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Facilities and Operations

Waste Analysis Plan for the 324 Building HLV Interim Removal Action Project

P.J. Weaver

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Prepared for
the U.S. Department of Energy
Under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

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WASTE ANALYSIS PLAN FOR THE 324 BUILDING HLV INTERIM REMOVAL ACTION PROJECT

Prepared by

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324 Facility Operations

6-7-96
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Acronyms

ACL	Analytical Chemistry Laboratory
ALARA	as low as reasonably achievable
CH-LLMW	contact handled low level mixed waste
CH-TRU	contact handled transuranic waste
CH-TRUMW	contact handled transuranic mixed waste
CWA	Clean Water Act
DSTs	Hanford Site Double Shell Tanks
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EDL	Engineering Development Laboratory
EPA	U.S. Environmental Protection Agency
HEPA	High Efficiency Particulate Air
HLMW	high level mixed waste
HLV	high level vault
IWMP	324 Building REC and HLV Interim Waste Management Plan
LDR	land disposal restriction
LLV	low level vault
LLW	low level waste
MW	mixed waste
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
QC	quality control
R&D	research and development
REC	Radiochemical Engineering Cells
RH-LLMW	remote handled low level mixed waste
RH-LLW	remote handled low level waste
RH-TRUMW	remote handled transuranic mixed waste
scfm	standard cubic feet per minute
Sr	Strontium
TCLP	Toxicity Characteristic Leaching Procedure
TPA	Tri-Party Agreement
TRU	transuranic
VTV	vacuum transfer vessel

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1.0 Purpose

This waste analysis plan has been developed to support the High Level Vault (HLV) Tank Interim Removal Action as required by TPA milestone M-89-01, pursuant to the requirements of 40 CFR 268.7(a)(4) and WAC 173-303-300. It is intended to describe the procedures which will be used to comply with applicable treatment standards for land disposal restricted wastes.

2.0 Background

The 324 Building is located in the 300 Area of the Hanford Site, Richland, WA and is operated by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). The 324 Building Radiochemical Engineering Cells (REC) and high level vault (HLV) tanks (which as part of the Hanford reservation are included in U.S. Environmental Protection Agency [EPA] ID# WA7890008967) have supported a variety of research and development (R&D) programs involving high-activity radioactive material. The REC and three of the four HLV tanks (TK-104, TK-105, and TK-107) contain material that includes known or potential mixed wastes (MW) (radioactive wastes mixed with nonradioactive hazardous or dangerous constituents) generated by cell restoration activities, as well as MW remaining from R&D work in the 324 Building.

To address the regulatory status of the HLV tanks, Tri-Party Agreement (TPA) milestone M-89 was negotiated between the EPA, the Washington State Department of Ecology (Ecology), and the DOE. Under this milestone, the *324 Building REC and HLV Interim Waste Management Plan* (IWMP) was prepared by PNNL and the management approach was approved by Ecology. The IWMP provides for the management of the HLV tanks.

The 324 Building HLV Interim Removal Action Project was established to address TPA milestone M-89-01, "Complete Removal of the 324 Building HLV Tank MW (e.g., TK-104, TK-105, TK-107) with the exception of residues which may remain following flushing and draining to the extent possible." The goal of the project is to implement a preliminary treatment strategy that will remove and stabilize the inventory of liquid waste from the 324 HLV tanks.[1] The approach which is being implemented to meet the goal is as follows:

1. Transfer the liquid wastes from the HLV tanks to the D-Cell using TK-112 located in the B-Cell as a transfer mid point.

2. Separate the hazardous and non-hazardous component of the waste stream using chemical precipitation.

[1]PNNL, April 1995, Project Management Plan Nuclear Facilities Management, Pacific Northwest Laboratory, Richland, WA

3. Separate the radioactive components of the waste stream such that the resulting wastes can be disposed of using existing disposal pathways.

4. Evaporate the residual solution or transfer it to the radioactive liquid waste system, which routes liquid through the low level vault (LLV) tanks to the 340 Building and from there to the 200 Area waste tanks via railcar.

2.1 Facility Description

The facility as described in this document refers to the portions of the 324 Building which will be used in support of the processing of the HLV tank wastes. These areas consist of the HLV, LLV, REC, and associated transfer piping.

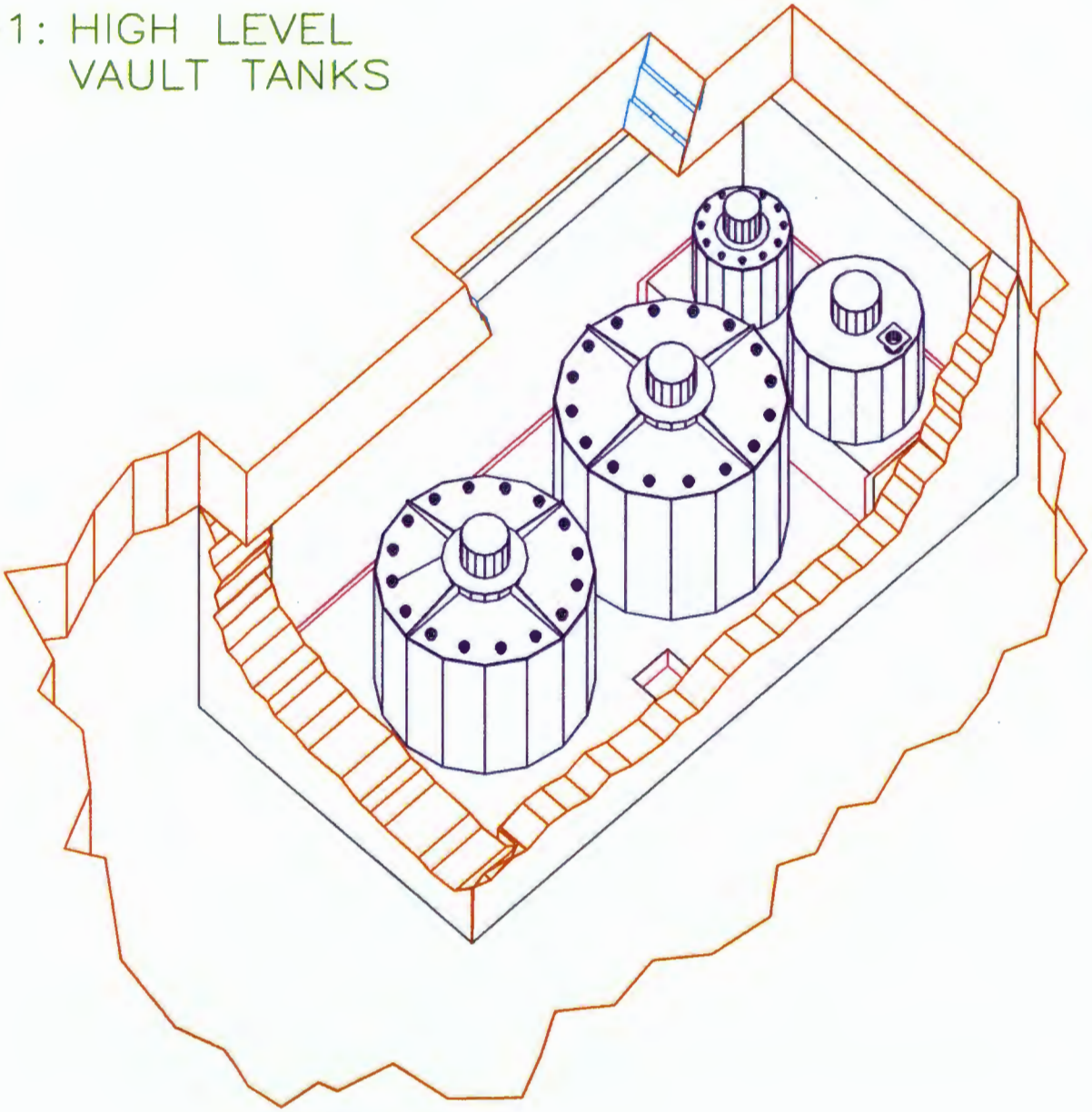
2.1.1 HLV

The HLV, located under the floor of the cask handling area, is used for storage of high-activity liquids. The HLV is 6.4 m long x 4.0 m wide x 4.4 m deep (21 ft x 13 ft x 14.5 ft). A 1.8 m (6 ft) ledge at one end enlarges the upper level of the HLV to 8.2 m x 4.0 m x 4.4 m deep (27 ft x 13 ft x 14.7 ft) (see Figure 2-1). The HLV contains four stainless steel tanks TK-104, TK-105, TK-106, and TK-107, with operating capacities of 14,807, 18,139, 1,677, and 3,626 L (3912, 4792, 443, and 958 gal), respectively. Each tank rests on stainless steel footings.

