X-WCP-H-00008

Revision 8

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Waste Compliance Program for Liquid Waste Transfers from H-Canyon to 241-H Tank Farm

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Summary of Revisions

X-WCP-H-00008, Revision 8 incorporates the addition of enriched uranium-molybdenum materials into the Highly Enriched Uranium (HEU) legacy materials being processed in the facility. In addition, the ammonium limit for PVV flush material is included in wt % of the CLFL requirement with the basis of the wt% documented in reference 31. The HCAN-RW-06 stream is expressly prohibited from transfer to Tank 50.

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Requirement: **This document meets the Condensate Storage and Transfer Facilities (CSTF) requirements of the following:**

- **DSA 6.5.2**
- **SAC 5.8.2.15**
- **SAC 5.8.2.25**
- **Admin Control 5.8.2.13**
- **Admin Control 5.8.2.32**
- **JCO WSRC-2003-00083, 5.02**

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1.0 Background and Waste Generator Responsibilities

Liquid Waste (LW) has established the Waste Acceptance Criteria (WAC) (Reference 1) to control receipts of liquid waste into the CST. The WAC requires that the waste generators develop a Waste Compliance Program (WCP) document which describes the waste generating process and the controls that ensure the stream(s) comply with the WAC requirements. The WCP is developed and revised in accordance with reference 23. The WCP characterizes each waste stream's composition, providing the basis for Liquid Waste Engineering (LWE) to evaluate the stream's acceptability. The WAC and WCP combine to bridge the interface between LW and the waste generator and ensure that waste transferred to CSTF can be safely stored and processed for disposal.

The WAC designates the waste generator as being responsible to:

- develop, document, co-approve, and implement a WCP;
- clearly identify items within the WCP that protect LWF SB requirements and the program for maintaining controls for these items (e.g., procedures, procurement specification);
- designate their "Liquid Waste Generator Representative" (LWGR), who serves as the primary contact with LW for all communications regarding these responsibilities;
- prepare all waste for transfer to HLW so that all WAC requirements are met;
- verify that any procedure changes associated with a waste stream do not impact any WAC/WCP agreements;
- input all characterization and transfer information into the Wisdom Workgroup WG08 as agreed to in the WCP and maintain records demonstrating compliance with the WAC and WCP;
- notify the LWE WAC Cognizant Engineer when a special transfer is terminated (e.g., completion of PVV flush);
- include compliance with their WCP as part of a self assessment program;
- finance any additional evaluations or other measures required for the CST to accept special waste;
- report a WAC non-compliance to LW and assist the investigation (e.g., PR/STAR, SIRIM);
- finance any required studies to develop technical bases for receipt of the waste;
- finance any corrective action resulting from the generator's failure to meet the WAC

Note: All items denoted above are included in this document.

2.0 H-Canyon and Outside Facilities Process Description

The H-Canyon and Outside facilities have recovered uranium, plutonium, neptunium, thorium and americium at various times since startup in 1953. The current mission of these facilities is to process unirradiated uranium fuels and Highly Enriched Uranium (HEU) legacy materials containing U-235 at enrichments from 1.1 % up to 100 % by weight to recover uranium and neptunium isotopes. The HEU legacy materials include miscellaneous uranium metals, oxides and powders. Waste derived from HEU legacy materials is chemically and isotopically similar to waste from irradiated fuels [Reference 16]. Neptunium solutions of various isotopic compositions were recovered and are currently stored in the canyon awaiting further disposition. These solutions are presently stored in stainless steel vessels in various cells in the canyon. Each cell is also equipped with a sump. The sump collects material in the unlikely event that one of these storage vessels leaks into a cell. H-Canyon receives Laboratory Sample Returns from F/H Area Laboratory and SRNL which is blended with canyon waste prior to processing. Since this is an irregular waste stream, approved procedures must be submitted to LW prior to receiving authorization for transfer. Rainwater, ground water, process solutions and process flush solutions collected at other facilities that meet the WAC and WCP plan requirements implemented by H-Area are also processed in H-Area.

2.1 Modified HM-Process (HCAN-RW-05 and HCAN-RW-06)

The HM-Process consists of multiple primary unit operations with a number of support operations. In the Dissolving process unirradiated fuel elements clad in aluminum are initially placed in a 4 M nitric acid bath that contains a 0.0007 M $Hg(NO_3)_2$ (mercuric nitrate) catalyst. HEU legacy materials are dissolved utilizing a similar flowsheet or are received as HEU solutions from HB-Line. HEU legacy materials may be blended with plant fuel solutions and processed through the Head End, First Cycle, and Second Uranium Cycles as described below.

In the Head End process, solution from the dissolver is evaporated until the concentration is approximately 1.0 M $Al(NO_3)_3$ and 2.3 M HNO_3. Next, a strike occurs in which gelatin is added to coagulate with the silica and cause a precipitate to form. The resulting slurry is then centrifuged. The clarified solution is sent to First Cycle while the precipitated cake is rinsed to recover uranium prior to transfer to a High Activity Waste (HAW) neutralization tank and eventually to the CSTF.

In the First Cycle process, the uranium and neptunium are separated from the aluminum, molybdenum, plutonium, and fission products in the feed through a series of three mixer-settler banks with various stages. A mixture of 7.5 % tri-butyl phosphate in n-paraffin is utilized either as the extractant in the 1A Bank or as the scrub in the 1B Bank. Various concentrations of nitric acid and ferrous sulfamate, $Fe(NH_2SO_3)_2$, are also utilized to effect separation. The waste stream from First Cycle consists nominally of 0.7 M $Al(NO_3)_3$, 1.8 M HNO_3, 0.02 M $Fe(NH_2SO_3)_2$, fission products, and trace quantities of Pu. The waste stream is processed through a decanter to remove entrained solvent and then fed to the HAW system (source of HCAN-RW-06 stream). The product stream 1CU from First Cycle is fed to the Second Uranium Cycle while product stream 1BP is routed via Tank 13.3 to the Second Product Cycle (if originally derived from irradiated materials) or processed directly as Low Activity Waste (LAW) (if coming from unirradiated material).

H-Canyon also has an option to exclude ferrous sulfamate from the 1AS input stream to the 1A Bank thereby extracting most of the Pu into the 1AU stream and precluding Pu from exiting in the 1AW stream. The Pu inventory exits the 1B Bank in the 1BP stream and is routed to the LAW system. The total amount of Pu sent to the CSTF does not increase but is merely redistributed from the HAW stream to the LAW stream. Precluding Pu from the 1AW stream substantially reduces the total alpha radiation in the liquid portion of neutralized waste in the HAW system. This processing scheme is in support of disposing Low Level Waste to the Saltstone Facility, reference 24.

In the Second Uranium Cycle process, the uranium product stream is processed through a decanter to remove entrained solvent and then concentrated from roughly 0.4 M HNO_3 to 4.5 M HNO_3. Solutions previously processed and stored in the Enriched Uranium Storage tank can be blended with 1CU. The stream is then fed to a series of two mixer-settler banks to further separate out Np, Pu, and fission product impurities. Inlet streams to these mixer-settler banks include various concentrations of dilute nitric acid, a mixture of 7.5 % tri-butyl phosphate in n-paraffin, and a 0.05 M $Fe(NH_2SO_3)_2$ stream. The waste stream from Second Uranium consists nominally of 3.4 M HNO_3, 0.006 M $Fe(NH_2SO_3)_2$, fission products, and trace quantities of Pu and Np. This waste stream is decanted and processed through the LAW system (source of HCAN-RW-05 stream).

In the Solvent Recovery process degradation products and radioactive contaminants are removed from the solvent used in the solvent extraction process. Because the quantity of solvent utilized in the banks is extensive and the quality of the solvent degrades upon exposure to radiation and nitric acid, the solvent must also be processed to remove radioactive impurities and mono- and di-butyl phosphates before it is recycled back to the mixer-settler banks. Solvent recovery utilizes a 2.5 % Na_2CO_3 wash to remove uranium, neptunium, fission product contaminants, and byproducts of TBP. The solvent is then washed with 0.75 % nitric acid. Each of the two sets of mixer-settler banks has a separate wash cycle. The waste generated through the sodium carbonate wash is processed through the LAW system whereas the waste generated in the acid wash phase is processed through the General Purpose evaporator (source of HCAN-RW-03 stream).

In the HAW process, waste is received from 1st Cycle (1AW) and Sumps (16.2). Tank 8.1 is used as a feed tank for the operation of evaporators 9.1E and 9.2E. Additionally, dilute solution from the Canyon's fuel bundle storage cells, swimming pool, warm canyon sump solution, and decon cell can be processed in HAW evaporators. Nitrite may also be introduced in the evaporators to destroy ammonium that is present in the waste stream. Any neutron poison (ferrous sulfamate/manganous nitrate) or $NaNO_2$ additions to sump material are made in Tank 16.2 prior to transferring into Tank 8.1. The evaporators are operated to the desired endpoint, while overheads are collected in Tank 9.3 and then transferred to the Acid Recovery Unit (ARU). Head End Evaporator 11.3E overheads are sent to Tank 11.4. The concentrated aluminum salts and radionuclides are then neutralized with NaOH. Head End cakes from 10.3C are also neutralized and sent to CSTF. When HAW solutions are going to Saltstone, recycle of canyon sump solutions through Head End and processing of sump solutions through HAW will be evaluated to determine the impact on Saltstone WAC limits.

The LAW system primarily processes solutions from Second Uranium Cycle, Solvent Recovery, sumps, and neptunium that are currently stored in the H-Canyon. After the waste is collected in a hold tank, the specific gravity is reduced to roughly 1.035 and 30 % sodium nitrite ($NaNO_2$) (nitrites only used in ferrous sulfamate bearing wastes) is added to the waste to destroy any residual sulfamate. The waste is then fed to a low heat waste batch evaporator (6.8E, 7.6E, or 7.7E) where the waste volume is reduced and a large fraction of the acid is recovered and recycled through the ARU in Outside Facilities. Nitrite may also be introduced in the evaporators to destroy ammonium that is present in the waste stream. In addition, miscellaneous solutions collected in Tank 805, consisting of rainwater in the stack and sand filter, can be fed to this process. Also, dilute solution from the Canyon's fuel bundle storage cells, swimming pool, decon cell, and solutions from other facilities that meet the WAC and WCP plan requirements implemented by H-Area can be processed in the LAW evaporators. Because process equipment is rarely deconned, this stream is mainly water contaminated with radionuclides. H-Canyon receives HCAN-IW-02, Lab Sample Returns (LSR) from F/H Area Laboratory and SRNL in Tank 10.5. LSR is blended with other waste in Tank 11.8 prior to decantation and evaporation. Since this is an irregular waste stream, approved procedures must be submitted to LW prior to receiving authorization for transfer.

