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WHC-EP-0342
Addendum 20

PUREX Plant Cooling Water Stream-Specific Report

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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PUREX Plant Cooling Water Stream-Specific Report

PUREX/UO_3 Operations

Date Published
August 1990

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

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ABSTRACT

PUREX/UO_3 OPERATIONS

The proposed wastestream designation for the Plutonium-Uranium Extraction (PUREX) Plant CWL wastestream is that this stream is not a dangerous waste, pursuant to the Washington (State) Administration Code (WAC) 173-303, Dangerous Waste Regulations.* *A combination of process knowledge and sampling data was used to make this determination.*

*Ecology, 1989, *Dangerous Waste Regulations*, Washington (State) Administrative Code (WAC) 173-303, Washington State Department of Ecology, Olympia, Washington.

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EXECUTIVE SUMMARY

The proposed wastestream designation for the Plutonium-Uranium Extraction (PUREX) Plant CWL (sometimes called the Cooling Water wastestream), located in the 200 East Area of the Hanford Site, is that this stream is not a dangerous waste, pursuant to the Washington (State) Administrative Code (WAC) 173-303, *Dangerous Waste Regulations*. A combination of process knowledge and sampling data was used to determine if the effluent contains a listed dangerous waste (WAC 173-303-080). Sampling data alone are used to compare to the dangerous waste criteria (WAC 173-303-100) and dangerous waste characteristics (WAC 173-303-090). Sample data were based on samples downstream of all process contributors. Sample data consisted of five random samples taken between November 1989 and February 1990.

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LIST OF TERMS

DOE	U.S. Department of Energy
EC%	equivalent concentration (percent)
Ecology	Washington State Department of Ecology
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
HH	halogenated hydrocarbons
MSDS	Material Safety Data Sheet
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
P&O	Pipe and Operations
PUREX	Plutonium-Uranium Extraction
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WAC	Washington (State) Administrative Code
90%CI	90% confidence interval

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PUREX PLANT CWL STREAM-SPECIFIC REPORT

1.0 INTRODUCTION

1.1 BACKGROUND

In response to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), comments were received from the public about relating the discharge of liquid effluents into the soil column. As a result, the U.S. Department of Energy (DOE), with the concurrence of the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA), committed to assess the contaminant migration potential of liquid discharges at the Hanford Site (Lawrence 1989).

This assessment is described in the *Liquid Effluent Study Project Plan* (WHC 1990a), a portion of which characterizes 33 liquid effluent streams. This characterization consists of integrating the following elements, pursuant to the Washington (State) Administrative Code, (WAC) 173-303 (Ecology 1989): process data, the sampling data, and dangerous waste regulations.

The results of the characterization study are documented in 33 separate reports, one report per wastestream. The complete list of stream-specific reports appears in Table 1-1. This document is one of the 33 reports.

1.2 APPROACH

This report characterizes the Plutonium-Uranium Extraction (PUREX) CWL, located in the 200 East Area of the Hanford Site, in sufficient detail so a wastestream designation, in accordance with WAC 173-303, can be proposed.

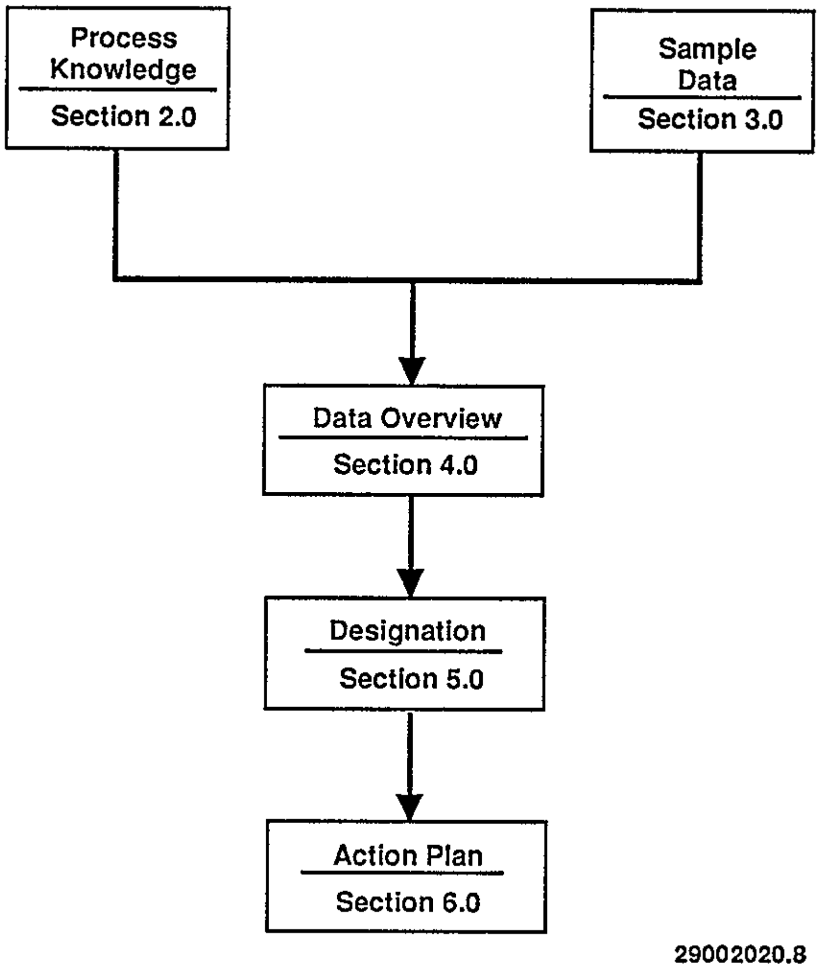
This characterization strategy (shown in Figure 1-1) is implemented by means of the following steps.

- Describe both process and sampling data (Chapters 2.0 and 3.0, respectively).
- Present the data (Chapter 4.0).
- Propose a designation (Chapter 5.0).
- Design an action plan, if needed, to obtain additional characterization data (Chapter 6.0).

Table 1-1. Stream-Specific Characterization Reports.

WHC-EP-0342	Addendum 1	300 Area Process Wastewater
WHC-EP-0342	Addendum 2	PUREX Plant Chemical Sewer
WHC-EP-0342	Addendum 3	N Reactor Effluent
WHC-EP-0342	Addendum 4	163N Demineralization Plant Wastewater
WHC-EP-0342	Addendum 5	PUREX Plant Steam Condensate
WHC-EP-0342	Addendum 6	B Plant Chemical Sewer
WHC-EP-0342	Addendum 7	UO_3/U Plant Wastewater
WHC-EP-0342	Addendum 8	Plutonium Finishing Plant Wastewater
WHC-EP-0342	Addendum 9	S Plant Wastewater
WHC-EP-0342	Addendum 10	T Plant Wastewater
WHC-EP-0342	Addendum 11	2724-W Laundry Wastewater
WHC-EP-0342	Addendum 12	PUREX Plant Process Condensate
WHC-EP-0342	Addendum 13	222-S Laboratory Wastewater
WHC-EP-0342	Addendum 14	PUREX Plant Ammonia Scrubber Condensate
WHC-EP-0342	Addendum 15	242-A Evaporator Process Condensate
WHC-EP-0342	Addendum 16	B Plant Steam Condensate
WHC-EP-0342	Addendum 17	B Plant Process Condensate
WHC-EP-0342	Addendum 18	2101-M Laboratory Wastewater
WHC-EP-0342	Addendum 19	UO_3 Plant Process Condensate
WHC-EP-0342	Addendum 20	PUREX Plant Cooling Water
WHC-EP-0342	Addendum 21	242-A Evaporator Cooling Water
WHC-EP-0342	Addendum 22	B Plant Cooling Water
WHC-EP-0342	Addendum 23	241-A Tank Farm Cooling Water
WHC-EP-0342	Addendum 24	284-E Powerplant Wastewater
WHC-EP-0342	Addendum 25	244-AR Vault Cooling Water
WHC-EP-0342	Addendum 26	242-A Evaporator Steam Condensate
WHC-EP-0342	Addendum 27	284-W Powerplant Wastewater
WHC-EP-0342	Addendum 28	400 Area Secondary Cooling Water
WHC-EP-0342	Addendum 29	242-S Evaporator Steam Condensate
WHC-EP-0342	Addendum 30	241-AY/AZ Tank Farms Steam Condensate
WHC-EP-0342	Addendum 31	209-E Laboratory Reflector Water
WHC-EP-0342	Addendum 32	T Plant Laboratory Wastewater
WHC-EP-0342	Addendum 33	183-D Filter Backwash Wastewater

Figure 1-1. Characterization Strategy.



1.3 SCOPE

The scope of this report is to characterize the PUREX Plant CWL effluent, which is currently being discharged to 216-B-3 Pond. This report does not address any other wastestream leaving the PUREX Plant, including solid waste, gaseous waste, or sanitary waste.

Historical changes, process campaign changes, and sampling data are considered only if relevant to the characterization of the wastestream as it presently exists.

2.0 PROCESS KNOWLEDGE

This section presents a historical perspective along with future projects to enable the reader to understand present status and both current and future disposition of the effluent. The section presents a qualitative characterization of the chemical and radiological constituents of the PUREX Plant CWL based on process knowledge. These process data are discussed in terms of the following factors:

- Location and physical layout of the process facility
- A general description of the present, past, and future activities of the process
- The identity of the wastestream contributors.

The PUREX CWL consists almost entirely of warm raw water and condensed steam, which are used to control the temperature of certain process vessels. ("Raw" water is untreated Columbia River water. The vessels involved are those process vessels that have little risk of steam or cooling coil failure and radionuclide release.) The CWL consists of water that has passed through cooling coils and condensate from steam that has passed through heating coils. No chemicals are added to the CWL in the PUREX Plant, although some corrosion products may be expected to be contributed by the plant piping. Some radionuclides may also be added through failure of heat transfer surfaces. Radiation process control monitors are in use to divert this stream to a diversion basin to provide containment in the event of above-normal levels of radioactivity.

The CWL is one of five process-related streams at the PUREX Plant addressed in the liquid effluent sampling plan.

2.1 PHYSICAL LAYOUT

The PUREX Plant is a collection of buildings and facilities located in the 200 East Area of the Hanford Site (Figures 2-1 and 2-2). The 202-A Building (Figure 2-3) is a heavily shielded, reinforced-concrete structure of the sort known as a canyon building. This building contains the main equipment used in the PUREX Plant process. The 202-A Building contributes cooling water and steam condensate from its vessels. Additional PUREX Plant facilities that add water to the CWL are the following:

- 2711-A Building
- 2712-A Building
- 276-A Building
- 293-A Building.

Figure 2-1. Location of PUREX Plant within Hanford.

