E-01	7.07E-01	7.01E-01	1.2%
134	<1.0E-02	<1.0E-02	<1.0E-02	--
135	6.99E-02	7.53E-02	7.26E-02	5.3%
136	<1.0E-02	<1.0E-02	<1.0E-02	--
137	2.24E-01	2.29E-01	2.27E-01	1.6%
138	<1.0E-02	<1.0E-02	<1.0E-02	--
139	<1.0E-02	<1.0E-02	<1.0E-02	--
140	<1.0E-02	<1.0E-02	<1.0E-02	--
141	<1.0E-02	<1.0E-02	<1.0E-02	--
142	<1.0E-02	<1.0E-02	<1.0E-02	--
143	<1.0E-02	<1.0E-02	<1.0E-02	--
144	<1.0E-02	<1.0E-02	<1.0E-02	--
145	<1.0E-02	<1.0E-02	<1.0E-02	--
146	<1.0E-02	<1.0E-02	<1.0E-02	--
147	<1.0E-02	<1.0E-02	<1.0E-02	--
148	<1.0E-02	<1.0E-02	<1.0E-02	--
149	<1.0E-02	<1.0E-02	<1.0E-02	--
150	<1.0E-02	<1.0E-02	<1.0E-02	--
151	<1.0E-02	<1.0E-02	<1.0E-02	--
152	<1.0E-02	<1.0E-02	<1.0E-02	--
153	<1.0E-02	<1.0E-02	<1.0E-02	--
154	<1.0E-02	<1.0E-02	<1.0E-02	--
155	<1.0E-02	<1.0E-02	<1.0E-02	--
156	<1.0E-02	<1.0E-02	<1.0E-02	--
157	<1.0E-02	<1.0E-02	<1.0E-02	--
158	<1.0E-02	<1.0E-02	<1.0E-02	--
159	<1.0E-02	<1.0E-02	<1.0E-02	--
160	<1.0E-02	<1.0E-02	<1.0E-02	--
161	<1.0E-02	<1.0E-02	<1.0E-02	--
162	<1.0E-02	<1.0E-02	<1.0E-02	--

Table A-11. Replicate analyses of the feed supernate by ICP-ES, in mg/L, part 3 of 4.

m/z	LW18016	LW18017	average	RSD
163	<1.0E-02	<1.0E-02	<1.0E-02	--
164	<1.0E-02	<1.0E-02	<1.0E-02	--
165	<1.0E-02	<1.0E-02	<1.0E-02	--
166	<1.0E-02	<1.0E-02	<1.0E-02	--
167	<1.0E-02	<1.0E-02	<1.0E-02	--
168	<1.0E-02	<1.0E-02	<1.0E-02	--
169	<1.0E-02	<1.0E-02	<1.0E-02	--
170	<1.0E-02	<1.0E-02	<1.0E-02	--
171	<1.0E-02	<1.0E-02	<1.0E-02	--
172	<1.0E-02	<1.0E-02	<1.0E-02	--
173	<1.0E-02	<1.0E-02	<1.0E-02	--
174	<1.0E-02	<1.0E-02	<1.0E-02	--
175	<1.0E-02	<1.0E-02	<1.0E-02	--
176	<1.0E-02	<1.0E-02	<1.0E-02	--
177	<1.0E-02	<1.0E-02	<1.0E-02	--
178	<1.0E-02	<1.0E-02	<1.0E-02	--
179	<1.0E-02	<1.0E-02	<1.0E-02	--
180	<1.0E-02	<1.0E-02	<1.0E-02	--
181	<1.0E-02	<1.0E-02	<1.0E-02	--
182	1.02E-02	1.10E-02	1.06E-02	5.3%
183	<1.0E-02	<1.0E-02	<1.0E-02	--
184	1.29E-02	1.30E-02	1.30E-02	0.5%
185	<1.0E-02	<1.0E-02	<1.0E-02	--
186	1.20E-02	1.24E-02	1.22E-02	2.3%
187	<1.0E-02	<1.0E-02	<1.0E-02	--
191	<1.0E-02	<1.0E-02	<1.0E-02	--
193	<1.0E-02	<1.0E-02	<1.0E-02	--
194	<1.0E-02	<1.0E-02	<1.0E-02	--
195	<1.0E-02	<1.0E-02	<1.0E-02	--
196	3.72E-02	4.25E-02	3.99E-02	9.4%
198	2.16E+00	2.40E+00	2.28E+00	7.4%
203	<1.0E-02	<1.0E-02	<1.0E-02	--
204	1.32E+00	1.46E+00	1.39E+00	7.1%
205	<1.0E-02	<1.0E-02	<1.0E-02	--
206	<1.0E-02	<1.0E-02	<1.0E-02	--
207	<1.0E-02	<1.0E-02	<1.0E-02	--
208	<1.0E-02	<1.0E-02	<1.0E-02	--
230	<1.0E-02	<1.0E-02	<1.0E-02	--

Table A-12. Replicate analyses of the feed supernate by ICP-ES, in mg/L, part 4 of 4.

m/z	LW18016	LW18017	average	RSD
232	<1.0E-02	<1.0E-02	<1.0E-02	--
233	<1.0E-02	<1.0E-02	<1.0E-02	--
234	4.53E-02	4.53E-02	4.53E-02	0.0%
235	3.46E+00	3.42E+00	3.44E+00	0.8%
236	3.33E-01	3.44E-01	3.39E-01	2.3%
237	<1.0E-02	<1.0E-02	<1.0E-02	--
238	3.36E+00	3.48E+00	3.42E+00	2.5%
239	<1.0E-02	<1.0E-02	<1.0E-02	--
240	<1.0E-02	<1.0E-02	<1.0E-02	--
241	<1.0E-02	<1.0E-02	<1.0E-02	--
242	<1.0E-02	<1.0E-02	<1.0E-02	--
243	<1.0E-02	<1.0E-02	<1.0E-02	--
244	<1.0E-02	<1.0E-02	<1.0E-02	--

Table A-13. Replicate analyses of the feed supernate by rad. chem. methods, in dpm/mL.

Analyte	LW18991	LW18992	average	RSD
^{238}Pu	2.50E+02	2.70E+02	2.60E+02	5.4%
^{239}Pu + ^{240}Pu	<4.8E+01	<1.4E+02	<4.8E+01	--
^{241}Pu	1.63E+03	1.17E+03	1.40E+03	23%
^{241}Am	<2.3E+02	<6.5E+02	<2.3E+02	--
^{243}Am	<8.8E+01	<4.0E+02	<8.8E+01	--
^{242m}Am	<3.4E+02	<6.0E+02	<3.4E+02	--
^{243}Cm	<3.4E+02	<1.3E+03	<3.4E+02	--
^{245}Cm	<3.4E+02	<1.3E+03	<3.4E+02	--
^{247}Cm	<3.4E+02	<1.4E+03	<3.4E+02	--
^{249}Cf	<3.7E+02	<1.5E+03	<3.7E+02	--
^{251}Cf	<1.4E+00	<1.9E+00	<1.4E+00	--
^{242}Cm	<2.8E+02	<4.9E+02	<2.8E+02	--
^{244}Cm	<1.9E+02	<3.0E+02	<1.9E+02	--

Table A-14. Replicate analyses of the product slurries from the SRAT acid addition heated tests by ICP-ES

Analyte	Slurry, 70% KMA (wt%)			Slurry, 100% KMA (wt%)			Slurry, 130% KMA (wt%)		
	LW18894	LW18895	LW18896	LW18897	LW18898	LW18899	LW18900	LW18901	LW18902
Ag	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03
Al	1.52E+00	1.34E+00	1.45E+00	1.45E+00	1.50E+00	1.38E+00	1.43E+00	1.37E+00	1.54E+00
B	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03
Ba	8.01E-03	8.06E-03	7.99E-03	8.00E-03	8.08E-03	8.23E-03	7.83E-03	7.77E-03	7.83E-03
Be	<8.5E-05	<8.5E-05	<8.4E-05	<8.5E-05	<8.5E-05	<8.6E-05	<8.5E-05	<8.5E-05	<8.5E-05
Ca	8.13E-02	8.39E-02	8.17E-02	8.33E-02	8.39E-02	8.49E-02	8.24E-02	8.27E-02	8.21E-02
Cd	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03
Ce	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02	<1.4E-02
Co	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03
Cr	2.38E-02	2.43E-02	2.43E-02	2.47E-02	2.41E-02	2.51E-02	2.33E-02	2.35E-02	2.37E-02
Cu	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03	<5.8E-03
Fe	1.24E+00	1.26E+00	1.25E+00	1.26E+00	1.28E+00	1.29E+00	1.22E+00	1.21E+00	1.22E+00
Gd	1.60E-02	1.62E-02	1.58E-02	1.56E-02	1.56E-02	1.57E-02	1.55E-02	1.56E-02	1.56E-02
K	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02
La	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03	<4.5E-03
Li	<2.3E-03	<2.3E-03	<2.2E-03	<2.3E-03	<2.3E-03	<2.3E-03	<2.3E-03	<2.3E-03	<2.3E-03
Mg	3.51E-02	3.53E-02	3.47E-02	3.45E-02	3.45E-02	3.50E-02	3.39E-02	3.41E-02	3.39E-02
Mn	2.39E-01	2.40E-01	2.38E-01	2.36E-01	2.35E-01	2.39E-01	2.32E-01	2.32E-01	2.31E-01
Mo	<5.7E-03	<5.7E-03	<5.7E-03	<5.7E-03	<5.7E-03	<5.8E-03	<5.7E-03	<5.7E-03	<5.7E-03
Na	1.91E+00	1.91E+00	1.88E+00	1.86E+00	1.85E+00	1.88E+00	1.83E+00	1.83E+00	1.82E+00
Ni	4.26E-02	4.28E-02	4.26E-02	4.25E-02	4.24E-02	4.42E-02	4.13E-02	4.10E-02	4.08E-02
P	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02
Pb	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02
Sb	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02
Si	4.42E-02	3.64E-02	4.49E-02	4.18E-02	4.14E-02	4.02E-02	4.32E-02	4.30E-02	4.07E-02
Sn	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02
Sr	<4.4E-03	<4.4E-03	<4.3E-03	<4.3E-03	<4.3E-03	<4.4E-03	<4.4E-03	<4.3E-03	<4.3E-03
Th	1.83E-01	2.09E-01	2.03E-01	2.19E-01	2.31E-01	2.39E-01	2.06E-01	2.02E-01	2.07E-01
Ti	1.73E-03	1.77E-03	1.76E-03	1.74E-03	1.80E-03	1.73E-03	1.66E-03	1.72E-03	1.73E-03
U	3.35E-01	3.40E-01	3.37E-01	3.32E-01	3.40E-01	3.34E-01	3.25E-01	3.26E-01	3.25E-01
V	<9.6E-04	<9.6E-04	<9.5E-04	<9.5E-04	<9.6E-04	<9.6E-04	<9.6E-04	<9.6E-04	<9.5E-04
Zn	2.63E-03	2.87E-03	2.95E-03	2.69E-03	2.82E-03	2.85E-03	2.71E-03	2.70E-03	2.83E-03
Zr	1.56E-02	1.60E-02	1.55E-02	1.58E-02	1.59E-02	1.63E-02	1.53E-02	1.51E-02	1.54E-02

Table A-15. Replicate analyses of the product slurries from the SRAT acid addition heated tests by ICP-MS, part 1 of 4

m/z	Slurry, 70% KMA (wt%)			Slurry, 100% KMA (wt%)			Slurry, 130% KMA (wt%)		
	LW18904	LW18905	LW18906	LW18907	LW18908	LW18909	LW18910	LW18911	LW18912
59	3.73E-04	3.57E-04	3.58E-04	3.55E-04	3.67E-04	3.56E-04	3.58E-04	3.47E-04	3.41E-04
75	4.49E-04	4.52E-04	4.21E-04	4.47E-04	4.57E-04	4.67E-04	4.31E-04	4.01E-04	4.36E-04
78	4.48E-03	4.50E-03	4.40E-03	4.29E-03	4.34E-03	4.31E-03	4.42E-03	4.25E-03	4.26E-03
82	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
84	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
85	<1.0E-05	<1.0E-05	1.05E-05	<9.9E-06	<1.0E-05	1.08E-05	1.04E-05	1.05E-05	1.17E-05
86	7.72E-05	7.80E-05	7.87E-05	7.96E-05	7.87E-05	8.45E-05	7.73E-05	8.99E-05	8.22E-05
87	8.18E-05	8.64E-05	8.86E-05	7.65E-05	7.51E-05	8.71E-05	8.09E-05	9.01E-05	7.83E-05
88	2.31E-03	2.31E-03	2.27E-03	2.28E-03	2.31E-03	2.36E-03	2.25E-03	2.31E-03	2.25E-03
89	2.28E-03	2.31E-03	2.28E-03	2.27E-03	2.31E-03	2.30E-03	2.21E-03	2.21E-03	2.22E-03
90	2.24E-03	2.28E-03	2.21E-03	2.26E-03	2.26E-03	2.34E-03	2.19E-03	2.17E-03	2.25E-03
91	2.75E-03	2.81E-03	2.72E-03	2.76E-03	2.78E-03	2.86E-03	2.72E-03	2.69E-03	2.75E-03
92	2.48E-03	2.54E-03	2.45E-03	2.47E-03	2.51E-03	2.54E-03	2.43E-03	2.41E-03	2.44E-03
93	3.24E-03	3.33E-03	3.21E-03	3.24E-03	3.29E-03	3.36E-03	3.18E-03	3.14E-03	3.22E-03
94	2.84E-03	2.90E-03	2.82E-03	2.83E-03	2.90E-03	2.91E-03	2.80E-03	2.75E-03	2.80E-03
95	1.56E-04	1.65E-04	1.59E-04	1.57E-04	1.44E-04	1.62E-04	1.50E-04	1.56E-04	1.56E-04
96	2.51E-03	2.56E-03	2.50E-03	2.50E-03	2.54E-03	2.59E-03	2.47E-03	2.43E-03	2.47E-03
97	1.41E-04	1.43E-04	1.31E-04	1.37E-04	1.26E-04	1.38E-04	1.34E-04	1.33E-04	1.34E-04
98	1.49E-04	1.55E-04	1.39E-04	1.48E-04	1.37E-04	1.50E-04	1.44E-04	1.55E-04	1.49E-04
99	2.17E-04	2.30E-04	2.17E-04	2.19E-04	2.24E-04	2.25E-04	2.16E-04	2.14E-04	2.17E-04
100	2.44E-04	2.47E-04	2.43E-04	2.43E-04	2.39E-04	2.48E-04	2.39E-04	2.39E-04	2.43E-04
101	2.58E-03	2.62E-03	2.61E-03	2.57E-03	2.60E-03	2.62E-03	2.53E-03	2.50E-03	2.55E-03
102	2.26E-03	2.29E-03	2.23E-03	2.22E-03	2.24E-03	2.27E-03	2.22E-03	2.17E-03	2.19E-03
103	1.29E-03	1.30E-03	1.27E-03	1.26E-03	1.27E-03	1.29E-03	1.24E-03	1.23E-03	1.25E-03
104	1.09E-03	1.13E-03	1.08E-03	1.08E-03	1.10E-03	1.12E-03	1.08E-03	1.06E-03	1.09E-03
105	1.31E-04	1.20E-04	1.32E-04	1.35E-04	1.29E-04	1.36E-04	1.30E-04	1.23E-04	1.26E-04
106	1.45E-04	1.36E-04	1.51E-04	1.50E-04	1.49E-04	1.60E-04	1.48E-04	1.46E-04	1.44E-04
107	4.79E-04	4.84E-04	4.77E-04	4.79E-04	4.74E-04	4.93E-04	4.70E-04	4.62E-04	4.82E-04
108	2.36E-05	2.25E-05	2.34E-05	2.31E-05	2.50E-05	2.47E-05	2.25E-05	2.29E-05	2.26E-05
109	4.38E-04	4.53E-04	4.36E-04	4.40E-04	4.47E-04	4.54E-04	4.36E-04	4.26E-04	4.33E-04
110	4.98E-05	5.00E-05	4.86E-05	4.98E-05	4.95E-05	5.07E-05	4.71E-05	4.90E-05	4.95E-05
111	6.24E-05	5.86E-05	5.86E-05	6.02E-05	6.23E-05	6.11E-05	6.09E-05	5.90E-05	6.13E-05
112	1.12E-04	1.11E-04	1.04E-04	1.07E-04	1.07E-04	1.08E-04	1.05E-04	1.07E-04	1.04E-04
113	5.80E-05	4.85E-05	4.39E-05	4.93E-05	5.30E-05	4.67E-05	5.25E-05	4.70E-05	4.78E-05
114	1.27E-04	1.26E-04	1.20E-04	1.22E-04	1.23E-04	1.29E-04	1.21E-04	1.18E-04	1.19E-04
116	4.89E-03	5.49E-03	5.35E-03	5.70E-03	6.15E-03	6.25E-03	5.43E-03	5.26E-03	5.43E-03
117	1.05E-05	5.11E-03	1.21E-05	1.22E-05	1.15E-05	1.16E-05	1.14E-05	1.36E-05	<1.0E-05
118	5.42E-05	5.44E-05	5.42E-05	5.51E-05	5.60E-05	5.36E-05	5.04E-05	5.54E-05	5.03E-05
119	5.15E-03	5.11E-03	4.99E-03	4.98E-03	5.01E-03	5.08E-03	5.05E-03	5.01E-03	4.94E-03
120	1.63E-05	1.84E-05	1.56E-05	1.60E-05	1.46E-05	1.84E-05	1.46E-05	2.63E-05	1.54E-05

Table A-16. Replicate analyses of the product slurries from the SRAT acid addition heated tests by ICP-MS, part 2 of 4

m/z	Slurry, 70% KMA (wt%)			Slurry, 100% KMA (wt%)			Slurry, 130% KMA (wt%)		
	LW18904	LW18905	LW18906	LW18907	LW18908	LW18909	LW18910	LW18911	LW18912
121	1.85E-05	2.14E-05	2.07E-05	1.81E-05	2.11E-05	1.84E-05	1.67E-05	2.23E-05	1.91E-05
122	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
123	2.01E-05	1.86E-05	1.75E-05	1.86E-05	1.84E-05	1.97E-05	1.74E-05	1.87E-05	1.98E-05
124	5.30E-05	6.66E-05	5.87E-05	6.25E-05	6.68E-05	6.97E-05	5.94E-05	6.51E-05	6.53E-05
125	1.97E-05	2.47E-05	2.07E-05	2.54E-05	2.19E-05	2.57E-05	2.46E-05	2.37E-05	2.00E-05
126	4.85E-05	4.46E-05	4.53E-05	3.67E-05	5.16E-05	4.13E-05	3.92E-05	3.83E-05	4.27E-05
128	2.57E-04	2.75E-04	2.39E-04	2.58E-04	2.49E-04	2.61E-04	2.49E-04	2.33E-04	2.58E-04
130	1.36E-03	1.39E-03	1.33E-03	1.35E-03	1.38E-03	1.39E-03	1.32E-03	1.32E-03	1.28E-03
133	1.28E-04	1.28E-04	1.36E-04	1.29E-04	1.25E-04	1.29E-04	1.27E-04	1.39E-04	1.31E-04
134	1.57E-04	1.64E-04	1.58E-04	1.55E-04	1.56E-04	1.62E-04	1.55E-04	1.58E-04	1.56E-04
135	4.60E-05	4.68E-05	5.02E-05	4.70E-05	4.51E-05	4.64E-05	4.61E-05	5.60E-05	4.07E-05
136	7.15E-05	7.13E-05	7.19E-05	7.08E-05	6.76E-05	7.02E-05	6.89E-05	8.11E-05	6.48E-05
137	1.73E-03	1.76E-03	1.71E-03	1.73E-03	1.72E-03	1.75E-03	1.69E-03	1.70E-03	1.69E-03
138	5.53E-03	5.59E-03	5.53E-03	5.49E-03	5.59E-03	5.70E-03	5.48E-03	5.53E-03	5.50E-03
139	5.54E-03	5.56E-03	5.44E-03	5.47E-03	5.50E-03	5.59E-03	5.35E-03	5.34E-03	5.40E-03
140	1.08E-02	1.09E-02	1.06E-02	1.06E-02	1.07E-02	1.09E-02	1.05E-02	1.05E-02	1.05E-02
141	4.68E-03	4.72E-03	4.64E-03	4.63E-03	4.67E-03	4.68E-03	4.54E-03	4.53E-03	4.58E-03
142	5.75E-03	5.76E-03	5.63E-03	5.63E-03	5.68E-03	5.76E-03	5.51E-03	5.48E-03	5.56E-03
143	4.29E-03	4.33E-03	4.22E-03	4.21E-03	4.26E-03	4.28E-03	4.13E-03	4.12E-03	4.16E-03
144	5.06E-03	5.11E-03	4.98E-03	4.96E-03	5.00E-03	5.06E-03	4.91E-03	4.83E-03	4.92E-03
145	3.10E-03	3.13E-03	3.06E-03	3.07E-03	3.09E-03	3.11E-03	3.00E-03	2.98E-03	3.03E-03
146	2.60E-03	2.64E-03	2.57E-03	2.57E-03	2.59E-03	2.61E-03	2.55E-03	2.50E-03	2.53E-03
147	1.47E-03	1.48E-03	1.46E-03	1.45E-03	1.45E-03	1.47E-03	1.43E-03	1.41E-03	1.43E-03
148	1.62E-03	1.66E-03	1.60E-03	1.60E-03	1.62E-03	1.62E-03	1.57E-03	1.57E-03	1.58E-03
149	6.23E-05	6.05E-05	5.94E-05	6.07E-05	6.11E-05	6.15E-05	5.86E-05	5.61E-05	5.74E-05
150	1.43E-03	1.44E-03	1.41E-03	1.41E-03	1.43E-03	1.45E-03	1.39E-03	1.38E-03	1.40E-03
151	6.04E-05	6.21E-05	6.11E-05	6.10E-05	6.25E-05	6.26E-05	6.07E-05	5.82E-05	5.93E-05
152	4.72E-04	4.70E-04	4.66E-04	4.66E-04	4.63E-04	4.66E-04	4.54E-04	4.44E-04	4.59E-04
153	2.06E-04	2.07E-04	2.04E-04	2.00E-04	2.05E-04	2.06E-04	2.05E-04	2.00E-04	2.01E-04
154	5.11E-04	5.13E-04	5.15E-04	5.10E-04	5.06E-04	5.16E-04	4.93E-04	4.91E-04	4.89E-04
155	2.38E-03	2.42E-03	2.35E-03	2.35E-03	2.33E-03	2.37E-03	2.31E-03	2.30E-03	2.31E-03
156	3.38E-03	3.42E-03	3.34E-03	3.34E-03	3.33E-03	3.37E-03	3.28E-03	3.25E-03	3.28E-03
157	2.51E-03	2.56E-03	2.49E-03	2.47E-03	2.48E-03	2.50E-03	2.43E-03	2.44E-03	2.42E-03
158	4.10E-03	4.15E-03	4.05E-03	4.05E-03	4.04E-03	4.10E-03	3.99E-03	3.97E-03	4.00E-03
159	2.25E-05	2.30E-05	2.30E-05	2.40E-05	2.23E-05	2.34E-05	2.26E-05	2.33E-05	2.40E-05
160	3.68E-03	3.71E-03	3.64E-03	3.62E-03	3.63E-03	3.66E-03	3.58E-03	3.56E-03	3.57E-03
161	1.59E-05	1.56E-05	1.58E-05	1.58E-05	1.64E-05	1.59E-05	1.56E-05	1.53E-05	1.60E-05
162	1.39E-05	1.43E-05	1.41E-05	1.44E-05	1.45E-05	1.47E-05	1.45E-05	1.38E-05	1.48E-05