The evaporator pot bottoms are concentrated until the acid and salt content reach a specific gravity of roughly 1.32. These bottoms containing salts and concentrated radionuclides are then stripped of recoverable nitric acid. The waste has a neutron poison (manganous nitrate) added, is neutralized with excess NaOH and sent to CSTF.

2.2 Sump Collection and Processing (HCAN-RW-07)

All cells in the hot and warm canyons have sumps to collect leaks from process lines and (in rare instances) process vessels. Liquid from piping leaks in the modified HM-process can be recycled through Head End and First Cycle (if it has significant amounts of product radionuclides) or blended into the feed streams to the HAW or LAW system. Liquid waste from periodic sump flushes throughout the Canyon is similarly handled. When HAW solutions are going to Saltstone, recycle of canyon sump solutions through Head End and processing of sump solutions through HAW will be evaluated to determine the impact on Saltstone WAC limits. Whether to reclaim or dispose of sump waste is based on an evaluation of leaks of 50 gal or more in volume or resulting in a large loss of actinides. A Special Waste Compliance Plan (SWCP) or deviation may be required if the waste causes streams HCAN-RW-05 / HCAN-RW-06 to violate compliance with CSTF WAC as described in this WCP.

H-Canyon retains the option to send sump waste directly to CSTF as stream HCAN-RW-07 instead of incorporating it in streams HCAN-RW-05 / HCAN-RW-06. However, stream HCAN-RW-07 is not currently authorized by CSTF. If and when the need arises, H-Canyon will seek approval from CSTF.

2.3 General Purpose Evaporator (HCAN-RW-03)

The General Purpose (GP) evaporator reduces the volume of miscellaneous low-level aqueous waste collected from various sources in the H-Canyon, HB-Line, and Outside Facilities. Potential sources for the GP evaporator include the Solvent Recovery process, the hot and warm gang valve catch tanks, the railroad tunnel airlock sump, and various sumps that collect rainwater from berms. In addition, rainwater, ground water, process solutions and process flush solutions collected at other facilities that meet the WAC and WCP plan requirements implemented by H-Area is also processed through the GP Evaporator. The feed to the evaporator is sampled and then neutralized with 50 wt % sodium hydroxide. The overheads generated are sent to the Effluent Treatment Project (ETP) for further processing while the evaporator's bottoms are sent to waste tanks in CSTF.

A schematic depicting the GP evaporator is presented in Attachment 12.2.

2.4 Process Vessel Vent Filter Flush for Hot and Warm Canyon (HCAN-IW-01)

The primary function of the process vessel vent (PVV) system is to provide a small negative pressure between the vessels within the canyons and the canyons themselves. This negative pressure provides a sweep across the surface of the contents of the canyon vessels and dilutes flammable vapors such as radiolytically generated hydrogen below safety limits. The PVV system has two filters to remove entrained materials: the warm canyon filter (5.7F) and the hot canyon filter (7.2F). Each filter is flushed periodically with approximately 40,000 lbs. of 5.5 wt % nitric acid solution to remove collected material (ammonium nitrate, uranium, and smaller amounts of other compounds). A schematic depicting the PVV Filter flush for the hot and the warm canyon filters is presented in Attachment 12.3.

The spent solution is transferred to a holding vessel and sampled for U, Pu, Np, Fe, Mn, Pu isotopics, U isotopics, ammonium, and acidity. Based on the fissile material content, Mn (as manganous nitrate) and/or Fe (as ferrous sulfamate) is / are added as required to poison the solution in compliance with CSTF WAC requirements for nuclear criticality safety (Section 9.6). Prior to transfer, the acidic waste is neutralized with sodium hydroxide.

The ammonium nitrate (AN) in the neutralized solution is calculated from the ammonium concentration measured in the acidic solution. To protect the flammability criterion (maximum 20 % of the Composite Lower Flammability Limit [CLFL]) on the vapor space in the receiving pump tank at overflow capacity, CSTF limits the volume of PVV filter flush waste in the tank to 5950.5 gal with a maximum content of 138.72 kg of AN (Reference 19). At these limits the waste ammonia levels are below the maximum 20% of the CLFL, however, increased pump tank ventilation is required since the ammonia concentration exceeds 5% of the CLFL. In turn, a transfer of a full pump tank volume to the receipt waste tank downstream is limited to 131.03 kg. However, the storage tank can accept up to 600 kg AN altogether in multiple transfers spaced at minimum intervals of 8 hours.

The ammonium in solution also provides a basis to calculate the actual buildup of AN in a PVV filter just prior to a flush (Reference 18). A single flush normally removes a minimum 80 % of accumulated AN. The result is contrasted against the estimated value prior to the flush and provides a baseline for the next estimate. H-Canyon normally plans a flush when AN in a filter approaches the operating limit (450 kg).

The nuclear composition of waste from a filter flush is variable, depending on the interval between flushes and the materials processed in H-Canyon during this period. For a conservative calculation of radiological hydrogen generation and inhalation dose potential the bounding isotopic distribution derived from irradiated Mark 16 and unirradiated Mark 22 fuel tubes (Table 1) is assumed.

Table 1 – Isotopic Composition of PVV Flush Waste
(All values in weight %)

U-234	1.3	Pu-238	16.7
U-235	59.7	Pu-239	69.2
U-236	22.8	Pu-240	9.2
U-238	16.1	Pu-241	4.4
	99.9	Pu-242	0.5
			100

2.5 Digested HB-Line Phase II Spent Resin Waste (HCAN-RW-09)

HB-Line Phase II uses Reillex HPQ resin to recover plutonium/neptunium from canyon solutions. Spent resin is periodically replaced as exposure to plutonium/neptunium and acid reduces efficiency. Before the resin is removed from the HB-Line resin columns, the residual Pu/Np is removed with weak acid. The resin is then slurried and transferred to H-Canyon Tank 5.2. The spent resin will consist of ~40 liters of resin slurried in about 40-60 liters of dilute nitric acid from the two columns. Approximately 500-600 liters of process water will be added to tank 5.2 in order to raise the liquid level in the tank above the agitator blades for proper agitation. About 5 liters of 50 % NaOH will be added to reach 0.1 M alkalinity. About 1600 lb of $KMnO_4$ will be added and tank contents heated to 71-76°C for 15 hours to digest the resin. The manganese from $KMnO_4$ will be credited as the neutron poison for the small amount of Pu-239 in the resin. In case of a malfunction, up to 80 g of Pu/Np may be present with the resin from both columns. The manganese will precipitate as MnO_2 [Reference 2]. The digested resin will be further treated with 50 % NaOH to bring the excess hydroxide to 1.2 M for corrosion inhibition in CSTF. About 3,000 liters of waste will be produced and transferred to CSTF for each spent resin changeout. An operating procedure will cover receipt of the resin from HB-Line, digestion, neutralization and the transfer of this stream to CSTF.

2.6 Laboratory Sample Returns (HCAN-IW-02)

Laboratory Sample Returns (LSR) originate as samples collected and analyzed at Savannah River National Laboratory (SRNL) and F/H Laboratory (F/H Lab). The LSR stream includes process samples and any analytical reagents added during the sample analysis. The SRNL samples are transferred into an HAWTT trailer which holds approximately 2,500 gallons and the F/H Lab samples are transferred into an LR-56 trailer which holds approximately 1,000 gallons. The trailers are delivered to the H-Canyon truck well on the west side of H-Canyon. A truck unloading station is utilized to transfer the solutions to canyon tank 10.5. The solutions are mixed with the routine LAW solutions, evaporated through the LAW evaporators, neutralized and chemically adjusted and transferred to LWF. A full characterization of both sources will be performed upon the first receipt of these solutions following approval of revision 7 of this document. Cl and SO_4 analysis has been added to the minimum characterization required for each transfer of these solutions.

3.0 Chemical Inventory

Chemical usage anticipated during operation of the HM-Process is based on recent usage data. The forecast is presented in Table 2.

The typical quantities of chemicals stored for use in H-Canyon, OF-H, and HA-Line processing have been documented [Reference 4] and compiled in Table 3. This list does not include maintenance and janitorial supplies (e.g., paint, greases, oils, cutting lubricants, dye check fluids, soaps, floor wax, etc.), some of which include RCRA constituents. RCRA hazardous wastes from maintenance and janitorial activities are controlled by the facility's Hazardous Waste program. No listed hazardous waste from maintenance activities enters the waste streams sent to CSTF.

The process solutions sent to CSTF are hazardous wastes and do exceed some of the Resource Conservation Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) threshold values. See Section 9.5 for further discussion.

Table 2 – Monthly Chemical Usage / Only HM-Process Operating

Process Chemicals	Typical Usage (lb/month)
Gelatin	8
40 wt % Ferrous Sulfamate	2,700
Mercury	317
50 wt % Nitric Acid	195,000
n-Paraffin	1,386
Sodium Carbonate	1,660
50 wt % Sodium Hydroxide	87,500
30 wt % Sodium Nitrite	2,300
Tributyl Phosphate	554

Table 3 – Typical Inventory of Chemicals in Storage

HM Process Chemicals In Storage	Typical Inventory (lb)
Aluminum Nitrate	46000
Boric Acid	4000
Ferrous Sulfamate	60,000
Manganous Nitrate	20,000
Mercuric Nitrate	0 *
Mercury	7000
Nitric Acid	300000
n-Paraffin	61000
Oxalic Acid	100
Potassium Permanganate	2000
Sodium Carbonate	10000
Sodium Hydroxide	220000
Sodium Nitrite	7000
Tributyl Phosphate	70000
Gadolinium Nitrate	1800

*Generated as needed for dissolving operations.

4.0 Waste Stream Categories and Characterization

The WAC defines three Waste Stream Categories that determine the characterization and reporting requirements. The key to categorizing a given stream is the variability in what species are present and the variability in their concentrations.

- Regular Waste (RW) has a consistent composition – both the species present, and their concentrations, are relatively constant (over time). Since a given RW stream has little variation in composition, that characterization is sufficient to evaluate the stream's acceptability. Reporting the volume of each waste stream transferred is sufficient to allow tracking of the receipts (and the waste tank inventories). The volume of such waste streams may be large and transfers to the CSTF may be frequent, helping to minimize the variability in composition. For example, "HM low heat process waste" is generated continuously by the production process.