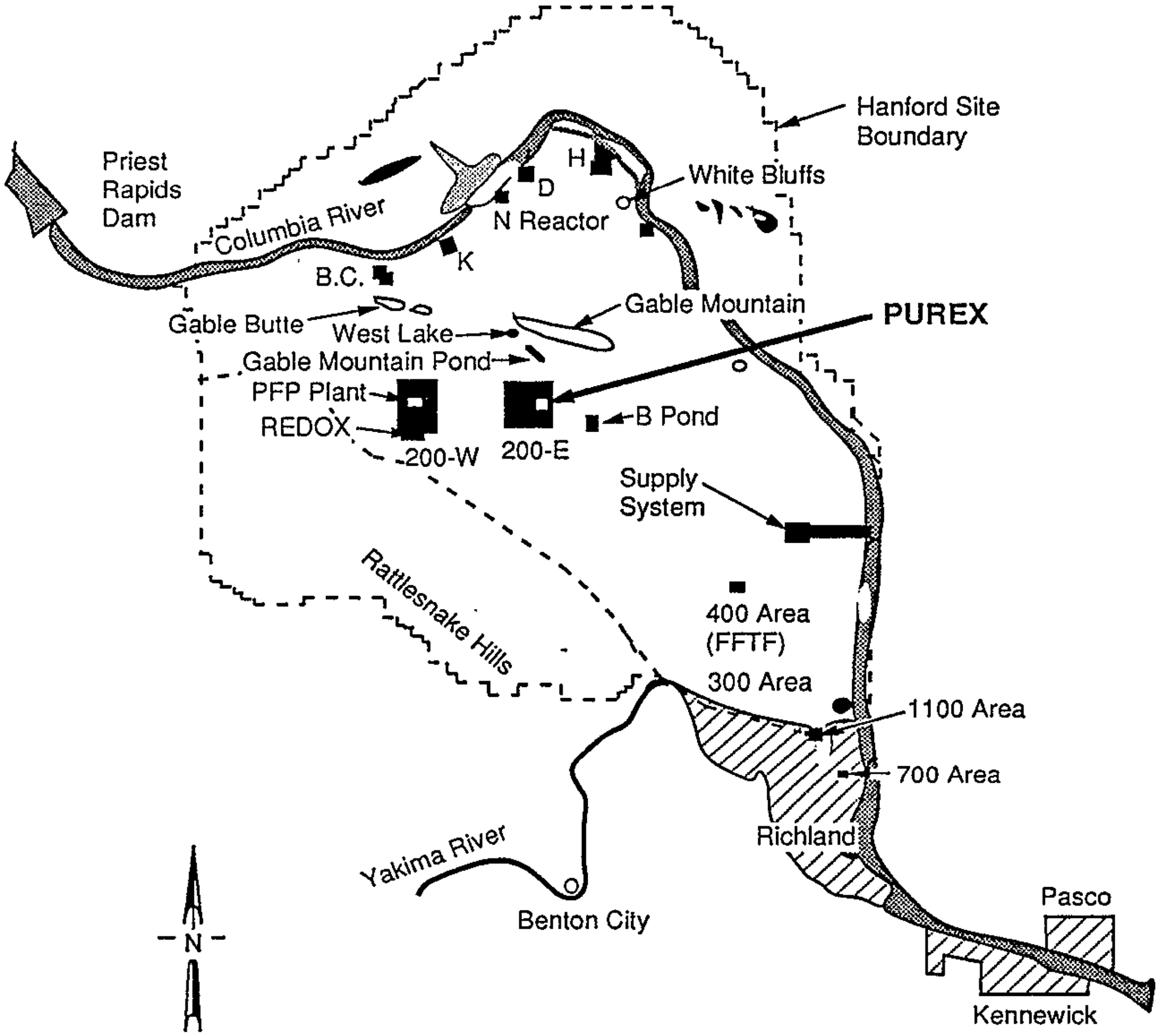


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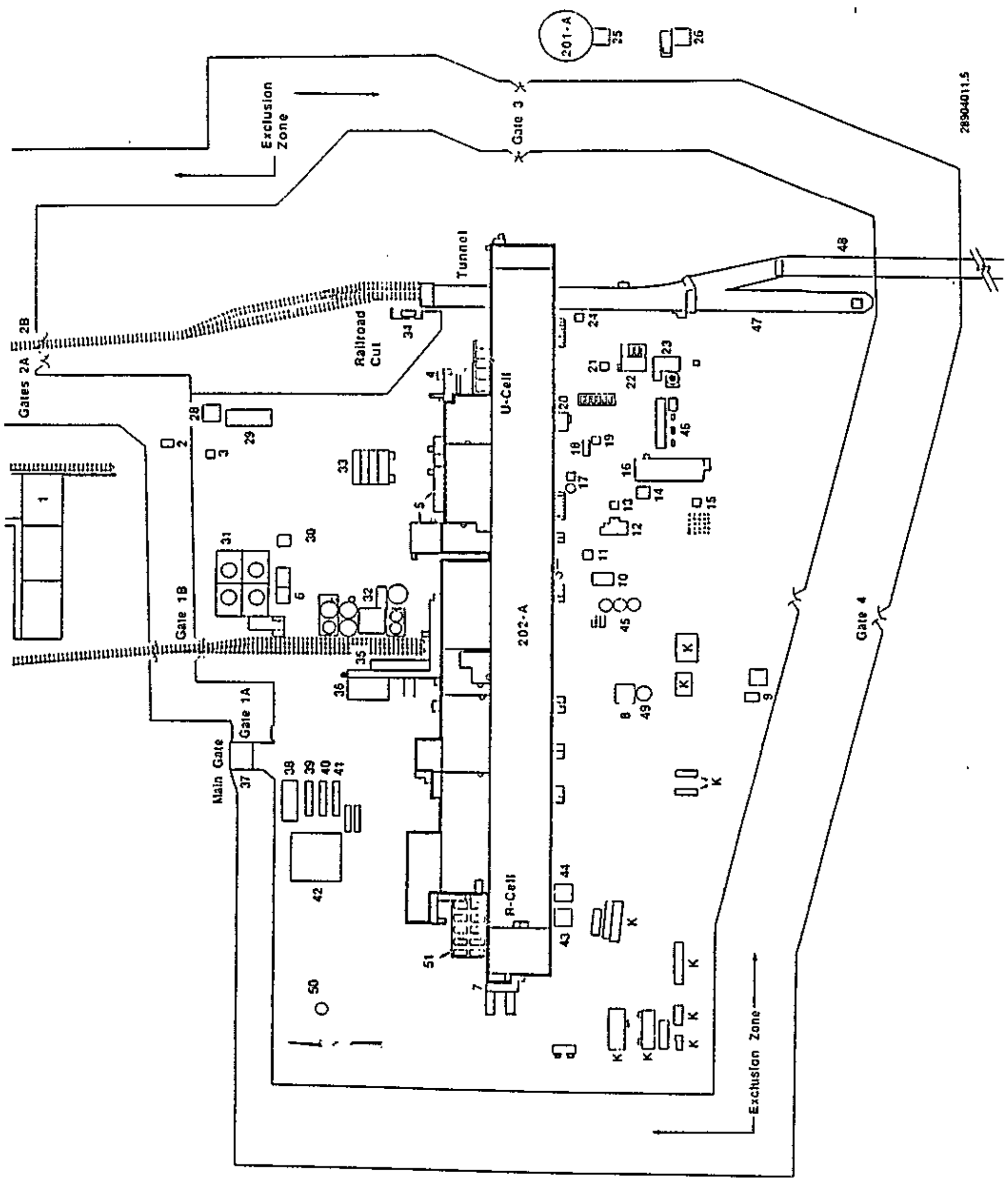
Figure 2-2. PUREX Plant Plot Plan.



1. 275-EA Warehouse
2. CSL PIT
3. 295-AC CSL (Chem. Sewer Line)
4. 206-A Fractionator
5. Laboratory Sample Receiving Dock
6. 203-A UNH Pump House/Control Room
7. PR-Dock
8. 295-AB POD (Process Distillate Discharge)
9. A-4 PIT.POD PIT
10. 213-A Reg Maint. Workshop
11. 291-AB Sample Shack
12. Shielded Valve PIT
13. 291-AC Instr. Shack
14. 291-AG Instr. Shack
15. 291-AJ Instr. Shack
16. 291-AE #4 Filter Bldg.
17. 295-AA SCD (Steam Condensate Discharge)
18. 291-AH Ammonia Off Gas Filter Bldg.
19. 291-AH Ammonia Off Gas Sampler Bldg.
20. 212-A Load Out
21 294-A Instr. Shack
22. 293-A Dissolver Off Gas Bldg.
23. 292-AB Main Stack Bldg.
24 295-A ASD (Ammonia Scrubber Discharge)
25. 201-A Pump PIT
26. 295-AD CWL (Cooling Water Line)
27. BT2 Exhauster Area
28. 252-A
29 281-A Emergency Generators
30. MO-332
31. 203-A Storage Area
32. 211-A Demineralizer Bldg.
33. MO-409 Laboratory Trailer
34. Railroad Storage Shed
35. 214 A, B, C, D
36. 2714-A
37. 2701-A Badge House
38. MO-035 Training Trailer
39. MO-707
40. 64-15323
41. 202A-T-1
42. MO-023 Engineering Trailer
43. 2711-A-1
44. 2712-A
45. Hydrogen Peroxide Tanks
46. 291-A Exhaust Fans
47. 218-E-14 Storage Tunnel
48. 218-E-15 Storage Tunnel
49. 216-A-5
50. 2901-A Water Tank
51. 276-A R Cell

K = Kaiser Related Facilities

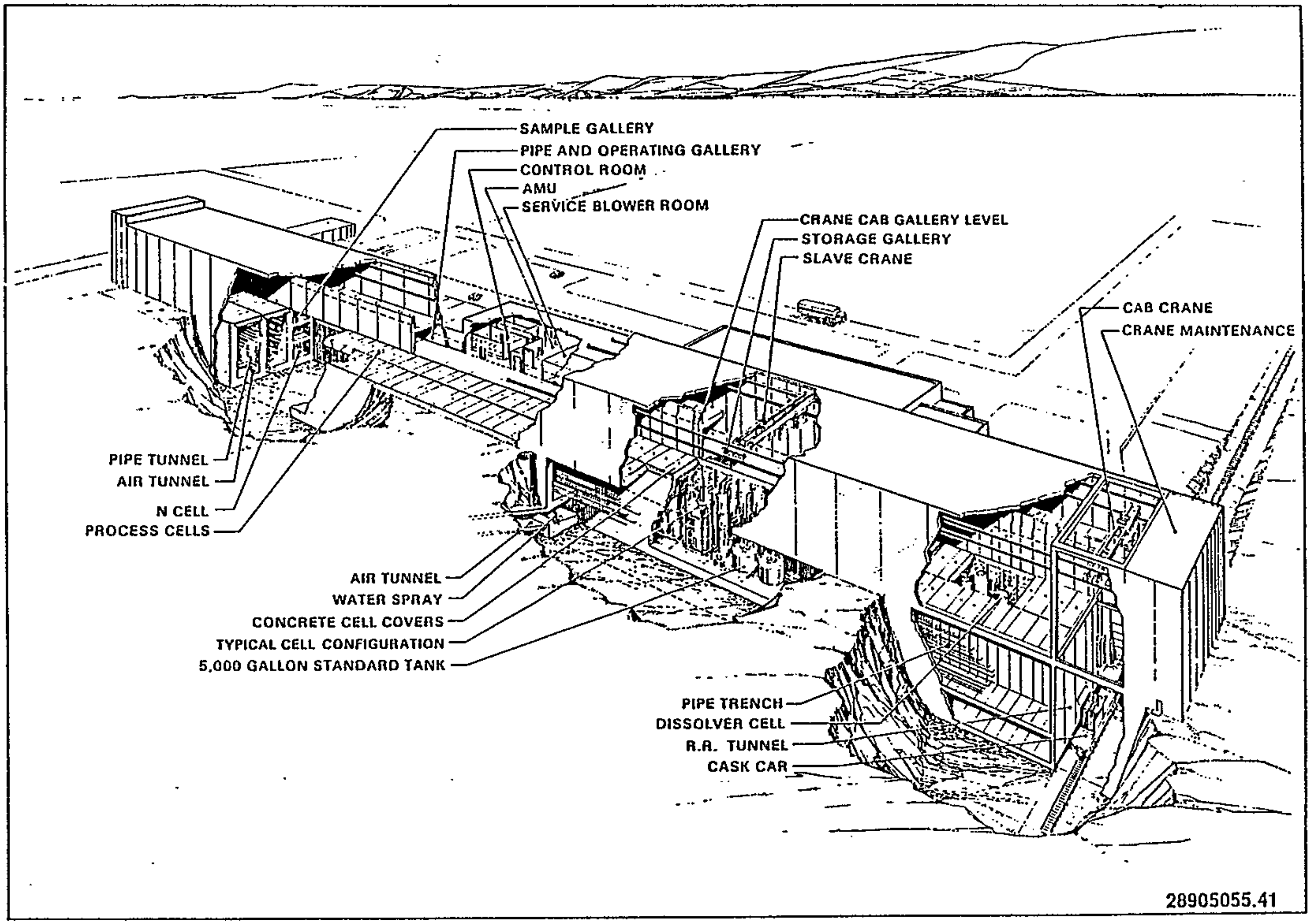


Figure 2-3. The 202-A Building.