Table A-17. Replicate analyses of the product slurries from the SRAT acid addition heated tests by ICP-MS, part 3 of 4

m/z	Slurry, 70% KMA (wt%)			Slurry, 100% KMA (wt%)			Slurry, 130% KMA (wt%)		
	LW18904	LW18905	LW18906	LW18907	LW18908	LW18909	LW18910	LW18911	LW18912
163	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
164	<1.0E-05	<1.0E-05	1.02E-05	<9.9E-06	<1.0E-05	1.01E-05	<1.0E-05	<1.0E-05	<1.0E-05
165	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
166	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
167	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
168	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
169	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
170	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
171	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
172	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
173	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
174	1.18E-05	1.12E-05	1.21E-05	1.15E-05	1.20E-05	1.21E-05	1.20E-05	1.18E-05	1.16E-05
175	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
176	1.01E-05	1.09E-05	1.11E-05	1.14E-05	1.10E-05	1.02E-05	1.07E-05	1.03E-05	1.00E-05
177	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
178	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
179	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
180	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
181	2.18E-05	1.93E-05	2.13E-05	2.36E-05	1.55E-05	2.16E-05	2.41E-05	2.67E-05	2.35E-05
182	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
183	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
184	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
185	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
186	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
187	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
191	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
193	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
194	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
195	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
196	2.92E-04	2.94E-04	2.98E-04	2.94E-04	2.89E-04	3.03E-04	2.87E-04	2.89E-04	2.85E-04
198	1.95E-02	1.96E-02	1.97E-02	1.95E-02	1.98E-02	2.05E-02	1.93E-02	1.92E-02	1.93E-02
203	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
204	1.08E-02	1.10E-02	1.11E-02	1.09E-02	1.11E-02	1.13E-02	1.07E-02	1.06E-02	1.08E-02
205	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
206	3.44E-04	3.43E-04	3.40E-04	3.37E-04	3.38E-04	3.48E-04	3.33E-04	3.57E-04	3.30E-04
207	2.98E-04	2.99E-04	2.93E-04	2.94E-04	2.98E-04	2.99E-04	2.87E-04	3.07E-04	2.89E-04
208	7.23E-04	7.23E-04	7.26E-04	7.15E-04	7.38E-04	7.29E-04	7.00E-04	7.51E-04	6.96E-04
229	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
230	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05

Table A-18. Replicate analyses of the product slurries from the SRAT acid addition heated tests by ICP-MS, part 4 of 4

m/z	Slurry, 70% KMA (wt%)			Slurry, 100% KMA (wt%)			Slurry, 130% KMA (wt%)		
	LW18904	LW18905	LW18906	LW18907	LW18908	LW18909	LW18910	LW18911	LW18912
232	1.80E-01	2.04E-01	2.02E-01	2.13E-01	2.28E-01	2.34E-01	2.05E-01	1.98E-01	2.06E-01
233	4.93E-05	5.18E-05	5.27E-05	5.17E-05	5.44E-05	5.58E-05	5.14E-05	4.94E-05	5.08E-05
234	3.81E-04	3.73E-04	3.70E-04	3.68E-04	3.59E-04	3.64E-04	3.64E-04	3.55E-04	3.54E-04
235	2.36E-02	2.36E-02	2.33E-02	2.27E-02	2.28E-02	2.31E-02	2.23E-02	2.24E-02	2.21E-02
236	2.13E-03	2.11E-03	2.10E-03	2.05E-03	2.06E-03	2.07E-03	2.05E-03	2.02E-03	2.02E-03
237	2.17E-04	2.24E-04	2.22E-04	2.19E-04	2.21E-04	2.21E-04	2.17E-04	2.13E-04	2.12E-04
238	3.44E-01	3.42E-01	3.39E-01	3.32E-01	3.33E-01	3.39E-01	3.29E-01	3.28E-01	3.29E-01
239	2.03E-03	2.10E-03	2.08E-03	2.10E-03	2.16E-03	2.18E-03	2.06E-03	2.04E-03	2.05E-03
240	1.75E-04	1.82E-04	1.81E-04	1.80E-04	1.85E-04	1.86E-04	1.78E-04	1.78E-04	1.78E-04
241	5.13E-05	5.25E-05	5.16E-05	5.18E-05	5.13E-05	5.21E-05	4.94E-05	5.00E-05	5.16E-05
242	1.74E-05	1.72E-05	1.70E-05	1.69E-05	1.63E-05	1.64E-05	1.71E-05	1.57E-05	1.65E-05
243	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
244	<1.0E-05	<1.0E-05	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05

Table A-19. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by ICP-ES

Analyte	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18914	LW18915	LW18916	LW18917	LW18918	LW18919	LW18920	LW18921	LW18922
Ag	<4.6E+00	<4.5E+00	<4.4E+00	<4.5E+00	<4.5E+00	<4.4E+00	<4.6E+00	<4.5E+00	<4.5E+00
Al	1.43E+02	1.41E+02	1.42E+02	1.23E+03	1.24E+03	1.23E+03	1.65E+03	1.65E+03	1.63E+03
B	<6.6E+00	<6.4E+00	<6.3E+00	<6.5E+00	<6.4E+00	<6.4E+00	<6.6E+00	<6.4E+00	<6.4E+00
Ba	2.40E+00	2.68E+00	2.51E+00	2.95E+00	3.05E+00	3.09E+00	2.43E+00	2.95E+00	2.85E+00
Be	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01
Ca	4.07E+02	4.02E+02	4.06E+02	7.55E+02	7.53E+02	7.57E+02	8.16E+02	8.15E+02	8.08E+02
Cd	<3.8E+00	<3.7E+00	<3.7E+00	<3.8E+00	<3.7E+00	<3.7E+00	<3.9E+00	<3.7E+00	<3.7E+00
Ce	<5.4E+01	<5.3E+01	<5.2E+01	<5.3E+01	<5.3E+01	<5.2E+01	<5.4E+01	<5.3E+01	<5.3E+01
Co	<4.8E+00	<4.6E+00	<4.6E+00	<4.7E+00	<4.6E+00	<4.6E+00	<4.8E+00	<4.6E+00	<4.6E+00
Cr	5.28E+01	5.16E+01	5.21E+01	1.43E+02	1.42E+02	1.43E+02	1.62E+02	1.63E+02	1.60E+02
Cu	<1.1E+01	<1.0E+01	<1.0E+01	2.31E+01	2.47E+01	2.39E+01	3.39E+01	3.45E+01	3.39E+01
Fe	1.98E+01	1.91E+01	1.98E+01	3.56E+02	3.54E+02	3.56E+02	7.78E+02	7.81E+02	7.72E+02
Gd	2.99E+01	2.97E+01	2.99E+01	1.45E+02	1.45E+02	1.45E+02	1.68E+02	1.69E+02	1.67E+02
K	<7.4E+01	<7.2E+01	<7.1E+01	<7.3E+01	<7.2E+01	<7.2E+01	<7.4E+01	<7.2E+01	<7.2E+01
La	<1.2E+00	<1.2E+00	<1.1E+00	1.64E+01	1.63E+01	1.67E+01	2.77E+01	2.76E+01	2.73E+01
Li	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01	<1.3E+01
Mg	1.98E+02	1.97E+02	1.98E+02	3.01E+02	2.99E+02	3.01E+02	3.41E+02	3.41E+02	3.37E+02
Mn	7.23E+02	7.19E+02	7.19E+02	2.00E+03	1.99E+03	2.00E+03	2.28E+03	2.29E+03	2.26E+03
Mo	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01
Na	2.07E+04	2.07E+04	2.08E+04	2.05E+04	2.06E+04	2.06E+04	2.05E+04	2.05E+04	2.05E+04
Ni	2.19E+01	2.03E+01	2.02E+01	1.93E+02	1.91E+02	1.92E+02	2.72E+02	2.70E+02	2.69E+02
P	<2.8E+01	<2.8E+01	<2.7E+01	<2.8E+01	<2.7E+01	<2.7E+01	<2.8E+01	<2.7E+01	<2.7E+01
Pb	<3.2E+01	<3.2E+01	<3.1E+01	<3.2E+01	<3.1E+01	<3.1E+01	<3.2E+01	<3.1E+01	<3.1E+01
Sb	<6.1E+01	<6.0E+01	<5.9E+01	<6.0E+01	<6.0E+01	<5.9E+01	<6.2E+01	<6.0E+01	<6.0E+01
Si	<4.0E+01	<3.9E+01	<3.9E+01	2.71E+02	2.68E+02	2.72E+02	2.42E+02	2.42E+02	2.37E+02
Sn	<2.8E+01	<2.8E+01	<2.7E+01	<2.8E+01	<2.7E+01	<2.7E+01	<2.8E+01	<2.8E+01	<2.8E+01
Sr	1.12E+01	1.11E+01	1.12E+01	1.70E+01	1.69E+01	1.70E+01	1.95E+01	1.95E+01	1.93E+01
Th	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02
Ti	<3.4E+00	<3.3E+00	<3.3E+00	<3.3E+00	<3.3E+00	<3.3E+00	<3.4E+00	<3.3E+00	<3.3E+00
U	1.33E+03	1.34E+03	1.33E+03	3.96E+03	3.93E+03	3.96E+03	3.98E+03	3.99E+03	3.98E+03
V	<2.6E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.6E+00	<2.5E+00	<2.5E+00
Zn	<1.1E+01	<1.0E+01	<1.0E+01	<1.0E+01	<1.0E+01	<1.0E+01	<1.1E+01	<1.0E+01	<1.0E+01
Zr	<3.6E+01	<3.5E+01	<3.4E+01	<3.5E+01	<3.4E+01	<3.4E+01	<3.6E+01	<3.5E+01	<3.5E+01

Table A-20. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by ICP-MS, part 1 of 4

m/z	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18924	LW18925	LW18926	LW18927	LW18928	LW18929	LW18930	LW18931	LW18932
59	9.15E-02	7.98E-02	8.65E-02	1.86E+00	1.88E+00	1.83E+00	2.56E+00	2.60E+00	2.61E+00
75	1.96E-01	1.65E-01	1.93E-01	1.77E+00	1.68E+00	1.69E+00	2.42E+00	2.42E+00	2.42E+00
78	6.32E+00	6.40E+00	6.28E+00	3.39E+01	3.40E+01	3.37E+01	3.98E+01	3.98E+01	4.06E+01
82	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
84	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
85	7.85E-02	7.70E-02	7.74E-02	7.35E-02	7.73E-02	8.04E-02	8.48E-02	9.49E-02	7.79E-02
86	2.57E-01	2.49E-01	2.52E-01	3.80E-01	3.81E-01	3.74E-01	4.30E-01	4.33E-01	4.21E-01
87	3.86E-01	3.60E-01	3.84E-01	4.87E-01	4.67E-01	4.78E-01	4.78E-01	5.33E-01	5.17E-01
88	7.90E+00	7.82E+00	7.97E+00	1.19E+01	1.20E+01	1.20E+01	1.36E+01	1.36E+01	1.36E+01
89	2.47E+00	2.52E+00	2.50E+00	1.24E+01	1.24E+01	1.23E+01	1.51E+01	1.51E+01	1.50E+01
90	1.76E+00	1.71E+00	1.76E+00	5.58E+00	5.66E+00	5.68E+00	7.82E+00	7.81E+00	7.74E+00
91	3.99E-01	3.92E-01	3.88E-01	3.16E+00	3.19E+00	3.11E+00	4.60E+00	4.61E+00	4.62E+00
92	3.77E-01	3.64E-01	3.57E-01	2.89E+00	2.90E+00	2.89E+00	4.23E+00	4.23E+00	4.19E+00
93	4.31E-01	4.40E-01	4.46E-01	3.62E+00	3.67E+00	3.64E+00	5.48E+00	5.47E+00	5.49E+00
94	4.06E-01	4.24E-01	4.24E-01	3.30E+00	3.33E+00	3.32E+00	4.79E+00	4.87E+00	4.84E+00
95	3.88E-02	4.13E-02	4.02E-02	1.98E-01	1.99E-01	1.93E-01	3.09E-01	3.24E-01	3.13E-01
96	3.68E-01	3.74E-01	3.66E-01	2.91E+00	2.96E+00	2.93E+00	4.26E+00	4.27E+00	4.24E+00
97	3.49E-02	3.57E-02	3.17E-02	1.78E-01	1.75E-01	1.67E-01	2.76E-01	2.81E-01	2.81E-01
98	3.60E-02	3.85E-02	3.83E-02	1.89E-01	1.94E-01	1.91E-01	3.04E-01	3.15E-01	3.03E-01
99	7.26E-01	7.30E-01	7.28E-01	9.13E-01	9.12E-01	9.26E-01	9.80E-01	9.59E-01	9.60E-01
100	3.82E-01	3.63E-01	3.68E-01	7.76E-01	7.69E-01	7.83E-01	1.01E+00	1.03E+00	1.03E+00
101	6.95E+00	6.87E+00	6.95E+00	1.24E+01	1.24E+01	1.24E+01	1.55E+01	1.56E+01	1.55E+01
102	6.14E+00	6.02E+00	6.07E+00	1.08E+01	1.09E+01	1.08E+01	1.36E+01	1.37E+01	1.36E+01
103	5.80E+00	5.73E+00	5.71E+00	9.05E+00	9.12E+00	9.06E+00	1.05E+01	1.04E+01	1.04E+01
104	2.89E+00	2.91E+00	2.91E+00	5.18E+00	5.25E+00	5.24E+00	6.47E+00	6.56E+00	6.46E+00
105	<2.7E-02	<2.9E-02	<2.6E-02	1.00E-01	1.04E-01	1.09E-01	<2.7E-02	<2.6E-02	<2.6E-02
106	<2.7E-02	<3.7E-02	<2.6E-02	1.54E-01	1.54E-01	1.56E-01	<2.7E-02	<2.6E-02	<2.6E-02
107	<2.7E-02	<2.6E-02	<2.6E-02	9.68E-02	9.13E-02	8.98E-02	2.94E-01	3.12E-01	3.12E-01
108	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
109	<2.7E-02	<2.6E-02	<2.6E-02	5.86E-02	4.98E-02	4.53E-02	3.00E-01	3.02E-01	3.09E-01
110	<2.7E-02	3.10E-02	2.70E-02	1.47E-01	1.45E-01	1.39E-01	1.60E-01	1.57E-01	1.63E-01
111	6.59E-02	7.24E-02	7.46E-02	2.26E-01	2.27E-01	2.29E-01	2.75E-01	2.81E-01	2.74E-01
112	1.18E-01	1.15E-01	1.22E-01	4.01E-01	3.98E-01	3.92E-01	4.87E-01	4.87E-01	4.62E-01
113	5.81E-02	7.29E-02	6.53E-02	1.79E-01	1.91E-01	1.80E-01	2.21E-01	2.13E-01	1.99E-01
114	1.49E-01	1.49E-01	1.46E-01	4.83E-01	4.79E-01	4.91E-01	6.02E-01	5.71E-01	5.65E-01
116	7.53E-02	7.01E-02	7.45E-02	1.46E+00	1.47E+00	1.46E+00	2.18E+00	2.17E+00	2.16E+00
117	2.81E-02	2.62E-02	2.81E-02	8.77E-02	8.03E-02	8.48E-02	8.92E-02	8.48E-02	8.98E-02
118	1.68E-01	1.70E-01	1.70E-01	4.84E-01	4.71E-01	4.76E-01	5.06E-01	5.02E-01	5.04E-01
119	1.93E+01	1.90E+01	2.20E+01	7.35E+01	7.28E+01	7.35E+01	7.39E+01	7.32E+01	7.37E+01
120	<2.7E-02	<2.6E-02	<2.6E-02	4.91E-02	4.42E-02	5.33E-02	6.29E-02	6.08E-02	5.93E-02

Table A-21. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by ICP-MS, part 2 of 4

m/z	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18924	LW18925	LW18926	LW18927	LW18928	LW18929	LW18930	LW18931	LW18932
121	<2.7E-02	<2.6E-02	<2.6E-02	7.46E-02	7.20E-02	7.04E-02	9.46E-02	9.38E-02	9.62E-02
122	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
123	<2.7E-02	<2.6E-02	<2.6E-02	7.36E-02	7.37E-02	7.21E-02	8.24E-02	9.67E-02	8.58E-02
124	<2.7E-02	<2.6E-02	<2.6E-02	3.07E-02	3.91E-02	3.45E-02	4.33E-02	4.53E-02	4.18E-02
125	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
126	4.98E-02	4.07E-02	5.22E-02	1.67E-01	1.72E-01	1.69E-01	2.02E-01	2.11E-01	2.09E-01
128	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	3.64E-02	<2.6E-02	3.82E-02
130	<2.7E-02	<2.6E-02	<2.6E-02	3.36E-02	3.76E-02	3.51E-02	1.38E-01	1.52E-01	1.31E-01
133	1.20E+00	1.09E+00	1.13E+00	1.27E+00	1.26E+00	1.32E+00	1.24E+00	1.24E+00	1.27E+00
134	6.64E-02	6.77E-02	6.43E-02	8.34E-02	8.64E-02	8.10E-02	7.34E-02	7.64E-02	7.75E-02
135	1.24E-01	1.27E-01	1.21E-01	1.47E-01	1.32E-01	1.45E-01	1.43E-01	1.26E-01	1.38E-01
136	<2.7E-02	<2.6E-02	<2.6E-02	2.88E-02	3.34E-02	2.81E-02	4.17E-02	3.60E-02	4.29E-02
137	1.19E+00	1.14E+00	1.19E+00	1.37E+00	1.35E+00	1.38E+00	1.23E+00	1.24E+00	1.23E+00
138	1.84E+00	1.80E+00	1.82E+00	2.28E+00	2.34E+00	2.31E+00	2.16E+00	2.19E+00	2.13E+00
139	1.50E+00	1.49E+00	1.55E+00	1.86E+01	1.87E+01	1.87E+01	3.10E+01	3.11E+01	3.11E+01
140	5.88E-01	5.99E-01	6.24E-01	8.54E+00	8.53E+00	8.40E+00	1.77E+01	1.76E+01	1.88E+01
141	1.50E+00	1.50E+00	1.52E+00	1.61E+01	1.60E+01	1.61E+01	2.58E+01	2.59E+01	2.58E+01
142	5.19E-01	5.19E-01	5.19E-01	6.45E+00	6.48E+00	6.47E+00	1.20E+01	1.21E+01	1.19E+01
143	1.89E+00	1.87E+00	1.89E+00	1.68E+01	1.68E+01	1.67E+01	2.57E+01	2.57E+01	2.57E+01
144	2.13E+00	2.14E+00	2.13E+00	1.89E+01	1.89E+01	1.93E+01	2.88E+01	2.87E+01	2.88E+01
145	1.38E+00	1.37E+00	1.38E+00	1.22E+01	1.22E+01	1.23E+01	1.78E+01	1.77E+01	1.76E+01
146	1.16E+00	1.14E+00	1.17E+00	1.02E+01	1.02E+01	1.01E+01	1.49E+01	1.48E+01	1.48E+01
147	8.14E-01	7.99E-01	8.13E-01	6.29E+00	6.28E+00	6.25E+00	8.59E+00	8.65E+00	8.59E+00
148	7.38E-01	7.47E-01	7.37E-01	6.37E+00	6.47E+00	6.40E+00	9.29E+00	9.27E+00	9.26E+00
149	3.27E-02	3.29E-02	3.31E-02	2.63E-01	2.58E-01	2.48E-01	3.61E-01	3.60E-01	3.50E-01
150	7.54E-01	7.28E-01	7.38E-01	6.08E+00	6.04E+00	6.02E+00	8.45E+00	8.44E+00	8.43E+00
151	3.57E-02	3.56E-02	3.46E-02	2.63E-01	2.68E-01	2.66E-01	3.62E-01	3.68E-01	3.56E-01
152	3.03E-01	2.94E-01	2.95E-01	2.22E+00	2.22E+00	2.18E+00	2.94E+00	2.94E+00	2.93E+00
153	1.33E-01	1.29E-01	1.29E-01	9.45E-01	9.58E-01	9.40E-01	1.26E+00	1.25E+00	1.24E+00
154	7.17E-01	7.24E-01	7.40E-01	3.99E+00	3.97E+00	3.97E+00	4.73E+00	4.66E+00	4.68E+00
155	3.92E+00	3.88E+00	3.90E+00	2.14E+01	2.12E+01	2.13E+01	2.49E+01	2.49E+01	2.47E+01
156	5.48E+00	5.47E+00	5.49E+00	3.01E+01	2.99E+01	2.97E+01	3.47E+01	3.49E+01	3.49E+01
157	4.16E+00	4.11E+00	4.14E+00	2.24E+01	2.26E+01	2.24E+01	2.63E+01	2.64E+01	2.61E+01
158	6.77E+00	6.66E+00	6.72E+00	3.64E+01	3.66E+01	3.63E+01	4.24E+01	4.25E+01	4.21E+01
159	<2.7E-02	<2.6E-02	<2.6E-02	8.53E-02	8.70E-02	8.93E-02	1.23E-01	1.24E-01	1.25E-01
160	6.09E+00	5.99E+00	6.07E+00	3.29E+01	3.31E+01	3.29E+01	3.85E+01	3.87E+01	3.85E+01
161	<2.7E-02	<2.6E-02	<2.6E-02	6.43E-02	6.50E-02	6.66E-02	9.04E-02	9.05E-02	9.35E-02
162	<2.7E-02	<2.6E-02	<2.6E-02	5.86E-02	6.03E-02	6.05E-02	8.41E-02	8.23E-02	8.44E-02