- Irregular Waste (IW) has variable composition – the concentrations of various species vary within some bounds, but the same species are present (over time). Since a given IW stream contains the same species and their concentrations can be bounded, that bounded composition is sufficient to evaluate the stream's acceptability. However, to permit tracking of the receipts (and the waste tank inventory), the composition of each batch must be reported (or perhaps just selected "indicator" species). An IW stream may be generated frequently or intermittently, but it has a potential for large composition variations. The species in a particular IW may be the same as those present in the RW of that process, but the concentrations vary widely (e.g., from batch to batch). No new species/process chemicals are introduced.

- Special Waste (SW) has a highly variable composition – either different species are present, or their concentrations may vary too widely to be bounded satisfactorily. Special waste may also encompass material that is non-routine (or Irregular) and not necessarily waste. For SW the species may have significant variation in composition from batch to batch, or may contain constituents that are not present in waste normally received by by CSTF. As such, characterization of each batch must be reported in more detail (to allow tracking of the receipts and waste tank inventory). In this context, the term "batch" may refer to individual waste transfers, or it may apply to a certain campaign, etc. – the appropriate scope is to be defined by the generator in the WCP. These wastes may be generated as part of special activities (e.g., use of special cleaning solutions), or in a process where the presence of species changes from batch to batch, or from one-time activities (e.g., facility decommissioning and closure).

Furthermore, the WAC specifies that:

- The WCP will characterize the waste streams based on a combination of (1) process knowledge (e.g., material balances) and (2) analysis of process samples. Where sufficient analyses are available for a species, then they should be the basis for the characterization. When process knowledge is used for some species and analyses are used for others, then the validity of the process knowledge can be corroborated by following a similar reasoning for the "analyzed" species, and comparing that process knowledge to the sample analyses.
- Initially, all waste generators will provide a "Complete" characterization of each routine waste stream. Periodically, all waste generators will also provide a "Minimum" analysis of each waste stream. For RW, the minimum characterization will be done semi-annually (2X/year), and for IW/SW the appropriate frequency will be defined in the Generator's WCP.
- A waste generator may take exception to anything in this WAC (i.e., any deviation can be proposed), and such deviations will be documented in the generator's WCP. In this context, the terms "deviation", "exception", and "exemption" have the same meaning. If the WCP takes exception to a characterization requirement, it shall provide a defensible rationale and/or alternative. Approval of the WCP by LW will thus include any requested deviations [Reference 1].
- All sample analyses used to demonstrate compliance with the requirements for flammable species and inhalation dose potential must include the analytical uncertainty of those measurements. The only exception is analyses used to demonstrate compliance with inhalation dose potential requirements for currently approved regular waste streams.

The WAC specifies that the generator's WCP is to define the waste streams and assign them to appropriate categories. Characterization information should be provided within four weeks prior to the planned transfer. H-Canyon Canyon regular and irregular waste streams are listed in Table 4.

Table 4 – Summary of H-Canyon's Waste Streams

Waste Stream Name	Designation	Status
GP Evaporator Bottoms	HCAN-RW-03	Approved WCP (X-WCP-H-00008)
LAW from HM-processing	HCAN-RW-05	Approved WCP (X-WCP-H-00008)
HAW from HM-processing	HCAN-RW-06	Approved WCP (X-WCP-H-00008)
PVV Filter Flush	HCAN-IW-01	Approved WCP (X-WCP-H-00008)
Laboratory Sample Returns	HCAN-IW-02	Approved WCP (X-WCP-H-00008)
HBL Digested Resin	HCAN-RW-09	Approved WCP (X-WCP-H-00008)

Streams HCAN-RW-03, HCAN-RW-04, HCAN-RW-05, HCAN-RW-06, HCAN-RW-07, HCAN-RW-09, HCAN-IW-01, and HCAN-IW-02 are described in this WCP. Other streams are either no longer generated or are covered in special waste compliance plans. A list of the procedures utilized to transfer the waste streams to the CSTF is provided in Table 9.

The GP Evaporator Bottoms Waste (HCAN-RW-03) stream is categorized as Regular Waste because water collected from the sources of feed to the GP Evaporator should not vary significantly. Sources of feed for the GP Evaporator include the hot and warm gang valve catch tanks, the railroad tunnel airlock sump, various drain tanks in old cold feed prep, and various sumps that collect rainwater from berms around tanks including similar sources from other facilities that meet the WAC and WCP requirements implemented by H-Area. In addition to meeting the WAC and WCP requirements, any material from other facilities being processed through the GP Evaporator shall be evaluated and documented to demonstrate that the stream meets the Low Level Waste (LLW) requirements for transfer to Tank 50. Completed procedures and sample cards confirm the uniformity of both feed sent to the evaporator and neutralized waste sent to CSTF (See WG08 database). The uranium content of each batch transferred must be less than 15 grams of equivalent U-235 when sent to tank 43. Total U-235 is restricted to less than 120 g per calendar month when the stream is sent to tank 43. When this stream is sent to tank 50 the criticality safety limits outlined in section 9.6 apply.

This waste stream produces 2,000-4,000 gallons of waste per month. The waste is transferred in batches of approximately 700 gallons.

A deviation to WAC requirements exists because the free hydroxide level does not meet the requirements 100 % of the time. Based on pH results, the free hydroxide has at times dropped to 0.15 M. Caustic is added prior to feeding the solution to the evaporator. The free hydroxide concentration of 1.2 M (pH 14) is not likely to be met on each transfer. However, the pH of each transfer is between 13 and 14.

This stream underwent a complete characterization in 2004 via analysis of process samples to ensure the stream complies with Saltstone WAC limits. The results of the isotopic and chemical characterization and historical sampling results are included in reference 28.

The H-Canyon Low Activity Waste from HM-Processing (HCAN-RW-05) stream is categorized as Regular Waste since it originates primarily from relatively consistent sources, 1DW Second Uranium waste from Tank 16.7, solvent wash from Tank 13.7, sumps, and 1BP First Cycle waste from Tank 13.3. When PuCS material from the EUS tank is fed to Second Uranium Cycle the fluoride concentration in the LAW system will increase insignificantly (Table 9). Feed to LAW also includes sources from other facilities that meet the WAC and WCP requirements implemented by H-Area. Also, the water collected in the 805 tank from both the stack and sand filter should be fairly uniform when processed through the evaporators. This will be mainly nitric acid with small amounts of plutonium and neptunium losses. Previous analysis recorded on sample cards and in the WG08 indicates that the gross alpha results were consistently within one order of magnitude (See WG08 database). Additionally, the Np and U results varied by a factor of 2. The nitrate ion concentration is relatively uniform. The pH requirement determination will be achieved procedurally. The free OH requirement determination will be achieved through the use of a calculation in the operating procedure.

H-Canyon also has an option to exclude ferrous sulfamate from the 1AS-FS input stream to the 1A Bank in the First Cycle extraction process, thereby extracting most of the Pu into the 1AU stream and precluding Pu from exiting in the 1AW stream. In this operational mode, the shifted Pu inventory exits the 1B Bank in the 1BP output stream routed to the LAW system. The total amount of Pu sent to CSTF does not increase but is merely redistributed from waste stream HCAN-RW-06 to waste stream HCAN-RW-05. Precluding Pu from the 1AW stream substantially reduces the total alpha radiation in the liquid portion of neutralized waste in the HAW system. This processing option helps ensure that the HAW waste stream meets the Saltstone WAC requirements.

This waste stream produces 6,000-10,000 gallons of waste per month. The waste is transferred in batches of approximately 1,500-2,000 gallons.

The characterization of HCAN-RW-04 included a mixture of GP Evaporator Bottoms and LAW to simulate canyon operations without solvent extraction in operation. The levels of chrome and lead exceed the RCRA TCLP threshold limits. This waste stream is not currently authorized for transfer to HLW.

The stream characterization and historical sampling results are included in reference 28.

The Laboratory Sample Return (LSR) (HCAN-IW-02) stream is categorized as an Irregular Waste. This waste is generated from the receipt of LSR trailers from Savannah River National Laboratory (HAWTT) and F/H Laboratory (LR-56). This waste is fairly constant in constituents but the concentration of individual species is variable from one shipment to the next. The solutions are received into H-Canyon through a truck unloading station, transferred to a canyon vessel and combined with routine LAW solutions. This waste stream is currently not authorized for transfer. Its transfer will require submittal of approved procedures to LW.

The sulfate and chloride concentration in LSR can potentially peak at concentrations that exceed the WAC limits of ≤ 0.18 M and ≤ 0.11 M, respectively, but, on average, these streams will be below the respective WAC

The HAWTT delivers ~2,500 gal/transfer and the LR-56 delivers ~1,000 gal/transfer. Each trailer makes ~6 deliveries/year for a total waste stream of ~21,000 gal/year.

The H-Canyon High Activity Waste from HM-Processing (HCAN-RW-06) stream is categorized as Regular Waste since the feed streams from the centrifuge in the Head End process and the 1AW stream from First Cycle are relatively consistent/uniform. Previous analysis of HAW samples recorded on sample cards and entered into the WG08 database also indicates that results vary by a factor of roughly 5000 [Reference 28]. Some of this variance is attributable to problems being experienced with the centrifuge wash cycle. When HAW solutions are going to Saltstone, recycle of canyon sump solutions through Head End and processing of sump solutions through HAW will be evaluated to determine the impact on Saltstone WAC limits. The WCP pH requirement determination will be achieved procedurally. The WCP free OH requirement determination will be achieved through the use of a calculation in the operating procedure.

This waste stream produces 12,000-30,000 gallons of waste per month. The waste is transferred in batches of approximately 1,500 to 2,000 gallons.

This stream underwent a complete characterization in 2004 via analysis of process samples to ensure the stream complies with Saltstone WAC limits. The results of the isotopic and chemical characterization and historical sampling results are included in reference 28. Characterization of the stream including Super Kukla is provided in Reference 32. This revision of the WCP does not include provision for transfer of HCAN-RW-06 to Tank 50, the Saltstone feed tank.

The Sump/Rerun Waste (HCAN-RW-07) stream is categorized as Regular Waste since the waste generated from sump flushing and leaks of non-process chemicals are relatively consistent/uniform. Wastes generated from process wastes collected in sumps are expected to be minimal since these wastes are generally recovered and processed through First Cycle. The HAW and LAW streams bound the sump/rerun waste stream. When HAW solutions are going to Saltstone, recycle of canyon sump solutions through Head End and processing of sump solutions through HAW will be evaluated to determine the impact on Saltstone WAC limits. This waste stream is not currently authorized for transfer to LW.

