RESEARCH AND DEVELOPMENT ACTIVITIES IN SUPPORT OF HANFORD PRIVATIZATION – SRTC PROGRAM (U)

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ABSTRACT

A team led by BNFL, Inc. was awarded the contract to remediate and immobilize the Hanford radioactive tank waste in support of the Hanford Tank Waste Remediation System program (TWRS). BNFL, Inc. is teamed with BNFL Engineering, LTD., Bechtel National, GTS Duratek, and Science Application International Corporation to develop and design integrated facilities for pretreatment and vitrification in support of the TWRS mission. This facility will pretreat and immobilize approximately 0.375 MT/day of high level waste (HLW, producing 1.5 MT/day of HLW glass) and approximately 4.5 MT/day of low activity waste (LAW, producing 30 MT/day of LAW glass) during Part B2 of the TWRS project. During the initial phase of Part B (FY98 – FY00, B1), the technology is expected to be optimized to the point that it can be used as the basis for final design, construction, and operation of a vitrification facility in Hanford, Washington.

As part of the overall Hanford Tank Waste Remediation System (TWRS) Project, BNFL, Inc. has contracted DOE-Westinghouse Savannah River Company's Savannah River Technology Center (SRTC) to provide research and development services in characterization, pretreatment, and immobilization of actual Hanford tank wastes. Additionally, SRTC is developing design basis data using simulants of Hanford tank wastes in areas of ion exchange, filtration, precipitation, glass former blending, evaporation, and slurry mixing. This paper will provide an overview of the SRTC TWRS development program.

INTRODUCTION

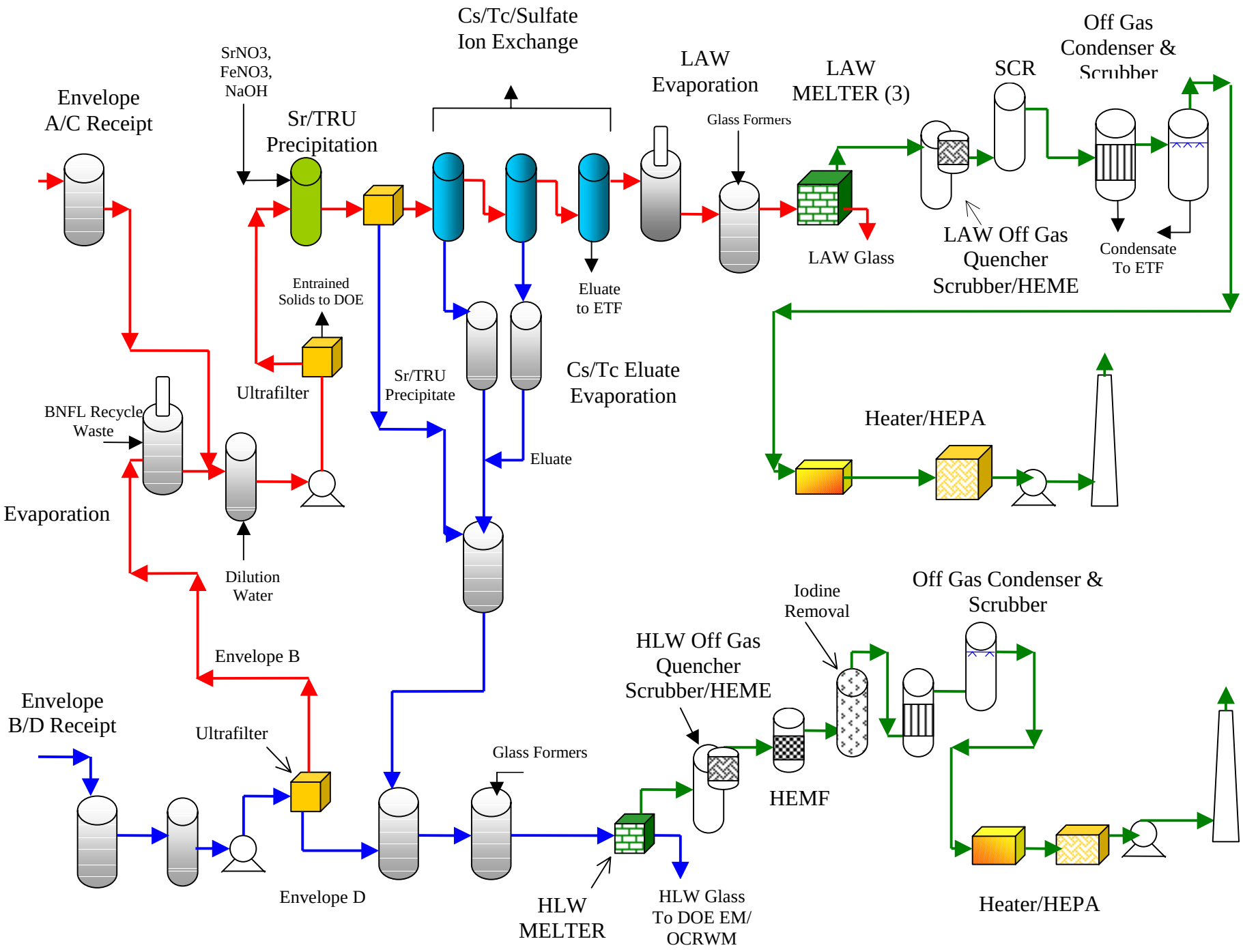
In August 1998 the US Department of Energy and BNFL, Inc. signed a historic contract that will provide a safe path forward for the pretreatment and immobilization of Hanford's radioactive tank waste [1]. This contract will work in two parts: Part B1 and B2. During the initial two-year period (Part B1), BNFL will complete approximately 30 percent of the facility design, prepare to start construction, and obtain financing to proceed with Part B2. DOE will reimburse BNFL the full cost ($300 million) of the Part B1 contract including a maximum fee of $50 million depending on BNFL's performance. The expected cost of the Part B2 contract is currently estimated at $6.9 billion dollars. During Part B2, the facilities constructed for the BNFL TWRS project are expected to produce 600 HLW canisters and 6000 units of immobilized LAW[a].