Table A-22. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by ICP-MS, part 3 of 4

m/z	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18924	LW18925	LW18926	LW18927	LW18928	LW18929	LW18930	LW18931	LW18932
163	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	3.30E-02	3.10E-02	2.92E-02
164	<2.7E-02	<2.6E-02	<2.6E-02	4.40E-02	4.38E-02	4.58E-02	6.26E-02	6.14E-02	5.90E-02
165	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
166	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
167	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
168	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
169	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
170	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
171	<2.7E-02	<2.6E-02	<2.6E-02	5.54E-02	5.63E-02	5.36E-02	6.29E-02	6.53E-02	6.20E-02
172	<2.7E-02	<2.6E-02	<2.6E-02	7.87E-02	7.98E-02	8.23E-02	9.45E-02	9.44E-02	9.78E-02
173	<2.7E-02	<2.6E-02	<2.6E-02	6.52E-02	6.61E-02	6.71E-02	7.71E-02	8.28E-02	7.63E-02
174	<2.7E-02	<2.6E-02	<2.6E-02	1.01E-01	9.81E-02	1.03E-01	1.20E-01	1.17E-01	1.14E-01
175	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	2.58E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
176	<2.7E-02	<2.6E-02	<2.6E-02	9.48E-02	8.70E-02	9.33E-02	1.03E-01	9.93E-02	1.00E-01
177	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
178	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
179	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
180	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
181	<2.7E-02	<2.6E-02	<2.6E-02	4.20E-02	4.03E-02	4.51E-02	1.16E-01	1.07E-01	1.13E-01
182	<2.7E-02	<2.6E-02	3.30E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
183	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
184	<2.7E-02	<2.6E-02	3.85E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
185	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
186	<2.7E-02	<2.6E-02	3.54E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
187	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
191	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
193	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
194	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
195	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
196	<2.7E-02	<2.6E-02	<2.6E-02	4.33E-02	4.50E-02	4.53E-02	5.69E-02	6.07E-02	7.94E-02
198	1.47E-01	1.10E-01	9.18E-02	2.80E+00	2.58E+00	2.67E+00	3.54E+00	3.56E+00	4.75E+00
203	<4.8E-02	<4.7E-02	<4.6E-02	<4.7E-02	<4.7E-02	<4.7E-02	<4.8E-02	<4.7E-02	<4.7E-02
204	7.82E-02	6.08E-02	4.97E-02	1.45E+00	1.33E+00	1.37E+00	1.80E+00	1.85E+00	2.44E+00
205	<1.1E-01	<1.1E-01	<1.1E-01	<1.1E-01	<1.1E-01	<1.1E-01	<1.2E-01	<1.1E-01	<1.1E-01
206	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
207	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
208	5.59E-02	<2.6E-02	3.03E-02	<2.6E-02	<2.6E-02	3.33E-02	<2.7E-02	<2.6E-02	3.43E-02
229	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
230	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02

Table A-23. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by ICP-MS, part 4 of 4

m/z	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18924	LW18925	LW18926	LW18927	LW18928	LW18929	LW18930	LW18931	LW18932
232	1.11E+00	1.10E+00	1.11E+00	5.16E+01	5.12E+01	5.18E+01	7.78E+01	7.75E+01	7.74E+01
233	6.70E-02	6.94E-02	6.92E-02	2.46E-01	2.43E-01	2.47E-01	2.50E-01	2.48E-01	2.50E-01
234	1.42E+00	1.40E+00	1.41E+00	3.74E+00	3.65E+00	3.82E+00	3.76E+00	3.76E+00	3.95E+00
235	9.53E+01	9.17E+01	9.10E+01	2.49E+02	2.46E+02	2.46E+02	2.47E+02	2.46E+02	2.47E+02
236	8.95E+00	8.90E+00	8.96E+00	2.53E+01	2.54E+01	2.55E+01	2.55E+01	2.54E+01	2.52E+01
237	9.02E-01	9.14E-01	9.08E-01	1.90E+00	1.88E+00	1.90E+00	1.99E+00	1.98E+00	1.98E+00
238	1.23E+03	1.31E+03	1.26E+03	3.71E+03	3.54E+03	3.63E+03	3.68E+03	3.70E+03	3.67E+03
239	2.98E-01	2.92E-01	3.01E-01	6.10E+00	6.03E+00	6.07E+00	9.79E+00	9.66E+00	9.64E+00
240	<2.7E-02	<2.6E-02	<2.6E-02	5.20E-01	5.21E-01	5.16E-01	8.39E-01	8.41E-01	8.20E-01
241	<2.7E-02	<2.6E-02	<2.6E-02	1.66E-01	1.64E-01	1.60E-01	2.63E-01	2.67E-01	2.62E-01
242	<2.7E-02	<2.6E-02	<2.6E-02	4.08E-02	4.13E-02	3.91E-02	6.12E-02	6.25E-02	6.36E-02
243	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02
244	<2.7E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02	<2.6E-02

Table A-24. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by rad. chem. methods, in dpm/mL

Analyte	Supernate, 70% KMA (dpm/mL)			Supernate, 100% KMA (dpm/mL)			Supernate, 130% KMA (dpm/mL)		
	LW18933	LW18934	LW18935	LW18936	LW18937	LW18938	LW18939	LW18940	LW18941
^{238}Pu	1.46E+05	1.08E+05	1.30E+05	3.00E+06	3.38E+06	3.23E+06	6.11E+06	4.84E+06	5.28E+06
$^{239}Pu + ^{240}Pu$	5.12E+04	3.84E+04	5.03E+04	1.08E+06	1.22E+06	1.17E+06	2.13E+06	1.74E+06	1.91E+06
^{241}Pu	4.40E+05	3.29E+05	3.84E+05	8.07E+06	8.75E+06	8.45E+06	1.99E+07	1.59E+07	1.30E+07
^{241}Am	<5.0E+03	<1.3E+04	<1.3E+04	3.89E+04	4.31E+04	4.11E+04	6.20E+04	3.79E+04	6.28E+04
^{243}Am	<2.1E+01	<6.1E+01	<5.5E+01	<2.0E+02	<1.8E+02	<1.5E+02	<3.9E+02	<2.2E+02	<2.9E+02
^{242m}Am	<1.6E+02	<5.1E+02	<3.0E+02	<1.6E+02	<1.5E+02	<1.0E+02	<1.4E+02	<2.5E+01	<5.5E+01
^{243}Cm	<2.5E+03	<1.1E+04	<6.0E+03	<3.2E+03	<3.3E+03	<2.6E+03	<4.1E+03	<1.1E+03	<4.0E+03
^{245}Cm	<2.1E+03	<9.4E+03	<4.9E+03	<2.6E+03	<2.7E+03	<2.2E+03	<3.3E+03	<8.8E+02	<3.3E+03
^{247}Cm	<2.9E+03	<1.4E+04	<7.3E+03	<3.2E+03	<3.7E+03	<2.6E+03	<4.3E+03	<9.1E+02	<4.1E+03
^{249}Cf	<3.1E+03	<1.5E+04	<7.8E+03	<3.4E+03	<3.9E+03	<2.7E+03	<4.6E+03	<9.4E+02	<4.4E+03
^{251}Cf	<2.3E+03	<1.1E+04	<5.5E+03	<2.7E+03	<2.9E+03	<2.2E+03	<3.5E+03	<7.8E+02	<3.4E+03
^{242}Cm	<1.3E+02	<4.2E+02	<2.5E+02	<1.3E+02	<1.3E+02	<8.6E+01	<1.2E+02	<2.1E+01	<4.5E+01
^{244}Cm	<1.7E+03	<4.6E+03	<4.5E+03	1.25E+04	1.55E+04	1.09E+04	1.55E+04	9.45E+03	1.54E+04

Table A-25. Replicate analyses of the product filtrates from the SRAT acid addition heated tests by rad. chem. methods, in mg/L

Analyte	Supernate, 70% KMA (mg/L)			Supernate, 100% KMA (mg/L)			Supernate, 130% KMA (mg/L)		
	LW18933	LW18934	LW18935	LW18936	LW18937	LW18938	LW18939	LW18940	LW18941
^{238}Pu	3.84E-03	2.84E-03	3.42E-03	7.89E-02	8.89E-02	8.50E-02	1.61E-01	1.27E-01	1.39E-01
^{241}Pu	1.92E-03	1.44E-03	1.68E-03	3.53E-02	3.83E-02	3.70E-02	8.70E-02	6.95E-02	5.69E-02
^{241}Am	<6.5E-04	<1.7E-03	<1.7E-03	5.11E-03	5.66E-03	5.39E-03	8.14E-03	4.97E-03	8.24E-03
^{243}Am	<4.7E-05	<1.4E-04	<1.2E-04	<4.5E-04	<4.0E-04	<3.3E-04	<8.9E-04	<5.0E-04	<6.4E-04
^{242m}Am	<7.4E-06	<2.3E-05	<1.4E-05	<7.6E-06	<7.0E-06	<4.8E-06	<6.6E-06	<1.2E-06	<2.5E-06
^{243}Cm	<2.2E-05	<9.9E-05	<5.3E-05	<2.8E-05	<2.9E-05	<2.3E-05	<3.6E-05	<9.3E-06	<3.5E-05
^{245}Cm	<5.4E-05	<2.5E-04	<1.3E-04	<6.8E-05	<7.2E-05	<5.7E-05	<8.8E-05	<2.3E-05	<8.6E-05
^{247}Cm	<1.4E+01	<6.9E+01	<3.6E+01	<1.6E+01	<1.8E+01	<1.3E+01	<2.1E+01	<4.4E+00	<2.0E+01
^{242}Cm	<1.8E-08	<5.7E-08	<3.4E-08	<1.8E-08	<1.7E-08	<1.2E-08	<1.6E-08	<2.9E-09	<6.2E-09
^{244}Cm	<9.5E-06	<2.6E-05	<2.5E-05	6.96E-05	8.63E-05	6.07E-05	8.63E-05	5.26E-05	8.57E-05

Table A-26. Replicate analyses of the product slurries from the additional pH adjustment tests by ICP-ES

Analyte	Slurry, adjusted to pH 3 (wt%)			Slurry, adjusted to pH2 (wt%)			Slurry, adjusted to pH 0.7 (wt%)		
	LW18943	LW18944	LW18945	LW18949	LW18950	LW18951	LW18946	LW18947	LW18948
Ag	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03	<1.7E-03
Al	1.38E+00	1.42E+00	1.48E+00	1.45E+00	1.48E+00	1.41E+00	1.38E+00	1.39E+00	1.40E+00
B	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03	<2.5E-03
Ba	7.19E-03	7.09E-03	7.16E-03	6.89E-03	6.91E-03	6.97E-03	6.76E-03	6.54E-03	6.59E-03
Be	<8.4E-05	<8.4E-05	<8.5E-05	<8.5E-05	<8.4E-05	<8.5E-05	<8.5E-05	<8.5E-05	<8.5E-05
Ca	7.93E-02	8.00E-02	7.95E-02	7.92E-02	7.98E-02	8.04E-02	7.32E-02	7.26E-02	7.25E-02
Cd	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03	<1.2E-03
Ce	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02
Co	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03	<1.8E-03
Cr	2.21E-02	2.25E-02	2.26E-02	2.15E-02	2.21E-02	2.21E-02	2.03E-02	2.00E-02	2.05E-02
Cu	<5.3E-03	<5.4E-03	<5.4E-03	<5.4E-03	<5.4E-03	<5.4E-03	<5.4E-03	<5.4E-03	<5.4E-03
Fe	1.14E+00	1.14E+00	1.14E+00	1.12E+00	1.12E+00	1.12E+00	1.07E+00	1.06E+00	1.05E+00
Gd	1.49E-02	1.50E-02	1.50E-02	1.49E-02	1.51E-02	1.52E-02	1.36E-02	1.35E-02	1.39E-02
K	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02	<2.8E-02
La	<4.9E-03	<4.9E-03	<4.9E-03	<4.9E-03	<4.9E-03	<4.9E-03	<5.0E-03	<4.9E-03	<5.0E-03
Li	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03	<2.1E-03
Mg	3.20E-02	3.21E-02	3.23E-02	3.20E-02	3.21E-02	3.24E-02	2.98E-02	2.95E-02	2.97E-02
Mn	2.17E-01	2.18E-01	2.18E-01	2.15E-01	2.17E-01	2.17E-01	1.99E-01	1.99E-01	2.00E-01
Mo	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03	<6.5E-03
Na	1.73E+00	1.73E+00	1.73E+00	1.70E+00	1.70E+00	1.72E+00	1.58E+00	1.57E+00	1.58E+00
Ni	3.85E-02	3.96E-02	3.89E-02	3.74E-02	3.89E-02	3.82E-02	3.61E-02	3.57E-02	3.64E-02
P	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02
Pb	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02	<1.2E-02
Sb	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02	<2.3E-02
Si	3.25E-02	2.99E-02	3.23E-02	3.57E-02	3.42E-02	3.26E-02	3.39E-02	3.34E-02	3.11E-02
Sn	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02	<1.1E-02
Sr	<7.4E-03	<7.4E-03	<7.4E-03	<7.4E-03	<7.5E-03	<7.4E-03	<7.5E-03	<7.4E-03	<7.5E-03
Th	1.94E-01	1.86E-01	1.94E-01	1.97E-01	2.01E-01	1.95E-01	1.78E-01	1.84E-01	1.78E-01
Ti	1.67E-03	1.67E-03	1.71E-03	1.67E-03	1.69E-03	1.69E-03	1.58E-03	1.59E-03	1.63E-03
U	3.06E-01	3.00E-01	3.12E-01	3.00E-01	3.03E-01	3.04E-01	2.81E-01	2.80E-01	2.81E-01
V	<9.5E-04	<9.5E-04	<9.5E-04	<9.5E-04	<9.5E-04	<9.5E-04	<9.6E-04	<9.5E-04	<9.6E-04
Zn	2.55E-03	2.62E-03	2.65E-03	2.45E-03	2.59E-03	2.55E-03	2.46E-03	2.29E-03	2.29E-03
Zr	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02	<1.6E-02

Table A-27. Replicate analyses of the product slurries from the additional pH adjustment tests by ICP-MS, part 1 of 4

m/z	Slurry, adjusted to pH 3 (wt%)			Slurry, adjusted to pH2 (wt%)			Slurry, adjusted to pH 0.7 (wt%)		
	LW18953	LW18954	LW18955	LW18959	LW18960	LW18961	LW18956	LW18957	LW18958
59	3.28E-04	3.20E-04	3.18E-04	3.05E-04	3.10E-04	3.08E-04	3.06E-04	3.03E-04	2.93E-04
75	3.86E-04	3.80E-04	4.17E-04	4.22E-04	3.74E-04	4.05E-04	3.74E-04	3.54E-04	3.78E-04
78	9.45E-04	9.17E-04	9.41E-04	9.40E-04	9.00E-04	9.31E-04	8.55E-04	8.53E-04	8.59E-04
82	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
84	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
85	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
86	7.41E-05	7.22E-05	7.89E-05	7.55E-05	7.56E-05	7.39E-05	6.65E-05	6.87E-05	6.54E-05
87	7.15E-05	7.38E-05	6.86E-05	7.77E-05	7.86E-05	7.05E-05	7.50E-05	6.74E-05	6.79E-05
88	2.11E-03	2.08E-03	2.12E-03	2.07E-03	2.08E-03	2.09E-03	1.93E-03	1.98E-03	1.91E-03
89	2.10E-03	2.12E-03	2.09E-03	2.07E-03	2.06E-03	2.05E-03	1.94E-03	1.89E-03	1.93E-03
90	2.16E-03	2.13E-03	2.16E-03	2.15E-03	2.11E-03	2.07E-03	1.98E-03	2.01E-03	1.99E-03
91	2.58E-03	2.56E-03	2.56E-03	2.47E-03	2.48E-03	2.50E-03	2.36E-03	2.37E-03	2.36E-03
92	2.39E-03	2.34E-03	2.36E-03	2.29E-03	2.29E-03	2.28E-03	2.17E-03	2.16E-03	2.16E-03
93	3.06E-03	2.99E-03	3.02E-03	2.94E-03	2.92E-03	2.90E-03	2.78E-03	2.78E-03	2.76E-03
94	2.63E-03	2.59E-03	2.62E-03	2.52E-03	2.52E-03	2.51E-03	2.42E-03	2.39E-03	2.40E-03
95	1.57E-04	1.52E-04	1.53E-04	1.49E-04	1.50E-04	1.45E-04	1.43E-04	1.39E-04	1.41E-04
96	2.36E-03	2.35E-03	2.37E-03	2.30E-03	2.28E-03	2.28E-03	2.17E-03	2.19E-03	2.16E-03
97	1.27E-04	1.28E-04	1.29E-04	1.25E-04	1.25E-04	1.22E-04	1.20E-04	1.21E-04	1.18E-04
98	1.42E-04	1.42E-04	1.35E-04	1.30E-04	1.34E-04	1.36E-04	1.25E-04	1.28E-04	1.31E-04
99	2.16E-04	2.09E-04	2.15E-04	2.10E-04	2.09E-04	2.08E-04	1.96E-04	1.96E-04	1.95E-04
100	2.30E-04	2.25E-04	2.33E-04	2.27E-04	2.24E-04	2.23E-04	2.08E-04	2.11E-04	2.14E-04
101	2.40E-03	2.40E-03	2.45E-03	2.36E-03	2.37E-03	2.31E-03	2.18E-03	2.19E-03	2.17E-03
102	2.10E-03	2.06E-03	2.09E-03	2.06E-03	2.03E-03	2.02E-03	2.02E-03	1.91E-03	1.91E-03
103	1.19E-03	1.19E-03	1.20E-03	1.16E-03	1.18E-03	1.15E-03	1.08E-03	1.08E-03	1.08E-03
104	1.03E-03	1.01E-03	1.02E-03	9.94E-04	9.89E-04	9.82E-04	9.34E-04	9.35E-04	9.38E-04
105	1.07E-04	1.09E-04	1.07E-04	1.00E-04	1.03E-04	9.73E-05	9.89E-05	9.66E-05	9.46E-05
106	1.25E-04	1.25E-04	1.22E-04	1.16E-04	1.22E-04	1.16E-04	1.05E-04	1.12E-04	1.12E-04
107	4.60E-04	4.67E-04	4.65E-04	4.57E-04	4.59E-04	4.52E-04	4.30E-04	4.26E-04	4.34E-04
108	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
109	3.93E-04	4.02E-04	4.02E-04	3.89E-04	3.91E-04	3.82E-04	3.65E-04	3.69E-04	3.68E-04
110	3.40E-05	3.53E-05	3.38E-05	3.15E-05	2.99E-05	3.22E-05	2.60E-05	2.88E-05	2.97E-05
111	5.58E-05	5.63E-05	5.84E-05	5.49E-05	5.71E-05	5.94E-05	5.70E-05	5.28E-05	5.25E-05
112	9.93E-05	1.01E-04	1.03E-04	9.69E-05	9.56E-05	1.11E-04	9.37E-05	9.04E-05	9.21E-05
113	4.52E-05	4.27E-05	4.20E-05	3.79E-05	3.52E-05	4.36E-05	3.54E-05	3.43E-05	3.43E-05
114	1.12E-04	1.10E-04	1.19E-04	1.11E-04	1.14E-04	1.21E-04	1.08E-04	9.79E-05	9.96E-05
116	5.50E-03	5.22E-03	5.46E-03	5.55E-03	5.60E-03	5.35E-03	5.04E-03	5.18E-03	4.97E-03
117	1.09E-05	9.93E-06	1.05E-05	9.97E-06	1.07E-05	1.17E-05	1.00E-05	9.95E-06	1.05E-05
118	4.94E-05	5.21E-05	5.00E-05	5.40E-05	4.75E-05	5.27E-05	4.72E-05	4.75E-05	4.35E-05
119	4.97E-03	4.93E-03	4.92E-03	4.87E-03	4.89E-03	4.84E-03	4.53E-03	4.49E-03	4.52E-03
120	1.68E-05	1.72E-05	1.59E-05	1.87E-05	1.58E-05	1.83E-05	1.22E-05	1.49E-05	1.56E-05