This stream is combined with the LAW stream so volume and frequency are included with LAW.

Hot and Warm Canyon PVV Filter Flush Waste (HCAN-IW-01) stream is categorized as an Irregular Waste since this waste is generated during a PVV filter flush only. This waste is fairly constant in constituents but the concentration of individual species is variable from one flush to the next. Constituents include nitric acid (used to flush the filter) plus ammonium nitrate, U, and lesser amounts of other materials including Pu and Np (washed out of the filter). This waste stream is currently not authorized for transfer. Its transfer will require submittal of approved procedures to LW.

This waste stream produces 10,000-15,000 gallons of waste per flush. The waste is transferred in batches of approximately 1500-3000 gallons.

This waste stream is generated every two to three years and will be analyzed following the flush.

Digested HB-Line Phase II Spent Resin Waste (HCAN-RW-09) stream is categorized as Regular Waste Waste because the characterization of the waste is not expected to vary from one batch to the other. The chemical composition of the resin and all of the processing steps including the elution step, the digestion step and the neutralization step that the resin will undergo will be controlled either through the procurement process or procedural process to allow for minimum variation. The Reillex resin digestion studies done by SRNL [References 2-3] indicate the absence of volatile organic compounds. A trace of formic acid was discovered in one sample and no other volatile organic species (including volatile alcohols, aldehydes, ketones, acids, benzene, acetone, pyridine, and styrene) were identified. The presence of chloride, fluoride, and sulfate is expected to be in trace amounts. The nitrate ion concentration is about 1.0 M. Digested resin contains solids that can plug the canyon samplers, so no sample is drawn.

This stream produces approximately 3,000 liters liters of waste per resin change out.

5.0 Liquid Waste Generator Representative (LWGR)

The WAC specifies that each organization that transfers waste to CSTF will designate a LWGR. The LWGR will be the generator's point of contact for communications with LWE. The LWGR will be knowledgeable of all processes in the generator's facilities, especially in relation to the quantity and composition of waste, to provide accurate information on waste transfers.

The H-Canyon LWGR is the H-Canyon Liquid Waste Compliance Engineer. H-Canyon's designated alternate is the H-Canyon Technical Engineering Manager.

6.0 Documenting Waste Volumes Transferred to HLW [*A/C* CST Admin Control 5.8.2.32]

The WAC specifies that the waste generator will enter characterization and transfer information into Wisdom Work Group (i.e., WG08, HLW-WRT) to provide easy tracking. In addition, an independent verification of the data will be performed, which is a safety basis requirement. H-Canyon's monthly waste transfer report will be issued by the LWGR and will be sent to LWE as per Table 5.

Table 5 – Frequency of Waste Transfer Report

Base Volume	Report Frequency
< 3000 gal/month	Quarterly
≥ 3000 gal/month	Monthly

In accordance with the WAC, the generators will perform independent verification of data and the transfer and sample data will be entered into the Wisdom Work Group WG08 database within two weeks of the waste transfers. Copies of the completed procedures will be made available for LWE inspection upon request.

CSTF Operations also requires that the waste sending facility notify CSTF of the intent to make the transfer. This notification is essential for meeting the CSTF Safety Basis before the start of the transfer of the waste stream. This implementation will be included in the neutralization and transfer procedures.

7.0 Deviations from the WAC Requirements

When deviating from the WAC, generators must submit a written request approved by the Engineering and Operations Managers after a USQ has been performed against the proposed activity and approved by the FOSC. When generators deviate from their WCP, a written evaluation must be performed on the proposed activity which must be approved by Engineering and Operations Managers. Also, whether a WCP contains a deviation must be clearly identified and summarized in the Introduction and Conclusion [Reference 1].

8.0 Related Programs, Self-Assessment, and Future Enhancements

8.1 Recovery from a Non-Compliance

The WAC specifies that the LWGR is to inform LWM of any requirements which have not been satisfied (e.g., due to inadvertent transfers, process upsets, etc.) immediately. In conjunction with LWO, LWE will determine what actions are to be performed by the Generator before the waste can be (or continue to be) accepted into CSTF. Note: the PR and SIRIM procedures are to be invoked as appropriate.

Volume and characterization data will be provided to LWE as soon as available to determine the impact on CSTF. Potential corrective actions will be evaluated with LWE (e.g., chasing un-neutralized waste with NaOH) and performed as soon as practical. The composition of the waste being generated is expected to be consistent while MK 16/22 fuel tubes and similar materials are processed through the facility. Information and characterization data will be provided, as it becomes available, and will assist in determining the impact to CSTF. The H-Canyon facility will notify the LWM of any non-compliance, and will participate in the appropriate investigations.

8.2 Related Programs

Decontamination chemicals in Outside Facilities and H-Canyon are utilized both throughout the facility and in a designated area termed the Decon Cell. The chemicals utilized in the Decon Cell to decontaminate process equipment prior to repair consist of potassium permanganate and sodium carbonate. Decontamination of process equipment in the Decon Cell is only performed sporadically now and results in essentially no waste. Decontamination of personnel areas results in wastes disposed of with absorbent and mop heads as solid wastes. Decontamination chemicals will not be a significant component of any of the waste streams sent to CSTF.

8.3 Waste Minimization

The quantity of waste generated by H-Canyon is dependent largely upon the following: the number and type of fuel elements processed, the quantity and type of material processed, the neutron flux experienced by the fuel elements in the reactor, the quantity of uranium processed, the quantity and type of chemicals utilized to process the uranium and the degree to which the waste was concentrated. The majority of the H-Canyon's waste is created through the disposal of aluminum nitrate from First Cycle. Concentrating the stream minimizes its volume. H-Canyon use of gadolinium and manganese instead of iron for neutron poisoning minimizes the formation of sludge in CSTF.

8.4 Records

All operations performed by H-Canyon are per approved procedures. Procedures require Operations to record the quantity of material transferred to, from, and within the facility. H-Canyon tanks and transfer lines are monitored sufficiently to ensure an accurate record of transfer quantities is maintained.

8.5 Self-Assessment

Every six months, H-Canyon Engineering performs a self-assessment of the Waste Compliance Program. The assessment involves the check or completion of monthly waste transfer reports, H-Canyon waste forecasts, periodic sampling performance and required completeness of WG08 database.

Semi-annual analysis of the following three streams will be performed to validate/improve the characterization: Low Activity Waste from HM-processing (HCAN-RW-05), High Activity Waste from HM-processing (HCAN-RW-06), and the GP evaporator bottoms streams (HCAN-RW-03). The Sump/Rerun waste stream (HCAN-RW-07) will not be analyzed since it is blended into the LAW stream. The LAW in Standby stream (HCAN-RW-04) will not be analyzed until the canyon goes into standby again.

The LWGR will compare all analysis results to the waste characterizations described in the WAC (or alternatively, any other written communication from the LWGR that updates the characterization while the WAC revision is pending). The results of the analysis will typically be provided to LW within four weeks of the sample being delivered to the laboratory performing the analysis, pending the laboratory's ability to support such a schedule.

Upon confirmation of any laboratory result that is outside of the characterization described in this WCP, the LWGR will contact the receiver's representative to jointly evaluate the need to modify the characterization and/or initiate additional investigative or corrective actions.

H-Canyon will notify LW of any non-compliance to this WCP.

8.6 Characterization

A complete characterization, as shown in Table 7, is required prior to the approval of any and all waste streams. A comprehensive initial analysis on the streams designated HCAN-RW-05 and HCAN-RW-06 was performed in December 1998. The results from these analyses and the periodic minimum characterization sample analysis taken since the initial analysis are contained in reference 28. HCAN-RW-03 (GPE Bottoms) and HCAN-RW-06 (HAW) underwent a complete characterization via analysis of process samples to ensure the streams comply with Saltstone WAC limits. The results of the characterization for HAW and GPE can also be found in reference 28. A "minimum" characterization as defined in CSTF WAC, and listed in Table 6, will be performed semi-annually for all streams going to the CST. Characterization data will be reviewed and approved by appropriate HMD technical support and process engineering organizations to validate process assumptions. Since HCAN-RW-03 (GPE Bottoms) and HCAN-RW-06 (HAW) have been going to Tank 50, the minimum characterization has been performed quarterly. The results of the quarterly characterizations indicate that the waste stream compositions are consistent with initial, complete characterizations of those waste streams. Per section 6.2 of X-SD-G-00001, the quarterly requirement to characterize regular waste streams may be relaxed if generators' procedures analyzed for major constituents, which is currently done and documented in WG-08. HCAN-RW-07, the Rerun/Sump stream is temporarily being combined with the LAW stream. Hence, HCAN-RW-07 will not be sampled until it is segregated from LAW again.

Periodic sampling of waste streams going to Tank 50 will also include Sr-90, U-235, and Pu-239. Sr-90 analysis is needed due to the proximity of this constituent to the Saltstone limit. U-235 and Pu-239 analysis is needed to ensure the assumptions of reference 25 are maintained.

Every transfer to CSTF will be analyzed for a much smaller number of constituents. Currently, the analysis listed in Table 6 is performed on the Regular Waste streams either prior to neutralization or directly after neutralization, except the digested resin waste from HB-Line Phase II. Digested resin and HAW contain solids that would plug the samplers; therefore, no post-neutralization sample can can be drawn. For HAW and LAW free OH will be determined by a calculation in the operating procedure. Excess caustic will be added to reach 1.2 M free hydroxide according to procedure before transfer of the waste to CSTF. Thus, the pH and excess OH criteria will be attained procedurally. The temperature of each waste stream will be verified to be < 50°C and excess caustic > 1.2 M caustic. In the evaporators, the more volatile components are the organics. Consequently, the overheads become concentrated in organics and the bottoms become concentrated in aqueous. Evaporation effectively reduces organics down to trace levels in the concentrate. The HAW and LAW streams are in contact with less than 8.5 % TBP. The HAW and LAW wastes are decanted to remove organic before feeding the material to the evaporators.

Any constituent that is in close proximity to WAC limits will be closely monitored. If monitoring indicates the running average of any constituent is trending close to or exceeds WAC limits, CSTF will be notified per section 8.1 of this document.