Construction is expected to start late in FY01. HLW Hot Start is expected in FY07 with LAW Hot Start expected in FY08 [2].

The following discussion is a plausible feed sequence based upon the current contract. As the project progresses, BNFL and DOE/RL will jointly establish the sequence of waste tank feed to the BNFL facility.

During the initial two years of actual waste treatment operations, BNFL expects to receive a combined Envelope B/D[b] feed for processing. Envelope B/D waste resulted from neutralizing acidic Purex waste with NaOH and allowing the waste to settle and cool in storage tanks. The neutralized waste was allowed to precipitate and separate into a supernate (Envelope B) and a sludge (Envelope D) fraction. The DOE/RL and the primary Hanford site management contractor (PHMC) are expected to transfer the combined Envelope B/D feed from tanks 241-AZ101 and 241-AZ102 to BNFL receipt tanks in the BNFL waste treatment facilities. BNFL plans to process the received waste through a set of cross flow filters that will separate the liquid fraction from the solid sludge fraction. Figure 1 contains a flow sheet of the proposed BNFL process.

The liquid fraction from ultra-filtration of Envelope B/D will be forwarded to an evaporator feed tank. BNFL plans to collect the plant recycle waste streams for blending with the Envelope B liquid. The resulting feed will be concentrated through a forced circulation evaporator to approximately 5 – 7 M Na solution. The concentrated liquid will be cooled to 25 – 30°C and processed through a cross flow filter unit to remove solids. The resulting filtrate will be fed through cesium, technetium, and sulfate ion exchange columns (elutable organic based resins). The decontaminated low activity waste will be concentrated through a forced circulation evaporator. Glass formers will be added to the concentrated LAW and fed to three 10 metric ton per day joule-heated, refractory-lined melters that have been designed to operate at 1150°C (nominal).



BNFL TWRS PROCESS – FIGURE 1

BNFL plans to evaporate, store, sample, and analyze the cesium and technetium eluates generated from pretreating envelope B through the ion exchange systems. The nitric acid based eluates will be blended with the concentrated Envelope D solids (sludge). Glass formers will be added, and the resulting melter feed will be vitrified as HLW. BNFL plans to use a joule-heated refractory-lined melter that will be operated at 1150°C (nominal). All the waste stored in tanks 241-AZ101 and 241-AZ102 will not be vitrified in the first two years of HLW operations. Therefore, BNFL will pretreat and store the remaining HLW sludge not vitrified during the first two years of plant operations, until vitrification in the later years is accomplished. Pretreated Envelope B LAW will be concentrated and returned to DOE.

During the initial two years of plant operations, BNFL plans to conduct combined pretreatment and vitrification of only HLW feeds. During the next 10 years of operations, BNFL will conduct combined pretreatment and vitrification of both HLW and LAW feeds.

The TWRS Privatization contract specifies a LAW feed sequence based on metric tons of sodium in each feed envelope, but does not currently identify a source tank(s) for the LAW feed. BNFL and DOE/RL will jointly establish the sequence of waste tank feed to the BNFL facility. The following discussion is a plausible feed sequence based on the current contract.

The feed to the BNFL LAW/HLW facilities after the first two years of operations will be Envelope C[c] feed from tanks 241-AN-102 and 241-AN-107. BNFL will process the Envelope C feed for two to three years, depending on the quantity of waste actually received. One additional unit operation is added to the BNFL flow sheet during Envelope C pretreatment. Strontium nitrate and ferric nitrate are added to coprecipitate strontium-90 and transuranic (TRU) radioactive ions in the Envelope C waste. The resulting slurry is filtered using a cross flow filter. The Sr/TRU precipitate slurry is combined with Cs/Tc eluates and HLW sludge and vitrified as HLW. After most of Envelope C is processed, the next six to eight years of operations will pretreat and vitrify Envelope A[d] feed from tanks 241-AN103, 241-AN104, 241-AN105, and 241-AW101. The feed sequence has not been determined by DOE/RL at this time. DOE/RL may elect to have BNFL process a portion of the pretreated Envelope B material that was pretreated during the first two years of BNFL HLW operations.