Table A-28. Replicate analyses of the product slurries from the additional pH adjustment tests by ICP-MS, part 2 of 4

m/z	Slurry, adjusted to pH 3 (wt%)			Slurry, adjusted to pH2 (wt%)			Slurry, adjusted to pH 0.7 (wt%)		
	LW18953	LW18954	LW18955	LW18959	LW18960	LW18961	LW18956	LW18957	LW18958
121	1.71E-05	1.81E-05	1.80E-05	1.80E-05	2.19E-05	1.68E-05	1.50E-05	1.96E-05	1.72E-05
122	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
123	1.76E-05	1.81E-05	1.89E-05	1.91E-05	1.78E-05	1.72E-05	1.73E-05	1.81E-05	1.73E-05
124	5.87E-05	6.05E-05	5.78E-05	5.68E-05	5.66E-05	6.13E-05	5.28E-05	5.34E-05	4.97E-05
125	1.61E-05	2.31E-05	2.41E-05	1.84E-05	1.52E-05	2.25E-05	2.25E-05	1.57E-05	1.65E-05
126	4.02E-05	4.00E-05	4.74E-05	5.08E-05	4.87E-05	3.86E-05	3.89E-05	3.70E-05	3.34E-05
128	2.31E-04	2.35E-04	2.10E-04	2.17E-04	2.21E-04	2.16E-04	1.95E-04	2.29E-04	2.08E-04
130	1.20E-03	1.20E-03	1.20E-03	1.15E-03	1.13E-03	1.14E-03	1.08E-03	1.11E-03	1.09E-03
133	1.16E-04	1.16E-04	1.14E-04	1.13E-04	1.11E-04	1.21E-04	1.03E-04	1.02E-04	1.06E-04
134	1.52E-04	1.51E-04	1.45E-04	1.47E-04	1.46E-04	1.44E-04	1.39E-04	1.34E-04	1.38E-04
135	4.59E-05	4.36E-05	4.52E-05	4.52E-05	4.20E-05	4.46E-05	4.05E-05	4.04E-05	3.77E-05
136	6.75E-05	6.96E-05	6.45E-05	6.53E-05	6.05E-05	6.50E-05	6.64E-05	6.25E-05	5.94E-05
137	1.60E-03	1.57E-03	1.59E-03	1.53E-03	1.53E-03	1.53E-03	1.48E-03	1.44E-03	1.44E-03
138	5.05E-03	4.99E-03	5.02E-03	4.83E-03	4.82E-03	4.86E-03	4.69E-03	4.58E-03	4.58E-03
139	5.06E-03	5.03E-03	5.05E-03	4.96E-03	4.92E-03	4.87E-03	4.62E-03	4.59E-03	4.57E-03
140	9.96E-03	9.94E-03	9.89E-03	9.59E-03	9.59E-03	9.53E-03	9.18E-03	9.19E-03	9.06E-03
141	4.29E-03	4.29E-03	4.26E-03	4.20E-03	4.18E-03	4.14E-03	3.94E-03	3.91E-03	3.91E-03
142	5.29E-03	5.24E-03	5.23E-03	5.10E-03	5.03E-03	5.04E-03	4.85E-03	4.83E-03	4.80E-03
143	3.94E-03	3.93E-03	3.95E-03	3.86E-03	3.82E-03	3.82E-03	3.64E-03	3.60E-03	3.62E-03
144	4.68E-03	4.67E-03	4.68E-03	4.57E-03	4.55E-03	4.51E-03	4.30E-03	4.27E-03	4.27E-03
145	2.87E-03	2.85E-03	2.88E-03	2.79E-03	2.76E-03	2.74E-03	2.64E-03	2.62E-03	2.60E-03
146	2.37E-03	2.36E-03	2.39E-03	2.33E-03	2.31E-03	2.29E-03	2.18E-03	2.18E-03	2.16E-03
147	1.41E-03	1.40E-03	1.41E-03	1.38E-03	1.37E-03	1.34E-03	1.30E-03	1.28E-03	1.29E-03
148	1.50E-03	1.50E-03	1.51E-03	1.48E-03	1.46E-03	1.44E-03	1.38E-03	1.38E-03	1.37E-03
149	5.74E-05	5.78E-05	5.83E-05	5.38E-05	5.55E-05	5.55E-05	5.23E-05	5.26E-05	5.24E-05
150	1.31E-03	1.31E-03	1.31E-03	1.28E-03	1.28E-03	1.26E-03	1.21E-03	1.18E-03	1.20E-03
151	5.47E-05	5.53E-05	5.59E-05	5.37E-05	5.52E-05	5.50E-05	5.16E-05	5.04E-05	4.96E-05
152	4.30E-04	4.24E-04	4.26E-04	4.13E-04	4.15E-04	4.18E-04	3.95E-04	3.90E-04	3.86E-04
153	1.88E-04	1.91E-04	1.89E-04	1.85E-04	1.86E-04	1.87E-04	1.75E-04	1.72E-04	1.75E-04
154	4.69E-04	4.64E-04	4.65E-04	4.54E-04	4.65E-04	4.58E-04	4.26E-04	4.24E-04	4.26E-04
155	2.27E-03	2.25E-03	2.26E-03	2.21E-03	2.21E-03	2.18E-03	2.05E-03	2.05E-03	2.05E-03
156	3.20E-03	3.19E-03	3.20E-03	3.15E-03	3.11E-03	3.10E-03	2.90E-03	2.89E-03	2.90E-03
157	2.35E-03	2.35E-03	2.35E-03	2.32E-03	2.32E-03	2.28E-03	2.15E-03	2.13E-03	2.12E-03
158	3.82E-03	3.81E-03	3.83E-03	3.76E-03	3.74E-03	3.72E-03	3.48E-03	3.48E-03	3.46E-03
159	2.08E-05	2.18E-05	2.05E-05	2.01E-05	1.93E-05	2.05E-05	1.86E-05	1.79E-05	1.84E-05
160	3.36E-03	3.38E-03	3.38E-03	3.32E-03	3.28E-03	3.27E-03	3.08E-03	3.05E-03	3.04E-03
161	1.34E-05	1.36E-05	1.30E-05	1.29E-05	1.32E-05	1.31E-05	1.31E-05	1.24E-05	1.22E-05
162	1.25E-05	1.23E-05	1.35E-05	1.24E-05	1.18E-05	1.15E-05	1.17E-05	1.13E-05	1.14E-05

Table A-29. Replicate analyses of the product slurries from the additional pH adjustment tests by ICP-MS, part 3 of 4

m/z	Slurry, adjusted to pH 3 (wt%)			Slurry, adjusted to pH2 (wt%)			Slurry, adjusted to pH 0.7 (wt%)		
	LW18953	LW18954	LW18955	LW18959	LW18960	LW18961	LW18956	LW18957	LW18958
163	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
164	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
165	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
166	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
167	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
168	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
169	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
170	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
171	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
172	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
173	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
174	1.00E-05	1.09E-05	<1.0E-05	1.05E-05	1.00E-05	1.02E-05	<1.0E-05	<1.0E-05	1.03E-05
175	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
176	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
177	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
178	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
179	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
180	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
181	2.07E-05	1.96E-05	2.16E-05	2.04E-05	2.15E-05	2.35E-05	1.88E-05	2.00E-05	1.93E-05
182	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
183	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
184	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
185	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
186	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
187	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
191	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
193	1.58E-05	1.08E-05	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
194	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
195	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
196	2.68E-04	2.75E-04	2.72E-04	2.64E-04	2.68E-04	2.59E-04	2.51E-04	2.47E-04	2.52E-04
198	1.75E-02	1.77E-02	1.79E-02	1.73E-02	1.72E-02	1.71E-02	1.64E-02	1.65E-02	1.63E-02
203	1.32E-05	1.03E-05	9.96E-06	9.96E-06	9.93E-06	9.96E-06	1.02E-05	9.95E-06	1.00E-05
204	9.38E-03	9.60E-03	9.78E-03	9.36E-03	9.38E-03	9.30E-03	8.95E-03	8.88E-03	8.87E-03
205	2.82E-05	2.19E-05	1.70E-05	9.96E-06	9.93E-06	1.35E-05	1.87E-05	1.26E-05	1.13E-05
206	3.19E-04	3.18E-04	3.22E-04	3.04E-04	3.10E-04	3.14E-04	2.94E-04	2.93E-04	2.93E-04
207	2.73E-04	2.78E-04	2.80E-04	2.69E-04	2.69E-04	2.75E-04	2.59E-04	2.53E-04	2.58E-04
208	6.65E-04	6.67E-04	6.78E-04	6.50E-04	6.43E-04	6.55E-04	6.10E-04	6.16E-04	6.22E-04
229	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
230	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05

Table A-30. Replicate analyses of the product slurries from the additional pH adjustment tests by ICP-MS, part 4 of 4

m/z	Slurry, adjusted to pH 3 (wt%)			Slurry, adjusted to pH2 (wt%)			Slurry, adjusted to pH 0.7 (wt%)		
	LW18953	LW18954	LW18955	LW18959	LW18960	LW18961	LW18956	LW18957	LW18958
232	1.76E-01	1.71E-01	1.78E-01	1.79E-01	1.81E-01	1.74E-01	1.65E-01	1.68E-01	1.64E-01
233	4.88E-05	4.81E-05	4.93E-05	4.76E-05	4.75E-05	4.81E-05	4.39E-05	4.45E-05	4.45E-05
234	3.16E-04	3.17E-04	3.18E-04	3.11E-04	3.11E-04	3.11E-04	2.93E-04	2.87E-04	2.90E-04
235	2.14E-02	2.14E-02	2.15E-02	2.10E-02	2.14E-02	2.09E-02	1.96E-02	1.91E-02	1.95E-02
236	1.92E-03	1.92E-03	1.93E-03	1.88E-03	1.88E-03	1.87E-03	1.75E-03	1.74E-03	1.75E-03
237	2.03E-04	2.04E-04	2.08E-04	1.99E-04	1.98E-04	1.98E-04	1.85E-04	1.85E-04	1.87E-04
238	2.84E-01	2.84E-01	2.87E-01	2.82E-01	2.81E-01	2.81E-01	2.60E-01	2.60E-01	2.61E-01
239	1.97E-03	1.93E-03	1.96E-03	1.92E-03	1.93E-03	1.89E-03	1.78E-03	1.79E-03	1.78E-03
240	1.66E-04	1.66E-04	1.72E-04	1.64E-04	1.65E-04	1.64E-04	1.55E-04	1.55E-04	1.54E-04
241	4.86E-05	4.83E-05	4.69E-05	4.62E-05	4.75E-05	4.66E-05	4.40E-05	4.28E-05	4.43E-05
242	1.54E-05	1.61E-05	1.59E-05	1.55E-05	1.53E-05	1.47E-05	1.47E-05	1.44E-05	1.45E-05
243	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
244	<9.9E-06	<9.9E-06	<1.0E-05	<1.0E-05	<9.9E-06	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05

Table A-31. Replicate analyses of the product filtrates from the additional pH adjustment tests by ICP-ES

Analyte	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18963	LW18964	LW18965	LW18969	LW18970	LW18971	LW18966	LW18967	LW18968
Ag	<4.5E+00	<4.5E+00	<4.4E+00	<4.4E+00	<4.4E+00	<4.5E+00	<4.5E+00	<4.6E+00	<4.6E+00
Al	1.20E+03	1.24E+03	1.25E+03	1.25E+03	1.25E+03	1.27E+03	1.32E+03	1.31E+03	1.32E+03
B	<6.4E+00	<6.4E+00	<6.4E+00	<6.4E+00	<6.4E+00	<6.5E+00	<6.5E+00	<6.6E+00	<6.5E+00
Ba	3.92E+00	4.09E+00	4.06E+00	4.26E+00	4.25E+00	4.22E+00	7.43E+00	7.38E+00	7.43E+00
Be	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01	<1.4E-01
Ca	7.57E+02	7.85E+02	7.82E+02	7.88E+02	7.85E+02	8.01E+02	7.48E+02	7.37E+02	7.35E+02
Cd	<3.7E+00	<3.7E+00	<3.7E+00	<3.7E+00	<3.7E+00	<3.8E+00	<3.8E+00	<3.8E+00	<3.8E+00
Ce	<4.2E+01	<4.2E+01	<4.2E+01	<4.2E+01	<4.2E+01	<4.3E+01	<4.3E+01	<4.3E+01	<4.3E+01
Co	<4.6E+00	<4.6E+00	<4.6E+00	<4.6E+00	<4.6E+00	<4.7E+00	<4.7E+00	<4.7E+00	<4.7E+00
Cr	1.31E+02	1.36E+02	1.35E+02	1.35E+02	1.36E+02	1.36E+02	1.41E+02	1.40E+02	1.41E+02
Cu	<2.9E+01	<2.9E+01	<2.9E+01	<2.9E+01	<2.9E+01	<3.0E+01	<3.0E+01	<3.0E+01	<3.0E+01
Fe	3.89E+02	4.03E+02	4.02E+02	4.85E+02	4.84E+02	4.86E+02	1.03E+03	1.02E+03	1.03E+03
Gd	1.37E+02	1.40E+02	1.41E+02	1.35E+02	1.36E+02	1.39E+02	1.42E+02	1.38E+02	1.39E+02
K	<7.2E+01	<7.2E+01	<7.2E+01	<7.1E+01	<7.2E+01	<7.3E+01	<7.3E+01	<7.4E+01	<7.3E+01
La	2.07E+01	2.14E+01	2.17E+01	2.13E+01	2.10E+01	2.27E+01	2.66E+01	2.60E+01	2.51E+01
Li	<9.7E+00	<9.7E+00	<9.6E+00	<9.6E+00	<9.7E+00	<9.8E+00	<9.9E+00	<1.0E+01	<9.9E+00
Mg	2.69E+02	2.78E+02	2.78E+02	2.77E+02	2.77E+02	2.80E+02	2.70E+02	2.67E+02	2.67E+02
Mn	1.84E+03	1.90E+03	1.90E+03	1.90E+03	1.90E+03	1.91E+03	1.84E+03	1.83E+03	1.83E+03
Mo	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01	<1.5E+01
Na	1.87E+04	1.94E+04	1.93E+04	1.89E+04	1.90E+04	1.91E+04	1.79E+04	1.78E+04	1.79E+04
Ni	1.73E+02	1.77E+02	1.77E+02	1.85E+02	1.83E+02	1.82E+02	1.88E+02	1.89E+02	1.90E+02
P	<2.7E+01	<2.7E+01	<2.7E+01	<2.7E+01	<2.7E+01	<2.8E+01	<2.8E+01	<2.8E+01	<2.8E+01
Pb	<3.1E+01	<3.1E+01	<3.1E+01	<3.1E+01	<3.1E+01	<3.2E+01	<3.2E+01	<3.2E+01	<3.2E+01
Sb	<5.9E+01	<6.0E+01	<5.9E+01	<5.9E+01	<5.9E+01	<6.1E+01	<6.1E+01	<6.1E+01	<6.1E+01
Si	2.83E+02	2.91E+02	2.88E+02	3.01E+02	3.02E+02	2.99E+02	3.24E+02	3.24E+02	3.27E+02
Sn	<2.7E+01	<2.7E+01	<2.7E+01	<2.7E+01	<2.7E+01	<2.8E+01	<2.8E+01	<2.8E+01	<2.8E+01
Sr	1.87E+01	1.94E+01	1.93E+01	< 20.3.0	2.02E+01	2.01E+01	1.90E+01	1.92E+01	1.93E+01
Th	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02	<1.3E+02
Ti	<2.7E+00	<2.7E+00	<2.7E+00	<2.7E+00	<2.7E+00	<2.8E+00	<2.8E+00	<2.8E+00	<2.8E+00
U	3.46E+03	3.58E+03	3.55E+03	3.53E+03	3.53E+03	3.50E+03	3.36E+03	3.38E+03	3.39E+03
V	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00	<2.5E+00
Zn	<6.1E+00	<6.1E+00	<6.1E+00	<6.1E+00	<6.1E+00	<6.6E+00	<6.2E+00	<6.3E+00	<6.2E+00
Zr	1.84E+01	1.89E+01	1.88E+01	1.85E+01	1.88E+01	1.86E+01	1.85E+01	1.81E+01	1.85E+01

Table A-32. Replicate analyses of the product filtrates from the additional pH adjustment tests by ICP-MS, part 1 of 4

m/z	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18973	LW18974	LW18975	LW18979	LW18980	LW18981	LW18976	LW18977	LW18978
59	1.73E+00	1.81E+00	1.79E+00	1.85E+00	1.79E+00	1.84E+00	1.93E+00	1.98E+00	1.93E+00
75	1.76E+00	1.81E+00	1.91E+00	2.00E+00	1.83E+00	1.90E+00	1.99E+00	2.03E+00	2.12E+00
78	3.31E+01	3.44E+01	3.43E+01	3.40E+01	3.39E+01	3.42E+01	3.45E+01	3.49E+01	3.51E+01
82	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
84	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
85	9.80E-02	7.55E-02	8.25E-02	6.98E-02	8.52E-02	8.75E-02	9.16E-02	8.09E-02	8.33E-02
86	3.94E-01	3.98E-01	4.06E-01	4.26E-01	4.17E-01	4.24E-01	3.99E-01	4.27E-01	3.85E-01
87	4.57E-01	4.88E-01	5.03E-01	4.92E-01	5.03E-01	4.88E-01	4.76E-01	4.71E-01	4.80E-01
88	1.28E+01	1.33E+01	1.33E+01	1.39E+01	1.39E+01	1.37E+01	1.31E+01	1.32E+01	1.31E+01
89	1.21E+01	1.24E+01	1.27E+01	1.25E+01	1.25E+01	1.24E+01	1.26E+01	1.27E+01	1.26E+01
90	6.95E+00	7.10E+00	7.20E+00	7.18E+00	7.16E+00	7.16E+00	6.69E+00	6.80E+00	6.70E+00
91	2.82E+00	2.91E+00	2.94E+00	2.86E+00	2.86E+00	2.86E+00	2.79E+00	2.87E+00	2.85E+00
92	2.52E+00	2.59E+00	2.63E+00	2.55E+00	2.54E+00	2.52E+00	2.52E+00	2.54E+00	2.54E+00
93	3.18E+00	3.30E+00	3.32E+00	3.27E+00	3.27E+00	3.24E+00	3.30E+00	3.35E+00	3.36E+00
94	2.93E+00	3.01E+00	3.00E+00	2.90E+00	2.92E+00	2.93E+00	2.91E+00	2.93E+00	2.96E+00
95	2.03E-01	2.07E-01	2.11E-01	2.09E-01	2.08E-01	2.11E-01	1.68E-01	1.63E-01	1.66E-01
96	2.58E+00	2.64E+00	2.69E+00	2.63E+00	2.58E+00	2.59E+00	2.59E+00	2.58E+00	2.59E+00
97	1.76E-01	1.80E-01	1.74E-01	1.78E-01	1.80E-01	1.78E-01	1.42E-01	1.32E-01	1.43E-01
98	1.98E-01	1.99E-01	2.05E-01	1.99E-01	2.05E-01	2.05E-01	1.62E-01	1.55E-01	1.58E-01
99	7.54E-01	7.74E-01	7.93E-01	7.86E-01	7.78E-01	7.61E-01	7.71E-01	7.71E-01	7.75E-01
100	7.10E-01	7.30E-01	7.43E-01	7.48E-01	7.48E-01	7.47E-01	6.99E-01	6.82E-01	6.86E-01
101	1.11E+01	1.14E+01	1.14E+01	1.15E+01	1.15E+01	1.15E+01	1.12E+01	1.13E+01	1.12E+01
102	9.63E+00	9.82E+00	9.91E+00	9.97E+00	1.00E+01	9.92E+00	9.79E+00	9.81E+00	9.70E+00
103	8.15E+00	8.24E+00	8.30E+00	8.26E+00	8.27E+00	8.20E+00	7.91E+00	7.96E+00	7.87E+00
104	4.70E+00	4.81E+00	4.78E+00	4.78E+00	4.81E+00	4.80E+00	4.71E+00	4.78E+00	4.70E+00
105	8.35E-02	9.33E-02	9.82E-02	4.07E-02	4.72E-02	5.50E-02	4.37E-02	4.69E-02	4.94E-02
106	1.33E-01	1.40E-01	1.45E-01	7.73E-02	7.91E-02	9.01E-02	7.73E-02	7.45E-02	7.64E-02
107	3.71E-01	3.60E-01	3.65E-01	6.52E-01	6.75E-01	6.86E-01	1.88E+00	1.89E+00	1.87E+00
108	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
109	3.68E-01	3.37E-01	3.34E-01	6.71E-01	6.79E-01	6.74E-01	1.94E+00	1.95E+00	1.92E+00
110	1.22E-01	1.43E-01	1.32E-01	1.38E-01	1.45E-01	1.37E-01	1.47E-01	1.56E-01	1.47E-01
111	2.13E-01	2.19E-01	2.17E-01	2.23E-01	2.28E-01	2.25E-01	2.50E-01	2.46E-01	2.54E-01
112	3.86E-01	3.92E-01	3.90E-01	4.00E-01	4.01E-01	4.00E-01	4.44E-01	4.37E-01	4.39E-01
113	1.94E-01	1.85E-01	1.92E-01	2.05E-01	2.00E-01	1.98E-01	2.13E-01	2.19E-01	1.98E-01
114	4.53E-01	4.58E-01	4.66E-01	4.78E-01	4.80E-01	4.70E-01	5.17E-01	5.29E-01	5.15E-01
116	1.14E+00	1.15E+00	1.16E+00	1.22E+00	1.21E+00	1.17E+00	1.22E+00	1.20E+00	1.19E+00
117	8.29E-02	7.73E-02	7.73E-02	7.67E-02	7.67E-02	7.33E-02	7.23E-02	6.69E-02	6.84E-02
118	4.59E-01	4.73E-01	4.85E-01	4.54E-01	4.60E-01	4.60E-01	4.44E-01	4.36E-01	4.27E-01
119	6.83E+01	6.99E+01	7.00E+01	6.88E+01	6.83E+01	6.84E+01	6.57E+01	6.61E+01	6.55E+01
120	5.23E-02	4.77E-02	5.40E-02	4.46E-02	4.51E-02	4.54E-02	<2.6E-02	<2.7E-02	<2.6E-02

Table A-33. Replicate analyses of the product filtrates from the additional pH adjustment tests by ICP-MS, part 2 of 4

m/z	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18973	LW18974	LW18975	LW18979	LW18980	LW18981	LW18976	LW18977	LW18978
121	7.09E-02	6.77E-02	6.88E-02	8.09E-02	6.68E-02	7.30E-02	8.20E-02	7.26E-02	8.38E-02
122	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
123	6.55E-02	6.88E-02	6.48E-02	7.26E-02	6.31E-02	5.91E-02	8.47E-02	7.99E-02	7.13E-02
124	2.85E-02	2.62E-02	3.51E-02	2.59E-02	2.63E-02	3.12E-02	<2.6E-02	<2.7E-02	<2.6E-02
125	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	3.57E-02
126	1.70E-01	1.59E-01	1.88E-01	1.76E-01	1.59E-01	1.60E-01	1.29E-01	1.50E-01	8.86E-02
128	6.46E-02	5.29E-02	5.14E-02	8.13E-02	7.90E-02	9.54E-02	2.48E-01	3.03E-01	2.79E-01
130	2.86E-01	2.91E-01	2.94E-01	4.55E-01	4.42E-01	4.22E-01	1.54E+00	1.49E+00	1.51E+00
133	1.26E+00	1.24E+00	1.25E+00	1.30E+00	1.30E+00	1.33E+00	1.17E+00	1.20E+00	1.21E+00
134	9.72E-02	1.04E-01	1.10E-01	1.05E-01	1.13E-01	1.02E-01	1.84E-01	1.82E-01	1.80E-01
135	1.42E-01	1.45E-01	1.45E-01	1.38E-01	1.41E-01	1.39E-01	1.56E-01	1.52E-01	1.57E-01
136	3.67E-02	3.62E-02	3.14E-02	3.94E-02	3.84E-02	4.35E-02	6.65E-02	6.18E-02	6.16E-02
137	1.61E+00	1.63E+00	1.65E+00	1.68E+00	1.71E+00	1.70E+00	2.57E+00	2.61E+00	2.59E+00
138	2.76E+00	2.82E+00	2.79E+00	2.94E+00	2.89E+00	2.95E+00	4.99E+00	5.02E+00	4.93E+00
139	2.16E+01	2.22E+01	2.23E+01	2.30E+01	2.30E+01	2.29E+01	2.93E+01	2.94E+01	2.91E+01
140	8.76E+00	9.04E+00	9.10E+00	9.61E+00	9.59E+00	9.49E+00	1.18E+01	1.19E+01	1.18E+01
141	1.79E+01	1.83E+01	1.83E+01	1.88E+01	1.87E+01	1.86E+01	2.35E+01	2.29E+01	2.35E+01
142	6.82E+00	7.03E+00	7.03E+00	7.33E+00	7.37E+00	7.29E+00	8.91E+00	8.90E+00	8.90E+00
143	1.79E+01	1.85E+01	1.85E+01	1.87E+01	1.87E+01	1.86E+01	2.13E+01	2.13E+01	2.20E+01
144	2.00E+01	2.18E+01	2.19E+01	2.21E+01	2.22E+01	2.12E+01	2.52E+01	2.54E+01	2.52E+01
145	1.32E+01	1.34E+01	1.35E+01	1.37E+01	1.37E+01	1.36E+01	1.56E+01	1.56E+01	1.56E+01
146	1.10E+01	1.13E+01	1.13E+01	1.14E+01	1.14E+01	1.14E+01	1.30E+01	1.31E+01	1.30E+01
147	6.54E+00	6.66E+00	6.64E+00	6.67E+00	6.62E+00	6.64E+00	7.30E+00	7.35E+00	7.31E+00
148	6.94E+00	7.02E+00	7.09E+00	7.13E+00	7.12E+00	7.10E+00	8.08E+00	8.16E+00	8.07E+00
149	2.77E-01	2.74E-01	2.85E-01	2.77E-01	2.69E-01	2.74E-01	3.04E-01	2.98E-01	3.19E-01
150	6.33E+00	6.48E+00	6.56E+00	6.51E+00	6.55E+00	6.50E+00	7.27E+00	7.31E+00	7.30E+00
151	2.76E-01	2.77E-01	2.81E-01	2.72E-01	2.76E-01	2.82E-01	3.02E-01	3.05E-01	3.00E-01
152	2.23E+00	2.28E+00	2.33E+00	2.27E+00	2.28E+00	2.29E+00	2.48E+00	2.49E+00	2.50E+00
153	9.49E-01	9.77E-01	9.75E-01	9.83E-01	9.63E-01	9.64E-01	1.05E+00	1.06E+00	1.07E+00
154	3.80E+00	3.86E+00	3.90E+00	3.82E+00	3.82E+00	3.79E+00	3.95E+00	3.99E+00	3.97E+00
155	2.02E+01	2.08E+01	2.07E+01	2.05E+01	2.05E+01	2.01E+01	2.07E+01	2.10E+01	2.10E+01
156	2.83E+01	2.91E+01	2.92E+01	2.86E+01	2.86E+01	2.83E+01	2.93E+01	2.96E+01	2.92E+01
157	2.17E+01	2.20E+01	2.19E+01	2.16E+01	2.16E+01	2.13E+01	2.22E+01	2.23E+01	2.19E+01
158	3.47E+01	3.54E+01	3.52E+01	3.47E+01	3.46E+01	3.42E+01	3.54E+01	3.57E+01	3.51E+01
159	8.93E-02	9.39E-02	9.34E-02	8.99E-02	9.13E-02	9.40E-02	1.10E-01	1.04E-01	1.04E-01
160	3.13E+01	3.18E+01	3.19E+01	3.12E+01	3.14E+01	3.08E+01	3.24E+01	3.25E+01	3.23E+01
161	6.78E-02	6.81E-02	6.81E-02	6.94E-02	7.36E-02	7.40E-02	8.03E-02	8.10E-02	7.74E-02
162	6.43E-02	6.60E-02	6.53E-02	6.43E-02	6.29E-02	6.40E-02	7.66E-02	7.42E-02	7.38E-02