Table 6 – Summary of Minimum Characterization for Each Transfer

Analysis	HCAN-RW-03 NOP 221-H-1160	HCAN-RW-04 HCAN-RW-05 HCAN-IW-02 NOP 221-H-4743	HCAN-RW-06 NOP 221-H-4710	HCAN-RW-07 NOP 221-H-4866	HCAN-IW-01 NOP 221-H-4711 NOP 221-H-4766
Specific Gravity	Basic	Acidic	Acidic	Acidic	Acidic
Uranium Concentration	NA	Acidic	Acidic	Acidic	Acidic
Acid Molarity	NA	Acidic	Acidic	Acidic	Acidic
Pu Alpha	NA	Acidic	Acidic	NA	Acidic
Pu TEVA	NA	NA	NA	Acidic	NA
Gross alpha	NA	Acidic	NA	NA	Acidic
Fe/Mn	NA	Acidic	Acidic	Acidic	Acidic
Np alpha	NA	Acidic	Acidic	NA	Acidic
pH	Basic	Basic	Basic	Basic	Basic
NH_4 *	N/A	Acidic	Acidic	Acidic	Acidic
Cl**	N/A	Acidic	N/A	N/A	N/A
SO_4**	N/A	Acidic	N/A	N/A	N/A

* This sampling requirement will continue until the LFL requirement is determined to be consistently implemented.

**H-Can-IW-02 only

Table 7 – Species to be Included in Characterization

Minimum Characterization consists of:

Anion	**Miscellaneous**	**Radionuclide**
NO_3^-	pH	total-α
NO_2^-	Specific Gravity	total-β/γ
free OH^-	NH_4	**gamma PHA for:**
		^{60}Co
		^{106}Ru
		^{125}Sb
		^{137}Cs
		^{154}Eu

Complete Characterization consists of the Minimum Characterization plus:

Anion	**Cation**	**Organic & Miscellaneous**	**Radionuclide**
$CO_3^=$	Ag	Total Organic Carbon	^{3}H
*$C_2O_4^=$	Al	Total Insoluble Solids	*^{14}C
Cl^-	As	Total Dissolved Solids	*^{63}Ni
F^-	Ba	*TPB	$^{89,90}Sr$
*PO_4^{-3}	Cd	Volatile/semi-volatile organics	*^{99}Tc
SO_4^+	Cr	**facilities using TBP:**	*^{129}I
	Fe	n-butanol	U isotopics & total
	Hg		Pu isotopics & total
	Mn		^{237}Np
	Na^+		Am isotopics & total
	NH_4^+		Cm isotopics & total
	Pb		*Total Gamma
	Se		any known isotope >1 Ci%
	Ce		
	Si		

Note: If the waste contains insoluble solids, then the sludge and supernate phases are to be characterized individually.

*** These constituents are WAC for transfers into Saltstone, therefore are only required for transfers into Tank 50.**

A maximum temperature limit of 50°C (prior to steam jetting) will be maintained for waste streams from H-Canyon to ensure WAC limit is protected. The temperature limit is incorporated in the transfer procedures to CSTF listed in Table 8.

Table 8 – Transfer Procedures

Stream #	Stream Description	Procedure #	Procedure Title
HCAN-RW-03	General Purpose Evaporator	NOP 211-H-1160	Transferring From Tank 710 to H CST
HCAN-RW-05	LAW	NOP 221-H-4743 NOP 211-H-4725	Neutralizing Low Activity Waste in Tank 9.8 Adjusting LAW in Tank 8.6
HCAN-RW-06	HAW	NOP 221-H-4710* NOP 221-H-4704	Neutralizing High Activity Waste in Tank 8.4 Neutralizing High Activity Waste in Tank 8.2
HCAN-RW-07	Sumps/Rerun	NOP 221-H-4866 *	Neutralizing Waste in Tank 16.1
HCAN-RW-09	Digested Resin	NOP 221-H-4905 *	Resin Digestion in Tank 5.2
HCAN-IW-01	PVV Flush	NOP 221-H-4776 *	Neutralizing High Activity Waste from PVV Flush Waste From Tank 8.1 and Tank 8.3 in Tank 8.4.
HCAN-IW-02	LSR	NOP 221-H-4743 NOP 211-H-4725	Neutralizing Low Activity Waste in Tank 9.8 Adjusting LAW in Tank 8.6

* These procedures are inactive and will be activated when needed.

9.0 Compliance with Specific Criteria for High Level Liquid Waste Receipts

9.1 Requirements for Corrosion Prevention [*A/C* CST Admin Control 5.8.2.13 and DSA 6.5.2]

The minimum pH of > 9.5 will be met by adding excess hydroxide to all waste streams during the neutralization process, with the exception of the GP evaporator bottoms, until the final NaOH concentration is calculated to be 1.2 M (pH ≈ 14). The calculation is based on total acid results from the lab. The lab determines total acid by titration which includes all sulfates and nitrates as well as nitric acid. The calculation uses the lab results to determine the quantity of NaOH needed to reach a pH of 11. A second term in the calculation is used to determine the quantity of NaOH needed to reach a 1.2M excess. If the lab uses a method other than titration LW will be notified for concurrence. The use of an alternate method will be included in the next WCP revision. The GP evaporator is operated at a basic pH by adding NaOH to the evaporator feed. Hence, excess hydroxide is not added to the evaporator waste stream to exceed the requirement which is an approved deviation to this WCP. The pH of this stream is typically in the range of 13 to 14.

After neutralization, the nitrate concentration will be between 1.0 M and 8.0 M for all the streams. The combined free hydroxide and nitrite concentration will exceed 1.1 M [Reference 1]. The combined free hydroxide and sodium nitrite concentration should exceed 1.1 M through the addition of excess sodium hydroxide to 1.2 M for streams HCAN-RW-04, HCAN-RW-05, HCAN-RW-06, HCAN-RW-07, HCAN-RW-09, and HCAN-IW-01. The free hydroxide of 1.1 M will also satisfy the WAC requirement for minimum inhibitor content for waste generated.

No chloride is utilized in the HM-process, the PVV Filter flush, and the HB-Line Phase II digested resin. Hence, this species is expected in trace amounts only. Fluoride will be used in legacy U and Pu Pu campaigns to ensure complete dissolution. The concentration of the fluoride in the HCAN-RW-06 (HAW) waste stream is calculated to be 0.003M. If If processed through the EUS tank the concentration of fluoride in the HCAN-RW-05 (LAW) waste stream is calculated to be 0.005 M. The CST uncomplexed fluoride limit is <0.086 M, the Saltstone limit is equivalent to 0.26M, so the limit will not be challenged.

Sulfate is present since ferrous sulfamate is added as a reducing agent in the First Cycle and Second Uranium processes. When HAW solutions are going to Saltstone, ferrous sulfamate will not be utilized in the A bank of First Cycle as discussed in Section 2.1. Analytical results indicate that the sulfate concentration for stream HCAN-RW-04 reaches a maximum of 0.31 M. Sulfate is also generated through the addition of ferrous sulfamate to the waste stream for criticality protection. HCAN-RW-04 sulfate level was above the 0.18 M limit listed in the WAC. HCAN-RW-04 is the LAW standby stream, which is not transferred and it is not expected to be transferred until H-Canyon goes into standby. When HCAN-RW-04 transfers resume the sulfate content of the stream will be re-evaluated. HCAN-RW-05 is calculated to average 0.158 M over a year's period. With the use of manganese as a neutron poison in place of iron from ferrous sulfamate, the sulfate ion concentration is expected to drop further. Nitrate is sufficiently inhibited in the LAW streams through the addition of 1.2 M caustic. HCAN-RW-03, HCAN-RW-06 and HCAN-RW-07 are all below the sulfate limits set in the WAC. The concentration of corrosive species of H-Canyon's waste streams is presented in Table 9.

Table 9 – Expected Concentration of Corrosive Species

Designation	pH	Nitrate	Minimum Free Hydroxide	Fluoride Ion[3]	Chloride Ion	Sulfate Ion
WAC Limit	> 9.5	≤8.5M	≥ 1.1 M	≤0.086M	≤0.11M	≤0.18M
HCAN-RW-03	> 9.5	3.24 M	0.15 M	0.0026M	0.007M	0.06 M
HCAN-RW-04[2]	> 9.5	3.7 M	≥ 1.1 M	Trace	Trace	0.31 M
HCAN-RW-05	> 9.5	3.7 M[1]	≥ 1.1 M	Trace	Trace	0.15 M
HCAN-RW-06	> 9.5	6.3 M	≥ 1.1 M	Trace	Trace	6.59E-04
HCAN-RW-07	> 9.5	3.7 M	≥ 1.1 M	Trace	Trace	0.1 M
HCAN-RW-09	> 9.5	1.0 M	> 1.1 M	Trace	Trace	Trace
HCAN-IW-01	> 9.5	0.460-1.04 M	> 1.1 M	Trace	Trace	0.043 M
HCAN-IW-02	> 9.5	0.24 M	> 1.1 M	0.006 M	0.071 M	0.008 M

1. The normal nitrate concentration in HCAN-RW-05 can temporarily rise to a maximum 7.38 M when H-Canyon processes F/H-Area Laboratory LSR and 4.72 M for SRNL LSR [Reference20].
2. This stream is not currently approved for transfer to HLW, when necessary the stream will be analyzed and the appropriate measures taken to ensure compliance.
3. Uncomplexed concentration

9.2 Requirements to Prevent Accumulation of Flammable Species [*A/C* CST SAC 5.8.2.15]

Waste streams other than PVV filter flush and spent HBL resin may come in contact with volatile flammable species and organic compounds. Various canyon processes will be utilized to minimize the total quantity of these products in the waste stream. Digested resin analysis indicates no significant flammability risk exists. [Reference 29]. The concentration of these species will be insufficient to cause a fire or explosion under equilibrium conditions.

9.2.1 Organic Vapor Control [*A/C* CST SAC 5.8.2.15]

Prior to waste streams entering the HLW, the waste streams shall be evaluated and shown to have less than, or equal to, a 5 % (0.0164 wt% ammonia concentration, which neglects any contribution from trace quantities of organic vapors, reference 19). organic contribution to the hydrogen LFL at 100°C. This includes volatile organics as well as ammonia. Although the CSTF DSA calculates LFL values at 100°C in the pump tank (so reliance on temperature controls is not needed), generators are still required to transfer waste at no greater than 70°C [Reference 1].

There are three regular waste streams being transferred to CSTF covered by this WCP that have contacted organic during process operations. These are HCAN-RW-03, HCAN-RW-05 and HCAN-RW-06. HCAN-RW-05 and HCAN-RW-06 are decanted and evaporated to reduce organic material. HCAN-RW-03 is skimmed, neutralized, and evaporated. Thus, all regular waste streams comply with the WAC.