The vault is constructed of concrete and partially lined with stainless steel plate welded at the seams, which covers the floor and extends 1.1 m (3.5 ft) up the walls from the floor and 0.15m (0.5 ft) above the ledge. The stainless-steel liners provide secondary containment for the vault. The floor of the vault is sloped to a sump, which has an alarmed liquid-detection system to indicate possible tank leakage. The HLV is shielded by thick concrete blocks totaling 1.8 m (6 ft). Due to radioactivity hazards, entry to the vault is prevented by a set of 1.2 m (4 ft)-thick concrete shielding blocks in place over cover blocks constructed of 0.6 m (2 ft)-thick concrete that have overlying removable steel-plate ventilation barriers with integral manhole covers.

The vault tanks are fitted with manometers for measuring liquid level, specific gravity, and tank pressure. Thermocouples are used for measuring temperature. Instrument readings are recorded by technicians daily in the tank status logbook. The tanks are also equipped with high-liquid-level and high-temperature alarms. The alarms are part of the building annunciator panel which is monitored 24 hours per day. The vault tanks are vented through a common-vessel vent system that pulls air and tank vapors through two High Efficiency Particulate Air (HEPA) filters and discharges them to the atmosphere outside the main 324 Building ventilation system. A sample room for sampling each of the four tanks is located in the north-west corner of Engineering Development Laboratory (room 145). The HLV Tank samplers are enclosed in a shielded hood, and sampling is performed remotely with a manipulator.

FIGURE 2-1: HIGH LEVEL VAULT TANKS



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2.1.2 LLV

The LLV, located under the floor of the manipulator repair shop (room 147), is used for storage of medium to low-activity liquids. The LLV is 8.8 m long x 4.0 m wide x 5.7 m deep (28.5 ft x 13 ft x 18.5 ft). The LLV contains four stainless steel tanks TK-101, TK-102, TK-103, and TK-108, with operating capacities of 12,323, 18,435, 12,323, and 12,323 L (3286, 4916, 3286, and 3286 gal), respectively. Each tank rests on stainless steel footings.

The vault is constructed of concrete and partially lined with stainless steel plate welded at the seams, which covers the floor and extends 1.2 m (4.0 ft) up the walls from the floor. The stainless-steel liners provide secondary containment for the vault. The floor of the vault is sloped to a sump, which has an alarmed liquid-detection system to indicate possible tank leakage. The LLV is shielded by concrete blocks totaling 0.6 m (2 ft). Due to radioactivity hazards, entry to the vault is prevented by the shielding blocks that have overlying removable steel-plate ventilation barriers with integral manhole covers.

The vault tanks are fitted with manometers for measuring liquid level, specific gravity, and tank pressure. Thermocouples are used for measuring temperature. Instrument readings are recorded by technicians daily in the tank status logbook. The vault tanks are vented through a common-vessel vent system that pulls air and tank vapors through two HEPA filters and discharges them to the atmosphere outside the main 324 Building ventilation system. A sample room for sampling each of the four tanks is located in the north-west corner of Engineering Development Laboratory (room 145). The LLV Tank samplers are enclosed in a clear plastic hood and sampling is performed hands on.

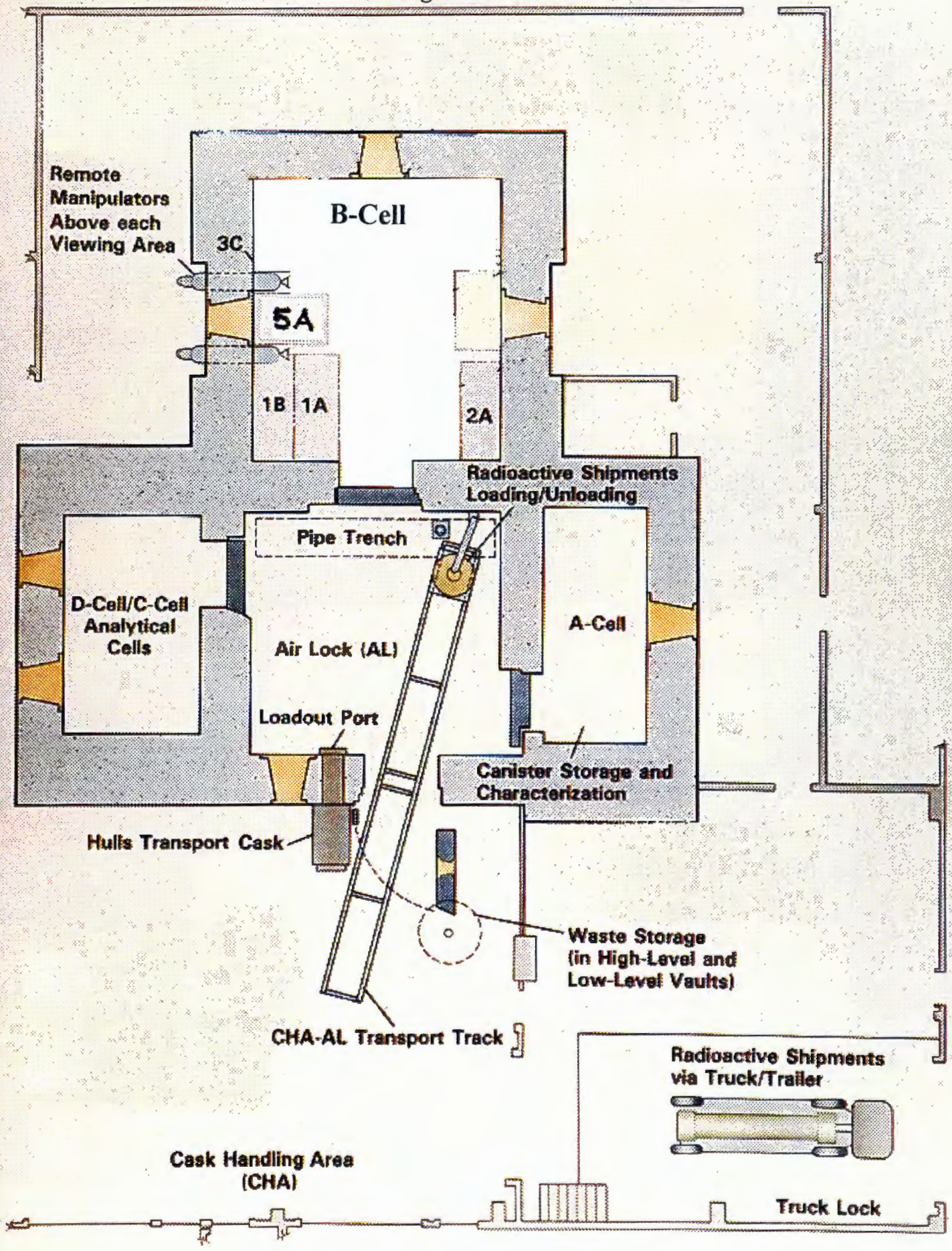
TK-101 and TK-102 are connected to the 300 Area Radioactive Liquid Waste System which connects the 324 Building to the 340 facility via underground piping. Liquid transfers from the 324 Building to the 340 facility are conducted using steam jets. Once liquids are at the 340 facility, they are transferred to the Hanford Site Double Shell Tanks (DSTs) using railcars.

2.1.3 REC

The entire REC complex, located in the north portion of the 324 Building consists of four hot-cells (A, B, C, and D) located around a central airlock. The walls are constructed of 1.3 m (4 ft)-thick high-density concrete or 1.37 m (4.5 ft)-thick normal-density concrete. The cells and airlock are joined, forming a T-shaped structure, with D-Cell located above C-Cell on the south side, and B-Cell at the bottom (west end) of the "T" (Figure 2-2). Access is by operating galleries on the first and second floor levels. The airlock is used primarily as a transition zone for maintenance, decontamination, and transfer of material and equipment into and out of adjoining hot cells.

The four cells (A, B, C, and D) are equipped with manipulators, remotely operated cranes, closed-circuit television, shielded viewing windows, and a communication system that permit complete experiments to be carried out. The B-, C-, and D-Cells have periscopes with optical magnification for detailed examination of materials. The airlock is equipped with cranes that facilitate remote installation, maintenance, and operation of equipment.

324 BUILDING
RADIOCHEMICAL ENGINEERING CELLS
Figure 2-2



All normal operations in the REC are performed remotely. Manned entry into the cells is prohibited due to the high dose rate of ionizing radiation from the present radioactive material inventory. The 9.1 m (30 ft)-high B-Cell functions as a general purpose processing cell and is operated by remote instrumentation from the control room. The shorter D-Cell is capable of handling equipment up to 3.4 m (11 ft) high, and is operated entirely by direct viewing and manipulators with assistance from remotely operated overhead cranes.

2.1.3.1 B-Cell

The B-Cell is the largest of the four cells, measuring 7.6 m long x 6.7 m wide x 9.3 m (25 ft x 22 ft x 30.5 ft) high. The floor and walls, up to 8.2 m (27 ft) high, are lined with a stainless steel plate that is fully welded at the seams. Under the floor plate is a 15.24 cm (6 in.)-thick slab of concrete, and under the concrete is packed native soil. The cell is surrounded on three sides by operating galleries on the first and second floors and on two sides by a gallery at the basement level. The B-Cell sample hood is a stainless steel and Lucite closed hood. This hood is equipped with glove ports, a hoist, and a door for sample removal. Shielding walls are constructed of high-density concrete that is 1.3 m (4 ft) thick. Normal services into the B-Cell include electricity, water, and compressed air.