While processing these LAW feeds, BNFL will vitrify the HLW solids stored from pretreatment of the combined B/D feed, as well as HLW (Envelope D) solids retrieved from tank 241-C106 and 241-AY102.

In order to complete the development and initial design of these facilities, BNFL has formed a team that includes BNFL Engineering, LTD., Bechtel National, GTS Duratek, and Science Application International Corporation. BNFL is also working with IBC Advanced Technologies, Inc. to develop ion exchange resins for the pretreatment process. Additionally, BNFL has contracted the Westinghouse Savannah River Technology Center (SRTC), the Battelle Pacific Northwest National Laboratory and Catholic

University's Vitreous State Laboratory (VSL) to provide fundamental research and development for the project. In using the DOE or DOE-funded laboratories, BNFL will be able to efficiently transfer the technology developed by DOE to the private sector. Specifically, BNFL will be able to transfer the lessons learned from the West Valley and Defense Waste Processing Facilities to the TWRS project. This paper discusses the development program at the Savannah River Technology Center that will be conducted in support of the TWRS Part B1 project.

SRTC TWRS PART B1 DEVELOPMENT PROGRAM

SRTC supported BNFL during the Part A of the Hanford Privatization contract. SRTC fulfilled critical research and development needs for the Part A deliverables [3, 4]. Pursuant to this, BNFL awarded SRTC a two-year research and development contract to provide critical design basis data in support of the TWRS Part B1 project phase. SRTC is supporting BNFL in the areas of characterization, pretreatment, and vitrification. SRTC is developing design basis data using actual and simulated Hanford tank wastes in areas of filtration, ion exchange, precipitation, glass former blending, evaporation, slurry mixing and vitrification. SRTC R&D efforts are being conducted in accordance with DOE Contract DE-AC06-96RL13308 (TWRS contract) and BNFL-SRTC contract.

CHARACTERIZATION

SRTC will receive the following liquid and solid samples from the Hanford tank farm areas.

Hanford Tank Samples to be processed at SRTC[e]
Table 1

Sample Name	Tank	Hanford Waste Type	Quantity (liters)
Envelope A	AN103	DSSF	1.25 – 1.5
Envelope A (Denoted as sample AA)	AN104	DSSF	1.25 – 1.5
Envelope B/D	AZ102	NCAW	1.25 – 3.5 200 – 300g sludge solids (dry basis)
Envelope C	AN102	CC	Part of LC 1.25 – 1.5
Envelope LC (LC denotes Large C)	AN102	CC	>15 L

The Hanford tank waste samples will be characterized for chemical and radionuclide content. Additionally, SRTC plans to obtain density vs. temperature, viscosity vs. temperature, and specific heats for each sample. Ion exchange tests will also be conducted using 25 L of Savannah River Purex HLW supernate which is comparable to Envelope A tank wastes at Hanford.

Simulant Development

SRTC has formulated simulants based upon the tank analysis data, literature sources, and the BNFL TWRS flow sheet. The simulants will be used to perform non-radioactive experiments and to test experimental equipment prior to placing the equipment in radioactive service. The simulants will be characterized for physical and chemical properties. Simulants have been formulated to represent specific tank wastes that are expected to be processed during the initial radioactive operations of the plant. No hypothetical blend recipes will be formulated. Supernate simulants (nominal plus realistic concentration extremes) will be developed to simulate Envelopes A, B and C. A sludge simulant has been formulated to model the expected NCAW waste. These simulants will be characterized for chemical content, particle size, density and rheology.

Since BNFL plans to operate with only Envelope D feed combined with eluates during the first two years of HLW vitrification operations, HLW melter feed simulants will be developed on the basis of a sludge/eluate process and on the basis of a sludge/eluate/Sr/TRU precipitate process. Corrosion testing using the Hanford radioactive wastes will also be conducted.