H-Canyon decants and evaporates those waste streams that have come in contact with organic matter. This combined processing effectively removes all organics to trace levels. This conclusion is substantiated by a technical report on the efficiency of H-Canyon decanters [References 11-12], a technical report on steam stripping of TBP during evaporation [References 13-14], an engineering calculation on general organics stripping by evaporation [Reference 15], and statistics on process sample analysis [Reference 17]. H-Canyon verifies the quality of streams HCAN-RW-03, HCAN-RW-05, and HCAN-RW-06 through semi-annual analytical determinations of volatile and semi-volatile organics.

CSTF reduces ammonia by atmospheric venting at the receiving pump tank. Upstream, H-Canyon reduces ammonia prior to evaporation by adding sodium nitrite to destroy precursors from the hydrolysis of ferrous sulfamate. Nitrite may also be introduced in the LAW and HAW evaporators to destroy ammonium that is present in the waste streams. Based on sample results, the ammonium concentration can also be adjusted to meet WAC requirements by dilution. H-Canyon also reduced the potential for additional ammonia since adopting manganese nitrate as a neutron poison instead of supplementary ferrous sulfamate prior to neutralization. With organics reduced to trace quantities through decantation and evaporation the WAC requirement of 5% organic contribution to the hydrogen LFL is met by limiting the ammonia concentration to <0.0164 wt%. (no adjustment of purge flow of receipt pump tanks.) (Ref. 11-15, 19). Transfers containing ammonia concentrations of up to 20% (<0.0656 wt%, reference 31,) organic contribution to the hydrogen LFL can be made provided the required purge flow of the receipt pump tanks is adjusted for the additional contribution of organics and LWF approval is received.

An additional criterion for H-Canyon waste is the limitation of temperature due to the limited vapor pressure equilibrium data required to support the hydrogen LFL determinations. H-Canyon must demonstrate the waste transferred remains below 70°C. The temperature of waste is confirmed less than 50°C prior to steam jetting (steam jetting can increase temperature up to 20°C.)

Canyon PVV flushes may exceed the 5 % limit and be transferred into CSTF if they are evaluated and shown to have:

- Less than, or equal to, a 20% (<0.0656 wt%) organic contribution to the hydrogen LFL in receipt pump tank (at 100°C), and
- Less than, or equal to, a 5% (<0.0164 wt%) organic contribution to the hydrogen LFL in locations downstream of the receipt pump tank (at 100°C) (Reference 1).

The evaluation of effects downstream of the receipt pump tank may take credit for actual facility conditions in showing the organic contribution to the hydrogen LFL is less than, or equal to, 5 %. The required purge flow of receipt pump tanks for transfers exceeding a 5 % organic contribution (up to a 20 % organic contribution) is adjusted to account for the additional contribution of the organics. To transition the flow requirement back to the non-PVV flow requirement, sufficient pump tank flushes shall be performed to reduce the organic contribution to LFL to less than or equal to, 5 % (at 100°C) (Reference 19). The number of flushes required shall be determined on a case by case basis by an engineering evaluation of the organic concentrations required to meet the 5 % limit.

The HCAN-IW-01 (PVV Filter flush) and the HCAN-RW-09 (HB-Line Phase II spent resin) do not go through any evaporator process and do not use or contact any organic material in its processing steps.

A HLW study [Reference 5] indicates that no volatile organic carbons (VOC) were detected in the vapor space of waste Tanks 39 and 43. The report analyzed the available data and determined that n-paraffin and TBP were not detected in the floating liquid surfaces of waste tanks, pump tanks and also in the waste that has been transferred from the canyons.

Occasionally, H-Canyon disposes waste to CSTF that has not come into contact with organic or flammable material and does not contain any flammable matter. In this instance decantation and evaporation to remove organic material is not required.

9.2.2 Hydrogen Generation Rate Rate [*A/C* CST SAC 5.8.2.15 & 5.8.2.25]

Hydrogen generation rates were calculated based upon the heat generation rate from the decay heat and both the nitrate and nitrite ion concentrations.

To determine the maximum hydrogen generation rate for any stream, a final nitrate ion concentration of 1 M was assumed. The final nitrite ion concentration was assumed to be 0 M for all streams. The actual nitrate ion concentrations of the waste streams are listed in Table 10. This assumption is quite conservative since the nitrate ion concentration is always greater than 1 M [References 1 and 6].

Hydrogen Production Rate (ft^3 H_2/gal/h) =

Heat Generation Rate (BTU/h/gal) * ($R_\alpha + R_{\beta/\gamma}$)($ft^3$ H_2/10^6 BTU), where

$R_\alpha = 134.7 - 82.3 * Eff [NO_3^-]^{1/3} - 13.6 * Eff [NO_3^-]^{2/3} + 11.8 * Eff [NO_3^-]$

$R_{\beta/\gamma} = 48.36 - 52.78 * Eff [NO_3^-]^{1/3} + 14.1 * Eff [NO_3^-]^{2/3} + 0.572 * Eff [NO_3^-]$

Effective $[NO_3^-] = [NO_3^-] + 0.5 * [NO_2^-]$

Table 10– Hydrogen Generation Rates

Stream #	Nitrate (M)	Hydrogen Generation (ft^3 H_2/hr/gal)	WAC Limit		Reference
			Type 3 & 3A (ft^3 H_2/hr/gal)	Evaporator Feed (ft^3 H_2/hr/gal)	
HCAN-RW-03	1[3]	8.5E-11[3,4]	1.50E-05	9.60E-06	27
HCAN-RW-05	3.7	1.63E-08[1,4]	1.50E-05	9.60E-06	22
HCAN-RW-06	1[2]	1.79E-9[2,4]	1.50E-05	9.60E-06	26
HCAN-RW-09	1.0	9.44E-08[4]	1.50E-05	9.60E-06	29
HCAN-IW-01	0.460-1.04	3.86E-07[4]	1.50E-05	9.60E-06	21
HCAN-IW-02	0.03	2.96E-07[4]	1.50E-05	9.60E-06	22

1. The normal radiological hydrogen generation from HCAN-RW-05 can temporarily rise to a maximum 1.72E-08 ft^3 H_2/hr/gal when H-Canyon processes F/H-Area Laboratory LSR and 4.28E-08 ft^3 H_2/hr/gal for SRNL LSR [Reference 20]. With FS removed from A Bank in First Cycle HCAN-RW-05 can temporarily rise to a maximum of 2.23-07 ft^3 H_2/hr/gal when H-Canyon processes F/H-Area Laboratory LSR and 2.37E-08 ft^3 H_2/hr/gal for SRNL LSR [Reference 22]
2. Reference 26, bounding values for NO_3 used
3. Reference 27, bounding values for NO_3 used
4. Includes measurement uncertainty associated with sample analysis

All waste streams are below the WAC hydrogen generation rate limit.

The range of hydrogen generation rates for the Sumps/Rerun stream, HCAN-RW-07, is representative of HAW and LAW process streams impacting the Sumps/Rerun stream.

9.3 Prevent Formation of Shock Sensitive Compounds

The waste being sent to CSTF has the same constituents as the historical waste that has been discharged. An SRNL study that evaluated the waste stored in CSTF concluded that 10 out of the 14 explosive classes could not be formed in CSTF and the remaining four classes had adequate controls to prevent the formation or concentration of these compounds [Reference 7].

One of the controls to prevent the formation of explosive compounds is to limit the quantities of silver discharged to CSTF. In the past, acid flushing of silver coated Berl saddles, used to prevent the release of radioiodine, sent large quantities of silver to CSTF which resulted in the formation of silver nitride, a shock sensitive compound. Instead of flushing the Berl saddles, the saddles are collected after the useful life has expired and are treated as a mixed solid waste. Hence, no shock sensitive compounds are expected to form in in CSTF from H-Canyon waste transfers.

Table 11– Concentration of Silver

	Designation	Ag	Reference
GP Evaporator Bottoms	HCAN-RW-03	< 0.5 mg/L	28
LAW in Standby	HCAN-RW-04	< 0.3 mg/L	8
LAW from HM-processing	HCAN-RW-05	0.56 mg/L	8
HAW from HM-processing	HCAN-RW-06	0.08 mg/L	28
Sumps/Rerun Waste	HCAN-RW-07	< 10 mg/L	8
PVV Filter Flush	HCAN-IW-01	0.56 mg/L*	8
Lab Sample Returns	HCAN-IW-02	10 mg/L	20

* PVV Ag bounded by HAW

9.4 Requirements for Radionuclide Content [*A/C* CST SAC 5.8.2.15 & 5.8.2.25 & JCO WSRC-2003-00083, 5.02]

The inhalation dose potential (IDP) for each isotope was calculated from the concentrations of various isotopes utilized in the hydrogen calculations and the ICRP-68/72 adult dose values. IDP values for each waste stream are summarized in Table 12. The isotopic spectra for individual streams are provided in the associated references. The range of inhalation dose potential rates for the Sumps/Rerun stream, HCAN-RW-07, is representative of HAW and LAW process streams impacting the Sumps/Rerun stream.

The following equation was utilized to determine the inhalation dose potential for each constituent:

$$\text{IDP} = \left(\frac{\text{grams of constituent}}{\text{L}}\right)\left(\frac{\text{rem}}{\text{g}}\right)\left(\frac{3.785\ \text{L}}{\text{gal}}\right)$$

Table 12 – Inhalation Dose Potential

Waste Stream Name	Designation	Low-Rem Supernate Transfers IDP (rem/gal)	WAC Limit (rem/gal)				Reference
			Tank 50	Non Sludge-slurry	Low-rem	Maximum	
GP Evaporator Bottoms	HCAN-RW-03	9.65E+02	≤2.09E+05	≤9.80E+07	≤2.00E+08	<1.50E+09	27
LAW from HM-processing	HCAN-RW-05	9.74E+05[1]	N/A	≤9.80E+07	≤2.00E+08	<1.50E+09	22
HAW from HM-processing	HCAN-RW-06	2.03E+04	≤2.09E+05	≤9.80E+07	≤2.00E+08	<1.50E+09	26
Digested Reillex Resin	HCAN-RW-09	3.30E+06	N/A	≤9.80E+07	≤2.00E+08	<1.50E+09	29
PVV Filter FlushLab Sample Returns	HCAN-IW-02	3.7E+07	N/A	≤9.80E+07	≤2.00E+08	<1.50E+09	2120, 22
Lab Sample Returns	HCAN-IW-02	4.943.7E+07	N/A	≤9.80E+07	≤2.00E+08	<1.50E+09	20, 22

All waste streams are below the WAC limit for inhalation dose potential. All H-Canyon waste transfers are Low-Rem (< 2.0E+08 rem/gal). In addition, these streams are not considered sludge-slurries and require no special flushing requirements since they are below the WAC Limit of 9.8E+07 rem/gal.