TK-112 is located in the 1B equipment rack within B-Cell. The tank is constructed of 304 stainless steel, has a capacity of 1000 liters, and is equipped with instrumentation for level indication. TK-112 also is equipped with a closed loop sampling system. An air jet is used to draw solution from the bottom of the tank, through a 20-ml sample bottle, and back into the top of the tank. When the air is turned off, the lines drain back into the tank and a sample is left in the sample bottle. During previous research activities, TK-112 was used as a utility tank for temporary holding of liquids within B-Cell. The last material to be contained in TK-112 was the solution currently stored in TK-107.

2.1.3.2 D-Cell

The D-Cell is physically located directly over the C-Cell in the southern end of the REC. It is accessible only from the second floor. The D-Cell measures 6.1 m long x 3.66 m wide x 4.9 m (20 ft long x 12 ft wide x 16 ft) high. The floor is lined with stainless steel, and the walls are painted concrete. The cell is adjoined by the airlock on the north side and by a service gallery on the south side. Shielding walls are constructed of 1.3 m (4 ft)-thick high-density concrete. Normal services into the D-Cell include electricity, water, and compressed air.

The treatment equipment which will be used to treat the HLV tank wastes consists of (see Figure 2-3): a vacuum transfer/Neutralization tank, a metals filter feed tank, a metals filter, a carbonate precipitation tank, a carbonate filter, an ion exchange feed tank, an ion exchange column, evaporation tanks, a filter drier and a vessel vent system. The vacuum transfer/neutralization tank, metals filter feed tank, carbonate precipitation tank, and ion exchange feed tank each consist of 37-gallon stainless steel pressure/vacuum units with all penetrations through the top and diplegs for solution removal. The metals and carbonate filters are cartridge type sintered metal filters with approximate dimensions of 25 cm (10 in.) diameter by 50 cm (20 in.) long and 5 cm (2 in.) diameter by 45 cm (18 in) long, respectively. The ion exchange columns will

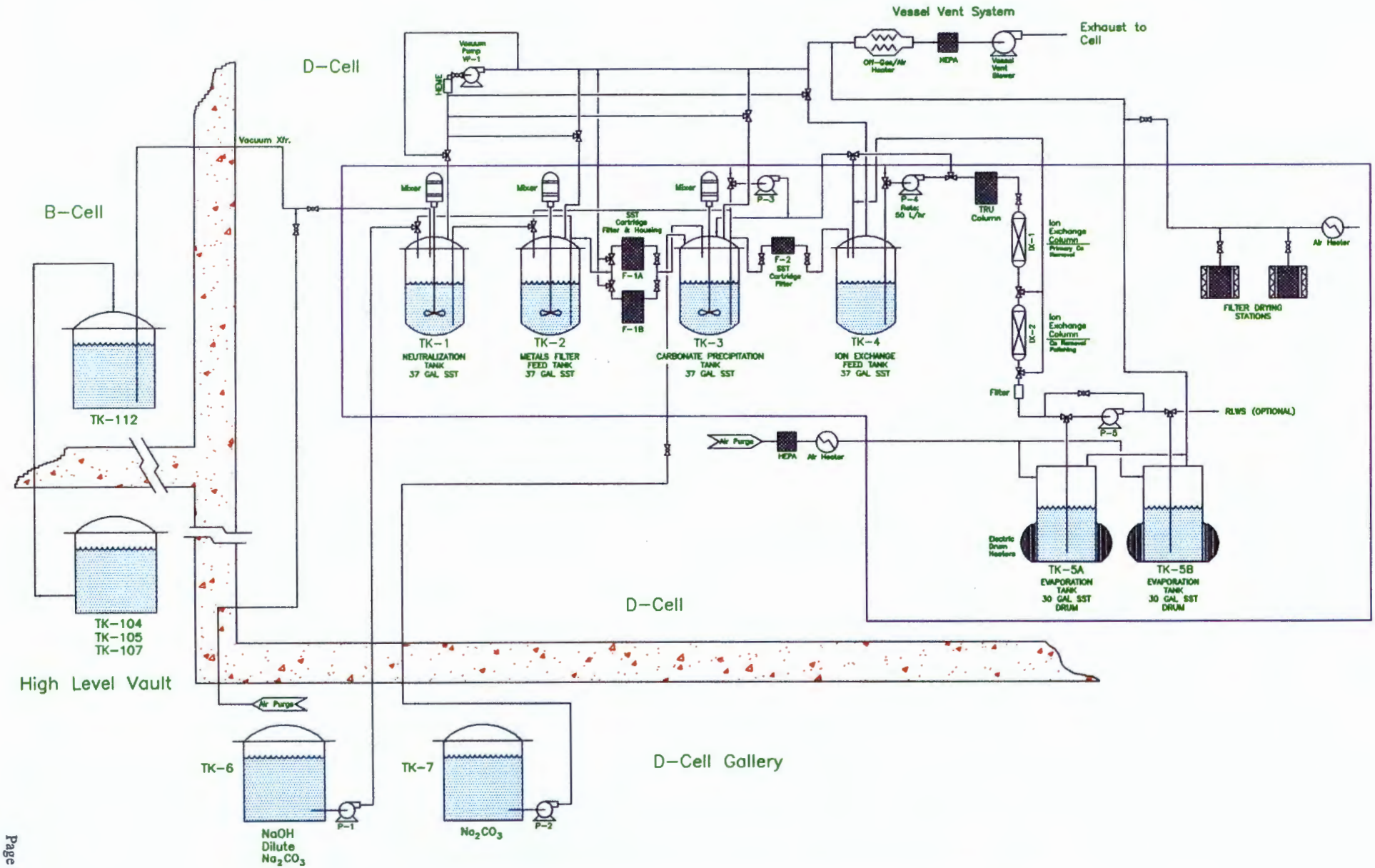


FIGURE 2-3: HIGH LEVEL VAULT EVAPORATION SYSTEM FLOW DIAGRAM

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consist of closed end stainless steel pipes, 20 cm (8 in.) diameter by 90 cm (36 in.) long, fitted with inlet and outlet fittings. The columns will be packed with an ion-exchange media with a high specificity for cesium and strontium. The evaporation tanks are 113-liter (30-gallon) stainless steel drums heated with band and platform heaters. The filter drier will consist of a heating unit which will fit around the filter columns. The vessel vent system will consist of a HEPA filter and blower, and serves as a prefilter before the treatment system is vented to D-Cell. All of the equipment will be assembled into "units" which will be contained inside stainless steel drip pans. These drip pans will provide secondary containment during the HLV processing and have a capacity of 250 liters which is over 200% of the largest vessel which will be used during the processing.

2.1.4 Transfer Piping

Piping connected to the vault tanks serves a variety of functions, including liquid transfer, instrumentation access, tank venting and sparging, cooling water supply and return, and sampling. The 324 Building piping for radioactive liquids is constructed of 3.8 cm (1.5 in.) and 5.1 cm (2 in.) diameter stainless steel pipe with welded joints. The piping was constructed above the tanks in the vault, which serves as secondary containment in the event a pipe leak should develop. The pipes are typically hung by harness and strap from the joist system of the floor above. The piping within the building is not encased except were it passes through a concrete structure. At these points, it is encased in a 10.2 cm (4 in.) diameter fiberglass reinforced epoxy pipe. All building piping was pressure tested at 3 psi and then at 250 psi (gravity and steam, respectively) and did not experience pressure loss in 24 hours at the time of installation (in 1965).

The stainless steel piping drains to the tanks by gravity flow. The gravity piping system was designed with a fall of 0.52 cm per meter (0.0625 in. per ft) of run. This slope yields a flow capacity of 30.32 L (8 gal) per minute for the 3.8 cm (1.5 in.) diameter pipe and 60.64 L (16 gal) per minute for the 5.08 cm (2 in.) diameter pipe. Material also is moved through the piping by steam jets. The steam jets create a venturi suction that serves to move liquid through the piping system. Instrumentation piping, vent piping, sparging piping, and sampling piping are constructed with a continuous upward slope from the vault tanks. This construction was designed to eliminate the potential for a backflow to develop in these particullar piping systems.

2.2 Process Description

The treatment process was designed specifically for the intended use of treating the HLV tank waste and rinsate. It has the capacity to safely treat liquid wastes with the exception of ignitable or reactive liquids. A flow diagram of the treatment process is provided in Figure 2-3.