Table A-34. Replicate analyses of the product filtrates from the additional pH adjustment tests by ICP-MS, part 3 of 4

m/z	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18973	LW18974	LW18975	LW18979	LW18980	LW18981	LW18976	LW18977	LW18978
163	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	2.76E-02	<2.7E-02	2.93E-02
164	4.66E-02	4.34E-02	4.64E-02	4.37E-02	4.80E-02	4.76E-02	5.16E-02	5.08E-02	5.06E-02
165	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
166	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
167	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
168	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
169	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
170	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
171	5.04E-02	5.17E-02	5.38E-02	5.24E-02	5.11E-02	5.21E-02	5.44E-02	5.08E-02	5.15E-02
172	7.19E-02	7.96E-02	8.03E-02	7.72E-02	7.75E-02	8.07E-02	8.03E-02	7.85E-02	7.30E-02
173	5.85E-02	6.34E-02	6.36E-02	6.53E-02	6.44E-02	6.44E-02	6.42E-02	6.50E-02	6.66E-02
174	9.34E-02	9.89E-02	9.84E-02	9.35E-02	9.63E-02	9.42E-02	9.61E-02	9.20E-02	1.03E-01
175	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
176	8.13E-02	8.48E-02	8.72E-02	8.51E-02	8.67E-02	8.20E-02	8.53E-02	8.70E-02	8.80E-02
177	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
178	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
179	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
180	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
181	5.39E-02	5.41E-02	5.54E-02	4.54E-02	4.39E-02	4.57E-02	5.64E-02	5.28E-02	5.09E-02
182	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
183	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
184	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
185	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
186	2.73E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
187	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
191	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
193	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
194	<2.6E-02	3.11E-02	3.14E-02	<2.6E-02	<2.6E-02	<2.6E-02	2.80E-02	<2.7E-02	<2.6E-02
195	<2.6E-02	3.14E-02	3.19E-02	<2.6E-02	<2.6E-02	<2.6E-02	2.68E-02	<2.7E-02	<2.6E-02
196	1.73E+00	2.01E+00	1.99E+00	3.70E+00	3.63E+00	3.68E+00	4.33E+00	4.38E+00	4.33E+00
198	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
203	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
204	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
205	<5.0E-02	<5.0E-02	<5.0E-02	<5.0E-02	<5.0E-02	<5.1E-02	<5.1E-02	<5.1E-02	<5.1E-02
206	<2.6E-02	<2.6E-02	<2.6E-02	4.16E-02	5.31E-02	1.27E-01	5.04E-01	5.19E-01	4.65E-01
207	<2.6E-02	<2.6E-02	<2.6E-02	4.01E-02	4.34E-02	1.14E-01	4.41E-01	4.60E-01	4.25E-01
208	2.86E-02	2.59E-02	5.25E-02	9.33E-02	1.10E-01	2.78E-01	1.05E+00	1.11E+00	1.02E+00
229	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
230	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02

Table A-35. Replicate analyses of the product filtrates from the additional pH adjustment tests by ICP-MS, part 4 of 4

m/z	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18973	LW18974	LW18975	LW18979	LW18980	LW18981	LW18976	LW18977	LW18978
232	3.76E+01	3.88E+01	3.88E+01	4.07E+01	4.03E+01	4.04E+01	4.09E+01	4.10E+01	4.07E+01
233	2.21E-01	2.22E-01	2.23E-01	2.21E-01	2.20E-01	2.23E-01	2.09E-01	2.13E-01	2.10E-01
234	3.94E+00	3.99E+00	3.83E+00	3.72E+00	3.79E+00	3.65E+00	3.32E+00	3.62E+00	3.40E+00
235	2.42E+02	2.50E+02	2.44E+02	2.38E+02	2.38E+02	2.36E+02	2.28E+02	2.29E+02	2.23E+02
236	2.33E+01	2.37E+01	2.36E+01	2.32E+01	2.33E+01	2.32E+01	2.22E+01	2.23E+01	2.21E+01
237	1.74E+00	1.78E+00	1.78E+00	1.74E+00	1.75E+00	1.75E+00	1.71E+00	1.73E+00	1.70E+00
238	3.37E+03	3.46E+03	3.42E+03	3.30E+03	3.32E+03	3.26E+03	3.16E+03	3.19E+03	3.12E+03
239	5.99E+00	6.10E+00	6.14E+00	6.24E+00	6.23E+00	6.18E+00	6.65E+00	6.66E+00	6.65E+00
240	5.18E-01	5.32E-01	5.31E-01	5.42E-01	5.32E-01	5.39E-01	5.70E-01	5.81E-01	5.68E-01
241	1.84E-01	1.86E-01	1.88E-01	1.90E-01	1.91E-01	1.96E-01	2.42E-01	2.45E-01	2.39E-01
242	3.90E-02	4.18E-02	4.21E-02	4.23E-02	4.23E-02	4.20E-02	4.67E-02	4.51E-02	4.48E-02
243	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02
244	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.6E-02	<2.7E-02	<2.6E-02

Table A-36. Replicate analyses of the product filtrates from the additional pH adjustment tests by rad. chem. methods, in dpm/mL

Analyte	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18982	LW18983	LW18984	LW18988	LW18989	LW18990	LW18985	LW18986	LW18987
^{238}Pu	3.16E+06	3.53E+06	3.06E+06	3.32E+06	3.54E+06	3.86E+06	3.32E+06	3.37E+06	3.58E+06
$^{239}Pu + ^{240}Pu$	1.11E+06	1.21E+06	1.09E+06	1.18E+06	1.22E+06	1.39E+06	1.20E+06	1.19E+06	1.26E+06
^{241}Pu	8.89E+06	1.02E+07	8.44E+06	9.73E+06	9.90E+06	1.22E+06	9.66E+06	1.08E+07	9.80E+06
^{241}Am	4.86E+04	4.71E+04	4.84E+04	5.03E+04	5.19E+04	4.68E+04	1.22E+05	6.41E+04	6.19E+04
^{243}Am	<2.1E+02	<2.2E+02	<2.1E+02	<3.2E+02	<3.0E+02	<2.1E+02	<6.3E+02	<2.7E+02	<2.2E+02
^{242m}Am	6.76E+01	<4.8E+01	9.32E+01	4.31E+01	5.35E+01	2.20E+01	2.84E+02	<5.2E+01	1.02E+02
^{243}Cm	<9.4E+02	<1.1E+03	<9.6E+02	<1.5E+03	<1.8E+03	<7.1E+02	<2.0E+03	<9.1E+02	<9.5E+02
^{245}Cm	<7.7E+02	<8.8E+02	<7.9E+02	<1.3E+03	<1.5E+03	<5.8E+02	<1.7E+03	<7.5E+02	<7.8E+02
^{247}Cm	<8.1E+02	<1.1E+03	<7.7E+02	<1.0E+03	<1.4E+03	<4.6E+02	<1.9E+03	<6.6E+02	<8.7E+02
^{249}Cf	<8.2E+02	<1.1E+03	<8.0E+02	<1.1E+03	<1.6E+03	<4.8E+02	<2.0E+03	<6.8E+02	<9.2E+02
^{251}Cf	<6.8E+02	<8.1E+02	<6.4E+02	<9.0E+02	<1.2E+03	<4.2E+02	<1.5E+03	<5.8E+02	<6.7E+02
^{242}Cm	5.59E+01	<3.9E+01	7.71E+01	3.56E+01	4.42E+01	1.82E+01	2.35E+02	<4.3E+01	8.43E+01
^{244}Cm	1.39E+04	9.30E+03	1.11E+04	1.41E+04	1.20E+04	1.30E+04	2.75E+04	1.23E+04	1.31E+04

Table A-37. Replicate analyses of the product filtrates from the additional pH adjustment tests by rad. chem. methods, in mg/L

Analyte	Supernate, adj. to pH 3 (mg/L)			Supernate, adj. to pH 2 (mg/L)			Supernate, adj. to pH 0.7 (mg/L)		
	LW18982	LW18983	LW18984	LW18988	LW18989	LW18990	LW18985	LW18986	LW18987
^{238}Pu	8.31E-02	9.29E-02	8.05E-02	8.74E-02	9.31E-02	1.02E-01	8.74E-02	8.87E-02	9.42E-02
^{241}Pu	3.89E-02	4.46E-02	3.69E-02	4.26E-02	4.33E-02	5.34E-03	4.22E-02	4.72E-02	4.29E-02
^{241}Am	6.38E-03	6.18E-03	6.35E-03	6.60E-03	6.81E-03	6.14E-03	1.60E-02	8.41E-03	8.12E-03
^{243}Am	<4.6E-04	<5.0E-04	<4.7E-04	<7.2E-04	<6.8E-04	<4.8E-04	<1.4E-03	<6.0E-04	<5.0E-04
^{242m}Am	3.13E-06	<2.2E-06	4.32E-06	2.00E-06	2.48E-06	1.02E-06	1.32E-05	<2.4E-06	4.73E-06
^{243}Cm	<8.2E-06	<9.4E-06	<8.4E-06	<1.3E-05	<1.6E-05	<6.2E-06	<1.8E-05	<8.0E-06	<8.3E-06
^{245}Cm	<2.0E-05	<2.3E-05	<2.1E-05	<3.3E-05	<3.9E-05	<1.5E-05	<4.4E-05	<2.0E-05	<2.0E-05
^{247}Cm	<3.9E+00	<5.1E+00	<3.7E+00	<4.8E+00	<6.9E+00	<2.2E+00	<9.4E+00	<3.2E+00	<4.2E+00
^{242}Cm	7.62E-09	<5.4E-09	1.05E-08	4.85E-09	6.02E-09	2.48E-09	3.20E-08	<5.9E-09	1.15E-08
^{244}Cm	7.74E-05	5.18E-05	6.18E-05	7.85E-05	6.68E-05	7.24E-05	1.53E-04	6.85E-05	7.29E-05

Table A-38. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed, ICP-ES

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	<1.0E-03	--	<2.1E-05	--
Al	1.46E+00	1.36E+00	9.55E-02	6.5%
B	<2.5E-03	--	2.14E-04	--
Ba	8.03E-03	8.01E-03	<1.5E-05	<0.2%
Be	<4.6E-05	--	<9.7E-07	--
Ca	8.92E-02	8.91E-02	3.55E-05	0.04%
Cd	<1.2E-03	--	<2.5E-05	--
Ce	1.76E-02	1.75E-02	<6.8E-05	<0.4%
Co	<1.5E-03	--	<3.1E-05	--
Cr	2.44E-02	2.28E-02	1.59E-03	6.5%
Cu	6.23E-03	6.22E-03	<7.7E-06	<0.1%
Fe	1.23E+00	1.23E+00	<3.4E-05	<0.003%
Gd	1.62E-02	1.62E-02	<2.1E-05	<0.1%
K	<2.4E-02	--	3.00E-03	--
La	4.37E-03	4.35E-03	<1.9E-05	<0.4%
Li	<1.9E-03	--	<3.3E-05	--
Mg	3.52E-02	3.51E-02	<1.5E-06	<0.004%
Mn	2.45E-01	2.45E-01	<8.5E-06	<0.003%
Mo	<4.9E-03	--	<2.1E-04	--
Na	1.93E+00	8.22E-02	1.85E+00	96%
Ni	4.30E-02	4.30E-02	<4.4E-05	<0.1%
P	<9.1E-03	--	<3.5E-04	--
Pb	<1.0E-02	--	<2.1E-04	--
Sb	<2.0E-02	--	<4.1E-04	--
Si	4.36E-02	4.35E-02	<9.7E-05	<0.2%
Sn	<9.2E-03	--	<1.9E-04	--
Sr	3.68E-03	3.68E-03	<2.5E-06	<0.1%
Th	2.24E-01	2.24E-01	<8.1E-05	<0.04%
Ti	1.92E-03	1.91E-03	<6.5E-06	<0.3%
U	3.82E-01	3.81E-01	<8.2E-04	<0.2%
V	<8.3E-04	--	<1.7E-05	--
Zn	3.12E-03	3.10E-03	<1.8E-05	<0.6%
Zr	1.68E-02	1.68E-02	<9.1E-06	<0.05%

Table A-39. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed, ICP-MS part 1 of 4

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
59	4.05E-04	4.04E-04	<8.8E-07	<0.2%
75	--	--	--	--
78	--	--	--	--
82	<8.6E-05	--	≤9.20E-07	--
84	<8.6E-05	--	<8.8E-07	--
85	<8.6E-05	--	8.61E-06	--
86	≤9.27E-05	--	<8.8E-07	--
87	<2.6E-04	--	1.66E-05	--
88	2.42E-03	2.41E-03	<8.8E-07	<0.04%
89	2.39E-03	2.39E-03	<8.8E-07	<0.04%
90	2.27E-03	2.27E-03	<8.8E-07	<0.04%
91	2.86E-03	2.86E-03	<8.8E-07	<0.03%
92	2.55E-03	2.55E-03	7.51E-06	0.3%
93	3.34E-03	3.34E-03	<8.8E-07	<0.03%
94	2.90E-03	2.90E-03	4.94E-06	0.2%
95	1.46E-04	1.02E-04	4.39E-05	30%
96	2.50E-03	2.49E-03	8.30E-06	0.3%
97	1.31E-04	9.13E-05	3.93E-05	30%
98	1.31E-04	8.55E-05	4.54E-05	35%
99	2.50E-04	2.06E-04	4.35E-05	17%
100	2.38E-04	1.98E-04	3.98E-05	17%
101	2.73E-03	2.72E-03	6.73E-06	0.2%
102	2.34E-03	2.34E-03	6.03E-06	0.3%
103	1.34E-03	1.34E-03	2.61E-06	0.2%
104	1.15E-03	1.15E-03	4.21E-06	0.4%
105	1.38E-04	1.34E-04	4.14E-06	3.0%
106	1.59E-04	1.55E-04	3.95E-06	2.5%
107	5.03E-04	5.00E-04	2.18E-06	0.4%
108	<8.6E-05	--	≤8.98E-07	--
109	4.36E-04	4.35E-04	≤9.11E-07	<0.2%
110	<8.6E-05	--	<8.8E-07	--
111	<8.6E-05	--	<8.8E-07	--
112	1.21E-04	1.20E-04	<8.8E-07	<0.7%
113	<6.9E-04	--	<8.8E-07	--
114	1.27E-04	1.26E-04	<8.8E-07	<0.7%
116	6.25E-03	6.25E-03	<8.8E-07	<0.01%
117	<8.6E-05	--	<8.8E-07	--
118	<8.6E-05	--	2.53E-06	--
119	5.96E-03	5.95E-03	5.94E-06	0.1%
120	<8.6E-05	--	2.48E-06	--

Table A-40. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed, ICP-MS part 2 of 4

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
121	<8.6E-05	--	<8.8E-07	--
122	<8.6E-05	--	<8.8E-07	--
123	<8.6E-05	--	<8.8E-07	--
124	3.07E-04	3.06E-04	9.33E-07	0.3%
125	<8.6E-05	--	<8.8E-07	--
126	1.58E-04	1.53E-04	5.64E-06	3.6%
128	3.99E-04	3.98E-04	<8.8E-07	<0.2%
130	1.37E-03	1.37E-03	<8.8E-07	<0.1%
^{133}Cs	1.25E-04	6.33E-05	6.17E-05	49%
134	1.53E-04	1.53E-04	<8.8E-07	<0.6%
135	<8.6E-05	--	6.39E-06	--
136	<8.6E-05	--	<8.8E-07	--
137	1.77E-03	1.75E-03	1.99E-05	1.1%
138	5.63E-03	5.63E-03	<8.8E-07	<0.02%
139	5.60E-03	5.60E-03	<8.8E-07	<0.02%
140	1.04E-02	1.04E-02	<8.8E-07	<0.01%
140	4.73E-03	4.73E-03	<8.8E-07	<0.02%
142	5.70E-03	5.70E-03	<8.8E-07	<0.02%
143	4.32E-03	4.32E-03	<8.8E-07	<0.02%
144	5.09E-03	5.09E-03	<8.8E-07	<0.02%
145	3.15E-03	3.15E-03	<8.8E-07	<0.03%
146	2.63E-03	2.63E-03	<8.8E-07	<0.03%
147	1.45E-03	1.45E-03	<8.8E-07	<0.1%
148	1.61E-03	1.61E-03	<8.8E-07	<0.1%
149	<8.6E-05	--	<8.8E-07	--
150	1.42E-03	1.42E-03	<8.8E-07	<0.1%
151	<8.6E-05	--	<8.8E-07	--
152	4.53E-04	4.52E-04	<8.8E-07	<0.2%
153	2.07E-04	2.06E-04	<8.8E-07	<0.4%
154	5.30E-04	5.29E-04	<8.8E-07	<0.2%
155	2.31E-03	2.31E-03	<8.8E-07	<0.04%
156	3.21E-03	3.21E-03	<8.8E-07	<0.03%
157	2.42E-03	2.42E-03	<8.8E-07	<0.04%
158	3.98E-03	3.98E-03	<8.8E-07	<0.02%
159	<8.6E-05	--	<8.8E-07	--
160	3.65E-03	3.65E-03	<8.8E-07	<0.02%
161	<8.6E-05	--	<8.8E-07	--
162	<8.6E-05	--	<8.8E-07	--

Table A-41. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed ICP-MS part 3 of 4

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
163	<8.6E-05	--	<8.8E-07	--
164	<8.6E-05	--	<8.8E-07	--
165	<8.6E-05	--	<8.8E-07	--
166	<8.6E-05	--	<8.8E-07	--
167	<8.6E-05	--	<8.8E-07	--
168	<8.6E-05	--	<8.8E-07	--
169	<8.6E-05	--	<8.8E-07	--
170	<8.6E-05	--	<8.8E-07	--
171	<8.6E-05	--	<8.8E-07	--
172	<8.6E-05	--	<8.8E-07	--
173	<8.6E-05	--	<8.8E-07	--
174	<8.6E-05	--	<8.8E-07	--
175	<8.6E-05	--	<8.8E-07	--
176	<8.6E-05	--	<8.8E-07	--
177	<8.6E-05	--	<8.8E-07	--
178	<8.6E-05	--	<8.8E-07	--
179	<8.6E-05	--	<8.8E-07	--
180	<8.6E-05	--	<8.8E-07	--
181	<8.6E-05	--	<8.8E-07	--
182	<8.6E-05	--	9.33E-07	>1.1%
183	<8.6E-05	--	<8.8E-07	--
184	<8.6E-05	--	1.14E-06	>1.3%
185	<8.6E-05	--	<8.8E-07	--
186	<8.6E-05	--	1.07E-06	>1.2%
187	<8.6E-05	--	<8.8E-07	--
191	<8.6E-05	--	<8.8E-07	--
193	<8.6E-05	--	<8.8E-07	--
194	<8.6E-05	--	<8.8E-07	--
195	<8.6E-05	--	<8.8E-07	--
196	3.20E-04	3.16E-04	3.51E-06	1.1%
198	1.89E-02	1.87E-02	2.01E-04	1.1%
203	<8.6E-05	--	<8.8E-07	--
204	1.15E-02	1.14E-02	1.22E-04	1.1%
205	<8.6E-05	--	<8.8E-07	--
206	3.76E-04	3.75E-04	<8.8E-07	<0.2%
207	3.33E-04	3.32E-04	<8.8E-07	<0.3%
208	7.93E-04	7.92E-04	<8.8E-07	<0.1%
229	--	--	--	--
230	<8.6E-05	--	<8.8E-07	--

Table A-42. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed, ICP-MS part 4 of 4