The 202-A Building is 1,005 ft long, 119 ft wide at its widest point, and about 100 ft high, with about 40 ft of this height below grade level. The canyon runs nearly the length of the 202-A Building. It contains and shields process equipment used for processing irradiated nuclear fuel. The canyon contains process cells where process vessels are located, as well as other facilities.

The process cells are rooms, shielded with massive concrete, that contain most of the process equipment. The floor of the canyon cells is a layer of reinforced concrete nearly 6 ft thick. The process cells are covered by cover blocks, which are removable blocks of reinforced concrete designed to provide radiation shielding.

The Pipe and Operations (P&O) Gallery contains "cold side" (nonradioactive) piping to the process.

The railroad tunnel is used for receiving irradiated fuel and large pieces of equipment transported to PUREX via railcars. The railroad tunnel enters the north side of the east end of Building 202-A, continues through the building, and exits on the south side of the building. The storage tunnels are an extension of the rail lines and consist of two parallel, earth-covered tunnels that contain railroad tracks and are separated by water-filled shield doors. The storage tunnels contain failed equipment (loaded on railroad cars) that is contaminated with high levels of radioactivity or that is too bulky for immediate burial. Storage of the equipment allows the radioactivity to decay to less dangerous levels.

2.2 CONTRIBUTORS

Table 2-1 lists the contributors to the PUREX Plant CWL wastestream. All but two of the contributors are heat transfer effluents. One of these exceptions is the seal water from two air pumps; the other is the railroad tunnel water-filled door drain. The PUREX Plant railroad tunnel, associated with the 202-A Building, has a water-fillable door that is used for shielding radiation. The door drain is used very infrequently when water is emptied from this door. Heat transfer effluents are warmed cooling water and condensed steam resulting from cooling/heating various pieces of equipment.

The existing sample point chosen was downstream of all contributors and was designated in the *Liquid Effluent Study Project Plan* (WHC 1990a) before sampling.

2.3 PROCESS DESCRIPTIONS

The process description proceeds in three parts. The first part describes the present process, that is, the process as it existed from October 1989 to March 1990. The second part describes changes which were made in the recent past (before October 1989). The third part describes the changes which are expected in the future (after March 1990).

Table 2-1. PUREX Plant CWL Contributors. (sheet 1 of 2)

Location	Process unit	Source description
2711-A, 2712-A		Pump seal water
202-A, L Cell	Tk-L3	3A feed tank coil
202-A, L Cell	E-L6	L-6 concentrator condenser cooling water
202-A, L Cell	E-L7-2	L-7 concentrator condenser cooling water
202-A, Q Cell	E-Q9	Ventilation jet condenser cooling water
276-A, R Cell	Tk-R8	20W waste tank coil
276-A, R Cell	Tk-R7	200 receiver tank coil
276-A, R Cell	Tk-R5	200 rework tank coil
276-A, R Cell	Tk-R2	20 waste tank coil
276-A, R Cell	Tk-R1	20 feed tank coil
202-A, PR Room	E-L12	Tk-L11 jet steam condenser cooling water
202-A, K Cell	Tk-K6	2UC sampler tank coil
202-A, K Cell	Spare	No connection
202-A, K Cell	Tk-K5	2UC receiver tank coil
202-A, K Cell	E-K4-2	K4 concentrator condenser cooling water (four contributors)
202-A, K Cell	E-K4-1	Left tube bundle steam condensate
202-A, K Cell	E-K4-1	Right tube bundle steam condensate
202-A, K Cell	Tk-K1	2D feed tank coil
202-A, J Cell	E-J8-1	J8 concentrator condenser cooling water (three contributors)
202-A, J Cell	Spare	No connection
202-A, J Cell	Tk-J3	1BX feed tank coil
202-A, J Cell	Tk-J1	3WB recycle tank coil
202-A, H Cell	Spare	No connection (two spares)
202-A, H Cell	E-H4-2	H4 concentrator condenser cooling water (three contributions)
202-A, G Cell	Tk-G8	10W waste tank coil
202-A, G Cell	Tk-G7	100 receiver tank coil
202-A, G Cell	Spare	No connection (two spares)
202-A, G Cell	Tk-G5	100 feed tank coil
202-A, G Cell	Tk-G2	10 waste tank coil
202-A, G Cell	Tk-G1	10 feed tank coil
202-A, F Cell	Tk-F18	Sump waste receiver tank coil
202-A, F Cell	Spare	No connection (10 spares)
202-A, F Cell	Tk-F13	Utility organic recovery tank coil
202-A, F Cell	Tk-F12	Ammonia concentrator feed tank coil
202-A, F Cell	E-F11-12	Ammonia concentrator condenser cooling water
(three contributors)		
202-A, F Cell	Tk-F10	3WF decanter coil
202-A, F Cell	E-F9	Tk-F8 ventilation condenser cooling water
202-A, F Cell	Tk-F26	1WW receiver tank coil
202-A, F Cell	E-F5	Acid absorber condenser cooling water (three contributors)
202-A, F Cell	Tk-F3	Acid receiver tank coil

Table 2-1. PUREX Plant CWL Contributors. (sheet 2 of 2)

Location	Process unit	Source description
202-A, E Cell	Spare	No connection
202-A, E Cell	E-F1	Process ventilation condenser cooling water (two contributors)
202-A, E Cell	Tk-E5	Decladding waste tank coil
202-A, E Cell	Tk-E3-2	Ammonia scrubber catch tank coil
202-A, E Cell	Tk-E3	Centrifuge feed tank coil
202-A, D Cell	Tk-D5	Metal solution accountability tank coil
202-A, D Cell	Tk-D4	Metal solution storage tank coil
202-A, D Cell	Spare	No connection (two spares)
202-A, D Cell	Tk-D3	Metal solution storage tank coil
202-A, D Cell	Tk-D2	Decladding waste receiver tank coil
202-A, D Cell	Tk-D1	Metathesis solution storage tank coil
202-A, C Cell (three contributors)	T-C3-1	Dissolver downdraft condenser cooling water
202-A, C Cell	Tk-C3-4	Ammonia scrubber catch tank coil
202-A		CWL/SCD cross tie
202-A, B Cell (three contributors)	T-B3-1	Dissolver downdraft condenser cooling water
202-A, B Cell	Tk-B3-4	Ammonia scrubber catch tank coil
202-A, A Cell (three contributors)	T-A3-1	Dissolver downdraft condenser cooling water
202-A, A Cell	Tk-A3-4	Ammonia scrubber catch tank coil
293-A	E-XA-1,2	NOx backup facility intercooler cooling water
293-A	Tk-XD	Recovered nitric acid catch tank coil
202-A	RR Tunnel	Drain from railroad tunnel water-fillable door

2.3.1 Present Activities

Present activities include those activities which occurred from October 1989 through March 1990. The discussion of present activities is divided into four parts. The first provides an overview of the PUREX process with emphasis on the five liquid effluent streams which have traditionally been released. The second describes the CWL process. The third discusses sampling points. The fourth discusses administrative controls.

2.3.1.1 PUREX Process Overview. The PUREX nuclear fuel processing plant, located in the 200 East area of the Department of Energy's Hanford Site in southeast Washington, separates usable actinides from fission products in irradiated nuclear fuel. Briefly, the process consists of dissolving the fuel and then separating the actinides using liquid-liquid solvent extraction. The driving forces for the separations consist of concentration changes, temperature changes, and chemical additions. PUREX is the source of five liquid effluent streams, which are mostly by-products of the various driving forces. These liquid effluent streams are the PDD, CWL, SCD, CSL, and ASD. Figure 2-4 shows the traditional disposition of these effluents.

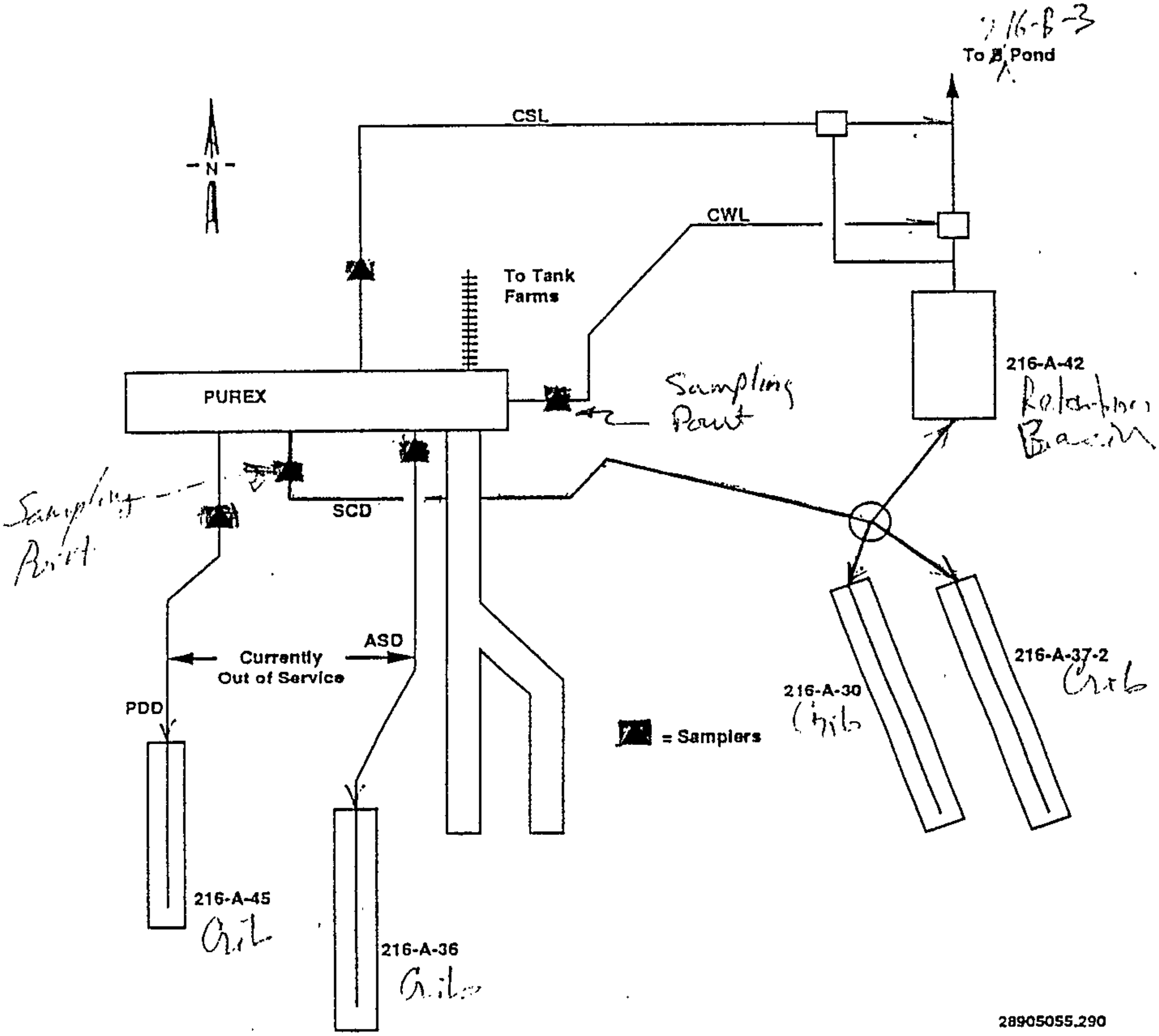
The concentration changes are provided by dilution with water and by removal of water (and sometimes nitric acid) by boiling. Cold chemical additions to the process add water which must be removed in the concentration stages. Although most of the water which is boiled out of solutions is re-used in dilution stages, there is some excess which requires disposal. This water is the source of the PDD, sometimes called Process Condensate. Addendum 12 addresses the PDD.