The IDP for both the HAW and GP Evaporator bottoms waste streams are below the 2.80E+05 rem/gal limit for material sent to Tank 50.

9.5 Requirements for Regulatory Compliance

Some of the waste streams have heavy metals that exceed the RCRA TCLP toxic characteristic concentration threshold. The elements found in the waste streams that exceed the RCRA TCLP toxic threshold are Cr, Pb and Hg. The CSTF waste water permit allows it to receive these heavy metals although the RCRA TCLP threshold for Cr, Pb and Hg are exceeded. Benzene is not utilized in the process and is not a constituent in the waste streams from the Canyon or Outside Facilities. Hence, benzene levels will be below the RCRA TCLP toxic waste concentration threshold. No RCRA hazardous "listed" waste will be transferred to CSTF as a result of these routine discharges from any of the four streams. This information is also provided to aid LWE in evaluating non-radiological air toxic emissions from the exhaust stacks of the tanks, evaporators, diversion boxes and other impacted facilities. In addition, this WCP identifies by chemical name and/or CAS number, all potential Criteria or Air Toxic pollutants (SCDHEC R.61-62.5, Standard 2 and Standard 8 pollutants, respectively) contained in the material to be transferred. The LWGR agrees to provide additional information upon request from LWE as necessary to complete air emission estimates for such regulated pollutant. Concentrations of some of the heavy metals are presented in References 26, 27, and 28. Prior to processing new waste streams an environmental evaluation checklist will be generated

9.6 Requirements for Criticality Safety [*A/C* CST SAC 5.8.2.15 & DSA 6.5.2]

Waste received in CSTF shall be inherently safe with respect to criticality for any concentration and mass in the uncontrolled geometry of the waste tanks. The method below provides the required weight ratio of neutron poison to equivalent U-235 and equivalent Pu-239 to ensure the waste is inherently safe.

Neutron poisoning is required if sampling indicates that there is 15 grams or greater of equivalent U-235 in the neutralization tank. The HAW and LAW waste streams receive residual ferrous sulfamate (FS) from First Cycle, Second Uranium, and Sumps. Iron (Fe) and Manganese (Mn) are are approved in the H-Canyon Double Contingency Analysis to serve as dual poisons for fissile material. Therefore, the Fe present from FS is credited, and if additional poison is needed, Mn is added in the form of 50 % manganous nitrate. In this case, 29 and 14 grams of Mn are required to poison one gram of Pu-239 and U-235, respectively.

General Purpose evaporator waste (HCAN-RW-03) will be limited to less than 15 grams of equivalent U-235 per batch and not to exceed 120 g U-235 per calendar month when transferring to Tank 43. HAW (HCAN-RW-06), LAW (HCAN-RW-05), and GP Evaporator Bottoms (HCAN-RW-03) transfers to Liquid Waste Facilities from H-Canyon containing more than 15 grams of equivalent U-235 will be poisoned either by the addition of manganese or from residual ferrous sulfamate, or the combination of both. All transfers to Tank 50 will be poisoned in a similar manner regardless of the fissile quantity. Procedural steps to control the ratios of Fe/Mn to equivalent U-235/Pu-239 are prescribed as nuclear criticality safety steps in the procedures listed in Table 9.

The equivalent U-235 for sludge slurries is determined utilizing the equivalency factors in Table 13. Waste transfers that contain U-235 should be considered Pu-239. If multiple neutron poisons are present in the waste stream, additional safe weight ratios for multiple neutron poison can be evaluated.

Manganese is used in a lower poison-to-fissile weight ratio than iron, which minimizes the waste produced. Therefore, manganese is preferred over iron as a neutron poison. In addition, unlike ferrous sulfamate (source for iron), manganese nitrate will not produce ammonia as a by-product which will reduce the ammonia scrubber water addition thus reducing waste volume. The reduction in ammonia will also help in the reduction of flammability and comply with the composite lower flammability limit (CLFL).

The four equations given below show the single and multiple weight ratios for neutron poisons to equivalent U-235 and equivalent Pu-239 for mixed fissile waste streams. The equations below do not use equivalency factors of any kind.

Single and Multiple Safe Weight Ratios for Neutron Poisons to Equivalent U-235 [Reference 1]

For Fe Addition:

Equation 1: [Fe: U-235] = (-5.8* [Mn: U-235]) + 70 – [known Fe: U-235]

For Mn Addition:

Equation 2: [Mn: U-235] = (-0.17* [Fe: U-235]) + 12 – [known Mn: U-235]

Single and Multiple Safe Weight Ratios for Neutron Poisons to Equivalent Pu-239

For Fe Addition:

Equation 3: [Fe: Pu-239] = (-5.7* [Mn: Pu-239]) + 160 – [known Fe: Pu-239]

For Mn Addition:

Equation 4: [Mn: Pu-239] = (-0.17* [Fe: Pu-239]) + 28 – [known Mn: Pu-239]

The always safe weight ratios for neutron poisons to equivalent U-235 and Pu-239, taken from the WAC, are shown in Table 13.

Credit for any existing neutron poisons weight ratio can be applied to either fissile component in determining the neutron poisons needed to be added for a mixed waste stream. To avoid double counting, the neutron poisons present must be applied to only one of the fissile constituents until the safe neutron poison weight ratios are met.

Table 13 – Safe Weight Ratios for Neutron Poisons to Equivalent U-235 and Pu-239

Single Neutron Poison	Required Weight Ratio to Equivalent U-235	Required Weight Ratio to Equivalent Pu-239	Equivalency Factor Pu-239 to U-235
Fe	72	160	2.25
Mn	14	29	2.07
U-238	103	–	1.6

Transfers into Tank 50 must contain no more than 16.5 mg/L U-235 and 1.68 mg/L Pu-239. These restrictions on Tank 50 are to protect the Tank 50 Valve Box NCSE (Reference 25). HCAN-H-RW-03 and HCAN-H-RW-06 initial characterizations verified these waste streams are in compliance with the limits in place to protect the Tank 50 Valve Box NCSE, as indicated in Table 14.

Table 14

Measured Isotope	HCAN-H-RW-03, mg/L	HCAN-H-RW-06, mg/L
U-235	2.31	4.38
Pu-239	1.45E-04	1.3E-01

9.6.1 Uranium Enrichment in 2H Evaporator System

(This Section applies only when CSTF stores GPE material in Tank 43H)

The stream HCAN-RW-03, OF-H GP evaporator bottom effluent transfer Tank 710 is restricted to:

- Less than 15 grams U-235 per transfer.
- All the transfers together shall not exceed 120 grams of U-235 per calendar month.

The above restrictions ensure that Tank 43H meets NCSE target enrichment of ≤ 0.7 % U-235.

These criteria were implemented in the operating procedure NOP-211-H-1160 and OSR-39-275.

9.7 Implementation of CST SB/SB Administrative Controls [*A/C* CST SAC 5.8.2.15]

Controls identified that directly protect the LW SB documents are recorded in the Linking Document Database (LDD) records, which identify implementation documents [Reference 9].

The following SB/SB Administrative Control requirements will be implemented and appropriate steps annotated with $ signs:

1. Notification shall be provided to the LWF Shift Manager prior to intended transfer.
2. The ability to secure the prime mover of a transfer shall be required.
3. When transferring material to the LWF with an inhalation dose potential greater than 2.0E+08 rem/gal, leak detection with control room alarm shall be operable within the leak detection boxes associated with the transfer path.
4. Transfer into the LWF shall be secured as a result of a tornado warning, tornado watch, or high wind warning for the LWF as issued by the SRS Operations Center. Transfers into the LWF shall also be secured following a seismic event.
5. For evolutions not intended for the LWF, double isolation shall be required. Where double valve isolation is not possible, notification shall be given to the LWF Shift Manager of the potential for an unintended waste transfer prior to the intended transfer.
6. Notification shall be given to the LWF Shift Manager prior to performing excavations potentially affecting LWF transfer lines.

9.8 Requirements to Satisfy Downstream Facility Acceptance Criteria

The GP Evaporator stream have been characterized as LLW (Reference 24) and authorized for transfer to Tank 50 and Saltstone. Any material from other facilities being processed through the GP Evaporator shall be evaluated and documented to demonstrate that the stream meets the LLW requirements for transfer to Tank 50 in addition to other Tank Farm WAC requirements.

The waste streams will be characterized sufficiently for LW to comply with the requirements of downstream facilities for Np. Np concentrations for four of the streams are presented in Table 15.

Table 15 – Neptunium Concentrations

	HCAN-RW-03	HCAN-RW-05	HCAN-RW-06	HCAN-IW-01
Np (pCi Np-237/ml)	<5	2.8E+03	2.7E+02	1.13E+01

The HAW stream, HCAN-RW-06, and the GP Evaporator bottom, HCAN-RW-03 are below the the Saltstone WAC target of 2.50E+05 pCi/mL Np-237 [Reference 10]. However, the HAW stream, HCAN-RW-06, is not currently qualified to be transferred to Tank 50.

9.9 Industrial Hygiene Concerns

Concentrations of ammonia in the waste stream at greater than 0.127 wt % in equilibrium at 70°C will cause the vapor space to reach concentrations of 1.49 vol % (425 times the Short Term Exposure Limit (STEL) of 35 ppm). Because equilibrium conditions are not expected to be reached and the pump tank is ventilated, these levels should not be reached. The odor detection limit for ammonia, 0.043 ppm, is significantly below the STEL which should provide personnel with an early indication that ammonia gas levels are rising and that the immediate area should be evacuated.

10.0 References

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18. X-TRT-H-00001, "Evaluation of Ammonium Nitrate Accumulations on Process Vessel Vent Filters", N.S. Martino and M.R. Price, 8/7/2003.
19. X-CLC-H-00490, "Acceptance of H-Canyon PVV Flush at 100°C", T.E. Britt, 7/2005
20. X-CLC-H-00493, "Impact of Lab Sample Returns on H-Canyon/H-Outside Facilities Liquid Waste Streams to Tank Farm and Effluent Treatment Facility".
21. X-CLC-H-00507, "Nuclear Hydrogen Generation and Inhalation Dose Potential of Liquid Waste Stream HCAN-IW-01 (PVV Filter Flush Waste) from H-Canyon to H-Tank Farm".
22. X-CLC-H-00503, "Nuclear Hydrogen Generation and Inhalation Dose Potential of Waste Stream HCAN-RW-05 Enhanced with Plutonium Reapportioned from Waste Stream HCAN-RW-06".