PRETREATMENT

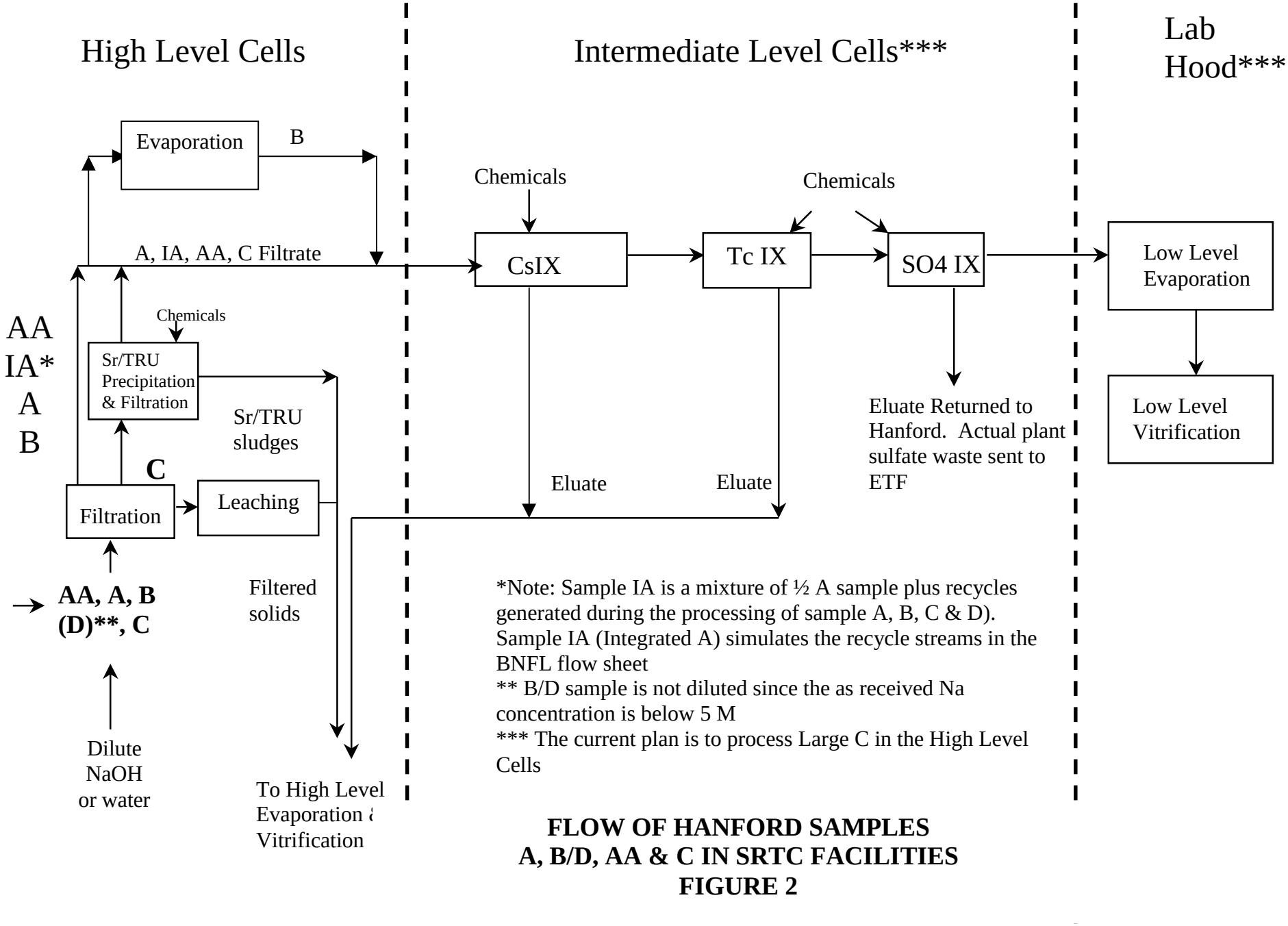
After characterization, the actual Hanford radioactive tank waste samples will be processed according to the BNFL baseline flow sheet. Figures 2 shows a schematic of how each sample will be processed through the SRTC facilities. SRTC and PNNL are collaborating on many of the pretreatment and vitrification process development activities. PNNL's experiences with actual Hanford waste will be applied to the process development activities at SRTC.

Filtration – Entrained Solids Removal and HLW Sludge Pretreatment

Supernate samples (Envelope A & C) will be diluted to approximately 5.5M Na and then filtered to remove entrained solids using cross flow filtration. The combined envelope B/D sample will be concentrated using cross flow filtration and the resulting filtrate (Envelope B) will be sent to an evaporator and then to the cesium ion exchange process. The filter concentrate, Envelope D, will be sent to HLW vitrification.

Radioactive filtration testing will be conducted using a cross flow filtration and solids washing system. The testing will be conducted to verify the performance of the cross flow filter during startup, operation, and shutdown sequences (e.g., back pulsing, filter cleaning/washing, permeate flow rates). Solubility versus temperature relations for entrained solids will be determined to estimate the quantity of entrained solids at the expected plant operating temperatures. The Envelope D sludge samples will be concentrated from a nominal 30-g solids/L to 125-g solids/L. Caustic leaching experiments will be conducted using the Envelope D sample. The leaching experiments will be conducted according to Specification 12 of the TWRS privatization contract. Each radioactive sample will be processed using an experimental apparatus similar to the

filter unit shown in Figure 3 [5]. Simulants will be used to demonstrate multi-tube cross flow filtration and determine conditions such as filtrate flow rates, pressure, and surface area needed to process active solutions. The pilot unit has seven tubes of one-meter length. The unit will be scaled based upon filter area to approximately 1:50 versus the actual plant. Individual tube diameter, tube length and pour size will be full scale.