Boiling process solutions and condensing the resulting vapors requires the use of steam and cooling water, and produces steam condensate and warm water as effluents. Changing the temperatures of process solutions to drive the separations produces more steam condensate and warm water. This steam condensate and warm water constitutes most of the liquid effluents from PUREX, namely, the CWL (sometimes called Cooling Water), SCD (sometimes called Steam Condensate), and most of the CSL (sometimes called Chemical Sewer). Addenda 20, 5, and 2 address the CWL, SCD, and CSL, respectively.

Ventilation, heating, and water services, together with room drainage (mostly shower rooms, water coolers, housekeeping water, and steam and water leaks, together with occasional chemical leaks) contribute the remainder of the CSL.

Removing the protective cladding from the fuel, the first step in fuel dissolution, produces large quantities of gaseous ammonia. This ammonia is scrubbed from the offgas with water to prevent releasing the ammonia to the air, and to alleviate the explosion hazard which the ammonia would otherwise present. The resulting ammonia solution, contaminated with radionuclides from the fuel, is then boiled to remove the radionuclides. Before 1987, the resulting ammonia-bearing condensate stream was released as the ASD, sometimes called Ammonia Scrubber Condensate. In the future, with the implementation

Figure 2-4. The PUREX Plant Liquid Effluents.



of the Ammonia Destruction process, this stream will consist of water with only traces of ammonia. The new ASD might be combined with the PDD, or it might be recycled to the ammonia scrubbers. Addendum 14 addresses the ASD.

2.3.1.2 The CWL Process. The PUREX CWL is made up of 200 East raw water and condensed steam (steam condensate). Figure 2-5 is a simplified schematic of the CWL process.

With the exception of the pump seal water and the waste from the water fillable door drain, the raw water and steam condensate enter the CWL via routes which are used to control the temperature of process vessels. The process vessels contributing to this stream are not expected to experience coil failure and subsequent release of radionuclides. The water used in the water fillable door (when it is filled) is used to shield out radiation, and is not expected to become contaminated by radioactive substances. Of the two air pumps from which the CWL collects seal water effluent, one provides dry air for certain gloveboxes, and the other exhausts filtered air from the air sampling system. (The gloveboxes do not tie into the CWL.) Consequently, contamination from the pumps should also be minimal.

The steam and cooling water contributors to the CWL enter the 202-A Building and flow through control valves to their penetrations of the north wall of the 202-A canyon. The penetrations contain piping which conducts the heating and cooling fluids via jumpers to their respective heat transfer surfaces. Figures 2-6 and 2-7 show typical heat transfer surfaces. The heat exchange effluents then flow through penetrations in the south wall of the 202-A canyon, which lead to an underground collection pipe. This collection pipe conducts the CWL to the 295-AD sample shack, where the stream flows over a weir for flow measurement. Table 2-2 contains the monthly flows reported by this system for the current period. From the sample shack, the CWL flows through a diversion structure and on to the 216-B-3 Pond (see Figure 2-8 for a flow diagram of the CWL).

Table 2-2. Current CWL Flows.

Month/ Year	Flow (l/month)
Oct 89	5.40 E+08
Nov 89	6.20 E+08
Dec 89	5.00 E+08
Jan 90	4.62 E+08
Feb 90	6.29 E+08
Mar 90	3.88 E+08

A continuously running pump transfers a small sample stream of the CWL to the 295-AD sample and monitor shack, where some of the CWL flows through two process control radiation monitors and past a composite sampler and the

Figure 2-5. Simplified Schematic Flow Diagram of the CWL.

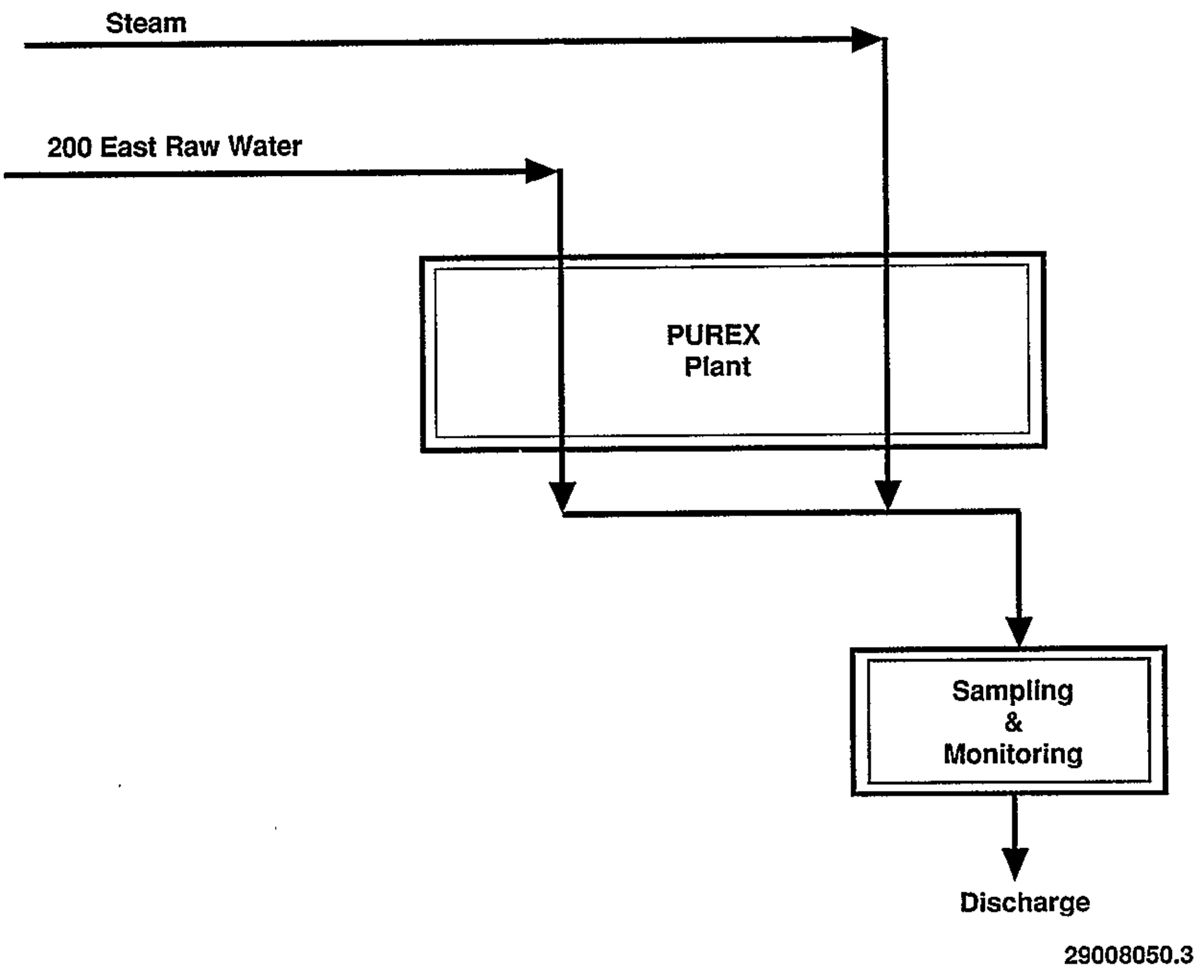


Figure 2-6. Typical Condenser Schematic.

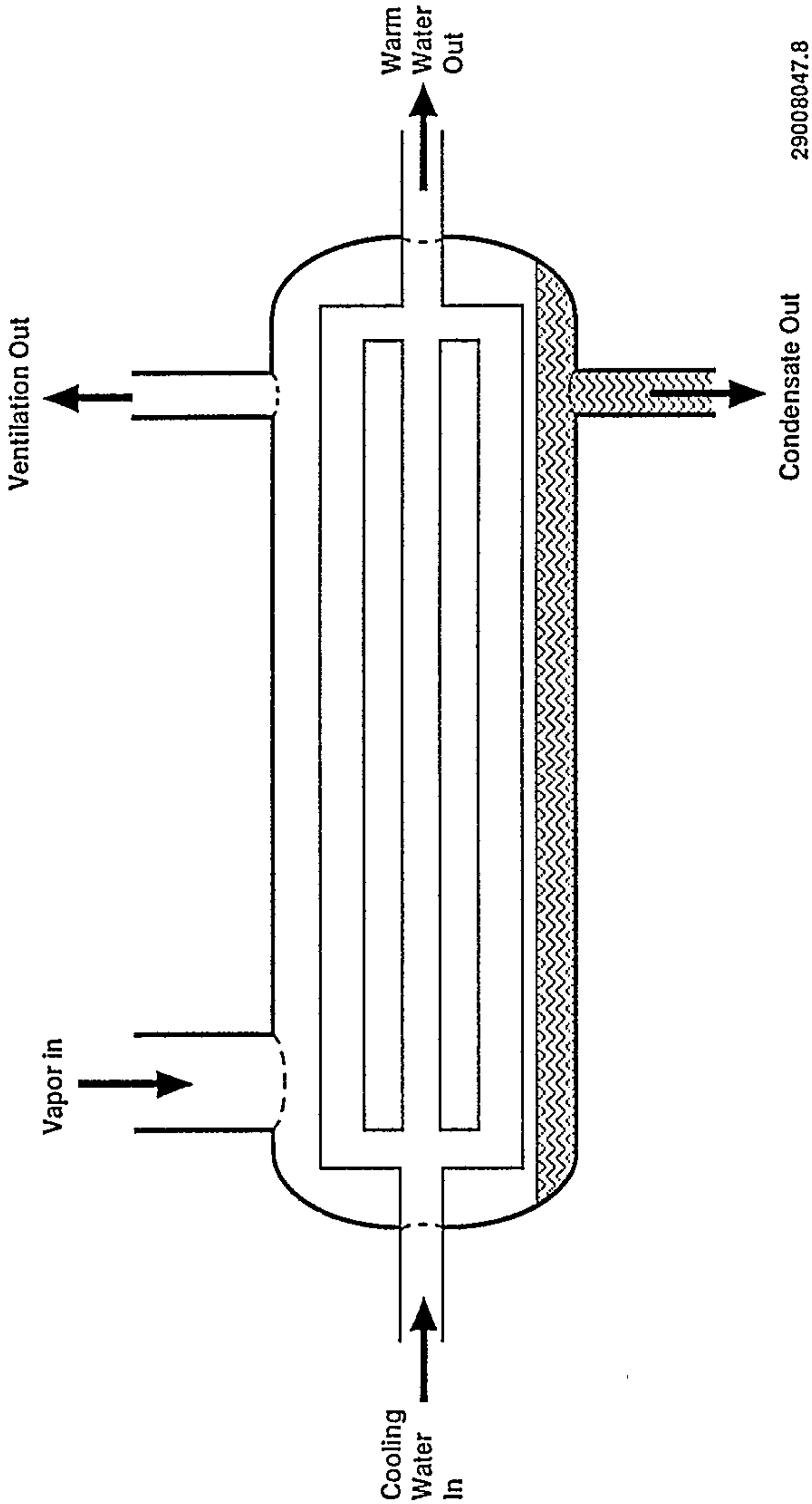


Figure 2-7. Tank Heating/Cooling Coil Schematic.