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{232}Th	2.11E-01	2.11E-01	<8.8E-07	<0.0004%
^{233}U	<8.6E-05	--	<8.8E-07	--
^{234}U	3.52E-04	3.48E-04	3.99E-06	1.1%
^{235}U	2.45E-02	2.42E-02	3.03E-04	1.2%
^{236}U	2.26E-03	2.23E-03	2.98E-05	1.3%
^{237}Np	2.39E-04	2.38E-04	<8.8E-07	<0.4%
^{238}U	3.39E-01	3.38E-01	3.01E-04	0.09%
^{239}Pu	2.36E-03	2.36E-03	<8.8E-07	<0.04%
^{240}Pu	2.01E-04	2.01E-04	<8.8E-07	<0.4%
mass 241	<8.6E-05	--	<8.8E-07	--
mass 242	<8.6E-05	--	<8.8E-07	--
mass 243	<8.6E-05	--	<8.8E-07	--
mass 244	<8.6E-05	--	<8.8E-07	--

Table A-43. Percent soluble calculated from the concentrations in each phase on a slurry basis for the feed, rad. chem. methods

Analyte	Feed			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{238}Pu	6.12E-05	6.12E-05	6.02E-10	0.001%
^{241}Pu	7.08E-06	7.08E-06	5.39E-10	0.008%
^{241}Am	5.14E-05	5.14E-05	<2.6E-09	<0.005%
^{243}Am	<3.6E-05	--	<1.7E-08	--
^{242m}Am	≤2.44E-08	--	<1.4E-09	--
^{243}Cm	<1.2E-07	--	<2.6E-10	--
^{245}Cm	<3.4E-07	--	<7.9E-10	--
^{247}Cm	<1.2E-02	--	<1.5E-04	--
^{242}Cm	≤5.92E-11	--	<3.4E-12	--
^{244}Cm	2.66E-07	2.66E-07	<9.3E-11	<0.03%

Table A-44. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, ICP-ES

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	<1.7E-03	--	<4.0E-04	--	<1.7E-03	--	<3.9E-04	--	<1.7E-03	--	<4.0E-04	--
Al	1.44E+00	1.42E+00	1.26E-02	0.9%	1.44E+00	1.34E+00	1.08E-01	7.5%	1.45E+00	1.30E+00	1.44E-01	9.9%
B	<2.5E-03	--	<5.7E-04	--	<2.5E-03	--	<5.6E-04	--	<2.5E-03	--	<5.7E-04	--
Ba	8.02E-03	7.80E-03	2.24E-04	2.8%	8.10E-03	7.84E-03	2.66E-04	3.3%	7.81E-03	7.57E-03	2.40E-04	3.1%
Be	<8.5E-05	--	<1.2E-05	--	<8.5E-05	--	<1.2E-05	--	<8.5E-05	--	<1.2E-05	--
Ca	8.23E-02	4.65E-02	3.58E-02	44%	8.40E-02	1.77E-02	6.63E-02	79%	8.24E-02	1.13E-02	7.11E-02	86%
Cd	<1.2E-03	--	<3.3E-04	--	<1.2E-03	--	<3.3E-04	--	<1.2E-03	--	<3.3E-04	--
Ce	<1.4E-02	--	<4.7E-03	--	<1.4E-02	--	<4.6E-03	--	<1.4E-02	--	<4.7E-03	--
Co	<1.8E-03	--	<4.1E-04	--	<1.8E-03	--	<4.1E-04	--	<1.8E-03	--	<4.1E-04	--
Cr	2.41E-02	1.95E-02	4.62E-03	19%	2.46E-02	1.21E-02	1.25E-02	51%	2.35E-02	9.37E-03	1.41E-02	60%
Cu	<5.8E-03	--	<9.2E-04	--	<5.8E-03	--	2.10E-03	>36%	<5.8E-03	--	2.98E-03	>51%
Fe	1.25E+00	1.25E+00	1.73E-03	0.1%	1.28E+00	1.25E+00	3.12E-02	2.4%	1.22E+00	1.15E+00	6.79E-02	5.6%
Gd	1.60E-02	1.34E-02	2.64E-03	16%	1.56E-02	2.90E-03	1.27E-02	81%	1.56E-02	8.81E-04	1.47E-02	94%
K	<2.8E-02	--	<6.4E-03	--	<2.8E-02	--	<6.3E-03	--	<2.8E-02	--	<6.4E-03	--
La	<4.5E-03	--	<1.0E-04	--	<4.5E-03	--	1.45E-03	>32%	<4.5E-03	--	2.41E-03	>54%
Li	<2.3E-03	--	<1.1E-03	--	<2.3E-03	--	<1.1E-03	--	<2.3E-03	--	<1.1E-03	--
Mg	3.50E-02	1.75E-02	1.75E-02	50%	3.47E-02	8.29E-03	2.64E-02	76%	3.40E-02	4.27E-03	2.97E-02	87%
Mn	2.39E-01	1.75E-01	6.37E-02	27%	2.37E-01	6.13E-02	1.75E-01	74%	2.32E-01	3.26E-02	1.99E-01	86%
Mo	<5.7E-03	--	<1.3E-03	--	<5.7E-03	--	<1.3E-03	--	<5.7E-03	--	<1.3E-03	--
Na	1.90E+00	6.53E-02	1.83E+00	97%	1.86E+00	5.72E-02	1.81E+00	97%	1.83E+00	3.46E-02	1.79E+00	98%
Ni	4.27E-02	4.08E-02	1.84E-03	4.3%	4.30E-02	2.62E-02	1.69E-02	39%	4.10E-02	1.74E-02	2.36E-02	58%
P	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--
Pb	<1.2E-02	--	<2.8E-03	--	<1.2E-02	--	<2.8E-03	--	<1.2E-02	--	<2.8E-03	--
Sb	<2.3E-02	--	<5.3E-03	--	<2.3E-02	--	<5.2E-03	--	<2.3E-02	--	<5.3E-03	--
Si	4.18E-02	--	<3.5E-03	<8%	4.11E-02	1.74E-02	2.37E-02	58%	4.23E-02	2.13E-02	2.10E-02	50%
Sn	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--
Sr	<4.3E-03	--	9.88E-04	>23%	<4.3E-03	--	1.49E-03	>34%	<4.3E-03	--	1.70E-03	>39%
Th	1.98E-01	--	<1.1E-02	<6%	2.30E-01	--	<1.1E-02	<5%	2.05E-01	--	<1.1E-02	<5%
Ti	1.75E-03	--	<2.9E-04	<17%	1.76E-03	--	<2.9E-04	<16%	1.70E-03	--	<2.9E-04	<17%
U	3.37E-01	2.19E-01	1.18E-01	35%	3.35E-01	-1.15E-02	3.47E-01	103%	3.25E-01	-2.29E-02	3.48E-01	107%
V	<9.6E-04	--	<2.2E-04	--	<9.6E-04	--	<2.2E-04	--	<9.6E-04	--	<2.2E-04	--
Zn	2.82E-03	--	<9.1E-04	<32%	2.79E-03	--	<9.0E-04	<32%	2.75E-03	--	<9.0E-04	<33%
Zr	1.57E-02	--	<3.1E-03	<20%	1.60E-02	--	<3.0E-03	<19%	1.53E-02	--	<3.1E-03	<20%

Table A-45. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, ICP-MS part 1 of 4

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
59	3.63E-04	3.55E-04	7.60E-06	2.1%	3.59E-04	1.96E-04	1.63E-04	45%	3.49E-04	1.22E-04	2.26E-04	65%
75	4.41E-04	4.24E-04	1.63E-05	3.7%	4.57E-04	3.07E-04	1.50E-04	33%	4.23E-04	2.11E-04	2.12E-04	50%
78	4.46E-03	3.90E-03	5.61E-04	13%	4.31E-03	1.34E-03	2.97E-03	69%	4.31E-03	8.08E-04	3.50E-03	81%
82	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
84	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
85	≤1.02E-05	3.33E-06	6.87E-06	67%	≤1.02E-05	3.46E-06	6.77E-06	66%	1.09E-05	3.36E-06	7.51E-06	69%
86	7.80E-05	5.56E-05	2.24E-05	29%	8.09E-05	4.77E-05	3.32E-05	41%	8.31E-05	4.57E-05	3.74E-05	45%
87	8.56E-05	5.23E-05	3.33E-05	39%	7.96E-05	3.76E-05	4.19E-05	53%	8.31E-05	3.86E-05	4.45E-05	54%
88	2.30E-03	1.60E-03	6.99E-04	30%	2.32E-03	1.27E-03	1.05E-03	45%	2.27E-03	1.08E-03	1.19E-03	52%
89	2.29E-03	2.07E-03	2.21E-04	10%	2.29E-03	1.20E-03	1.09E-03	47%	2.21E-03	8.95E-04	1.32E-03	60%
90	2.24E-03	2.09E-03	1.54E-04	6.9%	2.29E-03	1.79E-03	4.95E-04	22%	2.20E-03	1.52E-03	6.81E-04	31%
91	2.76E-03	2.72E-03	3.48E-05	1.3%	2.80E-03	2.53E-03	2.77E-04	10%	2.72E-03	2.31E-03	4.03E-04	15%
92	2.49E-03	2.46E-03	3.24E-05	1.3%	2.51E-03	2.25E-03	2.54E-04	10%	2.43E-03	2.06E-03	3.69E-04	15%
93	3.26E-03	3.22E-03	3.88E-05	1.2%	3.29E-03	2.97E-03	3.20E-04	10%	3.18E-03	2.70E-03	4.79E-04	15%
94	2.85E-03	2.82E-03	3.70E-05	1.3%	2.88E-03	2.59E-03	2.91E-04	10%	2.78E-03	2.36E-03	4.23E-04	15%
95	1.60E-04	1.57E-04	3.55E-06	2.2%	1.54E-04	1.37E-04	1.73E-05	11%	1.54E-04	1.26E-04	2.76E-05	18%
96	2.52E-03	2.49E-03	3.27E-05	1.3%	2.54E-03	2.29E-03	2.58E-04	10%	2.46E-03	2.08E-03	3.72E-04	15%
97	1.38E-04	1.35E-04	3.02E-06	2.2%	1.34E-04	1.19E-04	1.52E-05	11%	1.34E-04	1.09E-04	2.44E-05	18%
98	1.48E-04	1.45E-04	3.33E-06	2.2%	1.45E-04	1.28E-04	1.68E-05	12%	1.49E-04	1.22E-04	2.69E-05	18%
99	2.21E-04	1.57E-04	6.44E-05	29%	2.23E-04	1.42E-04	8.05E-05	36%	2.15E-04	1.31E-04	8.45E-05	39%
100	2.45E-04	2.12E-04	3.28E-05	13%	2.43E-04	1.75E-04	6.81E-05	28%	2.40E-04	1.51E-04	8.94E-05	37%
101	2.60E-03	1.99E-03	6.13E-04	24%	2.59E-03	1.51E-03	1.09E-03	42%	2.52E-03	1.16E-03	1.36E-03	54%
102	2.26E-03	1.72E-03	5.38E-04	24%	2.25E-03	1.29E-03	9.52E-04	42%	2.19E-03	1.00E-03	1.19E-03	54%
103	1.29E-03	7.78E-04	5.09E-04	40%	1.27E-03	4.76E-04	7.97E-04	63%	1.24E-03	3.29E-04	9.10E-04	73%
104	1.10E-03	8.44E-04	2.57E-04	23%	1.10E-03	6.42E-04	4.59E-04	42%	1.08E-03	5.10E-04	5.68E-04	53%
105	1.28E-04	--	<2.4E-06	<2%	1.33E-04	1.24E-04	9.18E-06	6.9%	1.27E-04	--	<2.3E-06	<2%
106	1.44E-04	--	<2.6E-06	<2%	1.53E-04	1.39E-04	1.36E-05	8.9%	1.46E-04	--	<2.3E-06	<2%
107	4.80E-04	--	<2.3E-06	<0.5%	4.82E-04	4.74E-04	8.14E-06	1.7%	4.72E-04	4.45E-04	2.68E-05	5.7%
108	2.32E-05	--	<2.3E-06	<10%	2.43E-05	--	<2.3E-06	<9%	2.27E-05	--	<2.3E-06	<10%
109	4.42E-04	--	<2.3E-06	<1%	4.47E-04	4.43E-04	4.50E-06	1.0%	4.31E-04	4.05E-04	2.66E-05	6.2%
110	4.95E-05	4.70E-05	≤2.5E-06	5.1%	5.00E-05	3.74E-05	1.26E-05	25%	4.85E-05	3.45E-05	1.40E-05	29%
111	5.99E-05	5.36E-05	6.28E-06	10%	6.12E-05	4.12E-05	2.00E-05	33%	6.04E-05	3.62E-05	2.42E-05	40%
112	1.09E-04	9.88E-05	1.05E-05	10%	1.07E-04	7.25E-05	3.49E-05	32%	1.05E-04	6.36E-05	4.19E-05	40%
113	5.02E-05	4.44E-05	5.79E-06	12%	4.97E-05	3.36E-05	1.61E-05	32%	4.91E-05	3.07E-05	1.84E-05	38%
114	1.24E-04	1.11E-04	1.31E-05	11%	1.25E-04	8.22E-05	4.25E-05	34%	1.19E-04	6.83E-05	5.06E-05	43%
116	5.24E-03	5.24E-03	6.49E-06	0.1%	6.03E-03	5.91E-03	1.29E-04	2.1%	5.37E-03	5.18E-03	1.89E-04	3.5%
117	1.71E-03	1.71E-03	2.43E-06	0.1%	1.18E-05	4.38E-06	7.40E-06	63%	≤1.16E-05	3.96E-06	7.68E-06	66%
118	5.43E-05	3.93E-05	1.50E-05	28%	5.49E-05	1.30E-05	4.19E-05	76%	5.20E-05	7.96E-06	4.41E-05	85%
119	5.08E-03	3.31E-03	1.78E-03	35%	5.02E-03	-1.41E-03	6.43E-03	128%	5.00E-03	-1.43E-03	6.44E-03	129%
120	1.68E-05	--	<2.3E-06	<14%	1.63E-05	1.21E-05	4.29E-06	26%	1.88E-05	1.34E-05	5.33E-06	28%

Table A-46. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, ICP-MS part 2 of 4

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
121	2.02E-05	--	<2.3E-06	<11%	1.92E-05	1.29E-05	6.35E-06	33%	1.94E-05	1.11E-05	8.29E-06	43%
122	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
123	1.87E-05	--	<2.3E-06	<12%	1.89E-05	1.25E-05	6.42E-06	34%	1.86E-05	1.09E-05	7.72E-06	41%
124	5.94E-05	--	<2.3E-06	<4%	6.63E-05	6.33E-05	3.05E-06	4.6%	6.33E-05	5.95E-05	3.80E-06	6.0%
125	2.17E-05	--	<2.3E-06	<11%	2.44E-05	--	<2.3E-06	<9%	2.28E-05	--	<2.3E-06	<10%
126	4.61E-05	4.19E-05	4.21E-06	9%	4.32E-05	2.84E-05	1.48E-05	34%	4.01E-05	2.19E-05	1.81E-05	45%
128	2.57E-04	--	<2.3E-06	<0.9%	2.56E-04	--	<2.3E-06	<0.9%	2.47E-04	2.44E-04	≤2.93E-06	1.2%
130	1.36E-03	--	<2.3E-06	<0.2%	1.37E-03	1.37E-03	3.11E-06	0.2%	1.31E-03	1.29E-03	1.23E-05	0.9%
133	1.31E-04	2.98E-05	1.01E-04	77%	1.27E-04	1.50E-05	1.12E-04	88%	1.32E-04	2.30E-05	1.09E-04	83%
134	1.60E-04	1.54E-04	5.85E-06	3.7%	1.58E-04	1.50E-04	7.34E-06	4.7%	1.56E-04	1.50E-04	6.62E-06	4.2%
135	4.76E-05	3.66E-05	1.10E-05	23%	4.62E-05	3.38E-05	1.24E-05	27%	4.76E-05	3.57E-05	1.18E-05	25%
136	7.16E-05	--	<2.3E-06	<3%	6.96E-05	6.69E-05	2.64E-06	3.8%	7.16E-05	6.81E-05	3.51E-06	4.9%
137	1.73E-03	1.63E-03	1.04E-04	6.0%	1.74E-03	1.62E-03	1.20E-04	6.9%	1.69E-03	1.58E-03	1.08E-04	6.4%
138	5.55E-03	5.39E-03	1.61E-04	2.9%	5.59E-03	5.39E-03	2.03E-04	3.6%	5.50E-03	5.31E-03	1.89E-04	3.4%
139	5.51E-03	5.38E-03	1.34E-04	2.4%	5.52E-03	3.88E-03	1.64E-03	30%	5.36E-03	2.65E-03	2.71E-03	51%
140	1.08E-02	1.07E-02	5.34E-05	0.5%	1.08E-02	1.00E-02	7.46E-04	6.9%	1.05E-02	8.92E-03	1.57E-03	15%
141	4.68E-03	4.55E-03	1.33E-04	2.9%	4.66E-03	3.25E-03	1.41E-03	30%	4.55E-03	2.29E-03	2.26E-03	50%
142	5.71E-03	5.67E-03	4.59E-05	0.8%	5.69E-03	5.12E-03	5.68E-04	10%	5.52E-03	4.47E-03	1.05E-03	19%
143	4.28E-03	4.11E-03	1.67E-04	3.9%	4.25E-03	2.78E-03	1.47E-03	35%	4.14E-03	1.89E-03	2.25E-03	54%
144	5.05E-03	4.86E-03	1.89E-04	3.7%	5.01E-03	3.33E-03	1.67E-03	33%	4.88E-03	2.37E-03	2.51E-03	51%
145	3.10E-03	2.97E-03	1.22E-04	3.9%	3.09E-03	2.02E-03	1.08E-03	35%	3.00E-03	1.46E-03	1.55E-03	51%
146	2.60E-03	2.50E-03	1.03E-04	3.9%	2.59E-03	1.69E-03	8.97E-04	35%	2.53E-03	1.23E-03	1.30E-03	51%
147	1.47E-03	1.40E-03	7.16E-05	4.9%	1.45E-03	9.03E-04	5.51E-04	38%	1.42E-03	6.71E-04	7.52E-04	53%
148	1.62E-03	1.56E-03	6.56E-05	4.0%	1.61E-03	1.05E-03	5.63E-04	35%	1.57E-03	7.61E-04	8.11E-04	52%
149	6.07E-05	5.78E-05	2.91E-06	4.8%	6.11E-05	3.86E-05	2.25E-05	37%	5.74E-05	2.62E-05	3.12E-05	54%
150	1.43E-03	1.36E-03	6.55E-05	4.6%	1.43E-03	8.99E-04	5.31E-04	37%	1.39E-03	6.49E-04	7.38E-04	53%
151	6.12E-05	5.81E-05	3.12E-06	5.1%	6.20E-05	3.87E-05	2.33E-05	38%	5.94E-05	2.77E-05	3.17E-05	53%
152	4.69E-04	4.43E-04	2.63E-05	5.6%	4.65E-04	2.71E-04	1.94E-04	42%	4.52E-04	1.96E-04	2.57E-04	57%
153	2.06E-04	1.94E-04	1.15E-05	5.6%	2.04E-04	1.20E-04	8.32E-05	41%	2.02E-04	9.23E-05	1.10E-04	54%
154	5.13E-04	4.49E-04	6.43E-05	13%	5.11E-04	1.61E-04	3.49E-04	68%	4.91E-04	8.13E-05	4.10E-04	83%
155	2.38E-03	2.04E-03	3.45E-04	14%	2.35E-03	4.76E-04	1.87E-03	80%	2.30E-03	1.31E-04	2.17E-03	94%
156	3.38E-03	2.89E-03	4.85E-04	14%	3.34E-03	7.18E-04	2.63E-03	79%	3.27E-03	2.22E-04	3.05E-03	93%
157	2.52E-03	2.15E-03	3.66E-04	15%	2.48E-03	5.09E-04	1.97E-03	80%	2.43E-03	1.31E-04	2.30E-03	95%
158	4.10E-03	3.50E-03	5.94E-04	14%	4.06E-03	8.64E-04	3.20E-03	79%	3.99E-03	2.86E-04	3.70E-03	93%
159	2.29E-05	--	<2.3E-06	<10%	2.33E-05	1.56E-05	7.65E-06	33%	2.33E-05	1.25E-05	1.08E-05	46%
160	3.68E-03	3.14E-03	5.35E-04	15%	3.64E-03	7.42E-04	2.89E-03	80%	3.57E-03	1.97E-04	3.37E-03	94%
161	1.58E-05	--	<2.3E-06	<15%	1.60E-05	1.03E-05	5.73E-06	36%	1.56E-05	7.65E-06	7.99E-06	51%
162	1.41E-05	--	<2.3E-06	<16%	1.45E-05	9.29E-06	5.25E-06	36%	1.44E-05	7.05E-06	7.31E-06	51%

Table A-47. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, ICP-MS part 3 of 4

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
163	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	2.71E-06	--
164	≤1.01E-05	--	<2.3E-06	<23%	≤1.00E-05	6.10E-06	3.91E-06	39%	<1.0E-05	--	5.33E-06	--
165	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
166	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
167	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
168	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
169	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
170	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
171	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	4.84E-06	--	<1.0E-05	--	5.54E-06	--
172	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	7.05E-06	--	<1.0E-05	--	8.36E-06	--
173	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	5.81E-06	--	<1.0E-05	--	6.88E-06	--
174	1.17E-05	--	<2.3E-06	<20%	1.19E-05	3.01E-06	8.85E-06	75%	1.18E-05	1.56E-06	1.02E-05	87%
175	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	≤2.27E-06	--	<1.0E-05	--	<2.3E-06	--
176	1.07E-05	--	<2.3E-06	<22%	1.09E-05	2.80E-06	8.05E-06	74%	1.03E-05	1.55E-06	8.80E-06	85%
177	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
178	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
179	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
180	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
181	2.08E-05	--	<2.3E-06	<11%	2.02E-05	1.65E-05	3.73E-06	18%	2.48E-05	1.50E-05	9.78E-06	39%
182	<1.0E-05	--	≤2.52E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
183	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
184	<1.0E-05	--	≤2.69E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
185	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
186	<1.0E-05	--	≤2.60E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
187	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
191	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
193	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
194	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
195	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
196	2.94E-04	--	<2.3E-06	<0.8%	2.95E-04	2.92E-04	3.91E-06	1.3%	2.87E-04	2.81E-04	5.74E-06	2.0%
198	1.96E-02	1.96E-02	1.03E-05	0.05%	1.99E-02	1.97E-02	2.35E-04	1.2%	1.93E-02	1.89E-02	3.45E-04	1.8%
203	<1.0E-05	--	<4.2E-06	--	<1.0E-05	--	<4.1E-06	--	<1.0E-05	--	<4.1E-06	--
204	1.10E-02	1.09E-02	5.57E-06	0.05%	1.11E-02	1.10E-02	1.22E-04	1.1%	1.07E-02	1.05E-02	1.77E-04	1.7%
205	<1.0E-05	--	<1.0E-05	--	<1.0E-05	--	<9.8E-06	--	<1.0E-05	--	<9.9E-06	--
206	3.43E-04	--	<2.3E-06	<0.7%	3.41E-04	--	<2.3E-06	<0.7%	3.40E-04	--	<2.3E-06	<0.7%
207	2.96E-04	--	<2.3E-06	<0.8%	2.97E-04	--	<2.3E-06	<0.8%	2.94E-04	--	<2.3E-06	<0.8%
208	7.24E-04	7.20E-04	≤3.31E-06	0.5%	7.28E-04	--	≤2.50E-06	<0.3%	7.16E-04	--	≤2.53E-06	<0.4%
229	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
230	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--