2.2.1 Transfer from HLV tanks to TK-112

The waste in the HLV tanks will be treated in the 324 Building REC D-Cell. The material will be transferred through existing piping to D-Cell via TK-112 in B-Cell. The transfer to TK-112 will be conducted in batches of approximately 1000 liters (250 gallons). The solutions in TK-104 and TK-105 are compatible and will be combined in the HLV (TK-104) and transferred to

TK-112 as a single waste stream[2]. TK-107 waste will not be commingled with TK-104/105 waste. While in TK-112, the solutions from each of the HLV tanks will be sampled to verify initial processing parameters using existing B-Cell sampling systems and equipment.

The transfer of HLV tank wastes to TK-112 provides two major functions. First, it serves as an intermediate step in the transfer to D-Cell. The elevation gained in moving from the HLV to D-Cell is approximately 10.6 m (35 ft) which cannot be accomplished in a single step using steam jets or vacuum transfer. TK-112 provides the necessary midpoint to allow completion of the transfer. Second, the existing sampling station in B-Cell will also allow samples to be taken from the HLV wastes without using the HLV sampling room. Sampling within B-Cell will greatly reduce the staff exposure resulting from the sampling activities and help keep the process exposure as low as reasonably achievable (ALARA).

2.2.2 Solution Transfer to D-Cell

The solution transfer from B-Cell to D-Cell is a batch process and will be accomplished by vacuum transfer. A jumper will be fabricated to directly connect TK-112 in B-Cell to existing piping that terminates in D-Cell. The vacuum transfer vessel (VTV) will be connected to this existing piping. The VTV will be located in D-Cell and consists of a 140 L (37.5 gal) stainless steel tank. A vacuum will be drawn on the VTV, drawing the solution from TK-112. Batch sizes for the transfer from TK-112 to the VTV will be approximately 100 L (26.6 gal). The outlet stream from the vacuum pump will be discharged through a HEPA filtered vessel vent system and then into the D-Cell ventilation system. The VTV will be vented to the vessel vent system at all times other than during solution transfer operations.

2.2.3 Neutralization

The function of the neutralization step is to remove the hazardous characteristics from the HLV tank wastes. By neutralizing the HLV tank solutions, the corrosive characteristic no longer exists and the resulting pH adjustment causes the hazardous metals to precipitate as solids. The solids will then be removed during the next step (e.g., metals filtration) in the process.

Neutralization will take place in the VTV after the vacuum transfer is complete. Chemicals (sodium hydroxide, sodium carbonate, and potassium phosphate) will be added to the tank solutions at a rate determined from the samples taken from TK-112.[3] The chemical addition will result in the precipitation of the hazardous constituents (i.e. barium, cadmium, chromium, and lead) as metal hydroxides or carbonates. The solution will be throughly mixed and the neutralized solution and solid precipitate will be transferred to the metals filter feed tank. The pH of the neutralized solution will be monitored by an in line pH meter to verify that the neutralization step was complete. The neutralization tank will be vented through the HEPA-filtered vessel vent system into D-Cell at all times.

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[2]Information pertaining to the composition of the HLV tank waste is provided in section 3.

[3] When neutralizing the waste solution from TK-107, higher concentrations of sodium carbonate and potassium phosphate may be added to precipitate the Sr-90 during this process step.

The metals filter feed tank is of the same design and construction as the VTV. A vacuum drawn on the tank will transfer the neutralized solution and solid precipitate from the VTV into the metals filter feed tank. The outlet from the vacuum pump will discharge to the vessel vent system.

2.2.4 Metals Filtration

Once in the metals filter feed tank, the neutralized solution and solid precipitate will be vacuum filtered through the metals filter into the carbonate precipitation tank. The solution will be transferred through the filter by evacuating the carbonate precipitation tank and allowing the carbonate precipitation tank to pull solution from the metals filter feed tank through the metals filter. As the solution is drawn through the metals filter, the precipitated solids will be filtered from the solution and accumulate in the filter. The filtrate will pass through the filter into the carbonate precipitation tank. This first filtration step will remove the hazardous metals (i.e., barium, cadmium, chromium, lead) and a portion of the strontium from the waste stream. Testing on nonradioactive simulants has demonstrated that the hazardous metals are removed sufficiently that the resulting filtrate will not designate as a characteristic dangerous (hazardous) waste[4]. Simulant testing also demonstrated that for the TK-104/105 wastes, the amount of Strontium (Sr) precipitated in this first step will be small, whereas for TK-107 higher concentrations of chemicals will have been added such that essentially all Sr will be precipitated in this step.

When fully loaded with solids, the filter will be removed from the processing unit and the filtered solids dried in a heater connected to the vessel vent system. The filter will be considered fully loaded when the flow through the filter decreases as indicated by an absence of weight gain in the receiving tank. After the drying, the filter will be reinstalled in the process system and loaded with additional solids. After the filter is loaded and dried a second time, the filter will be designated as dangerous (hazardous) mixed waste based on process knowledge and be properly disposed of.

2.2.5 Strontium Precipitation and Recovery

The strontium precipitation and recovery step has been engineered to produce a strontium source which is acceptable for use in the production of medical isotopes.[5] To accomplish this, the strontium must be relatively clean and chemically retrievable.

The strontium from the TK-104/105 metals filtrate will be recovered by adding additional sodium carbonate to the solution in the carbonate precipitation tank to produce a strontium carbonate precipitate. A sample will be collected from carbonate precipitation tank during the initial treatment batch to verify the level of strontium remaining after the metals filtration step. The strontium carbonate will be collected by filtering the solution through a small, sintered metal

---

[4]Additional information regarding results of simulant testing is provided in section 3.

[5]Due to the high levels of impurities remaining in the TK-107 solutions at this step (mostly iron), the strontium in TK-107 is not suitable for medical isotope recovery and will not undergo this process step. The Sr-90 in this tank will be precipitated out of solution in the neutralization step and removed in the metals filtration step.

filter unit, approximately 5 cm (2 in.) diameter by 45 cm (18 in.) long. The precipitated solution will be vacuum filtered through the carbonate filter and into the ion exchange feed tank. (The TK-107 metals filtrate will be transferred directly to the ion exchange feed tank without precipitation.) The ion exchange feed tank is of the same design and construction as the VTV. The strontium carbonate removal will be accomplished in the same manner as the metals filtration. The recovered strontium carbonate will be dried and stored on the filter units as a product for use in the medical isotopes program.

2.2.6 TRU and Cesium Removal

After the strontium precipitation, the remaining solution will contain primarily sodium nitrate and carbonate, contaminated with the cesium and trace transuranic (TRU) from the waste. The cesium and any residual strontium are removed from the solution by ion-exchange, and the resulting solution is fed to the evaporation tanks. A pump will draw the carbonate precipitation filtrate from the ion exchange feed tank, through a TRU removal column, through the primary cesium removal column, through a polishing column, and into the evaporation tanks. The TRU removal column will remove any residual TRU from the solution preventing the cesium removal columns from concentrating the TRU and generating a RH-TRU waste. The cesium loading on the column will be determined from the initial TK-112 sample and the volume of solution which has passed through the column. When the column is fully loaded, the column will be dried while vented through the vessel vent system.

It is expected that the TRU removal column will designate as a CH-TRUMW waste and the cesium removal columns will designate as a low level radioactive waste only. The designation of the cesium ion exchange columns will be conducted based on the results of core samples taken from each column while treating TK-104/105 waste. The designation of the cesium removal columns used during the treatment of TK-107 wastes will be based on solution samples collected from the ion exchange feed tank.

2.2.7 Evaporation / Solution Disposal

An air flow of 25 standard cubic feet per minute (scfm) to 50 scfm will be drawn through the head space, through the vessel vent system, and then out to D-Cell. The evaporation rate from each of the drums is estimated to be 5 L/hr (1.3 gal/hr). The solution by this time is nearly free from radionuclides and will be completely evaporated in the drums, leaving a solid sodium nitrate/sodium carbonate waste for disposal.

An alternative to evaporation is to manage the unconcentrated non-dangerous (non-hazardous) liquid by transferring the material to the 340 Building via the 324 Building LLV TK-102. The solutions will be transferred to TK-102 as they are treated. After all TK-104/105 and TK-107 wastes have been treated, a sample will be collected from TK-102 and analyzed to verify the solutions meet DSTs acceptance criteria.

A decision on which pathway to use will be made at the time of processing depending on the availability of the 340 Facility.

3.0 Waste Analysis

The primary objective of the HLV treatment process is to take waste streams which do not currently have a disposal path and treat them such that the resulting residues can be managed using existing Hanford Site waste management methods. Waste classifications with existing management pathways include low level waste (LLW), contact handled low level mixed waste (CH-LLMW), contact handled transuranic waste (CH-TRU), and contact handled transuranic mixed waste (CH-TRUMW).