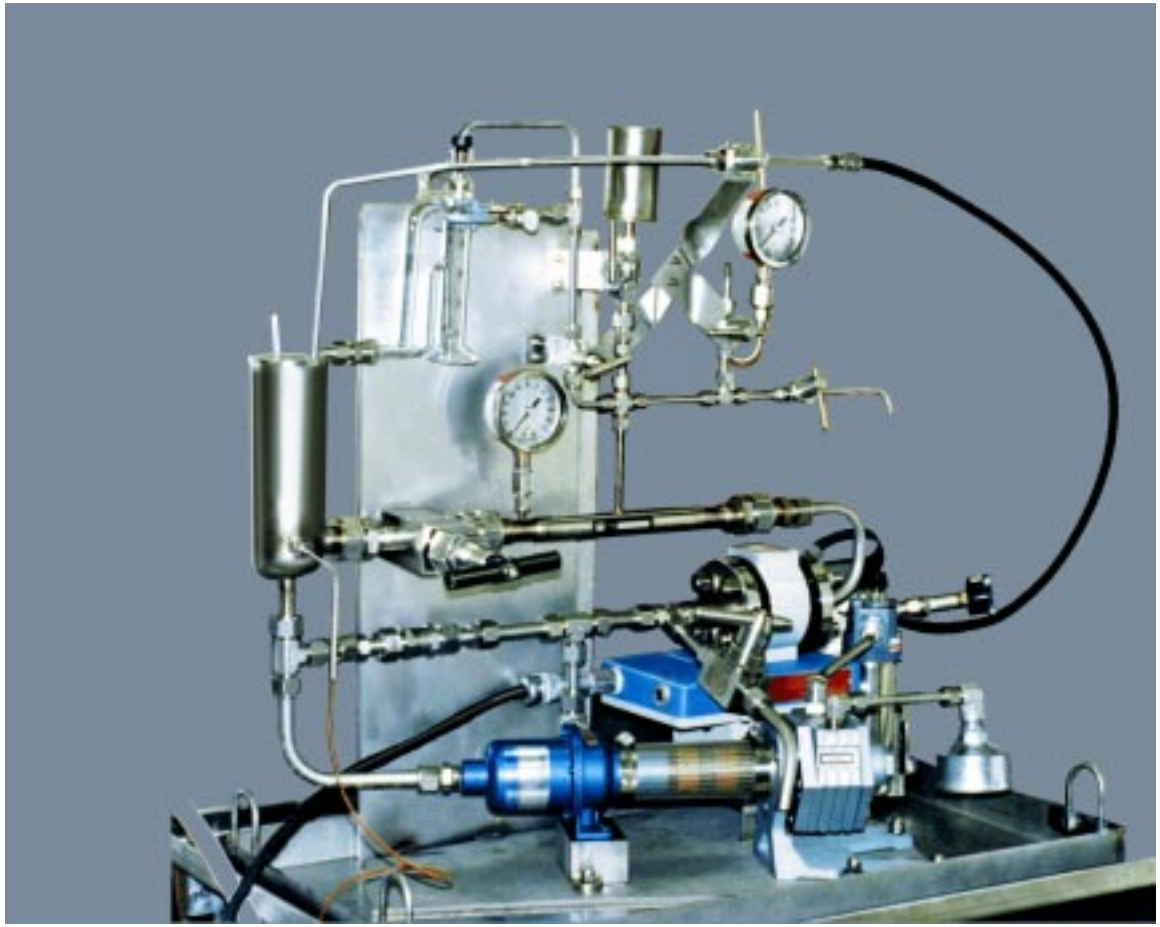


*Note: Sample IA is a mixture of ½ A sample plus recycles generated during the processing of sample A, B, C & D). Sample IA (Integrated A) simulates the recycle streams in the BNFL flow sheet

** B/D sample is not diluted since the as received Na concentration is below 5 M

*** The current plan is to process Large C in the High Level Cells

FLOW OF HANFORD SAMPLES A, B/D, AA & C IN SRTC FACILITIES FIGURE 2



REMOTE CROSS FLOW FILTER AT SRTC
FIGURE 3

Strontium/TRU Precipitation – Process Verification/Optimization/Adverse Reaction Evaluation

After filtration, Envelope C supernate is sent through the Strontium/TRU precipitation process. Envelope A and B supernates bypass this process and are sent directly to the cesium ion exchange process. Envelope C waste must be processed through the Strontium/TRU precipitation process because Sr/TRU radionuclides are more soluble in the waste due to the high levels of organic complexants.

The BNFL process uses strontium nitrate and ferric nitrate to coprecipitate ^{90}Sr and TRU radioactive ions during the pretreatment of Complex Concentrate (Envelope C) waste. Addition of non-radioactive strontium nitrate to the waste causes formation of a precipitate. An exchange of the complexed radioactive ^{90}Sr and the added non-radioactive strontium allows some of the ^{90}Sr to be freed from the complexes and precipitate. This process is known as "isotopic dilution". Ferric nitrate is used to precipitate plutonium and americium in a traditional carrier precipitation process. The resulting slurry is filtered using a cross flow filter.