Table A-48. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, ICP-MS part 4 of 4

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{232}Th	1.95E-01	1.95E-01	9.77E-05	0%	2.25E-01	2.21E-01	4.53E-03	2%	2.03E-01	1.96E-01	6.78E-03	3%
^{233}U	5.13E-05	4.52E-05	6.06E-06	12%	5.40E-05	3.24E-05	2.15E-05	40%	5.05E-05	2.87E-05	2.18E-05	43%
^{234}U	3.74E-04	2.50E-04	1.25E-04	33%	3.63E-04	3.54E-05	3.28E-04	90%	3.57E-04	2.32E-05	3.34E-04	93%
^{235}U	2.35E-02	1.53E-02	8.20E-03	35%	2.29E-02	1.19E-03	2.17E-02	95%	2.23E-02	7.09E-04	2.16E-02	97%
^{236}U	2.11E-03	1.32E-03	7.91E-04	37%	2.06E-03	-1.70E-04	2.23E-03	108%	2.03E-03	-1.88E-04	2.22E-03	109%
^{237}Np	2.21E-04	1.41E-04	8.03E-05	36%	2.20E-04	5.39E-05	1.67E-04	76%	2.14E-04	4.07E-05	1.73E-04	81%
^{238}U	3.42E-01	2.29E-01	1.12E-01	33%	3.35E-01	1.63E-02	3.18E-01	95%	3.29E-01	6.79E-03	3.22E-01	98%
^{239}Pu	2.07E-03	2.04E-03	2.63E-05	1.3%	2.15E-03	1.61E-03	5.33E-04	25%	2.05E-03	1.20E-03	8.48E-04	41%
^{240}Pu	1.79E-04	--	<2.3E-06	<1.3%	1.84E-04	1.38E-04	4.56E-05	25%	1.78E-04	1.05E-04	7.29E-05	41%
mass 241	5.18E-05	--	<2.3E-06	<4.5%	5.17E-05	3.74E-05	1.44E-05	28%	5.03E-05	2.73E-05	2.31E-05	46%
mass 242	1.72E-05	--	<2.3E-06	<13%	1.65E-05	1.30E-05	3.55E-06	21%	1.64E-05	1.10E-05	5.46E-06	33%
mass 243	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--
mass 244	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--	<1.0E-05	--	<2.3E-06	--

Table A-49. Percent soluble calculated from the concentrations in each phase on a slurry basis from the SRAT acid addition heated tests, rad. chem. methods

Analyte	70% KMA				100% KMA				130% KMA			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{238}Pu	5.71E-05	5.68E-05	2.98E-07	0.5%	5.61E-05	4.87E-05	7.40E-06	13%	5.46E-05	4.22E-05	1.24E-05	23%
^{241}Pu	6.61E-06	6.47E-06	1.49E-07	2.2%	6.49E-06	3.26E-06	3.24E-06	50%	6.33E-06	1.07E-07	6.22E-06	98%
^{241}Am	4.80E-05	4.79E-05	<5.8E-08	<0.1%	4.71E-05	4.67E-05	4.73E-07	1.0%	4.59E-05	4.53E-05	6.22E-07	1.4%
^{243}Am	<3.3E-05	--	<4.2E-09	--	<3.3E-05	--	<2.9E-08	--	<3.2E-05	--	<4.4E-08	--
^{242m}Am	≤2.27E-08	--	<6.6E-10	<2.9%	≤2.23E-08	--	<4.2E-10	<1.9%	≤2.17E-08	--	<1.0E-10	<0.5%
^{243}Cm	<1.1E-07	--	<2.0E-09	--	<1.1E-07	--	<2.0E-09	--	<1.0E-07	--	<8.2E-10	--
^{245}Cm	<3.2E-07	--	<4.8E-09	--	<3.1E-07	--	<5.0E-09	--	<3.0E-07	--	<2.0E-09	--
^{247}Cm	<1.1E-02	--	<1.3E-03	--	<1.1E-02	--	<1.1E-03	--	<1.0E-02	--	<3.9E-04	--
^{242}Cm	≤5.52E-11	--	<1.6E-12	<2.9%	≤5.42E-11	--	<1.0E-12	<1.9%	≤5.28E-11	--	<2.5E-13	<0.5%
^{244}Cm	2.48E-07	2.47E-07	<8.4E-10	0.3%	2.43E-07	2.37E-07	6.34E-09	2.6%	2.37E-07	2.31E-07	6.55E-09	2.8%

Table A-50. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, ICP-ES

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
Ag	<1.7E-03	--	<3.9E-04	--	<1.7E-03	--	<3.9E-04	--	<1.7E-03	--	<3.9E-04	--
Al	1.43E+00	1.32E+00	1.06E-01	7.5%	1.45E+00	1.34E+00	1.08E-01	7.5%	1.39E+00	1.28E+00	1.13E-01	8.1%
B	<2.5E-03	--	<5.5E-04	--	<2.5E-03	--	<5.5E-04	--	<2.5E-03	--	<5.6E-04	--
Ba	7.15E-03	6.80E-03	3.48E-04	4.9%	6.92E-03	6.56E-03	3.66E-04	5.3%	6.63E-03	6.00E-03	6.35E-04	9.6%
Be	<8.4E-05	--	<1.2E-05	--	<8.5E-05	--	<1.2E-05	--	<8.5E-05	--	<1.2E-05	--
Ca	7.96E-02	1.26E-02	6.70E-02	84%	7.98E-02	1.16E-02	6.82E-02	85%	7.28E-02	9.41E-03	6.34E-02	87%
Cd	<1.2E-03	--	<3.2E-04	--	<1.2E-03	--	<3.2E-04	--	<1.2E-03	--	<3.3E-04	--
Ce	<1.2E-02	--	<3.6E-03	--	<1.2E-02	--	<3.6E-03	--	<1.2E-02	--	<3.7E-03	--
Co	<1.8E-03	--	<4.0E-04	--	<1.8E-03	--	<4.0E-04	--	<1.8E-03	--	<4.0E-04	--
Cr	2.24E-02	1.08E-02	1.16E-02	52%	2.19E-02	1.02E-02	1.17E-02	53%	2.03E-02	8.22E-03	1.20E-02	59%
Cu	<5.3E-03	--	<2.5E-03	--	<5.4E-03	--	<2.5E-03	--	<5.4E-03	--	<2.5E-03	--
Fe	1.14E+00	1.11E+00	3.44E-02	3.0%	1.12E+00	1.08E+00	4.18E-02	3.7%	1.06E+00	9.72E-01	8.79E-02	8.3%
Gd	1.50E-02	2.92E-03	1.20E-02	80%	1.51E-02	3.29E-03	1.18E-02	78%	1.37E-02	1.71E-03	1.20E-02	88%
K	<2.8E-02	--	<6.2E-03	--	<2.8E-02	--	<6.2E-03	--	<2.8E-02	--	<6.3E-03	--
La	<4.9E-03	--	1.84E-03	--	<4.9E-03	--	1.87E-03	--	<5.0E-03	--	2.22E-03	--
Li	<2.1E-03	--	<8.4E-04	--	<2.1E-03	--	<8.4E-04	--	<2.1E-03	--	<8.5E-04	--
Mg	3.21E-02	8.36E-03	2.38E-02	74%	3.22E-02	8.20E-03	2.40E-02	75%	2.97E-02	6.72E-03	2.29E-02	77%
Mn	2.18E-01	5.51E-02	1.63E-01	75%	2.16E-01	5.23E-02	1.64E-01	76%	1.99E-01	4.24E-02	1.57E-01	79%
Mo	<6.5E-03	--	<1.3E-03	--	<6.5E-03	--	<1.3E-03	--	<6.5E-03	--	<1.3E-03	--
Na	1.73E+00	7.58E-02	1.65E+00	96%	1.71E+00	6.88E-02	1.64E+00	96%	1.58E+00	4.69E-02	1.53E+00	97%
Ni	3.90E-02	2.38E-02	1.52E-02	39%	3.82E-02	2.24E-02	1.58E-02	41%	3.61E-02	1.99E-02	1.62E-02	45%
P	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--
Pb	<1.2E-02	--	<2.7E-03	--	<1.2E-02	--	<2.7E-03	--	<1.2E-02	--	<2.7E-03	--
Sb	<2.3E-02	--	<5.1E-03	--	<2.3E-02	--	<5.1E-03	--	<2.3E-02	--	<5.2E-03	--
Si	3.16E-02	6.72E-03	2.48E-02	79%	3.42E-02	8.25E-03	2.59E-02	76%	3.28E-02	4.97E-03	2.78E-02	85%
Sn	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--	<1.1E-02	--	<2.4E-03	--
Sr	<7.4E-03	--	1.65E-03	--	<7.4E-03	--	1.74E-03	--	<7.4E-03	--	1.64E-03	--
Th	1.91E-01	--	<1.1E-02	<6%	1.98E-01	--	<1.1E-02	<5%	1.80E-01	--	<1.1E-02	<6%
Ti	1.68E-03	--	<2.4E-04	<14%	1.68E-03	--	<2.4E-04	<14%	1.60E-03	--	<2.4E-04	<15%
U	3.06E-01	8.03E-04	3.05E-01	100%	3.02E-01	-1.10E-03	3.03E-01	100%	2.81E-01	-8.46E-03	2.89E-01	103%
V	<9.5E-04	--	<2.1E-04	--	<9.5E-04	--	<2.1E-04	--	<9.6E-04	--	<2.2E-04	--
Zn	2.61E-03	--	<5.3E-04	<20%	2.53E-03	--	<5.4E-04	<21%	2.35E-03	--	<5.3E-04	<23%
Zr	<1.6E-02	--	1.62E-03	--	<1.6E-02	--	1.61E-03	--	<1.6E-02	--	1.57E-03	--

Table A-51. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, ICP-MS part 1 of 4

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
59	3.22E-04	1.68E-04	1.54E-04	48%	3.08E-04	1.50E-04	1.58E-04	51%	3.01E-04	1.34E-04	1.67E-04	55%
75	3.94E-04	2.36E-04	1.58E-04	40%	4.00E-04	2.36E-04	1.64E-04	41%	3.69E-04	1.93E-04	1.75E-04	48%
78	9.34E-04	-2.00E-03	2.93E-03	314%	9.24E-04	-2.01E-03	2.94E-03	318%	8.56E-04	-2.13E-03	2.98E-03	349%
82	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
84	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
85	<9.9E-06	--	7.38E-06	--	<1.0E-05	--	6.97E-06	--	<1.0E-05	--	7.30E-06	--
86	7.51E-05	4.06E-05	3.45E-05	46%	7.50E-05	3.86E-05	3.64E-05	49%	6.69E-05	3.23E-05	3.45E-05	52%
87	7.13E-05	2.96E-05	4.17E-05	59%	7.56E-05	3.30E-05	4.26E-05	56%	7.01E-05	2.94E-05	4.07E-05	58%
88	2.10E-03	9.66E-04	1.14E-03	54%	2.08E-03	8.86E-04	1.20E-03	57%	1.94E-03	8.15E-04	1.12E-03	58%
89	2.10E-03	1.03E-03	1.07E-03	51%	2.06E-03	9.84E-04	1.08E-03	52%	1.92E-03	8.37E-04	1.08E-03	56%
90	2.15E-03	1.54E-03	6.13E-04	28%	2.11E-03	1.49E-03	6.18E-04	29%	1.99E-03	1.42E-03	5.76E-04	29%
91	2.57E-03	2.32E-03	2.50E-04	9.7%	2.48E-03	2.23E-03	2.47E-04	9.9%	2.36E-03	2.12E-03	2.43E-04	10%
92	2.36E-03	2.14E-03	2.23E-04	9.4%	2.29E-03	2.07E-03	2.18E-04	9.5%	2.16E-03	1.95E-03	2.17E-04	10%
93	3.02E-03	2.74E-03	2.82E-04	9.3%	2.92E-03	2.64E-03	2.81E-04	9.6%	2.77E-03	2.49E-03	2.86E-04	10%
94	2.62E-03	2.36E-03	2.57E-04	9.8%	2.52E-03	2.26E-03	2.52E-04	10.0%	2.40E-03	2.15E-03	2.51E-04	10%
95	1.54E-04	1.36E-04	1.79E-05	12%	1.48E-04	1.30E-04	1.80E-05	12%	1.41E-04	1.27E-04	1.42E-05	10%
96	2.36E-03	2.13E-03	2.28E-04	9.7%	2.29E-03	2.06E-03	2.24E-04	9.8%	2.17E-03	1.95E-03	2.21E-04	10%
97	1.28E-04	1.13E-04	1.53E-05	12%	1.24E-04	1.09E-04	1.54E-05	12%	1.20E-04	1.08E-04	1.19E-05	9.9%
98	1.40E-04	1.22E-04	1.74E-05	12%	1.33E-04	1.16E-04	1.75E-05	13%	1.28E-04	1.14E-04	1.36E-05	11%
99	2.14E-04	1.47E-04	6.69E-05	31%	2.09E-04	1.42E-04	6.68E-05	32%	1.96E-04	1.30E-04	6.61E-05	34%
100	2.29E-04	1.66E-04	6.29E-05	27%	2.25E-04	1.60E-04	6.44E-05	29%	2.11E-04	1.52E-04	5.90E-05	28%
101	2.42E-03	1.44E-03	9.76E-04	40%	2.35E-03	1.36E-03	9.91E-04	42%	2.18E-03	1.22E-03	9.64E-04	44%
102	2.08E-03	1.24E-03	8.46E-04	41%	2.04E-03	1.18E-03	8.59E-04	42%	1.95E-03	1.11E-03	8.36E-04	43%
103	1.19E-03	4.80E-04	7.11E-04	60%	1.16E-03	4.51E-04	7.11E-04	61%	1.08E-03	4.05E-04	6.78E-04	63%
104	1.02E-03	6.08E-04	4.12E-04	40%	9.88E-04	5.75E-04	4.13E-04	42%	9.36E-04	5.30E-04	4.05E-04	43%
105	1.08E-04	9.99E-05	7.93E-06	7.4%	1.00E-04	9.60E-05	4.10E-06	4.1%	9.67E-05	9.27E-05	4.00E-06	4.1%
106	1.24E-04	1.12E-04	1.21E-05	9.8%	1.18E-04	1.11E-04	7.08E-06	6.0%	1.10E-04	1.03E-04	6.51E-06	5.9%
107	4.64E-04	4.32E-04	3.16E-05	6.8%	4.56E-04	3.98E-04	5.79E-05	13%	4.30E-04	2.69E-04	1.61E-04	37%
108	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
109	3.99E-04	3.69E-04	2.99E-05	7.5%	3.87E-04	3.29E-04	5.82E-05	15%	3.67E-04	2.02E-04	1.66E-04	45%
110	3.44E-05	2.29E-05	1.14E-05	33%	3.12E-05	1.91E-05	1.21E-05	39%	2.82E-05	1.53E-05	1.29E-05	46%
111	5.68E-05	3.81E-05	1.87E-05	33%	5.71E-05	3.77E-05	1.94E-05	34%	5.41E-05	3.27E-05	2.14E-05	40%
112	1.01E-04	6.75E-05	3.37E-05	33%	1.01E-04	6.68E-05	3.45E-05	34%	9.21E-05	5.44E-05	3.77E-05	41%
113	4.33E-05	2.69E-05	1.64E-05	38%	3.89E-05	2.16E-05	1.73E-05	45%	3.47E-05	1.67E-05	1.80E-05	52%
114	1.13E-04	7.37E-05	3.97E-05	35%	1.15E-04	7.43E-05	4.11E-05	36%	1.02E-04	5.73E-05	4.45E-05	44%
116	5.39E-03	5.30E-03	9.93E-05	1.8%	5.50E-03	5.40E-03	1.03E-04	1.9%	5.06E-03	4.96E-03	1.03E-04	2.0%
117	1.05E-05	3.62E-06	6.85E-06	65%	1.08E-05	4.26E-06	6.51E-06	60%	1.02E-05	4.23E-06	5.92E-06	58%
118	5.05E-05	9.66E-06	4.08E-05	81%	5.14E-05	1.19E-05	3.95E-05	77%	4.61E-05	8.77E-06	3.73E-05	81%
119	4.94E-03	-1.06E-03	6.00E-03	122%	4.87E-03	-1.03E-03	5.90E-03	121%	4.51E-03	-1.12E-03	5.63E-03	125%
120	1.66E-05	1.22E-05	4.44E-06	27%	1.76E-05	1.37E-05	3.88E-06	22%	1.42E-05	--	<2.3E-06	<16%

Table A-52. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, ICP-MS part 2 of 4

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
121	1.77E-05	1.18E-05	5.98E-06	34%	1.89E-05	1.26E-05	6.34E-06	34%	1.73E-05	1.05E-05	6.81E-06	39%
122	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
123	1.82E-05	1.25E-05	5.74E-06	32%	1.81E-05	1.25E-05	5.60E-06	31%	1.76E-05	1.08E-05	6.73E-06	38%
124	5.90E-05	5.64E-05	2.59E-06	4.4%	5.82E-05	5.58E-05	2.40E-06	4.1%	5.19E-05	--	<2.3E-06	<4%
125	2.11E-05	--	<2.2E-06	<11%	1.87E-05	--	<2.2E-06	<12%	1.82E-05	1.57E-05	≤2.53E-06	14%
126	4.25E-05	2.76E-05	1.49E-05	35%	4.61E-05	3.18E-05	1.42E-05	31%	3.65E-05	2.60E-05	1.05E-05	29%
128	2.25E-04	2.20E-04	4.87E-06	2.2%	2.18E-04	2.11E-04	7.35E-06	3.4%	2.11E-04	1.87E-04	2.37E-05	11%
130	1.20E-03	1.17E-03	2.51E-05	2.1%	1.14E-03	1.10E-03	3.79E-05	3.3%	1.10E-03	9.66E-04	1.30E-04	12%
133	1.15E-04	6.68E-06	1.08E-04	94%	1.15E-04	2.07E-06	1.13E-04	98%	1.04E-04	1.80E-06	1.02E-04	98%
134	1.49E-04	1.40E-04	8.97E-06	6.0%	1.46E-04	1.37E-04	9.19E-06	6.3%	1.37E-04	1.21E-04	1.56E-05	11%
135	4.49E-05	3.25E-05	1.24E-05	28%	4.39E-05	3.19E-05	1.20E-05	27%	3.96E-05	2.63E-05	1.33E-05	34%
136	6.72E-05	6.42E-05	3.01E-06	4.5%	6.36E-05	6.01E-05	3.49E-06	5.5%	6.28E-05	5.74E-05	5.42E-06	8.6%
137	1.59E-03	1.44E-03	1.41E-04	8.9%	1.53E-03	1.38E-03	1.46E-04	10%	1.45E-03	1.23E-03	2.22E-04	15%
138	5.02E-03	4.78E-03	2.41E-04	5%	4.84E-03	4.59E-03	2.52E-04	5.2%	4.61E-03	4.19E-03	4.26E-04	9.2%
139	5.05E-03	3.14E-03	1.90E-03	38%	4.91E-03	2.93E-03	1.98E-03	40%	4.59E-03	2.09E-03	2.50E-03	55%
140	9.93E-03	9.16E-03	7.75E-04	7.8%	9.57E-03	8.75E-03	8.24E-04	8.6%	9.14E-03	8.12E-03	1.02E-03	11%
141	4.28E-03	2.71E-03	1.57E-03	37%	4.17E-03	2.56E-03	1.61E-03	39%	3.92E-03	1.93E-03	1.99E-03	51%
142	5.25E-03	4.65E-03	6.02E-04	11%	5.05E-03	4.42E-03	6.32E-04	13%	4.83E-03	4.06E-03	7.62E-04	16%
143	3.94E-03	2.36E-03	1.58E-03	40%	3.84E-03	2.23E-03	1.61E-03	42%	3.62E-03	1.77E-03	1.85E-03	51%
144	4.68E-03	2.84E-03	1.84E-03	39%	4.54E-03	2.66E-03	1.88E-03	41%	4.28E-03	2.12E-03	2.16E-03	51%
145	2.86E-03	1.71E-03	1.16E-03	40%	2.76E-03	1.59E-03	1.18E-03	43%	2.62E-03	1.29E-03	1.34E-03	51%
146	2.37E-03	1.40E-03	9.68E-04	41%	2.31E-03	1.33E-03	9.83E-04	43%	2.17E-03	1.06E-03	1.12E-03	51%
147	1.40E-03	8.32E-04	5.72E-04	41%	1.36E-03	7.92E-04	5.73E-04	42%	1.29E-03	6.61E-04	6.27E-04	49%
148	1.50E-03	8.97E-04	6.07E-04	40%	1.46E-03	8.48E-04	6.13E-04	42%	1.38E-03	6.83E-04	6.94E-04	50%
149	5.78E-05	3.37E-05	2.41E-05	42%	5.49E-05	3.13E-05	2.36E-05	43%	5.24E-05	2.61E-05	2.63E-05	50%
150	1.31E-03	7.51E-04	5.58E-04	43%	1.27E-03	7.11E-04	5.62E-04	44%	1.20E-03	5.72E-04	6.25E-04	52%
151	5.53E-05	3.13E-05	2.40E-05	43%	5.46E-05	3.08E-05	2.39E-05	44%	5.06E-05	2.47E-05	2.59E-05	51%
152	4.27E-04	2.29E-04	1.97E-04	46%	4.15E-04	2.19E-04	1.97E-04	47%	3.91E-04	1.77E-04	2.13E-04	55%
153	1.89E-04	1.06E-04	8.36E-05	44%	1.86E-04	1.02E-04	8.36E-05	45%	1.74E-04	8.31E-05	9.08E-05	52%
154	4.66E-04	1.33E-04	3.33E-04	72%	4.59E-04	1.31E-04	3.28E-04	72%	4.25E-04	8.54E-05	3.40E-04	80%
155	2.26E-03	4.81E-04	1.78E-03	79%	2.20E-03	4.43E-04	1.76E-03	80%	2.05E-03	2.59E-04	1.79E-03	87%
156	3.20E-03	7.03E-04	2.49E-03	78%	3.12E-03	6.65E-04	2.45E-03	79%	2.90E-03	3.85E-04	2.51E-03	87%
157	2.35E-03	4.59E-04	1.89E-03	80%	2.30E-03	4.50E-04	1.85E-03	80%	2.13E-03	2.38E-04	1.89E-03	89%
158	3.82E-03	7.87E-04	3.04E-03	79%	3.74E-03	7.65E-04	2.97E-03	80%	3.47E-03	4.36E-04	3.03E-03	87%
159	2.10E-05	1.30E-05	7.97E-06	38%	2.00E-05	1.21E-05	7.91E-06	40%	1.83E-05	9.25E-06	9.07E-06	50%
160	3.38E-03	6.37E-04	2.74E-03	81%	3.29E-03	6.06E-04	2.68E-03	82%	3.06E-03	2.85E-04	2.77E-03	91%
161	1.33E-05	7.45E-06	5.88E-06	44%	1.31E-05	6.84E-06	6.24E-06	48%	1.26E-05	5.75E-06	6.81E-06	54%
162	1.28E-05	7.12E-06	5.63E-06	44%	1.19E-05	6.39E-06	5.49E-06	46%	1.15E-05	5.10E-06	6.41E-06	56%