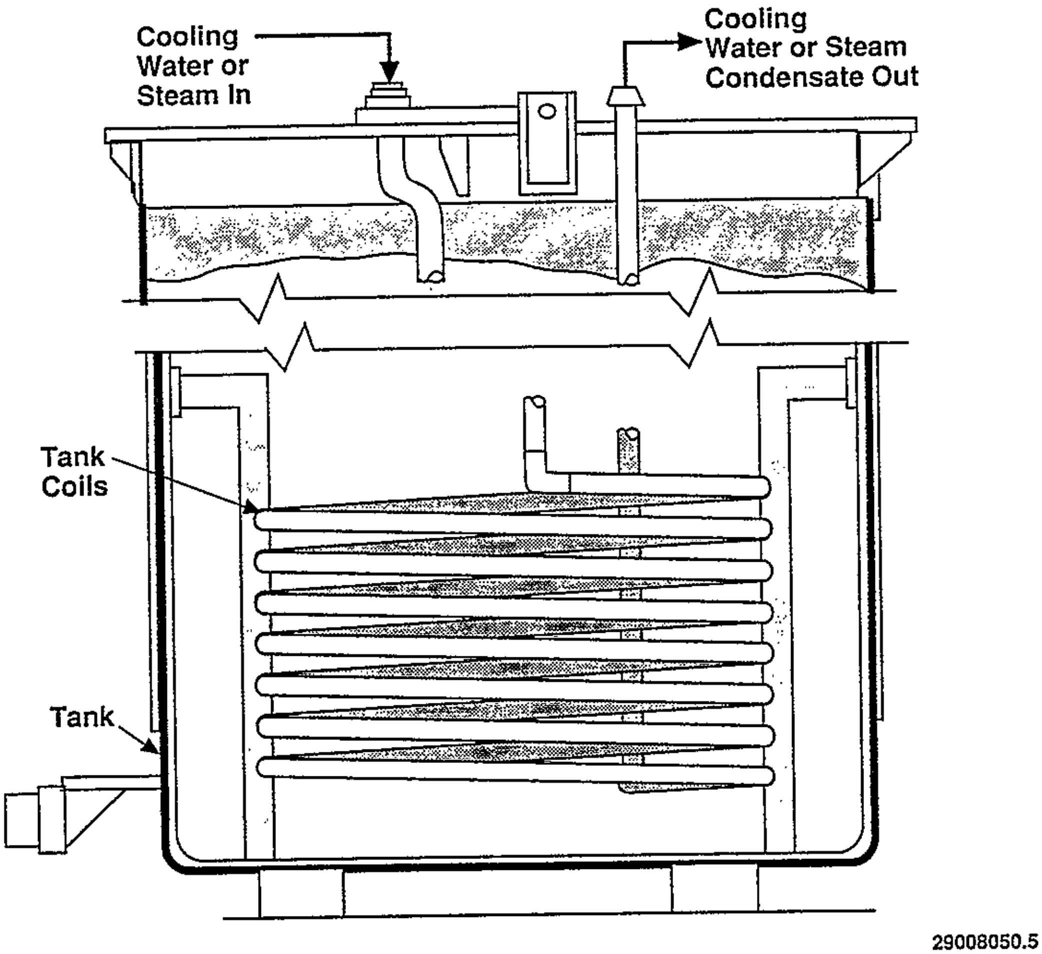
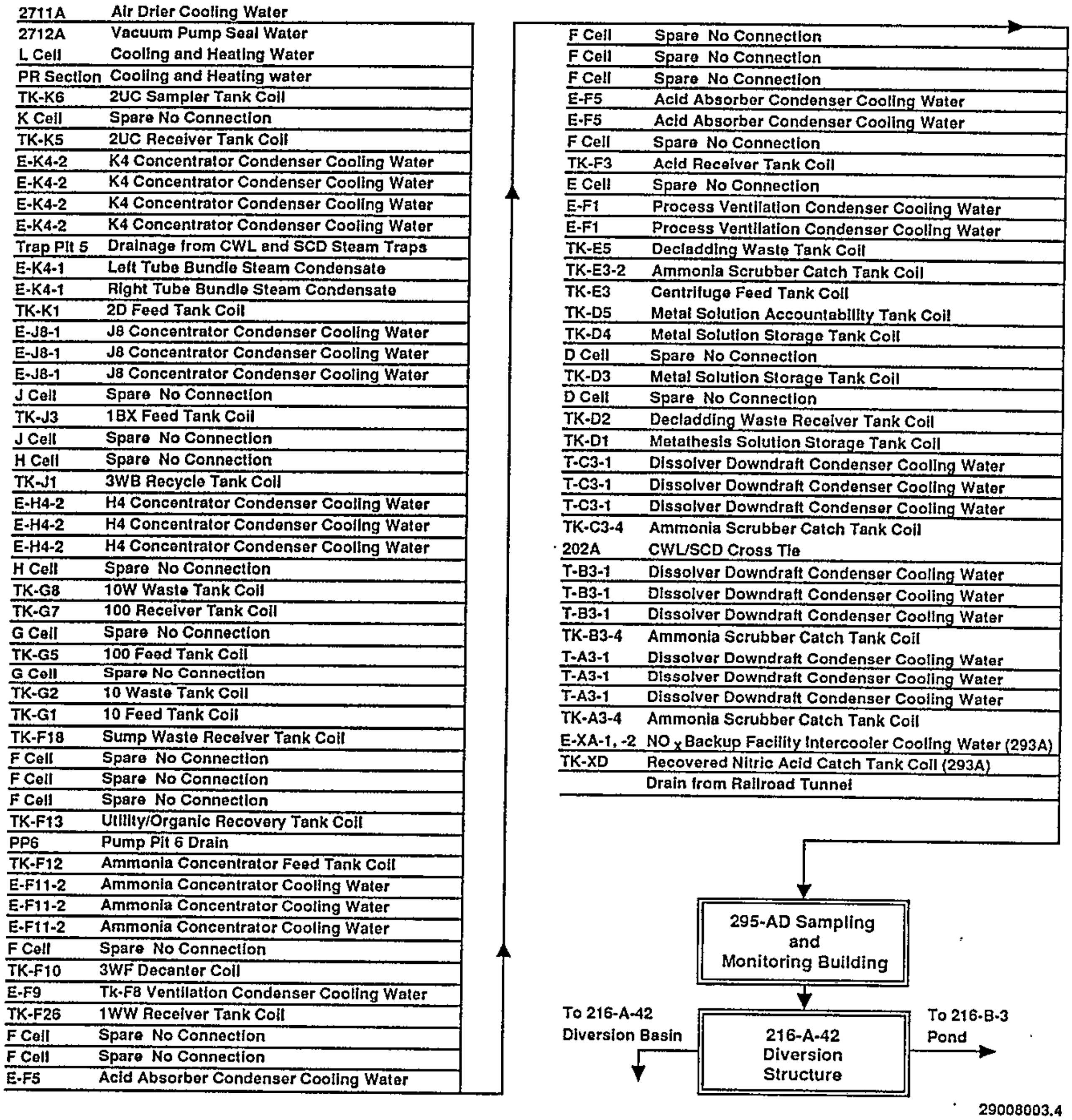


Figure 2-8. Flow Diagram of the CWL.



grab samplers which were used for the chemical samples of the CWL. One monitor is sensitive to alpha radiation and alarms if it detects 41 or more counts in a 1,000-s counting period (approximately 3.5 E-04 μCi/mL). The other monitor is sensitive to gamma radiation and alarms if it exceeds 30,000 counts/min (approximately 8.0 E-05 μCi/mL). When either monitor alarms, it diverts the flow from the 216-B-3 Pond to the 216-A-42 Retention Basin. Liquid effluents diverted to the retention basin are usually disposed either to the SCD cribs or to the 216-B-3 Pond, depending on radionuclide sample results of the diverted effluent. The option also exists to send the basin contents back to the PUREX Plant for processing if necessary.

In addition to the streams that flow through the 202-A canyon, the CWL receives air pump seal water, liquid from the railroad tunnel door drain, and the cooling heat transfer surfaces in the Backup Facility. The Backup Facility, or 293-A Building, contains equipment used to remove nitrogen oxides from the offgas of the dissolvers, and to convert the oxides to recyclable nitric acid.

2.3.1.3 Sampling. Existing sampling points were used because they were the first accessible points downstream of all contributors. These sample points were identified at the initiation of the study (WHC 1989). It is considered impractical to sample individual contributors because of safety issues including high temperature fluids and radiation fields. Sampling provisions on individual lines were not designed into the system. Additional sampling points would require engineering studies, development, and installation. Incoming laterals are approximately 10 ft below grade and are exposed to building radiation fields. Common header sampling provides a high sensitivity to leakage because of the radiation monitoring equipment.

2.3.1.4 Administrative Controls. Administrative controls have been enacted to implement the overall policy of conducting operations to meet the requirements, intent, and spirit of all applicable federal, state, and local environmental laws, regulations, and standards. A program of regulatory compliance based on the requirements of applicable environmental laws and input from appropriate regulatory agencies has been developed.

Since current technology does not exist for on-line (real-time) monitoring for all regulated materials, PUREX has incorporated administrative controls as an aid to prevent the release of material to the liquid effluent streams.

The administrative controls have general requirements that apply to all activities associated with regulated materials.

Training is a very important function of the administrative controls. General training courses are given to all employees, and specific training is given to employees working with regulated materials or in areas where they may come into contact with them. This training program includes annual refresher training.

A general requirement that acts as an important control is the system of frequent surveillances and inspections with the associated action findings and follow-up inspections. These are conducted on a regular basis and are supplemented with random surveillances.

Administrative controls for materials regulated by Ecology, the EPA, and the DOE have the clear goal of assuring that no regulated dangerous (hazardous) material is released into PUREX liquid effluent systems.

Specific activity control is maintained by the use of detailed, written procedures. These outline proper handling of materials as an aid to assure regulatory compliance. They are updated as needed when new regulatory requirements are mandated.

In terms of the management of sinks and drains, there are several stipulations. The most important one is that no dangerous (hazardous) waste shall be disposed of in drains.

There are also several requirements for the acquisition, storage, use and disposal of materials. They are to be physically controlled so that the risks of them entering the PUREX liquid effluent systems are minimized. This is achieved by placing them, wherever possible, at distances removed from entry points to the systems. Also, physical barriers such as closed doors and dams are used wherever possible.

2.3.2 Past Activities

Since most of the equipment served by the CWL source stream involves condenser cooling and tank cooling coils, the process configurations are relatively stable. System total flow was sometimes varied to reduce water useage with flows varying over the 3.0 E+08 L/min to 6.0 E+08 L/min range.

Historically there have been pin-hole leaks in the heat transfer devices, which under transient conditions (i.e., startup or shutdown) allow small amounts of process fluids to enter the discharge header. Radiation and monitoring equipment will respond rapidly to releases of this kind. If leaks were suspected, the unit was subsequently tested to verify if a breach exists. The necessary parts were replaced to terminate the release; however, low-levels of radionuclides have remained in the piping after the occurrence.

Since the current plant configuration is a flushed shutdown mode, present monitoring instrument data represents a reliable background condition suitable for comparison with prior and later operating conditions.

2.3.3 Future Activities

There are no plans for future changes to the PUREX Plant CWL wastestream upstream of the sampling and designation point. Downstream of that point, modifications are being made that will cause the CSL to empty into the CWL pipeline. The present sampling and monitoring systems of the Chemical Sewer, as well as the CWL, will remain in use (Figure 2-4). A Tri-Party Agreement milestone (M-17-00) will provide for treatment of several 200 East Area Streams, including the PUREX CWL stream.

2.4 PROCESS DATA

The PUREX process does not introduce chemicals into the CWL; however, a list of PUREX process chemicals is provided in Table 2-3.

Table 2-3. List of PUREX Plant Chemicals.