SRTC is conducting a bench simulant test to develop a model to predict the decontamination factors as a function of temperature, organic constituents, sodium, hydroxide, Al, Sr and Fe ion concentration. Additionally, method of addition and the ability to filter the resulting precipitate is also being studied. Reaction calorimetry experiments will be conducted using Envelope C simulants.

Bench scale radioactive tests will be conducted using AN102 samples to verify actual process sequences. Process conditions to be verified are rate of reagent additions, sequence of reagent addition, temperature, and mixing. Simulant and radioactive experiments will be conducted to determine the effects from abnormal operating conditions. Some of the abnormal conditions to be varied are: elevated reaction temperatures, elevated filtration temperature, insufficient addition of sodium hydroxide, excess addition of ferric nitrate and strontium nitrate, pumping failures, and dissolution of solids with acids (filter cleaning).

The performance of the Strontium/TRU precipitation process will be evaluated at pilot scale conditions using simulant solutions. A multi-tube cross flow filtration unit will be used to estimate filtrate flow rates, pressure and required filter surface area. The unit will be scaled based upon filter area to approximately 1:50 versus the actual plant. Individual tube diameter, tube length and pour size will be full scale.

Ion Exchange – Cs/Tc/Sulfate Removal

Cesium, technetium, and sulfate will be removed from Envelope A, B, and C waste using elutable organic based ion exchange resins. Each sample received from Hanford, as well as a 25 L SRS HLW Purex supernate sample, will be processed through a small-scale version of the BNFL ion exchange process.

SRTC is conducting extensive testing using ion exchange resins manufactured by IBC Advanced Technologies, Inc. SRTC will be conducting cesium ion exchange tests using IBC's SuperLig

644™ and 632™ resin. Tc ion exchange testing will be conducted using IBC's SuperLig 639™ resin and sulfate removal will be accomplished with SuperLig 655™.

Pilot scale tests (1 liter columns) will be conducted using simulants and Cs/Tc resins to determine relationships for pressure drop, mechanical (i.e., production of fines), chemical and expansion/contraction effects. Fluidization velocities and methods of separating the ion exchange fines from the bulk resin will be investigated. SuperLig 644™ is known to decompose slowly in the presence of air and sodium hydroxide. Therefore, the decomposition of the ion exchange resins in the presence of air and caustic solutions under realistic conditions will be investigated. Small-scale batch contact tests will be conducted with actual waste samples and Cs/Tc/Sulfate resins to determine the equilibrium distribution coefficients[f]. IBC Advanced Technologies will be performing radiation and chemical degradation studies.

Each supernate sample received will be pretreated using small ion exchange columns. The decontaminated LAW samples will be sent on to LAW vitrification. Small-scale radioactive testing will be conducted to determine system kinetics and separation efficiencies for Cs, Tc and sulfate. Intermediate scale testing (50 – 100 ml columns) will be done with both radioactive (LC and SRS Samples) and simulated wastes. System kinetics will be determined by varying the superficial velocity and the column aspect ratio for the intermediate scale columns. The columns will be eluted with nitric acid or water and the composition of the eluates and decontaminated supernates will be determined. The quantity of radionuclides and other elements remaining on the spent ion exchange material will be determined to verify the reference disposal pathway (LAW vitrification) does not violate the contract specifications for LAW glass. Additionally, both Cs and Tc ion exchange resin testing will be conducted using a 25-liter SRS HLW supernate sample, as this waste is comparable in speciation and composition to Envelope A. In particular, the technetium is in the pertechnetate form (TcO_4^-) and will be removed by the ion exchange resin. This is in contrast to the LC sample, which has a significant fraction of non-pertechnetate.

SRTC is developing models of the ion exchange process that will be integrated into the overall BNFL flow sheet model.

Mixing of Process Heels and Process and Recycle Streams

SRTC will evaluate the effects of mixing various recycle streams using simulants for each feed envelope. The simulants will be used to evaluate the chemical reactions and modifications to solution physical properties (e. g. density, viscosity). Initially, the BNFL recycle streams will be modeled using OLI Systems, Inc., Environmental Simulation Program (ESP). ESP will be used to guide the simulant development process and to predict the consequences of internal recycle stream mixing. The following recycle or heel mixing tests will be conducted:

- Heel of Envelope A mixes with C waste
- Heel of Envelope A mixes with B waste
- Heel of Envelope C mixes with B waste
- HLW wash water and leachate mixed with Envelope A feed
- HLW off gas scrubber recycled and mixed D waste

- LAW Entrained solids filter wash water mixed with A waste
- Sr/TRU precipitate wash water mixed with C waste

Actual Radioactive Hanford samples will be used to evaluate the effects of heel mixing in the BNFL TWRS double shell slurry feed tank. Additionally, SRTC will be conducting an integrated process demonstration (Sample IA) using part of envelope A sample, envelope A vitrification off gas condensate, envelope D filtrate, envelope A filter cleaning solution and possibly caustic leachate.