Table A-53. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, ICP-MS part 3 of 4

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
163	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	≤2.38E-06	--
164	<9.9E-06	--	3.93E-06	--	<1.0E-05	--	4.00E-06	--	<1.0E-05	--	4.37E-06	--
165	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
166	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
167	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
168	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
169	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
170	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
171	<9.9E-06	--	4.49E-06	--	<1.0E-05	--	4.47E-06	--	<1.0E-05	--	4.47E-06	--
172	<9.9E-06	--	6.68E-06	--	<1.0E-05	--	6.76E-06	--	<1.0E-05	--	6.61E-06	--
173	<9.9E-06	--	5.35E-06	--	<1.0E-05	--	5.58E-06	--	<1.0E-05	--	5.59E-06	--
174	≤1.03E-05	1.93E-06	8.38E-06	81%	≤1.03E-05	2.11E-06	8.16E-06	79%	≤1.01E-05	1.77E-06	8.31E-06	82%
175	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
176	<9.9E-06	--	7.30E-06	--	<1.0E-05	--	7.29E-06	--	<1.0E-05	--	7.43E-06	--
177	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
178	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
179	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
180	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
181	2.06E-05	1.59E-05	4.71E-06	23%	2.18E-05	1.79E-05	3.88E-06	18%	1.94E-05	1.48E-05	4.57E-06	24%
182	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
183	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
184	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
185	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
186	<9.9E-06	--	≤2.28E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
187	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
191	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
193	≤1.22E-05	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
194	<9.9E-06	--	≤2.55E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	≤2.31E-06	--
195	<9.9E-06	--	≤2.57E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	≤2.27E-06	--
196	2.72E-04	1.07E-04	1.65E-04	61%	2.64E-04	-5.25E-05	3.16E-04	120%	2.50E-04	-1.22E-04	3.72E-04	149%
198	1.77E-02	--	<2.2E-06	<0.01%	1.72E-02	--	<2.2E-06	<0.01%	1.64E-02	--	<2.3E-06	<0.01%
203	1.12E-05	--	<2.2E-06	<20%	9.95E-06	--	<2.2E-06	<22%	1.01E-05	--	<2.3E-06	<22%
204	9.59E-03	--	<2.2E-06	<0.02%	9.34E-03	--	<2.2E-06	<0.02%	8.90E-03	--	<2.3E-06	<0.03%
205	2.24E-05	--	<4.3E-06	<19%	1.11E-05	--	<4.3E-06	<39%	1.42E-05	--	<4.4E-06	<31%
206	3.20E-04	--	<2.2E-06	<0.7%	3.09E-04	3.03E-04	6.38E-06	2.1%	2.93E-04	2.51E-04	4.24E-05	14%
207	2.77E-04	--	<2.2E-06	<0.8%	2.71E-04	2.65E-04	5.67E-06	2.1%	2.56E-04	2.19E-04	3.78E-05	15%
208	6.70E-04	6.67E-04	3.08E-06	0.5%	6.49E-04	6.36E-04	1.38E-05	2.1%	6.16E-04	5.25E-04	9.07E-05	15%
229	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
230	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--

Table A-54. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, ICP-MS part 4 of 4

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{232}Th	1.75E-01	1.72E-01	3.32E-03	1.9%	1.78E-01	1.74E-01	3.49E-03	2.0%	1.65E-01	1.62E-01	3.50E-03	2.1%
^{233}U	4.87E-05	2.95E-05	1.92E-05	39%	4.77E-05	2.87E-05	1.91E-05	40%	4.43E-05	2.63E-05	1.81E-05	41%
^{234}U	3.17E-04	-2.19E-05	3.39E-04	107%	3.11E-04	-9.74E-06	3.21E-04	103%	2.90E-04	-4.92E-06	2.95E-04	102%
^{235}U	2.14E-02	1.96E-04	2.12E-02	99%	2.11E-02	6.03E-04	2.05E-02	97%	1.94E-02	-3.20E-05	1.94E-02	100%
^{236}U	1.92E-03	-1.13E-04	2.04E-03	106%	1.88E-03	-1.23E-04	2.00E-03	107%	1.75E-03	-1.54E-04	1.90E-03	109%
^{237}Np	2.05E-04	5.21E-05	1.53E-04	75%	1.99E-04	4.80E-05	1.50E-04	76%	1.86E-04	3.93E-05	1.46E-04	79%
^{238}U	2.85E-01	-1.01E-02	2.95E-01	104%	2.81E-01	-2.72E-03	2.84E-01	101%	2.60E-01	-9.91E-03	2.70E-01	104%
^{239}Pu	1.95E-03	1.43E-03	5.25E-04	27%	1.91E-03	1.38E-03	5.36E-04	28%	1.78E-03	1.21E-03	5.70E-04	32%
^{240}Pu	1.68E-04	1.22E-04	4.56E-05	27%	1.64E-04	1.18E-04	4.63E-05	28%	1.55E-04	1.06E-04	4.91E-05	32%
mass 241	4.79E-05	3.18E-05	1.61E-05	34%	4.68E-05	3.02E-05	1.66E-05	35%	4.37E-05	2.30E-05	2.07E-05	47%
mass 242	1.58E-05	1.23E-05	3.54E-06	22%	1.52E-05	1.15E-05	3.64E-06	24%	1.46E-05	1.07E-05	3.90E-06	27%
mass 243	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--
mass 244	<9.9E-06	--	<2.2E-06	--	<1.0E-05	--	<2.2E-06	--	<1.0E-05	--	<2.3E-06	--

Table A-55. Percent soluble calculated from the concentrations in each phase on a slurry basis from the additional pH adjustments, rad. chem. methods

Analyte	Adjusted to pH 3				Adjusted to pH 2				Adjusted to pH 0.7			
	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)	Total (wt% slurry)	Solid (wt% slurry)	Liquid (wt% slurry)	Soluble (%)
^{238}Pu	5.02E-05	4.28E-05	7.39E-06	15%	4.85E-05	4.04E-05	8.10E-06	17%	4.56E-05	3.78E-05	7.71E-06	17%
^{241}Pu	5.81E-06	2.34E-06	3.47E-06	60%	5.62E-06	3.00E-06	2.62E-06	47%	5.28E-06	1.50E-06	3.78E-06	72%
^{241}Am	4.22E-05	4.16E-05	5.45E-07	1%	4.08E-05	4.02E-05	5.62E-07	1%	3.83E-05	3.74E-05	9.29E-07	2%
^{243}Am	<2.9E-05	--	<4.1E-08	--	<2.8E-05	--	<5.4E-08	--	<2.7E-05	--	<7.2E-08	--
^{242m}Am	≤2.00E-08	1.97E-08	≤2.78E-10	1%	≤1.93E-08	1.91E-08	1.58E-10	1%	≤1.81E-08	1.76E-08	≤5.80E-10	3%
^{243}Cm	<9.6E-08	--	<7.5E-10	--	<9.2E-08	--	<1.0E-09	--	<8.7E-08	--	<9.7E-10	--
^{245}Cm	<2.8E-07	--	<1.9E-09	--	<2.7E-07	--	<2.5E-09	--	<2.5E-07	--	<2.4E-09	--
^{247}Cm	<9.4E-03	--	<3.7E-04	--	<9.1E-03	--	<4.0E-04	--	<8.6E-03	--	<4.8E-04	--
^{242}Cm	≤4.85E-11	4.79E-11	≤6.77E-13	1%	≤4.69E-11	4.65E-11	3.84E-13	1%	≤4.41E-11	4.27E-11	≤1.41E-12	3%
^{244}Cm	2.18E-07	2.12E-07	5.50E-09	3%	2.11E-07	2.04E-07	6.26E-09	3%	1.98E-07	1.89E-07	8.41E-09	4%

Appendix B. Inputs for Targeting 2500 g/m^3 Fissile in Glass

Edwards and Peeler developed a spreadsheet for estimating fissile loading in glass (grams of fissile per cubic meter of glass) for a given SME product composition.[38] The method relates the relative fissile to iron concentrations in the slurry to the fissile to iron composition of the glass. It was developed to determine the bounding high fissile loading in glass that would be produced from a SME product given the applicable uncertainties to assure the glass would be less than the 897 g/m^3 fissile limit with 95% confidence. In our case, we wanted to target greater than 2500 g/m^3 fissile in the glass. Thus, we switched the direction that the confidence limits were applied, using lower confidence limits in the calculation rather than the upper confidence limits of the original calculation. For our use, we used the unwashed sludge feed composition in place of SME composition, as the ratio of iron to fissile components are expected to be similar. The calculation spreadsheet is shown in Table B-1.

The following inputs were necessary to calculate the amount of additional fissile is required increase the fissile loading in glass to 2500 g/m^3:

- Concentrations of Fe, ^{235}U, ^{239}Pu, ^{233}U, and ^{241}Pu from the analysis of the Tank 51 slurry[32]
- The minimum iron concentration in glass, calculated in this appendix and listed in Table B-7
- The minimum glass density, calculated in this appendix and listed in Table B-9

Table B-1. Calculation of the amount of material required from ABD material to increase fissile loading in glass to 2500 g/m^3

Bounding the Fissile Loading of Sludge											
r_1	=	Ratio of Fissile/Fe	=	$(U\text{-}233+U\text{-}235+Pu\text{-}239+Pu\text{-}241)/((w_{AR}*Fe_{AR}+w_{PF}*Fe_{PF})/(w_{AR}+w_{PF}))$							
					From Tk51 sample:	U-235	Pu-239	Fe (wt% AR)	Fe (wt% PF)	U-233	Pu-241
					Sample Avg	1.44E-03	1.75E-03	9.22E-01	9.18E-01	5.22E-05	1.87E-04
					Partial	1.08724	1.08724	-0.01224	-0.01619	1.087244	1.087244
					Sample StdDev	1.15E-05	2.38048E-05	1.11E-02	9.64E-03	4.35E-07	9.97E-06
					n	4	4	4	4	4	4
					weight			32542.373	43049.327		
		r_1	=	0.026144053	U-235 from ABD:	0.020621654	<--- Goal seek G16 until E51 is 2500				
Assuming uncorrelated errors		Var (r_1)	=	1.0925E-08	U-235 total:	0.022062204	wt% of slurry				
		Std Dev (r_1)	=	0.000105							
		Deg of Freedom	=	6.146							
					t value (for 97.5%)						
		Lower Bnd on r_1	=	0.025888294	2.446911851						
		@ 97.5% confidence									
Bounding the Fissile Loading in Glass											
		g fissile/m^3 of glass	=	r_1 x Fe (glass) x density(glass)							
					(100^3/100)	g fissile/g Fe	g Fe/100 g glass	g / cm^3			
					conversion constants	r_1	Fe wt%	density (glass)			
		r = g fissile/m^3 of glass	=		10000	0.025888294	4.148	2.583	<--- Bounding high density input		
						bound		bound			
						Partial	668.6946396				
						Std Dev	0.2572				
						# obs	4				
		r	=	2773.67	<--- This is the target fissile to be >2500 g/m3 with 95% confidence						
		Var (r)	=	7394.99							
		Std Dev (r)	=	85.99							
		Deg of Freedom	=	3.000							
					t value (for 97.5%)						
		LCL (for overall 95% Conf)	=	2500.00	3.182446305						

H-Canyon Tank 10.2 Analysis

The other input needed for blending of the feed slurry material is the composition of the Tank 10.2 material. The Tank 10.2 sample had a density of 1.297 g/mL. Table B-2 contains a summary of the analytical results for the Tank 10.2 material used in this study. Table B-3 and Table B-4 contain the analytical results from the ICP-ES and ICP-MS analyses of Tank 10.2 material, respectively. The Tank 10.2 sample had ^{235}U/U or 63.6%.

Table B-2. Select Results of Tank 10.2 Sample Analysis.

	mg/L	wt%
Al	39900	3.08
Gd	192	0.0148
Mn	46.0	0.00355
U	3097	0.239
U-233	<0.1	<0.00001
U-235	1969	0.152
U-238	1043	0.0805
Pu-239	10.3	0.00079
Pu-241	1.27	0.00010
NO3	432000	33.3

Table B-3. ICP-ES Analysis of Tank 10.2

analyte	average (mg/L)	RSD	analyte	average (mg/L)	RSD
Ag	<5.29E+01	--	Mn	4.60E+01	9.9%
Al	3.99E+04	3.3%	Mo	<1.67E+02	--
B	<4.28E+01	--	Na	<1.54E+02	--
Ba	5.36E+01	1.1%	Ni	<2.69E+02	--
Be	<2.60E+00	--	P	<3.24E+02	--
Ca	5.74E+02	1.9%	Pb	<3.70E+02	--
Cd	<4.40E+01	--	Sb	<7.06E+02	--
Ce	<1.18E+02	--	Si	<1.68E+02	--
Co	<5.41E+01	--	Sn	<3.24E+02	--
Cr	2.81E+02	2.8%	Sr	2.11E+01	2.0%
Cu	5.54E+01	2.1%	Th	<9.53E+01	--
Fe	1.09E+03	2.6%	Ti	<1.12E+01	--
Gd	1.98E+02	2.4%	U	3.10E+03	1.8%
K	<8.50E+02	--	V	<2.93E+01	--
La	3.39E+01	3.9%	Zn	3.44E+01	3.3%
Li	<3.02E+01	--	Zr	7.74E+01	2.5%
Mg	3.06E+02	2.1%			

Table B-4. ICP-MS Analysis of Tank 10.2

m/z	average (mg/L)	RSD	m/z	average (mg/L)	RSD	m/z	average (mg/L)	RSD
59	1.22E+00	0.7%	126	1.10E+01	1.4%	173	4.15E-01	0.2%
82	3.70E-01	3.9%	128	2.28E+00	1.6%	174	4.20E-01	2.2%
84	<3.06E-02	--	130	7.77E+00	0.8%	175	5.11E-01	0.3%
85	3.85E+00	0.7%	133	3.07E+01	1.9%	176	1.88E-01	1.3%
86	≤3.42E-02	--	134	1.44E+00	0.6%	177	3.58E-01	1.5%
87	7.85E+00	0.6%	135	3.01E+00	0.9%	178	<3.06E-02	--
88	1.13E+01	0.8%	136	1.06E-01	13.7%	179	<3.06E-02	--
89	1.50E+01	1.1%	137	2.85E+01	0.6%	180	<3.06E-02	--
90	1.10E+01	0.5%	138	3.50E+01	1.2%	181	<3.06E-02	--
91	1.37E+01	0.8%	139	3.49E+01	1.5%	182	<3.06E-02	--
92	1.25E+01	0.6%	140	3.43E+01	1.0%	183	<3.06E-02	--
93	1.50E+01	1.7%	141	3.18E+01	1.5%	184	<3.06E-02	--
94	1.40E+01	2.9%	142	3.30E+01	1.8%	185	<3.06E-02	--
95	9.20E+00	2.0%	143	2.76E+01	2.2%	186	<3.06E-02	--
96	1.26E+01	1.1%	144	3.38E+01	1.9%	187	<3.06E-02	--
97	8.06E+00	0.1%	145	2.00E+01	0.9%	191	<3.06E-02	--
98	8.13E+00	1.3%	146	1.70E+01	1.8%	193	<3.06E-02	--
99	1.67E+01	0.4%	147	9.73E+00	1.0%	194	<3.06E-02	--
100	9.41E+00	4.2%	148	1.08E+01	1.1%	195	<3.06E-02	--
101	1.85E+01	0.5%	149	4.59E-01	1.4%	196	7.12E-01	1.2%
102	1.61E+01	1.1%	150	8.85E+00	0.7%	198	3.62E+01	5.2%
103	1.00E+01	0.3%	151	4.30E-01	1.7%	203	<3.06E-02	--
104	8.32E+00	2.0%	152	3.10E+00	1.0%	204	2.28E+01	4.7%
105	1.63E+00	1.1%	153	1.44E+00	0.9%	205	<3.06E-02	--
106	1.78E+00	1.7%	154	5.42E+00	0.5%	206	3.75E-01	0.7%
107	6.20E-01	3.2%	155	2.78E+01	3.0%	207	3.31E-01	1.7%
108	2.16E-01	4.3%	156	3.83E+01	3.7%	208	7.89E-01	1.0%
109	2.97E-01	3.1%	157	2.86E+01	2.9%	229	<3.06E-02	--
110	1.83E-01	4.2%	158	4.75E+01	2.5%	230	<3.06E-02	--
111	1.30E-01	2.5%	159	4.61E-01	1.9%	232	≤3.33E-02	--
112	1.36E-01	2.8%	160	4.32E+01	2.1%	233	<1.22E-01	--
113	3.57E-02	6.1%	161	3.64E-01	2.9%	234	2.76E+01	2.5%
114	1.10E-01	1.2%	162	2.42E-01	3.5%	235	1.97E+03	0.7%
116	9.24E-02	3.2%	163	1.40E-01	3.1%	236	1.93E+02	1.4%
117	6.25E-01	3.2%	164	1.02E-01	2.4%	237	5.39E+00	0.5%
118	1.09E+01	4.9%	165	8.54E-02	2.8%	238	1.04E+03	1.0%
119	1.78E+01	1.8%	166	≤3.07E-02	--	239	1.03E+01	0.1%
120	1.63E-01	1.0%	167	5.74E-02	3.0%	240	2.36E+00	0.1%
121	4.55E-02	9.2%	168	<3.06E-02	--	241	1.27E+00	0.9%
122	8.16E-02	4.4%	169	<3.06E-02	--	242	4.23E-01	0.9%
123	≤3.21E-02	--	170	<3.06E-02	--	243	4.92E-02	1.4%
124	1.45E-01	5.1%	171	1.45E-01	0.9%	244	<3.06E-02	--
125	1.56E-01	5.0%	172	3.70E-01	1.4%			

Determination of Minimum Fe in Glass and Glass Density

SRR provided SB10 a Tank 51 projection (without MST and without SRE) on a calcine basis for the 0.85M wash endpoint. The elemental concentrations were converted to oxides and normalized to 100 wt.% as shown in Table B-5.

Table B-5. Tank 51 Composition

Oxide	Concentration (wt.%)	Oxide	Concentration (wt.%)
Al_2O_3	32.506	MnO	3.157
B_2O_3	0.375	Na_2O	32.225
BaO	0.083	NiO	0.515
CaO	1.136	PbO	0.063
Ce_2O_3	0.190	SO_4^{2-}	2.482
Cr_2O_3	0.617	SiO_2	1.233
CuO	0.057	ThO_2	2.583
Fe_2O_3	17.809	TiO_2	0.032
K_2O	0.096	U_3O_8	3.912
La_2O_3	0.049	ZnO	0.023
Li_2O	0.038	ZrO_2	0.323
MgO	0.497		

Compositional variation (±) was applied to the individually tracked oxides and was represented by the larger of 0.5 wt.% or 7.5% of the nominal concentration. Those oxides not tracked individually were grouped into an "Others" component.[a] The resulting Tank 51 oxide intervals are shown in Table B-6 and represent the minimum and maximum oxide concentrations for sludge-only operation.

Table B-6. Tank 51 Oxide Intervals

Oxide	Concentration (wt.%)		
Al_2O_3	30.068	-	34.944
CaO	0.636	-	1.636
Fe_2O_3	16.473	-	19.145
MnO	2.657	-	3.657
Na_2O	29.808	-	34.642
NiO	0.015	-	1.015
SiO_2	0.733	-	1.733
ThO_2	2.083	-	3.083
TiO_2	0.000	-	0.532
U_3O_8	3.412	-	4.412
Others	4.391	-	5.391

Determination of Minimum Fe in Glass

The minimum concentration of Fe in glass was determined with the minimum Fe_2O_3 value in Table B-6 (16.473 wt.%) at 32% and 36% waste loading. The resulting values are shown in Table B-7.

[a] The "Others" components include B_2O_3, BaO, Ce_2O_3, Cr_2O_3, CuO, K_2O, La_2O_3, Li_2O, MgO, PbO, SO_4^{2-},.ZnO, and ZrO_2.

Table B-7. Fe_2O_3 and Fe Concentrations in Glass

Waste Loading	Fe_2O_3 (wt.%)	Fe (wt.%)
32%	5.271	3.687
36%	5.930	4.148

Determination of Minimum Glass Density

A total of 2,116 extreme vertices (EVs) were generated using the oxide intervals in Table B-6 and combined with twenty frits (Table B-8) at WLs in the interval of 32-40%. These twenty frits were used to incorporate compositional variation in the density prediction. The resulting glass compositions (380,880 total) were evaluated with a composition-based density model.[39] Table B-9 shows the minimum glass densities at 32% and 36% waste loading.

Table B-8. Frit Compositions[b]

B_2O_3 (wt.%)	Li_2O (wt.%)	Na_2O (wt.%)	SiO_2 (wt.%)
10	10	4	76
10	10	5	75
10	10	6	74
10	10	7	73
10	11	4	75
10	11	5	74
10	7	7	76
10	7	8	75
10	8	5	77
10	8	6	76
10	8	7	75
10	8	8	74
10	9	4	77
10	9	5	76
10	9	6	75
10	9	7	74
11	10	4	75
11	10	5	74
11	10	6	73
8	8	5	79

Table B-9. Glass Density

Waste Loading	Glass Density (g/cm^3)
32%	2.558
36%	2.583

[b] Note that the last frit shown in Table B-8 represents Frit 473, which has been recommended for SB10 processing. Since Frit 473 was selected based on the Tank 40 projections and not Tank 51, additional frit compositions were included in this evaluation.

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