Aluminum nitrate	Ammonium fluoride/ammonium nitrate
Antifoam (DOW 110)	Cadmium nitrate
Ferric nitrate	Ferrous sulfamate
Hydrazine	Hydrogen peroxide
Hydroxylamine nitrate	Ion exchange resins
Nitric acid	Normal paraffin hydrocarbon
Oxalic acid	Potassium fluoride
Potassium hydroxide	Potassium permanganate
Silver nitrate	Sodium carbonate
Sodium nitrate	Sodium nitrite
Sodium thiosulfate	Sugar (sucrose)
Sulfamic acid	Sulfuric acid
Tartaric acid	Tributyl phosphate
Cleaning surfactants	

A corrosion inhibitor called Filmeen* is added to the steam makeup water at the powerhouse. It is the only product added to the steam condensate portion of the stream. This corrosion inhibitor contains both fatty amines and organic acids. The Material Safety Data Sheet for this product (see Appendix A) does not list chemical ingredients. It does, however, state that the product does not contain EPA hazardous constituents.

The steam supply consists of sanitary water that has been softened in softeners similar to those in ordinary household use. "Sanitary" water is Columbia River water that has been treated with small amounts of aluminum sulfate (alum) and chlorine to make it potable. Steam condensate is estimated to make up only about 1% of the CWL.

"Raw" water is untreated Columbia River water. It is used in cooling process vessels. Raw water may contribute some corrosion products from the piping used in its transport.

*Filmeen is a trademark of Dearborn, Division of W.R. Grace Co.

Cooling water, steam condensate, air pump seal water, and water from the water-fillable door are the only contributors to the stream. No chemicals are intentionally added at the PUREX Plant to this stream. Chemicals expected to be detected in the steam condensate are those present in sanitary water, those contributed by the corrosion inhibitor, and those that might be contributed by slight corrosion of the piping involved in water treatment or in the PUREX process.

The PUREX Plant CWL wastestream is not expected to vary appreciably. Its variability should be similar to that of the Columbia River.

3.0 SAMPLE DATA

This section provides an evaluation of the sampling data pertaining to the PUREX Plant CWL wastestream. These data are divided into two categories: wastestream data and background data. The discussion identifies the source of the samples (Section 3.1) and presents the data (Section 3.2).

3.1 DATA SOURCE

Two sources of sampling data were used in this analysis: wastestream data and background data.

3.1.1 Wastestream Data

The chemical data for this report were obtained from samples taken at the 295-AD Building, which houses equipment used to monitor and sample the CWL. Samples were taken between November 1989 and February 1990. The analyses were performed at the contract laboratory.

Sampling and analytical protocols followed are discussed in Section 3.0 of the "parent" document of WHC-EP-0342.

Over 40,000 chemical analytes were of interest. The bulk of these analytes was compiled from a combined mass spectral library for the EPA, the National Institutes of Occupational Safety and Health, and the National Bureau of Standards. This library was composed of approximately 40,000 chemical constituents, each with a unique signature, on a gas chromatograph/ mass spectrometer analysis.

The methods for processing the raw analytical data are covered in this document and in the *Wastestream Designation for Liquid Effluent Analytical Data* (WHC 1990b).

Selection of analyses for radionuclides was based on historical process knowledge.

Radiological data for this stream were also obtained from the same sample set.

Appendix B contains new chemical and radiological data while Appendix C contains results of all old analyses of chemicals and radionuclides.

Table 3-1 shows the analyses performed, analytical method, and sample identification of the CWL samples.

Table 3-1. Procedures for PUREX CWL Samples. (sheet 1 of 3)

LEAD#	50725	50748	50764	50903
CofC#	50725	50748	50764	50903
Alkalinity	X	X	X	X
Alpha counting	X	X	X	
^{241}Am	X	X	X	
Ammonia	X	X	X	X
Arsenic	X	X	X	X
Atomic emission spectroscopy	X	X	X	X
Beta counting	X		X	
^{14}C		X	X	
Conductivity-field	X	X	X	X
Cyanide	X	X	X	X
Direct aqueous injection (GC)	X	X	X	X
Fluoride (LDL)	X	X	X	X
Gamma energy analysis	X	X	X	
Hydrazine	X	X	X	X
Ion chromatography	X	X	X	X
Lead	X	X	X	X
Low-energy photon detection		X	X	
Mercury	X	X	X	X
pH-field	X	X	X	X
Plutonium isotopes	X	X	X	
Selenium	X	X	X	X
Semivolatile organics (GC/MS)	X	X	X	X
Strontium beta counting	X	X	X	
Sulfide	X	X	X	X
Suspended solids	X	X	X	X
Temperature-field	X	X	X	X
Thallium	X	X	X	X
Total carbon	X	X	X	X
Total dissolved solids	X	X	X	X
Total organic carbon	X	X	X	X
Total organic halides (LDL)	X	X	X	X
Total radium alpha counting	X	X	X	
Tritium	X			
Uranium	X	X	X	
Uranium isotopes	X	X	X	
Volatile organics (GC/MS)	X	X	X	X
LEAD#	50725B	50748B	50764B	50903B
CofC#	50726	50749	50765	50904
Volatile organics (GC/MS)	X	X	X	X
LEAD#	50725T	50748T	50764T	50903T
CofC#	50727	50750	50766	50905
Volatile organics (GC/MS)	X	X	X	X

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 2 of 9)

Constituent	Sample #	Date	Method	Result
Copper	50725	10/25/89	ICP	<1.00E+01
Copper	50748	11/02/89	ICP	1.30E+01
Copper	50764	11/14/89	ICP	<1.00E+01
Copper	50903	1/26/90	ICP	<1.00E+01
Copper	50943	2/16/90	ICP	<1.00E+01
Copper	50967	2/22/90	ICP	<1.00E+01
Fluoride	50725	10/25/89	IC	<5.00E+02
Fluoride	50725	10/25/89	ISE	1.55E+02
Fluoride	50748	11/02/89	IC	<5.00E+02
Fluoride	50748	11/02/89	ISE	1.58E+02
Fluoride	50764	11/14/89	IC	<5.00E+02
Fluoride	50764	11/14/89	ISE	1.25E+02
Fluoride	50903	1/26/90	IC	<5.00E+02
Fluoride	50903	1/26/90	ISE	1.30E+02
Fluoride	50943	2/16/90	IC	<5.00E+02
Fluoride	50943	2/16/90	ISE	1.27E+02
Fluoride	50967	2/22/90	IC	<5.00E+02
Fluoride	50967	2/22/90	ISE	1.18E+02
Iron	50725	10/25/89	ICP	3.30E+01
Iron	50748	11/02/89	ICP	5.10E+01
Iron	50764	11/14/89	ICP	4.30E+01
Iron	50903	1/26/90	ICP	4.70E+01
Iron	50943	2/16/90	ICP	5.10E+01
Iron	50967	2/22/90	ICP	6.00E+01
Lead (EP Toxic)	50725E	10/25/89	ICP	<5.00E+02
Lead (EP Toxic)	50748E	11/02/89	ICP	<5.00E+02
Lead (EP Toxic)	50764E	11/14/89	ICP	<5.00E+02
Lead (EP Toxic)	50903E	1/26/90	ICP	<5.00E+02
Lead (EP Toxic)	50943E	2/16/90	ICP	<5.00E+02
Lead (EP Toxic)	50967E	2/22/90	ICP	<5.00E+02
Magnesium	50725	10/25/89	ICP	4.26E+03
Magnesium	50748	11/02/89	ICP	4.44E+03
Magnesium	50764	11/14/89	ICP	4.21E+03
Magnesium	50903	1/26/90	ICP	4.60E+03
Magnesium	50943	2/16/90	ICP	4.41E+03
Magnesium	50967	2/22/90	ICP	4.42E+03
Manganese	50725	10/25/89	ICP	<5.00E+00
Manganese	50748	11/02/89	ICP	8.00E+00
Manganese	50764	11/14/89	ICP	6.00E+00
Manganese	50903	1/26/90	ICP	<5.00E+00
Manganese	50943	2/16/90	ICP	<5.00E+00
Manganese	50967	2/22/90	ICP	8.00E+00
Mercury (EP Toxic)	50725E	10/25/89	CVAA/M	<2.00E+01
Mercury (EP Toxic)	50748E	11/02/89	CVAA/M	<2.00E+01
Mercury (EP Toxic)	50764E	11/14/89	CVAA/M	<2.00E+01
Mercury (EP Toxic)	50903E	1/26/90	CVAA/M	<2.00E+01
Mercury (EP Toxic)	50943E	2/16/90	CVAA/M	<2.00E+01
Mercury (EP Toxic)	50967E	2/22/90	CVAA/M	<2.00E+01

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 1 of 9)

Constituent	Sample #	Date	Method	Result
Arsenic (EP Toxic)	50725E	10/25/89	ICP	<5.00E+02
Arsenic (EP Toxic)	50748E	11/02/89	ICP	<5.00E+02
Arsenic (EP Toxic)	50764E	11/14/89	ICP	<5.00E+02
Arsenic (EP Toxic)	50903E	1/26/90	ICP	<5.00E+02
Arsenic (EP Toxic)	50943E	2/16/90	ICP	<5.00E+02
Arsenic (EP Toxic)	50967E	2/22/90	ICP	<5.00E+02
Barium	50725	10/25/89	ICP	3.10E+01
Barium	50748	11/02/89	ICP	3.20E+01
Barium	50764	11/14/89	ICP	3.20E+01
Barium	50903	1/26/90	ICP	3.20E+01
Barium	50943	2/16/90	ICP	2.80E+01
Barium	50967	2/22/90	ICP	2.80E+01
Barium (EP Toxic)	50725E	10/25/89	ICP	<1.00E+03
Barium (EP Toxic)	50748E	11/02/89	ICP	<1.00E+03
Barium (EP Toxic)	50764E	11/14/89	ICP	<1.00E+03
Barium (EP Toxic)	50903E	1/26/90	ICP	<1.00E+03
Barium (EP Toxic)	50943E	2/16/90	ICP	<1.00E+03
Barium (EP Toxic)	50967E	2/22/90	ICP	<1.00E+03
Boron	50725	10/25/89	ICP	1.50E+01
Boron	50748	11/02/89	ICP	1.30E+01
Boron	50764	11/14/89	ICP	<1.00E+01
Boron	50903	1/26/90	ICP	1.20E+01
Boron	50943	2/16/90	ICP	3.90E+01
Boron	50967	2/22/90	ICP	2.20E+01
Cadmium (EP Toxic)	50725E	10/25/89	ICP	<1.00E+02
Cadmium (EP Toxic)	50748E	11/02/89	ICP	<1.00E+02
Cadmium (EP Toxic)	50764E	11/14/89	ICP	<1.00E+02
Cadmium (EP Toxic)	50903E	1/26/90	ICP	<1.00E+02
Cadmium (EP Toxic)	50943E	2/16/90	ICP	<1.00E+02
Cadmium (EP Toxic)	50967E	2/22/90	ICP	<1.00E+02
Calcium	50725	10/25/89	ICP	1.96E+04
Calcium	50748	11/02/89	ICP	1.93E+04
Calcium	50764	11/14/89	ICP	1.88E+04
Calcium	50903	1/26/90	ICP	1.99E+04
Calcium	50943	2/16/90	ICP	1.85E+04
Calcium	50967	2/22/90	ICP	1.87E+04
Chloride	50725	10/25/89	IC	1.20E+03
Chloride	50748	11/02/89	IC	1.00E+03
Chloride	50764	11/14/89	IC	1.10E+03
Chloride	50903	1/26/90	IC	1.30E+03
Chloride	50943	2/16/90	IC	9.00E+02
Chloride	50967	2/22/90	IC	8.00E+02
Chromium (EP Toxic)	50725E	10/25/89	ICP	<5.00E+02
Chromium (EP Toxic)	50748E	11/02/89	ICP	<5.00E+02
Chromium (EP Toxic)	50764E	11/14/89	ICP	<5.00E+02
Chromium (EP Toxic)	50903E	1/26/90	ICP	<5.00E+02
Chromium (EP Toxic)	50943E	2/16/90	ICP	<5.00E+02
Chromium (EP Toxic)	50967E	2/22/90	ICP	<5.00E+02

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APPENDIX B

PRESENT SAMPLE DATA

Material Safety Data Sheet. (sheet 2 of 2)

Material Safety Data Sheet (continued) SUPER FILMEEN 14 CONTINUED

Section 6 Health Hazard Information

TOXICITY INFORMATION:

No TLV established for product.