23. S4 Manual, ENG.08, "Waste Acceptance Criteria (WAC), Waste Compliance Plan (WCP), and Special Waste Compliance Plan (SWCP) Procedure" (U).
24. WSRC-TR-2004-00328, "Characterization of H-Canyon Wastes When Processing Unirradiated Materials", W.G. Dyer, June 2004.
25. N-NCS-H-00132, "Nuclear Criticality Safety Evaluation: Tank 50 Valve Box Transfers", M.D. Murray, 3/28/04.
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11.0 Acronyms

AN	Ammonium nitrate
Ci	Curie
CLFL	Composite Lower Flammability Limit
CSTF	Condensate Storage and Transfer Facilities
DF	Decontamination Factor
HAW	High Activity Waste
HLW	High Level Waste
IW	Irregular Waste
LAW	Low Activity Waste
LFL	Lower Flammability Limit
LLW	Low Level Waste
LW	Liquid Waste
LWE	Liquid Waste Engineering
LWEC	Liquid Waste Engineering Compliance
LWF	Liquid Waste Facilities
LWGR	Liquid Waste Generator Representative
LWM	Liquid Waste Management
LWO	Liquid Waste Operations
PR	Problem Report
PVV	Process Vessel Vent
RCRA	Resource Conservation and Recovery Act
RW	Routine Waste
SIRIM	Site Item Reportability and Issue Management
TBP	Tri-butyl Phosphate
TCLP	Toxicity Characteristic Leaching Procedure
VOC	Volatile Organic Carbons
WAC	Waste Acceptance Criteria
WCP	Waste Compliance Program

12.0 Attachments

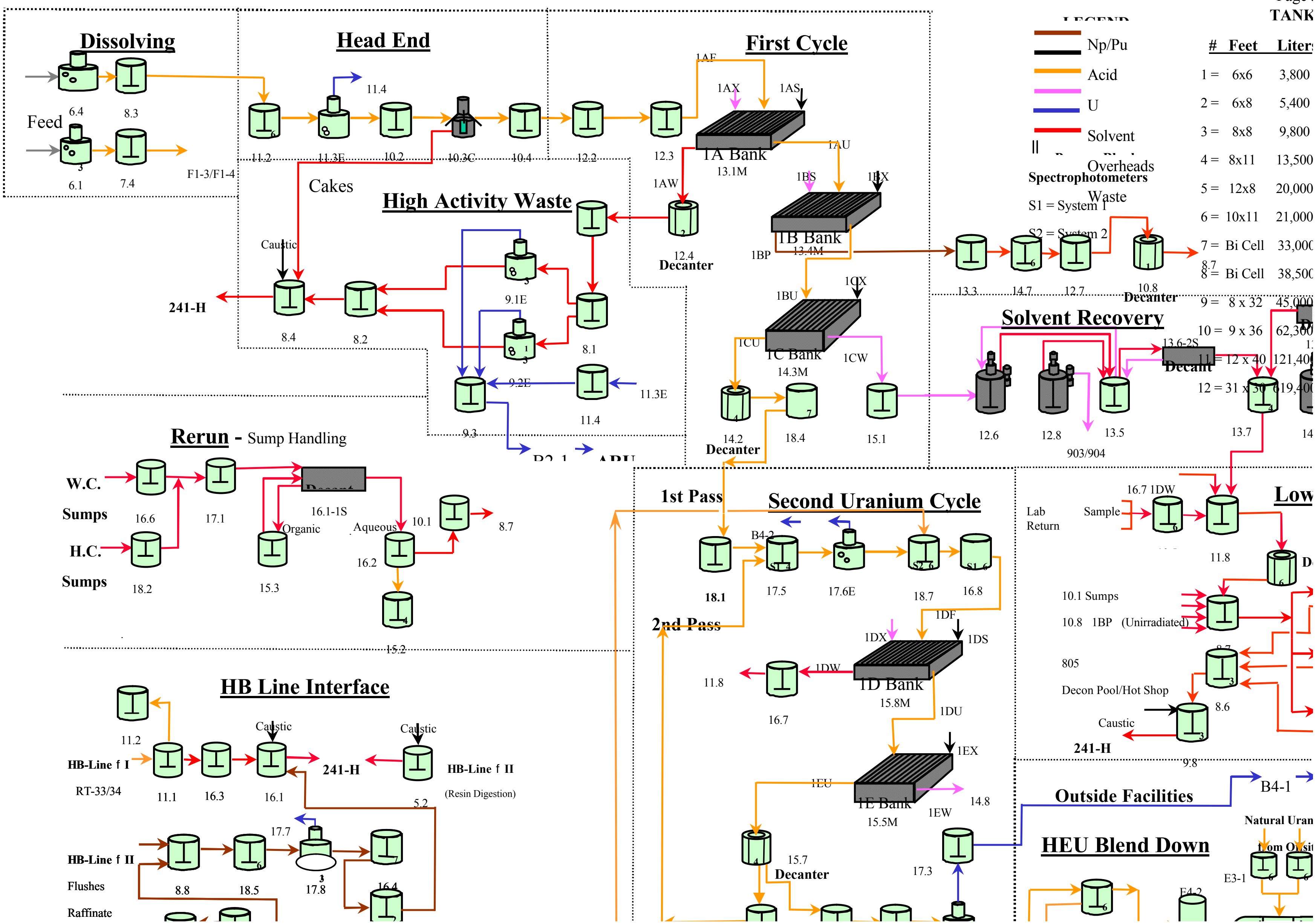
12.1 HM-Process Schematic

12.2 General Purpose Evaporator Schematic

12.3 PVV Filter Flush Schematic

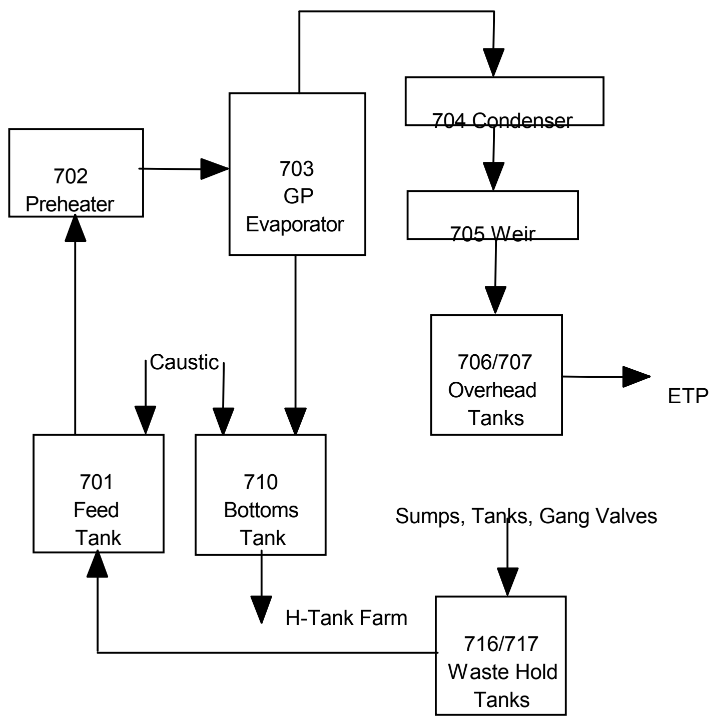
FOR INFORMATION ONLY

221-H Canyon HEU Process, rev 6, 4/10/07



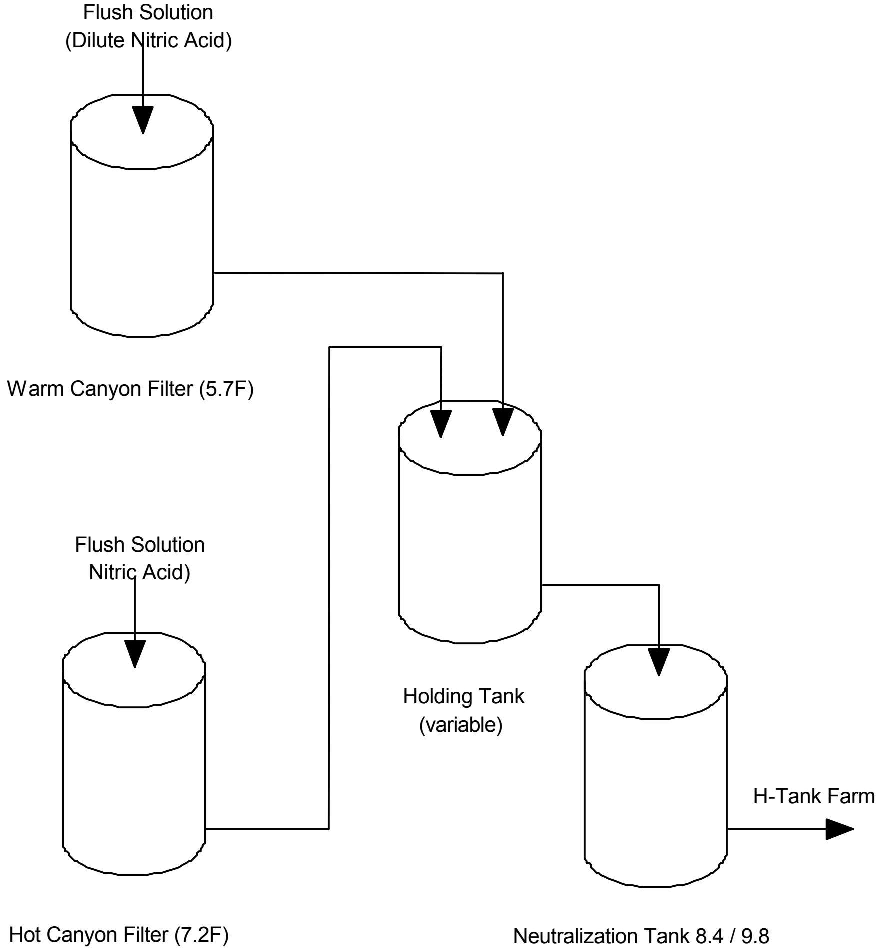
12.2 General Purpose Evaporator Schematic

NOTE: H-Canyon process configurations are subject to change. The process diagrams in this WCP are for information only and do not necessarily reflect the current configurations.



12.3 PVV Filter Flush Schematic

NOTE: H-Canyon process configurations are subject to change. The process diagrams in this WCP are for information only and do not necessarily reflect the current configurations.



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