Each of the HLV tank waste streams and process effluents were reviewed to determine the appropriate waste designation. Dangerous (hazardous) waste designations were made by following the logic detailed in Figure 3-1. Radioactive waste designations were made by reviewing each waste's radionuclide content and generation process against the definitions for High Level Waste, Transuranic Waste, and Low Level Waste. The following definitions are defined in DOE Order 5480.2A, "Radioactive Waste Management".[6]

High Level Waste: The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Transuranic Waste: Without regard to source or form, waste that is contaminated with alpha-emitting transuranic radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. Heads of Field Elements can determine that other alpha contaminated wastes, peculiar to a specific site, must be managed as transuranic waste.

Low Level Waste: Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or 11e(2) byproduct material as defined by this order. Test specimens of fissionable material irradiated for R&D only, and not for the production of power or plutonium, may be classified as LLW, provided the concentration of transuranic is less than 100 nCi/g.

The solutions currently stored in TK-104 and TK-105 are classified as remote handled transuranic mixed waste (RH-TRUMW), while TK-107 designates as high level mixed waste (HLMW). The approach which will be used for the treatment is to separate each of the components of the waste into a independent waste stream (separating the hazardous components from the non-hazardous components and the LLW components from the TRU components). By separating the individual components, the resulting wastes will have radioactive waste definitions of LLW or CH-TRUMW.

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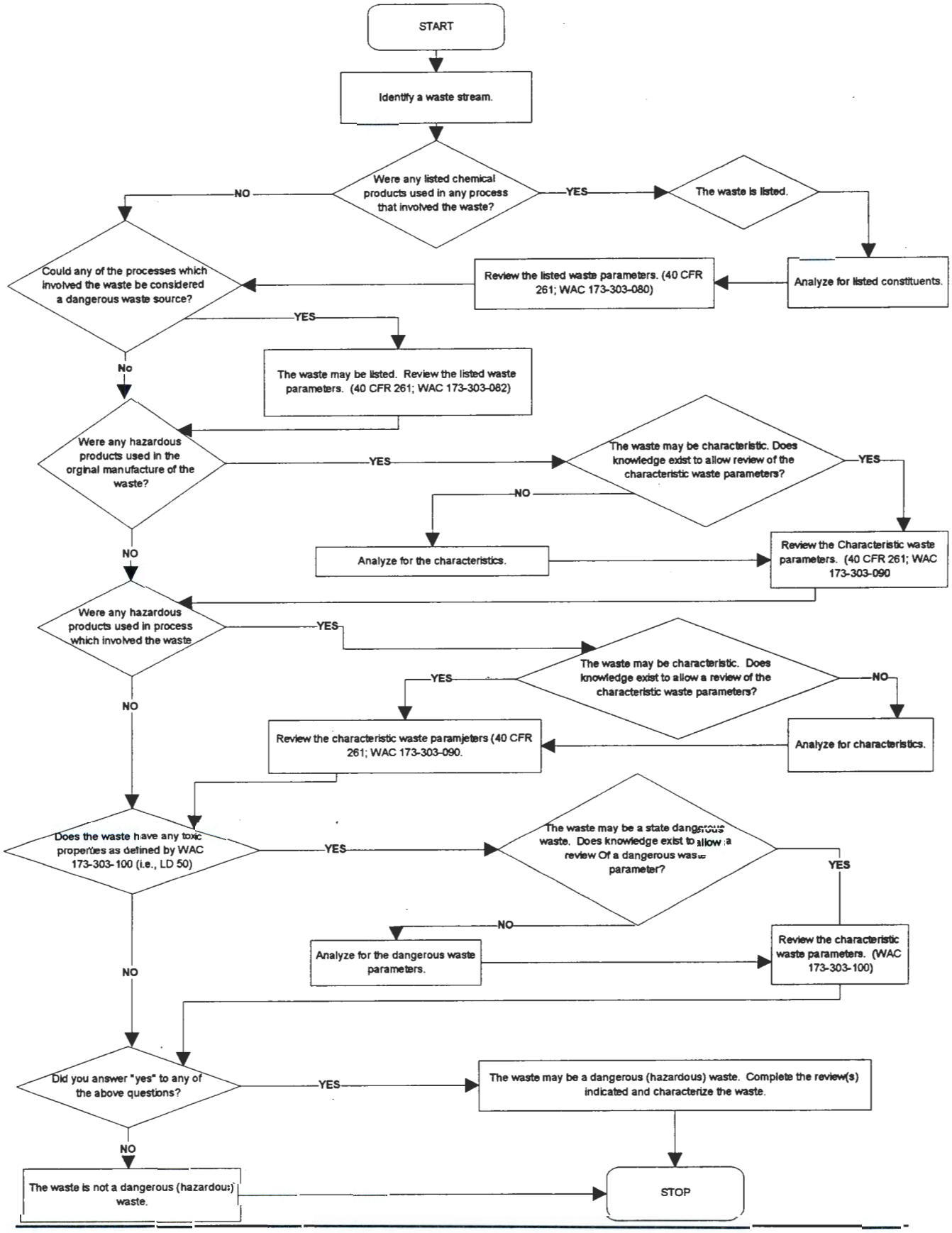
[6]DOE, Radioactive Waste Management, Order DOE 5820.2A, 9-26-88, U.S. Department of Energy, Washington, D.C.

Figure 3-1
Selection Process for Determining the Hazardous Waste Parameters to be Used to Characterize Wastes



3.1 Identification/Classification of Waste Streams

The initial waste streams stored in the HLV tanks were sampled in May/June 1990 and underwent a detailed analysis (Table 3-1). The analysis shows that each of the waste streams is a nitric acid based solution with varying levels of contaminates and that all of the waste streams are compatible. Since that time, the only change to the waste has been to add water to make up for evaporation. Based on this analysis combined with process knowledge of the generating process, the waste streams were designated as RH-TRUMW (TK-104 and TK-105) and HLMW (TK-107).

The treatment process for the HLV tank wastes was specifically designed to separate the liquid wastes into five distinct streams (TK-107 will only separated into four streams as detailed in the process description).

The classifications of these streams is as follows:

1. CH-TRUMW
2. Sr-90 product for medical isotope use (TK-104 and TK-105 only)
3. Remote handled low level waste (RH-LLW)
4. CH-LLMW
5. Rinse Solutions (to be designated).

The anticipated composition of each waste stream, based on bench scale testing with waste simulants, is given in Table 3-2. The projected volumes, classifications, EPA waste codes, and treatability group for each waste stream is given in Table 3-3.

3.1.1 CH-TRUMW Stream

The CH-TRUMW stream will be generated by two process steps, the metals filtration and the TRU removal column.

The metals filtration step will generate CH-TRUMW during a two stage process. The first stage is the addition of sodium hydroxide, sodium carbonate, and potassium phosphate to the initial HLV tank waste. The chemical addition will result in neutralization of the waste (eliminating the characteristic of corrosivity) and precipitation of the hazardous metals. In addition, the transuranic contamination in the waste will also precipitate out of solution. This stage will generate a particulate which will be filtered out during the second stage. The filtered solids will constitute the CH-TRUMW stream.

The CH-TRUMW designation results from the hazardous metals and transuranic isotopes precipitated by the chemical addition while most of the high dose cesium and strontium remains in solution. The HLMW designation of TK-107 is eliminated in this stage by separating the TRU component from the high dose LLW component which is consistent with DOE Order 5820.2A, "Radioactive Waste Management". The removal of the hazardous metals and TRU constituents combined with the elimination of the corrosivity characteristic results in liquid waste remaining after this stage designating as LLW.

Table 3-1
Analytical Results of HLV Tanks (June 7, 1990)

ANALYSES	TK-104	TK-105	TK-107
pH	1.4	1.5	0.7
Sr-90, d/m-l	1.52 E9	1.40 E10	9.23 E10
Total U, μg/ml	0.17	0.96	4.9
Fluoride, ppm	ND	648[a]	ND
Chloride, ppm	<500[b]	3678[a]	<15[b]
Nitrite, ppm	ND	300[a]	ND
Nitrate, ppm	6287	38650[a]	123600
Phosphate, ppm	ND	<40[a]	ND
Sulfate, ppm	ND	1976	ND
Cs-137, d/m-ml	1.09 E9	2.64 E10	1.42 E11
Cs-134, d/m-ml	ND	ND	6.47 E8
Eu-154 d/m-ml	ND	3.77 E5	1.50 E9
Am-241 d/m-ml	8500	1.55 E5	ND
Total α d/m-ml	16500	8.00 E5	2.32 E9

a - Samples were taken 7/1/90 b- Samples were taken 6/18/90 ND = No data available