MSDS #12387

EFFECTS OF OVEREXPOSURE:

INHALATION: Inhalation of vapors or mist may irritate nasal passages.

INGESTION: Harmful if swallowed.

SKIN OR EYE CONTACT: Prolonged or frequent skin contact may cause irritation.

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove affected persons to fresh air and treat symptoms.

INGESTION: If conscious, induce vomiting and feed citrus juice. Contact physician.

SKIN CONTACT: Wash with soap and water. Remove and wash contaminated clothing.

EYE CONTACT: Flush eyes with water and seek medical attention.

Section 7 Special Protection Information

VENTILATION REQUIREMENTS

Use adequate mechanical ventilation.

RESPIRATORY PROTECTION (SPECIFY TYPE)

None special

EYE PROTECTION

Safety glasses or goggles

GLOVES

Recommended

OTHER PROTECTIVE CLOTHING AND EQUIPMENT

Long sleeve work shirt and pants.

Section 8 Spill or Leak Procedures

STEPS TO TAKE IF MATERIAL IS RELEASED OR SPILLED

Collect using absorbent, place in container for proper disposal. Flush area of spill with water.

WASTE DISPOSAL METHOD

Dispose using authorized scavenger service in authorized landfill. For additional disposal instruction, contact your state water pollution control agency. This product is NOT an EPA Hazardous Waste.

Section 9 Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Keep container closed to prevent contamination or loss of water from emulsion by evaporation. Keep from freezing.

OTHER PRECAUTIONS

For industrial use only. Keep out of reach of children.

PREPARED BY: S. Morss DATE: 6/20/88

GRACE Dearborn

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Material Safety Data Sheet. (sheet 1 of 2)

Material Safety Data Sheet

MSDS #12387

Emergency Phone 312-438-8241

Section 1 Product Identification

TRADE NAME	PRODUCT TYPE	CODE IDENT
SUPER FILMEEN 14	Return line treatment	12-174

DOT SHIPPING NAME: Compound Boiler Cleansing, Preserving, Scale Removing Liquid

Section 2 Hazardous Ingredients

	CAS NUMBER	%	EXPOSURE CRITERIA
Does not contain hazardous constituents under 29 CFR 1910.1200, d(3) & (4).			

HIMS 2-0-0

Section 3 Physical Data

BOILING POINT, 760 mm Hg	ND	MELTING POINT	NA
FREEZING POINT	32 F	VAPOR PRESSURE	ND
SPECIFIC GRAVITY ($H_2O = 1$)	0.98	SOLUBILITY IN H_2O	Emulsion
VAPOR DENSITY (AIR = 1)	ND	EVAPORATION RATE (Bu Ac = 1)	< 1
% VOLATILES BY VOLUME	ND	pH	8-9

APPEARANCE & ODOR

White emulsion/characteristic odor

Section 4 Fire & Explosion Hazard Data

FLASH POINT (& METHOD USED)	FLAMMABLE LIMITS IN AIR % BY VOLUME LOWER	UPPER	AUTO IGNITION TEMPERATURE
NA, water-based product	NA	NA	NA

EXTINGUISHING MEDIA: FOAM CO2 DRY CHEMICAL

SPECIAL FIRE FIGHTING PROCEDURES:

Firefighters should wear full protective gear.

UNUSUAL FIRE AND EXPLOSION HAZARD:

None known

Section 5 Reactivity Data

STABILITY (NORMAL CONDITIONS)	CONDITIONS TO AVOID
Stable	Extreme heat

INCOMPATABILITY (MATERIALS TO AVOID)

Strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS

CO, CO2, nitrogen oxides

HAZARDOUS POLYMERIZATION	CONDITIONS TO AVOID
Will not occur	NA

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APPENDIX A

FILMEEN MATERIAL SAFETY DATA SHEET

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6.0 ACTION PLAN

This chapter addresses recommendations for future waste characterization tasks for the CWL that are within the scope of the Liquid Effluent Study. The final extent of and schedule for any recommended tasks are subject to negotiation between Ecology, the EPA, and DOE. An implementation schedule for the completion of these tasks will give consideration to other compliance actions already under way as part of the Tri-Party Agreement (Ecology et al. 1989), and on the availability of funding. All effluent monitoring and sampling will be conducted according to DOE Order 5400.1 ("General Environmental Protection Program", issued 11/9/88).

6.1 FUTURE SAMPLING

The random sampling conducted during the October 1989 to March 1990 period covered the only configuration. At different times during the sampling period, nearly all parts of the PUREX plant that contribute to the CWL operated.

There are no significant changes expected in the CWL. Therefore, there is currently no foreseen need to further sample the CWL.

During several discussions regarding the background level of analytes in the raw water and steam, it became apparent that the existing data could be improved. Additional site wide background sampling and analysis is recommended if resources are available.

6.2 TECHNICAL ISSUES

As described in Section 2.0, the effluent was sampled at the 295-AD Building. This sample point was chosen because it is a common, accessible location downstream of all the contributors to the CWL. The samples collected at this point show that the CWL has the composition expected for a pass-through stream composed of cooling water and steam condensate. As a result, the characterization data presented in this report are considered to be representative of the CWL. Furthermore, the configuration sampled is the only configuration for this stream. Therefore, additional sampling of the CWL is not recommended.

The primary technical issue which can be raised relative to the sampling is that the individual contributors were not sampled before they entered the CWL. The combination of process knowledge and sample results shows, however, that there is no reason to suspect that any of the contributors contain dangerous waste. Furthermore, the sampling of the individual contributors is not practical: The contributors arise in a remote area exposed to high radiation fields and exit the building below grade. Several contributors exhibit two-phase flow. Extensive resources would be needed to design and install additional, new sampling points.

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5.5.4 Extraction Procedure Toxicity

An effluent stream is considered regulated under the EP toxicity criteria (WAC 173-303-090[8]) if the upper limit of the one-sided 90%CI for the specific compounds in the wastestream exceeded the EP toxicity concentration limits (WHC 1990b). The SW-846 procedure provides specific guidance for obtaining data results for comparison against the EPA toxicity limits. The sampling data were collected and analyzed according to the EP toxicity method specified in SW-846. The EP toxicity data are included in Table 5-2.

No analytes with concentrations above detection limits that are on the EP toxic list were found in the CWL wastestream. Therefore, the CWL wastestream is not an EP toxic dangerous waste.

5.6 PROPOSED DESIGNATIONS

Based upon the analytical result of samples taken from November 1989 through March 1990, it was determined that the CWL wastestream does not contain any dangerous waste, as defined in WAC 173-303-070. It is proposed that the wastestream not be designated a dangerous waste.

One substance potentially present in the CWL wastestream was determined to be a carcinogenic chemical compound. This substance, dichloromethane (or methylene chloride), is listed in Table 5-2. Since the specific carcinogen does not exceed 1.00 E-02% (i.e., 0.01%), which is less than 1.0%, the CWL wastestream is not a carcinogenic dangerous waste.

5.5 DANGEROUS WASTE CHARACTERISTICS

A waste is considered a dangerous waste if it is ignitable, corrosive, reactive, or extraction procedure (EP) toxic (WAC 173-303-090). A description of the methods used to evaluate the data in terms of these characteristics is contained in the *Liquid Effluent Study Project Plan* (WHC 1990a). Summaries of the methods, along with the results, are contained in the following sections.

5.5.1 Ignitability

Flashpoint testing was performed on the CWL samples. The test determined that the CWL did not have a flashpoint of less than 208 °F. These data are included in Table 5-2.

5.5.2 Corrosivity

A waste is a corrosive dangerous waste if it has a pH of $\leq$2.0 or $\geq$12.5. The comparison to this characteristic was based on the lower limit of the one-sided 90%CI for a stream with a mean value of pH <7.25 and the upper limit of the one-sided 90%CI for a stream with a mean value of pH $\geq$7.25.

Because the mean value of the pH measurements for the PUREX CWL wastestream is above 7.25, the upper confidence interval limit of 7.89 is used. The wastestream is not a corrosive dangerous waste (WAC 173-303-090[6]).

5.5.3 Reactivity

An aqueous waste is reactive if the waste contains an amount of cyanide or sulfide under conditions near corrosivity to threaten human health or the environment (WAC 173-303-090[7]). A recent revision to the SW-846 procedure (EPA 1986) provides more quantitative "indicator" levels for cyanide and hydrogen sulfide (i.e., 250 mg/kg and 500 mg/kg, respectively). If the upper 90%CI for the compounds in the effluent streams was below these levels, the streams were considered not regulated based on reactivity. The revised SW-846 procedure was used for these samples.

The total sulfide and cyanide were each found to be <100 ppm in the sample data in Table 5-2. Therefore, this wastestream is not a reactive dangerous waste.

Table 5-2. Dangerous Waste Data Designation Report for PUREX Plant CWL. (sheet 2 of 2)

Dangerous Waste Data Designation Report for PUREX Cooling Water

Dangerous Waste Criteria - WAC 173-303-100

Substance	Toxic EC%	Persistant HH%	Persistant PAH%	Carcinogenic Total%	DW Number-Positive
Barium chloride	4.80E-09	0.00E+00	0.00E+00	0.00E+00	
Calcium tetraborate	3.57E-09	0.00E+00	0.00E+00	0.00E+00	
Copper(II) chloride	2.38E-07	0.00E+00	0.00E+00	0.00E+00	
Iron(III) fluoride	1.07E-07	0.00E+00	0.00E+00	0.00E+00	
Magnesium chloride	4.92E-08	0.00E+00	0.00E+00	0.00E+00	
Magnesium nitrate	2.51E-08	0.00E+00	0.00E+00	0.00E+00	
Magnesium sulfate	1.40E-07	0.00E+00	0.00E+00	0.00E+00	
Potassium fluoride	1.15E-07	0.00E+00	0.00E+00	0.00E+00	
Sodium fluoride	7.42E-09	0.00E+00	0.00E+00	0.00E+00	
Sodium metasilicate	5.74E-08	0.00E+00	0.00E+00	0.00E+00	
Uranyl nitrate	8.84E-10	0.00E+00	0.00E+00	0.00E+00	
Zinc nitrate	2.44E-09	0.00E+00	0.00E+00	0.00E+00	
Acetone	1.12E-10	0.00E+00	0.00E+00	0.00E+00	
Ammonia	5.17E-08	0.00E+00	0.00E+00	0.00E+00	
2-Butanone	1.00E-10	0.00E+00	0.00E+00	0.00E+00	
Dichloromethane	5.83E-10	5.83E-07	0.00E+00	5.83E-07	Undesignated
Total	8.03E-07	5.83E-07	0.00E+00	5.83E-07	
DW Number	Undesignated	Undesignated	Undesignated	Undesignated	

Dangerous Waste Constituents - WAC 173-303-9905

Substance
Hydrogen fluoride
Acetone
Dichloromethane
Barium and compounds,NOS

Substance names may include MB (monobasic), DB (dibasic), or TB (tribasic) to identify the equivalence of hydrogen ion that have been nutralized from polyprotic weak acids to form their conjugate bases.

Results based on a single datum are noted by an asterisk (*). Others are based on the lower limit of the one-tailed 90% confidence interval for pH data sets with mean values below 7.25 or by the upper limit of the one-tailed 90% confidence interval for all other data sets.

EP Toxic contaminants, ignitability, and reactivity are reported by standard methods when available. In the absence of EP Toxicity data, total contaminant concentrations are evaluated. In lieu of closed cup ignition results, ignitability is estimated from the sum of the contributions of all substances that are ignitable when pure. A waste is flagged as dangerous if sum of the ignitable substances exceeds one percent. Reactivity is by SW-846: 250 mg of cyanide as hydrogen cyanide per kg of waste or 500 mg of sulfide as hydrogen sulfide per kg of waste. Total cyanide and total sulfide are used in lieu of amenable cyanide and amenable sulfide.