Cs/Tc Eluate and LAW Evaporation

Once the Hanford tank samples (Envelope A, B and C) are decontaminated, each sample will be evaporated to approximately one half its original volume. The samples will be concentrated to approximately 80 percent of the known saturation point. A small bench-scale evaporator will be operated on a continuous basis to approximate the BNFL evaporation process. BNFL has chosen a forced circulation evaporator to evaporate the pretreated supernates prior to sending the waste to vitrification.

Prior to evaporation of the actual radioactive samples, evaporation studies will be conducted using simulants. The objective of these studies is to develop preliminary operating and corrosion data and expected concentration endpoints using simulants of A, B and C waste envelopes. Scoping studies will be conducted to determine the concentration at which precipitation first occurs. A small bench scale evaporator has been fabricated and will be used to evaluate scaling and foaming of simulated pretreated LAW. Organics will be spiked into the simulants to determine the distribution of organics in the concentrate, condensate, and evaporator off gas. This will provide a measure of organic entrainment in the LAW evaporator overheads. Analysis for hazardous metals will also be conducted. The concentrate and condensate will be characterized for chemical and physical properties (e.g. viscosity, density). The data developed during the LAW evaporation experiments will be used to validate an OLI ESP evaporation model that is also being developed by SRTC. Corrosion testing will be conducted using simulants and actual Hanford radioactive wastes.

BNFL plans to evaporate the Cs and Tc eluates generated during the ion exchange process prior to sending the eluates to the HLW vitrification process. The nitric acid (or water) eluates will be evaporated in a semi-continuous evaporator and the nitric acid overheads will be recovered and reused during the next elution cycle. SRTC will evaporate the radioactive Cs/Tc eluates prior to mixing these streams with envelope D sludge. A small bench-scale evaporator will be designed and installed in the SRTC Shielded Cells Facility to evaporate the eluates generated during the ion exchange process. Simulant tests will be conducted to develop a procedure and methodology for evaporating the radioactive eluates.

SRTC is performing extensive OLI ESP modeling of the BNFL eluate evaporation process. The initial modeling efforts will focus on determining the volatility of Cs and Tc at various operating temperatures (e. g. 50°C and 100°C). The purpose of the modeling is to develop mathematical equations that relate the solubility of eluate solutions to temperature, sodium, potassium, nitric acid, and Cs/Tc concentration. SRTC will also develop mathematical relationships that relate

temperature, sodium, potassium, nitric acid and Cs/Tc concentration to solution density and heat capacity. SRTC will perform bench scale solubility and evaporation experiments to validate the mathematical relationships developed by the OLI ESP models.

VITRIFICATION

The goal of BNFL TWRS project is to pretreat and immobilize the waste received from the Hanford HLW tanks such that it can safely stored by DOE at the Yucca Mountain, NV repository (HLW only) or at the Hanford site in a near surface disposal vault (LAW only).

Glass Former Feed Preparation

An important requirement for any chemical process, especially a radioactive waste immobilization process, is to ensure that the product is within specified compositional limits. For vitrified radioactive waste, these limits and the processes that control the limits become part of a "contract" (Waste Form Compliance Plan for HLW) between the producer (BNFL) and the receiver (DOE). Currently BNFL plans to control the vitrified HLW and LAW waste form by controlling and analyzing the composition of the blended glass formers and waste stream. Blended glass formers will be analyzed separately from the waste stream and then mixed with the waste stream and pumped into the melter. Depending on the vitrification process, a mixture of between four and 13 individual glass formers could be used to make up a blended glass former batch. It is, therefore, necessary to control the glass former materials, the weighing and mixing process, and the transferring of the blended glass formers to the slurry mix tanks.

In collaboration with the VSL, a glass former raw material selection criterion will be developed and raw materials will be selected. SRTC will characterize the chemical and physical properties of the individual glass formers as well as the expected raw material blends. Physical property measurements include powder flow properties, true particle and packed density, and particle size distribution. The individual materials will be characterized for trace impurities that may affect the vitrification process. Glass former sampling systems will also be evaluated. A conceptual design for the glass former feed preparation system will be generated from this effort.

Wet Feed Mixing – Melter Feed Rheology Studies

Once the Hanford supernate samples have been pretreated to remove suspended solids, Sr/TRU (Envelope C only), Cs, Tc, and sulfate, the resulting concentrated wastes are mixed with glass formers and characterized for rheological properties as a function of total solids concentration. The recipes for the glass formers are determined by Catholic University's Vitreous State Laboratory (VSL). The VSL is responsible for all glass formulation efforts on the BNFL TWRS project.

Rheological studies are also being conducted with simulants (A, B, C and D). Simulants, which have been previously evaporated, and glass formers, will be characterized for shear stress vs. shear rate at various solids concentrations. The change in rheological properties versus time will also be measured to determine if the expected melter feeds are stable during plant outage

conditions. As mentioned previously, HLW melter feed simulants will be developed on the basis of a sludge/eluate process and on the basis of a sludge/eluate/Sr/TRU precipitate process.