Table 3-1 (continued) Analytical Results of HLV Tanks (June 7, 1990)			
ANALYSES	TK-104	TK-105	TK-107
Al, µg/ml	3.0	ND	175
B, µg/ml	5.47	ND	131
Ba, µg/ml	1.90	ND	1074
Ca, µg/ml	12.6	ND	394
Cd, µg/ml	ND	ND	44
Co, µg/ml	ND	ND	800
Cr, µg/ml	.48	ND	405
Cs, µg/ml	67.7	619	2451
Cu, µg/ml	5.04	ND	ND
Dy, µg/ml	2.84	ND	ND
Fe, µg/ml	7.88	ND	12200
K, µg/ml	2.1	ND	ND
La, µg/ml	2.0	ND	820
Mg, µg/ml	2.84	ND	44
Mn, µg/ml	2.42	ND	220
Mo, µg/ml	ND	ND	1340
Na, µg/ml	45.9	ND	ND
Nd, µg/ml	ND	ND	190
Ni, µg/ml	1.46	ND	ND
P, µg/ml	11.5	ND	360
Pb, µg/ml	15.6	ND	ND
Ru, µg/ml	ND	ND	830
Se, µg/ml	ND	ND	ND
Si, µg/ml	19.6	ND	390
Sr, µg/ml	15.4	217	660
Te, µg/ml	ND	ND	ND
Ti, µg/ml	0.19	ND	130
U, µg/ml	0.6	1.3	5
V, µg/ml	ND	ND	ND
Zn, µg/ml	1.2	ND	93
Zr, µg/ml	2.78	ND	620

ND = No data available

Table 3-2 Estimated HLV Treatment Process Effluent Stream Compositions (Wt%)[1]

Constituent	CH-TRUMW		Sr-90 Product	RH-LLW		CH-LLMW	
	TK-107	TK-104/105	TK-104/105 only	TK-107	TK-104/105	TK-107	TK-104/105
Al	0.45	1.71	NA	NA	NA	0.01	NA
B	0.15	0.66	0.19	NA	NA	0.06	0.04
Ba	3.01	0.72	0.87	NA	NA	NA	NA
Ca	1.11	1.89	11.68	NA	NA	NA	NA
Cd	0.12	NA	NA	NA	NA	NA	NA
Ce	2.25	NA	NA	NA	NA	NA	NA
Cr	1.14	0.18	NA	NA	NA	NA	NA
Cs	0.57	0.08	0.01	3.11	2.85	NA	NA
Cu	NA	3.11	NA	NA	NA	NA	NA
Eu	0.01	NA	NA	NA	NA	NA	NA
Fe	34.30	4.90	NA	NA	NA	NA	NA
K	NA	NA	NA	NA	NA	NA	0.02
La	2.30	1.19	NA	NA	NA	NA	NA
Mg	0.12	0.94	0.77	NA	NA	NA	0.01
Mn	0.62	1.49	NA	NA	NA	NA	NA
Mo	0.75	NA	NA	NA	NA	0.75	NA
Nd	0.53	NA	NA	NA	NA	NA	NA
Ni	NA	0.81	NA	NA	NA	NA	NA
P	1.00	6.35	0.32	NA	NA	NA	0.01
Pb	NA	9.61	NA	NA	NA	NA	NA
Ru	2.33	NA	NA	NA	NA	NA	NA
Si	0.92	6.05	0.48	NA	NA	0.05	0.08
Sr	2.95	3.38	39.12	NA	0.01	NA	NA
Ti	0.37	0.10	NA	NA	NA	NA	NA
Zn	0.26	0.69	NA	NA	NA	NA	NA
Zr	1.74	1.68	NA	NA	NA	NA	NA
Na	NA	NA	NA	NA	NA	24.84	32.19
NO_3	NA	NA	NA	NA	NA	73.16	53.73
OH	20.79	51.46	NA	NA	NA	0.01	NA
CO_3	NA	3.00	46.55	NA	NA	NA	13.92
PO_4	22.20	NA	NA	NA	NA	1.12	NA
IE-96	NA	NA	NA	96.89	97.13	NA	NA
Total	99.99	100	99.99	100	99.99	100	100

1. The estimated HLV treatment process effluent stream compositions are based on bench scale testing with waste simulants.

NA = Not evaluated during the bench scale testing.

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Table 3-3 HLV Treatment Process Waste Streams

Waste Stream (Est. Quantity)	Hazard	Generating Process	Rationale for Designation	EPA/State Waste Codes[1]	LDR
TK-104/105 Liquid: S02[2], T23[2], T31 (3000 Kg)	Toxic / Corrosive	Initial Waste Stream	Process Knowledge/ Analytical Data	D002, D005, D006, D007	40CFR 268.40 (Waste Water)
TK-107 Liquid: S02, T23, T31 (825 Kg)	Toxic / Corrosive	Initial Waste Stream	Process Knowledge/ Analytical Data	D002, D008	40CFR 268.40 (Waste Water)
CH-TRUMW Solid: S01[2] (93.6 Kg)	Toxic / Radioactive	Neutralization/ Precipitation of Initial Waste; TRU Ion Exchange Column	Process Knowledge	D005, D006, D007, D008	40CFR 268.40 (Non-Waste Water)
RH-LLW (200 Kg)	Radioactive	Ion Exchange of Treated Waste Stream	Analytical Data	None	40CFR 268.40 (Non-Waste Water)
CH-LLW Solutions[3] (4119 Kg)	Radioactive	Ion Exchange of Treated Waste Stream	Analytical Data	None	40CFR 268.40 (Non-Waste Water)
CH-LLMW[4] Solid: S01 (233 Kg)	Toxic / Radioactive	Evaporation of Treated Waste Stream	Process Knowledge	WT02	40CFR 268.40 (Non-Waste Water)
Rinse Solutions Liquid: S02, T23, T31[2] (Quantity TBD)	Corrosive[5] / Radioactive	Rinsing of Empty Tanks	Analytical Testing	D002[5]	40CFR 268.40 (Waste Water)

1. Waste designations are preliminary. Official waste designations will be completed by PNNL Waste Management prior to disposal.
2. Management method for dangerous (hazardous) waste , Washington Administrative Code 173-303-380(2)(d) (S02 = storage in tank; T23 = treatment by chemical precipitation; S01 = storage in containers; T31 = treatment by neutralization)
3. This waste stream will be generated only if waste is sent to the DSTs.
4. This waste stream will not be generated if waste is sent to the DSTs.
5. This waste designation will be updated when test results are available.

The second process step to generate CH-TRUMW will be the TRU removal column. The ion exchange resin used during this process step will remove and concentrate the trace TRU and any residual hazardous metals remaining in the solution after the strontium precipitation step (metal filtration step for TK-107 wastes). This concentration of waste constituents will result in the TRU removal columns being designated as CH-TRUMW.

3.1.2 Sr-90 Product Stream

The Sr-90 product stream will be generated to provide a relatively pure isotope source for the production of Y-90 which is used in the treatment of cancer. After the CH-TRUMW solids have been removed from the waste solution, additional sodium carbonate will be added to the treatment process which will generate a strontium carbonate precipitate. The precipitate will then be recovered by filtering and managed as a product. This process step will not affect the LLW designation of the liquid waste.

The Sr-90 product stream will only be generated during the processing of the wastes from TK-104 and TK-105. It is estimated that 1.27 Kg (2.8 lbs) of Sr-90 will be recovered from this treatment process.

3.1.3 RH-LLW Stream

The RH- LLW stream will be generated by removing the Cs-137 and residual Sr-90 from the liquid waste using ion exchange technology. The liquid waste will be passed through an ion exchange column containing a resin with a high affinity for Cs-137 and Sr-90. The goal of this process step is to separate the high dose LLW portion into a package which can be sent to the Hanford Site Low Level Waste Burial Grounds. The remaining liquid waste will then consist of relatively low dose LLW which will either be transferred to the DSTs in the 200 Area via the 340 Building or evaporated in the final process step.

3.1.4 CH-LLW Solutions

The CH-LLW Solutions waste stream[7] will consist of solutions remaining after the completion of all process steps. The CH-LLW designation results from the removal of all hazardous constituents, TRU, and high dose radionuclides.

3.1.5 CH-LLMW Stream

The CH-LLMW stream[8] will be generated by the evaporation of the remaining low dose LLW. Evaporation of the liquid will result in the concentration of nitrates present in the solution. The final nitrate concentration will result in the designation of the evaporation solids as dangerous (hazardous) waste.

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[7]This waste stream will only be generated if the solutions from the ion exchange columns are sent to the DSTs.

[8]This waste stream will only be generated if the solutions from the ion exchange columns are not sent to the DSTs.

3.1.6 Rinse Solutions

After the waste solutions have been removed from the HLV tanks, each tank will be rinsed to remove any residual wastes. The initial rinse solutions will consist of dilute nitric acid (0.1 M and 0.01 M). The nitric solutions will be used to prevent precipitation from occurring due to a pH change in an HLV tank. After the tanks have been rinsed sufficiently to prevent precipitation, a final rinse will be conducted using a sodium carbonate solution (0.05 M). This will ensure that any residual rinse solution remaining in the HLV tanks is not corrosive. It is expected that the nitric acid rinse solutions will flush hazardous residuals from the HLV tanks resulting in the rinse solutions designating as remote handled low level mixed waste (RH-LLMW). To ensure proper management, the rinse solutions will undergo the same treatment process as the initial HLV tank wastes. The final sodium carbonate solution will be designated as LLW.