Vitrification

After mixing the blended glass formers with the pretreated LAW (Envelope A, B, C, IA, AA) and HLW (Envelope D + Cs/Tc Eluates + Sr/TRU precipitates), the melter feed samples will be vitrified in 60-gram batches at a temperature of 1150°C. Crucible samples will be cooled according to a design basis canister-cooling schedule. Scanning electron microscopy and x-ray diffraction analysis will be conducted to determine crystallinity. The glass will be characterized for chemical and radionuclide content and durability (Product Consistency Test-PCT at 40 and 90°C (LAW glasses) and 90°C (HLW glass) and Toxicity Characteristic Leaching Procedure-TCLP). PCT and TCLP testing will be conducted in accordance with national consensus standards and guidelines (ASTM C-1285 and EPA SW-846 Method 1311, respectively). All glasses will be tested to confirm that combustibles, explosives, organics, free liquids, and pyrophoric components are not present in the glass. Organic analysis will be conducted in accordance with the EPA SW-846 procedures. The Washington State Department of Ecology Fish Toxicity Test will be conducted on the LAW glasses.

The large C sample (≈ 15 L) will be blended with glass formers and vitrified in a continuously fed melter. The off gases and condensate from the Melter will be characterized for organics according EPA SW-846 procedures. Scanning electron microscopy and x-ray diffraction analysis will be conducted to determine crystallinity. The glass will be characterized for chemical and radionuclide content and durability (ASTM PCT at 40 and 90°C and EPA SW-846 TCLP).

ANALYTICAL DEVELOPMENT

The experimental work described above will generate a very large number of samples, both radioactive and non-radioactive, that require chemical analysis. The SRTC Analytical Development Section (ADS) will provide this service using ADS personnel, instrumentation, and procedures. Planning has taken place to estimate the number of samples and analyses required for each sample, along with the date the samples will be generated. This planning helps to assure that adequate SRTC resources will be available to meet the needs of the BNFL program.

In several cases, it will be necessary for SRTC to develop new analytical techniques and/or improvements in existing analytical methods to meet the analysis needs for the BNFL SRTC development program. Specific examples include: 1) developing an improved analysis for sulfate in solutions containing large amounts of salts and/or organic material to provide lower detection limits than possible with the existing methods and 2) developing a new, rapid radiochemical separation method for the determination of actinide isotopes. In addition, SRTC will determine the best means of providing the analyses of an extensive set of analytes for regulatory purposes.

SRTC is coordinating a development effort to identify and test methods for the on-line determination of technetium-99. Existing technologies for Tc monitors will be evaluated and tested. The Tc-99

monitor will be used to measure the Tc-99 content of the pretreated LAW waste (before and after the technetium removal column operation). The program will identify potential candidate techniques and one or more will be selected for radioactive testing.

CONCLUSIONS

SRTC is supporting BNFL in the development and design of the TWRS LAW & HLW pretreatment and immobilization facilities during the Part B1 phase of the DOE-BNFL contract. This paper provided a programmatic summary of the SRTC research and development efforts.

ACKNOWLEDGMENT

This paper is a tribute to the many individuals (both within SRS and across the DOE complex) who worked to make the radioactive operation of DWPF a reality. This paper was prepared in connection with work done under Contract no. DE-AC09-96SR185000.

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FOOTNOTES

[a] A HLW canister is defined as 4.5-meter tall canister. BNFL will design and test a 4.5-meter canister. The current West Valley and DWPF canister is approximately 3 meters. The canister diameter is the same as the West Valley and DWPF canister. A LAW unit is defined as a either a rectangular package (1.85 m L x 1.25 m W x 1.25 m H) or square package (1.45 m L x 1.45 m W x 1.45 m H). 1300 – 1600 LAW units are expected from Envelope B waste and with the balance derived from either Envelope A, B, or C.

[b] Envelope B/D waste is also known as Neutralized Current Acid Waste (NCAW). HLW generated in the Hanford Purex plant was denitrated with sugar and then neutralized with NaOH. Sodium nitrite was added to minimize corrosion in the tank farms.
[c] Envelope C waste is also known as Complex Concentrate waste. This waste resulted from Cs/Sr separation and encapsulation process which was operated in Hanford B plant. The waste has a high TOC due to the organic complexants that were added during the process.
[d] Envelope A waste is also known as Double Shell Slurry Feed (DSSF) waste and resulted from evaporating salts supernates stored in the original single shell tanks. Additionally, supernate wastes generated from Hanford B plant also are classified as Envelope A wastes.
[e] SRTC processed the following Hanford Tank wastes during Part A: Envelope C 241-AN107 and 241-AN102; Envelope A 241-AW101; Envelope D 241-C106; Envelope B 241-AN105. 241-AN105 is actually an Envelope A tank and was spiked with CsOH and potassium chromate so that it simulated an Envelope B sample.
[f] The equilibrium distribution coefficient (K_D) is defined as the ratio of the concentration of the ionic species on the ion exchange resin and in the solution phase.