3.2 Waste Analysis Parameters

All waste solutions currently stored in the HLV tanks TK-104, TK-105, and TK-107 originated from research activities conducted in the 324 Building. These research activities have provided extensive generator knowledge regarding the chemical characteristics of the waste. The wastes in TK-104 and TK-105 were generated from feed stock solutions used in the production of heat and radiation sources. The feed solutions were prepared from cesium nitrate and strontium nitrate solutions received from the B-Plant Waste Separation and Encapsulation Facility located in the Hanford Site 200 Area. The HLV tank waste streams were reviewed for possible presence of listed waste and organic waste characteristics and it was determined that neither of these waste categories were present[9]. The wastes in TK-107 were generated from the reprocessing of commercial spent fuel. Reprocessing does not utilize listed materials or characteristic organics and results in a nitric acid solution contaminated with hazardous metals and miscellaneous fission products. This information along with analytical data obtained from tank samples and treatment process design parameters was used as the basis for determining waste analysis parameters.

In selecting the waste analysis parameters, the goal was to provide the information necessary for proper waste identification, identification of incompatible wastes, land disposal restriction (LDR) requirements, and process verification.

3.2.1 Parameter Selection Criteria

The HLV waste treatment process must successfully separate the hazardous components from the high activity portion of the waste stream to allow for the process effluents to be disposed of using existing pathways. The acidic nature of the waste and the solubility of the waste constituents provide a uniform waste stream which will be fed to the treatment process. The treatment process equipment and waste containers have been designed and constructed to be compatible with the initial nitric acid wastes, chemicals which will be introduced to the system, and effluents generated during the treatment process.

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[9]Weaver, PJ. June 1995. *Regulatory Review of the RCRA Status for FRG Feed Materials*, Pacific Northwest Laboratory, Richland, Washington.

A parameter selection review was performed on the treatment process using the following criteria:

1. Identification and verification of constituents to allow for proper designation
2. Land disposal restriction requirements
3. Treatment process verification
4. Determination of optimum mix ratios for chemical additions during treatment
5. Process and design criteria

A review of process and operation records has determined that there are no listed wastes or characteristic organics present in the HLV tank waste streams. Analysis conducted on the HLV tank wastes in 1990 indicate the presence of metals and a low pH; therefore, the HLV tank wastes classify as characteristic wastes which are subject to federal land disposal restrictions. This dictates that the selected criteria need to provide sufficient data to allow characteration of the treatment process effluent streams for characteristic metals and pH and to demonstrate compliance with the applicable land disposal restrictions.

The LDR requirements were determined by reviewing the HLV tank waste designation and reviewing it against the requirements of 40 CFR 268.40. The LDR requirements are summarized in Table 3-4. The RH-LLW stream will be the only process effluent treated to meet LDR requirements. In addition, the Sr-90 stream will be a product and is therefore not subject to LDR.

3.2.2 Parameter Selection

To maintain the project exposure ALARA, some of the process effluent streams will be designated as mixed waste based on process knowledge. This will eliminate unnecessary sampling and analysis of high dose process effluents. Process effluents which will be designated using process knowledge are the CH-TRUMW and CH-LLMW streams.

Control of pH during the treatment is the key to success of the treatment process, which relies on chemical precipitation to separate the characteristic metals. To verify the success of this process step, the pH will be monitored after the chemical addition in the first stage of the treatment to ensure proper chemical addition and mixing.

The LLW process effluent generated from treatment of TK-104/105 waste will be sampled and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) hazardous metals to verify the non-dangerous (non-hazardous) designation and to ensure that the applicable LDRs have been met to allow the waste to be disposed of at the Hanford Site LLW Burial Grounds.

During the treatment of TK-107 waste, the in process solution will be sampled and analyzed for TCLP metals prior to the ion exchange columns. This analysis will be used to verify the

Table 3-4 LDR Requirements

Waste Code	Characteristic	Wastewater/ Nonwastewater	Applicable Standard (40 CFR 268.40)	Requirement
D002	Corrosivity	Wastewater	Technology Based	Deactivation[1]
D005	Barium	Wastewater	Constituent Concentration in waste	100 mg/l
D006	Cadmium	Wastewater	Constituent Concentration in waste	1.0 mg/l
D007	Chromium	Wastewater	Constituent Concentration in waste	5.0 mg/l
D008	Lead	Wastewater	Constituent Concentration in waste	5.0 mg/l
D005	Barium	Nonwastewater	Constituent Concentration in waste extract	100 mg/l
D006	Cadmium	Nonwastewater	Constituent Concentration in waste extract	1.0 mg/l
D007	Chromium	Nonwastewater	Constituent Concentration in waste extract	5.0 mg/l
D008	Lead	Nonwastewater	Constituent Concentration in waste extract	5.0 mg/l

1. The HLV tank waste treatment process meets the definition of a "CWA-Equivalent" system as defined in 40 CFR 268.37 (a) and is not required to meet F039 standards.

non-dangerous (non-hazardous) designation for the LLW generated from the treatment of TK-107 waste. The high cesium concentration and low waste volume of TK-107 waste allows the waste stream to be designated in this manner. The ion exchange columns will become loaded with cesium from a small volume of solution which prevents any possible concentration of hazardous constituents.

If the decision is made during processing to transfer the final LLW solution to the double shell tanks (instead of evaporation), samples will be taken to verify the LLW designation and that the solution meets DSTs acceptance criteria.

An overview of the parameters selected and the rationale for selection are presented in Table 3-5.

3.2.3 Special Parameter Selection Requirements

The extremely high radiation dose (>>1000 R/hr) of the HLV tank waste and some of the treatment process effluent streams present unique problems in sampling and analysis of waste streams. The high radiation dose will require that all work be conducted remotely. To minimize the risk to staff and maintain the treatment process exposure ALARA, the number of samples analyzed will be the minimum required for characterization, LDR, and process verification. The use of duplicate samples will be avoided whenever possible.

3.3 Sampling

The samples collected during the treatment process fall into two categories. The first is to ensure that the process was successful in separating the various components of the HLV tank waste; these samples are identified as "designation samples." These samples will be used for waste designation and confirmation that LDR requirements have been met. The second category is to gather information to be used during later stages in the process; there are identified as "process samples". Types of information gathered include specific isotopic curie levels and acidity of the waste stream. Specific sampling procedures detailing sampler operation and sample handling will be included in the operating procedure for the treatment process.

3.3.1 Sampling Strategies

Designation samples of the waste solution will be taken during the neutralization step, the ion exchange feed tank[9], and of each ion exchange column after it has been loaded and removed from service[10]. The remaining waste streams generated during the treatment will be designated using process knowledge which consists of testing conducted during process development. This method provides analytical data for the designation of all projected non-hazardous waste streams and process knowledge for all projected hazardous waste streams. The sampling strategies which will be used are summarized in Table 3-6.

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[9]These designation samples will only be collected during the treatment of TK-107 waste.

[10]These designation samples will only be collected during the treatment of TK-104/105 waste.

Table 3-5 Parameter Selection

Waste (Sample Location)	Parameter[1]	Rationale for Selection
TK-107; TK-104/105 (TK-112)	Acidity, Gamma Scanning, Alpha	To determine the appropriate volumes of neutralizing agents to be added and loading of filters and ion exchange columns.
TK-107; TK-104/105 (Neutralization Tank)	pH	To verify the end point of the neutralization step.
CH-TRUMW (N/A)	None	Based on process development testing, sufficient information exists to know that hazardous metals will be present above regulated levels.
Strontium Precipitate (Carbonate Precipitation Tank)	Sr-90	To ensure that strontium product filters are not overloaded with Sr-90.
In Process Solution (Ion Exchange Feed Tank)[2]	Gamma Scanning, TCLP-Metals	To verify hazardous metals removal and verify that the Ion Exchange columns are not overloaded with Cs-137.
RH-LLW (Ion Exchange Columns)[3]	Gamma Scanning, Alpha, TCLP-Metals	To ensure that the Ion Exchange columns are not overloaded with Cs-137, to verify the non-hazardous designation, and to verify that LDR requirements have been met.
CH-LLW Solutions (LLV)[4]	Gamma Scanning, TCLP-Metals, Cl^-	To verify that solutions met acceptance criteria for the DSTs.
CH-LLMW (N/A)[5]	None	Sufficient information exists from process development testing[6] and upstream testing, to know that the solids will not contain hazardous metals but will contain sufficient sodium nitrate to designate as a state only mixed waste.
Rinse Solutions (TK-112)	Acidity, Gamma Scan, TCLP-Metals	To verify waste designation and to determine if treatment is necessary and to determine the appropriate volumes of neutralizing agents to be added.

1. Information regarding specific analytical methods is provided in Table 3-7 "Analytical Methods".
2. These samples will only be collected during the treatment of TK-107 waste.
3. These samples will only be collected during the treatment of TK-104/105 waste.
4. This waste stream will only be generated if the treated solutions are transferred to the DSTs.
5. This waste stream will only be generated if the treated solutions are not transferred to the DSTs.
6. Reference Table 3-2.

Table 3-6 Sampling Strategies

Waste (Sample Location)	Sample Type	Sample Frequency	Sample Strategy	Rationale
TK-107; TK-104/105 (TK-112)	Grab	One per process batch[1]	Authoritative	The waste consists of a uniform matrix which is thoroughly mixed by the turbulence of the transfer from the HLV to B-Cell.
TK-107; TK-104/105 (Neutralization Tank)	In Line	Monitoring during transfer to next step	Authoritative	The pH will be monitored after chemical addition to ensure proper neutralization is achieved.
Strontium Precipitate (Carbonate Precipitation Tank)	Grab	Once during the first treatment batch[2] of TK-104/105 waste	Authoritative	The waste consists of a uniform matrix which is thoroughly mixed by the turbulence of the transfer through the metals filter.
In Process Solution (Ion Exchange Feed Tank)	Grab	One per treatment batch[2] of TK-107 waste	Authoritative	The waste consists of a uniform matrix which is thoroughly mixed by the turbulence of the transfer through the Sr-90 filter.
RH-LLW (Ion Exchange Columns)	Core	One per column for TK-104/105 waste	Authoritative	The waste is uniform in the axial direction due to diffusers located in the bottom of the column. In the longitudinal direction the waste is more concentrated in the bottom due to ion exchange absorption as the liquid travels up through the column.
CH-LLW Solutions[3]	Grab	Once	Authoritative	Treated Solutions will be collected in the LLW for transfer to the DSTs.
Rinse Solutions	Grab	One per process batch[1]	Authoritative	The waste consists of a uniform matrix which is thoroughly mixed by the turbulence of the transfer from the HLV to B-Cell.

1. A process batch consists of the HLV tank waste contained in TK-112 after a batch transfer from the HLV to B-Cell . Typical volume is 1000 liters (266 gal).
2. A treatment batch consists of the HLV tank waste contained in the VTV after a batch transfer from B-Cell to D-Cell. Typical volume is 100 liters (26.6 gal).
3. This sample will only be collected if the treated solutions are to be transferred to the DSTs.

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During the neutralization step the pH will be measured using a pH meter and recorded in the HLV project records. The pH meter will be calibrated prior to installation into the cell. After installation, the high radiation dose and process configuration will prevent operating staff from recalibrating the probe during operations. If pH readings deviate more than two from projected values (estimated from the titration of solutions to be processed), the pH probe will be replaced with a calibrated probe. During the construction of each ion exchange column, a tube will be inserted into the resin bed. After the column is loaded, the tube can be removed with a complete core sample of the resin bed. Specific sampling procedures will be included in the operational procedures for the treatment process.

Process samples will be taken at several stages of the treatment to verify process constraints (pH limits, curie limits). Initial samples will be collected from the HLV tank wastes and undergo titration, gamma scanning, and TRU analysis. This information will be used to determine the proper chemical addition needed during the neutralization step and the number of filters needed during the metals filtering step. Process samples will be taken at three other locations during the treatment process; the strontium feed tank, the rinse solutions, and TK-102. The strontium feed tank will be analyzed to verify the level of strontium recovery; the rinse solutions will be analyzed to determine any necessary treatment requirements; and TK-102 will be analyzed to verify that the solutions meet DSTs acceptance criteria.

3.3.2 Sampling Methods

The parameters selected require that samples be collected from three different locations in the process, TK-112, ion exchange feed tank, and the cesium ion exchange columns. Samples collected from TK-112 will be collected using the tank's closed loop sampler. A representative sample is collected by allowing the tank solution to recirculate through the sample bottle prior to stopping the air jet. The ion exchange feed tank will utilize a grab sample. The sample will be representative due to the in tank mixer. Prior to loading the ion exchange columns, a tube will be inserted into the resin bed. The tube will have a mesh screen at each end which will contain the ion exchange resin while allowing the solution to freely contact the resin inside. After the column is loaded with Cs-137 from the processing, the tube will be removed from the column providing a core sample.

3.3.3 Sample Preservation and Storage

Samples collected for gamma scanning and TRU analysis do not require sample preservation due to the nature of the testing. Titration and pH measurements will not require preservation due to the analysis being used only for indication purposes. High dose LLW samples will be collected and placed into glass containers and transported to an analytical laboratory.

3.3.4 Sampling Quality Assurance/Quality Control (QA/QC)

All samples collected for waste designation and verification of LDRs will use the following QA/QC procedures:

1. Chain of Custody (from collection to delivery to lab)

2. Compatible Sample Containers
3. Limited (1 in 20) Field Duplicate Samples (due to ALARA considerations)

Since pH will be monitored during the process and no samples will be collected, QA/QC for pH measurements will consist of calibrations of the pH meter.

3.4 Selecting a Laboratory and Analytical Methods

The Analytical Chemistry Laboratory (ACL), located in the 325 Building, has been selected as the laboratory for conducting all qualitative chemical testing required during the processing. The ACL is equipped to analyze high activity samples and has the necessary QA/QC procedures in place (QA Plan MCS-033) and technical expertise to complete the required analysis.

The selection of analytical testing methods were based on the following criteria:

1. Selected Testing Parameters
2. Waste Designation Requirements
3. LDR Treatment Standards

The selected methods are provided in Table 3-7. Each of the selected methods is based on SW-846 procedures with modifications as necessary to accommodate the high activity of the samples being analyzed.

3.5 Re-Evaluation Frequencies

Process samples will be re-evaluated when the waste entering the treatment process changes (switching from TK-104/TK-105 to TK-107 waste solutions). This will allow process parameters to be adjusted to maximize treatment efficiencies. Designation samples will be analyzed for each batch of process effluents generated during the treatment process. This frequency will ensure that all applicable LDR standards have been successfully met.

3.6 Waste Receipt from Off-Site Generators

The HLV tank waste treatment process will not receive waste from any off-site generators.

3.7 Ignitable, Reactive, and Incompatible Wastes

Prior to and after treatment, there will be no ignitable, reactive, or incompatible wastes present. Sufficient process knowledge and analytical data are available (see Table 3-1) to determine that each of the HLV tank wastes have similar compositions and are compatible with each other. Differences in the HLV tank wastes consist of concentration variations.

Table 3-7 Selected Analytical Methods

Parameter	Test Method	PNNL (ACL) Procedure	SW-846 Reference	Significant Variations
TCLP Metals	TCLP	PNL-ALO-110	1311	Smaller sample size, reagent volumes.
TCLP Metals	Acid Digestion	PNL-ALO-128	3010A	Block digested vs. Beaker digested; Smaller sample size; Closed system with small dilution factor vs. Digesting to low volume and making back up to original starting volume.
TCLP Metals	ICP	PNL-ALO-211	6010A	Interference correction vs. Background correction in combination with interference correction.
TCLP Metals	GFAA	PNL-ALO-252	7041; 7060; 7131; 7421; 7740; 7761; 7841	No substantive deviations.
Acidity	Titration	PNL-ALO-382	N/A	N/A
Alpha	Alpha Energy	PNL-ALO-128 PNL-ALO-420 PNL-ALO-421	N/A	N/A
Am/Cm/Pu	Chemical Separation/ Alpha Energy	PNL-ALO-128 PNL-ALO-417 PNL-ALO-422	N/A	N/A
Sr-90	ICP/MS	PNL-ALO-128 PNL-ALO-431 PNL-ALO-476	N/A	N/A
Gamma Scanning	Gamma Energy	PNL-ALO-128 PNL-ALO-450	N/A	N/A
Cl^-	IC Anion	PNL-ALO-212	N/A	N/A

The HLV tank wastes, which are acidic, will be mixed with caustic solutions at a controlled rate during the neutralization step. Prior to the addition of the caustic solution, a process sample will be taken from the HLV tank waste and titrated to determine the proper volume of caustic solution to be added. By using a controlled addition rate, excessive heat generation and violent reactions will be eliminated. The possibility of an accidental mixing of the two solutions is prevented by the HLV tank wastes being inside the hot cell and the caustic solution being maintained on the outside of the cell. Controlled chemical additions will be made using service plugs elevated two to three feet above the floor level of D-Cell.

3.8 Compliance with LDR Requirements

The HLV tank waste is subject to the LDRs in accordance with 40 CFR Part 268. The only treatment effluents which will be treated to LDR limits are the RH-LLW (ion exchange columns). This document details the activities which will be conducted to comply with LDR standards to allow burial of this waste in the Hanford Site LLW Burial Grounds. All records pertaining to the treatment of the HLV tank waste will be retained for a minium of five years.

The other process effluents will be transferred to permitted storage facilities (Hanford Site Central Waste Complex and/or the DSTs) and will require additional treatment prior to land disposal. LDR notifications and/or certifications will accompany shipment of the HLV tank waste and/or its treatment residues from the 324 Building. Thirty (30) days prior to the initiation of treatment, this document will be submitted to the EPA with a courtesy copy sent to Ecology.