Inorganic substances are fomulated and their possible concentrations calculated for designation purposes only. The actual existance in the waste of these substances is not implied and should not be infered.

Table 5-2. Dangerous Waste Data Designation Report for PUREX Plant CWL. (sheet 1 of 2)

Finding: Undesignated

Discarded Chemical Products - WAC 173-303-081

Substance	Review Number	Status	DW Number
Hydrogen fluoride	U134(DW)	Not Discarded	Undesignated
Acetone	U002(DW)	Not Discarded	Undesignated
2-Butanone	U159(DW)	Not Discarded	Undesignated
Dichloromethane	U080(EHW)	Not Discarded	Undesignated

Dangerous Waste Sources - WAC 173-303-082

Substance	Review Number	Status	DW Number
Acetone	F003	Unlisted Source	Undesignated
2-Butanone	F005	Unlisted Source	Undesignated
Dichloromethane	F001,F002	Unlisted Source	Undesignated

Infectous Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

	Toxic	Persistant		Carcinogenic
Substance	EC%	HH%	PAH%	Total%
Barium chloride	4.80E-09	0.00E+00	0.00E+00	0.00E+00
Calcium tetraborate	3.57E-09	0.00E+00	0.00E+00	0.00E+00
Copper(II) chloride	2.38E-07	0.00E+00	0.00E+00	0.00E+00
Iron(III) fluoride	1.07E-07	0.00E+00	0.00E+00	0.00E+00
Magnesium chloride	4.92E-08	0.00E+00	0.00E+00	0.00E+00
Magnesium nitrate	2.51E-08	0.00E+00	0.00E+00	0.00E+00
Magnesium sulfate	1.40E-07	0.00E+00	0.00E+00	0.00E+00
Potassium fluoride	1.15E-07	0.00E+00	0.00E+00	0.00E+00
Sodium fluoride	7.42E-09	0.00E+00	0.00E+00	0.00E+00
Sodium metasilicate	5.74E-08	0.00E+00	0.00E+00	0.00E+00
Uranyl nitrate	8.84E-10	0.00E+00	0.00E+00	0.00E+00
Zinc nitrate	2.44E-09	0.00E+00	0.00E+00	0.00E+00
Acetone	1.12E-10	0.00E+00	0.00E+00	0.00E+00
Ammonia	5.17E-08	0.00E+00	0.00E+00	0.00E+00
2-Butanone	1.00E-10	0.00E+00	0.00E+00	0.00E+00
Dichloromethane	5.83E-10	5.83E-07	0.00E+00	5.83E-07
Total	8.03E-07	5.83E-07	0.00E+00	5.83E-07
DW Number	Undesignated	Undesignated	Undesignated	Undesignated

Dangerous Waste Characteristics - WAC 173-303-090

Characteristic	Value	DW Number
Ignitability (Degrees F)	>208	Undesignated
Corrosivity-pH	7.89	Undesignated
Reactivity Cyanide (mg/kg)	<1.00E+02	Undesignated
Reactivity Sulfide (mg/kg)	<1.00E+02	Undesignated
EP Toxic Arsenic (mg/L)	<5.00E-01	Undesignated
EP Toxic Barium (mg/L)	<1.00E+00	Undesignated
EP Toxic Cadmium (mg/L)	<1.00E-01	Undesignated
EP Toxic Chromium (mg/L)	<5.00E-01	Undesignated
EP Toxic Lead (mg/L)	<5.00E-01	Undesignated
EP Toxic Mercury (mg/L)	<2.00E-02	Undesignated
EP Toxic Selenium (mg/L)	<5.00E-01	Undesignated
EP Toxic Silver (mg/L)	<5.00E-01	Undesignated

- Sum the resulting weight percent contributions to HH% and PAH% separately.
- Designate the wastestream as persistent if the HH% concentration is greater than 0.01% or if the PAH% concentration is greater than 1.0%, per WAC 173-303-9907.

One chemical compound detected in the CWL was HH: dichloromethane (methylene chloride). No chemical compounds present in the CWL were determined to be PAH. Since the HH% concentration of 0.000000583% is less than 0.01%, the PUREX CWL is not a persistent dangerous waste.

In accordance with EPA, the total organic halides analysis is used for screening only.

5.4.3 Carcinogenic Dangerous Wastes

The procedure for determining if a wastestream is a carcinogenic dangerous waste is as follows (WAC 173-303-103).

- Collect multiple grab samples of the wastestream.
- Determine the upper limit of the one-sided 90%CI for the substances of interest (WHC 1990b).
- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes because it is not possible to complete the evaluation based on the concentrations of cations and anions. This methodology is described in the *Liquid Effluent Study Project Plan* WHC (1990a) and is based on an evaluation of the most toxic substances that exist in an aqueous environment under normal temperatures and pressures.
- Determine which substances in the wastestream are human or animal carcinogens according to the International Agency for Research on Cancer.
- Calculate the weight percent concentration for each carcinogen.
- Sum the resulting weight percent contributions.
- Designate the wastestream as carcinogenic if any of the positive carcinogens are above 0.01% or if the total concentration for positive and suspected (human or animal) carcinogens is above 1.0%.

- Calculate the upper limit of the one-sided 90% confidence interval (90%CI) for each analyte in the wastestream (WHC 1990b).

- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes because it is not possible to complete the evaluation based on the concentration of cations and anions. This methodology is described in the *Liquid Effluent Study Project Plan* WHC (1990a) and is based on an evaluation of the most toxic substances that can exist in an aqueous environment under normal temperatures and pressures.

- Assign toxic categories to the substances detected or, in the case of inorganic analytes, postulated to be in the wastestream.

- Calculate the contribution of each substance to the percent equivalent concentration (EC%).

- Calculate the EC% by summing the contributions of each substance.

- Designate the wastestream as a toxic dangerous waste if the EC% is greater than 0.001%, per WAC 173-303-9906.

Sixteen substances potentially present in the CWL wastestream were determined to have toxic categories associated with them. These substances are listed in Table 5-2. The individual and sum EC% values for these substances are listed in the table. Since the EC% sum is 8.03 E-07, which is less than the designation limit of 1.0 E-03 (i.e., 0.001%), the wastestream is not a toxic dangerous waste.

The three highest contributors to the EC% sum are copper(II) chloride, magnesium sulfate (epsom salts), and potassium fluoride.

5.4.2 Persistent Dangerous Wastes

The procedure for determining if a wastestream is a persistent dangerous waste is as follows (WAC 173-303-102).

- Collect multiple grab samples of the wastestream.

- Determine which substances in the wastestream are halogenated hydrocarbons (HH) and which are polycyclic aromatic hydrocarbons (PAH).

- Determine the upper limit of the one-sided 90%CI for the substances of interest (WHC 1990b).

- Calculate the weight percent contribution of each HH and PAH separately.

5.3.2 Dangerous Waste Sources

The process evaluation (see Section 5.2) was also used to determine if the wastestream included any specific waste sources (K and W wastes) or any nonspecific waste sources (F Wastes) in the Dangerous Waste Source List (WAC 173-303-9904).

Sampling data were used to enhance the process evaluation. Three chemicals were identified as potentially present from a listed source. All three would be listed if they were spent solvents, and are discussed individually below. Spent solvents are not disposed to the CWL. The CWL does not contain any waste from a listed source.

5.3.2.1 Acetone. As discussed above, it is concluded that the only reported detection of acetone in the CWL was not indicative of CWL composition. Additionally, spent acetone solvent is not disposed to the CWL.

The CWL does not contain spent acetone solvent.

5.3.2.2 2-Butanone. As discussed above, it is concluded that the only reported detection of 2-butanone in the CWL was not indicative of CWL composition. Additionally, spent 2-butanone solvent is not disposed to the CWL.

The CWL does not contain spent 2-butanone solvent.

5.3.2.3 Dichloromethane. As discussed above, it is concluded that the only detection of dichloromethane in the CWL was not indicative of the CWL composition. Additionally, spent dichloromethane is not disposed to the CWL.

The CWL does not contain spent dichloromethane solvent.

5.4 DANGEROUS WASTE CRITERIA

A waste is considered a dangerous waste if it meets any of the following criteria categories (WAC 173-303-100): toxic dangerous waste, persistent dangerous waste, or carcinogenic dangerous waste. A description of the methods used to test the sampling data against the criteria is contained in the *Wastestream Designation for Liquid Effluent Analytical Data* (WHC 1990b). Summaries of the methods, along with the results, are contained in the following sections.

5.4.1 Toxic Dangerous Wastes

The procedure for determining if a wastestream is a toxic dangerous waste is as follows (WAC 173-303-101).

- Collect and analyze multiple samples from the wastestream.

Acetone appeared in one of the six samples taken of the wastewater stream. The concentration of acetone in this sample of the wastewater was 13 ppb (detection limit of 10 ppb). The threshold value for acetone, based on analyses of current data blanks taken site wide (including CWL) is 37 ppb as presented in Section 5.2 of the "parent" document of WHC-EP-0342. As the concentration of acetone seen in this single sample of the wastewater stream is less than the threshold value, this datum will not be considered in the designation of the wastestream as it is likely that acetone is present in the wastestream sample due to sample contamination.

5.3.1.3 2-Butanone [Methyl Ethyl Ketone (MEK)]. A review of PUREX chemical inventory data showed MEK is not used as a pure chemical in the PUREX Plant. Interviews with laboratory personnel provided no evidence that 2-butanone had been disposed of into the CWL. As previously noted there are no drains connected to the CWL.

The MEK appeared in one of the six samples taken of the wastewater stream. The concentration of MEK in this sample of the wastewater was 10 ppb. The threshold value for MEK based on analyses of current data blanks taken site wide is 59 ppb as presented in Section 5.2 of the "parent" document of WHC-EP-0342. As the concentration of MEK seen in this single sample of the wastewater stream is less than the threshold value, this datum will not be considered in the designation of the wastestream as it is likely that MEK is present in these wastestream samples due to sample contamination. It is further noted that one of the blank analyses associated with this particular sample of the CWL was found to contain MEK at a concentration of 14 ppb; this provides further evidence of the potential for sample contamination.

5.3.1.4 Dichloromethane (methylene chloride). Methylene chloride is used in PUREX laboratory operations and may be present in some paints. Interviews with laboratory and maintenance (painting) personnel provided no evidence that methylene chloride had been disposed to the CWL stream. As previously noted there are no drains connected to the CWL.

Methylene chloride appeared in one of the six samples taken of the wastewater stream. Dichloromethane was also detected in 4 of the 12 paired sample blanks, at concentrations ranging from 5 to 9 ppb. The concentration of methylene chloride in this sample of the wastewater was 7 ppb (detection limit of 5 ppb). The threshold value for methylene chloride based on analyses of current data blanks taken site wide is 1,147 ppb, as presented in Section 5.2 of the "parent" document of WHC-EP-0342. As the concentration of methylene chloride seen in this single sample of the wastewater stream is less than the threshold value, this data will not be considered in the designation of the wastestream as it is likely that methylene chloride is present in these wastestream samples due to sample contamination.

5.3 PROPOSED LISTED WASTE DESIGNATIONS

A process evaluation, along with a review of sampling data, indicated that the PUREX Plant CWL wastestream did not contain a discarded chemical product or a listed waste source. The following sections discuss the evaluation that was conducted to substantiate this conclusion.

5.3.1 Discarded Chemical Products

As discussed in Section 5.2, a process evaluation on the contributors to the PUREX Plant CWL wastestream was conducted. The processes contributing to the CWL wastestream are the flows of steam and water through heating and cooling coils, respectively. Process solutions are physically isolated from the stream, except in the event of coil failures. Should a coil failure occur, the presence of radioactive process solutions in the CWL stream is identified by sensitive radiation monitoring instrumentation. There are no known leaks of process solutions to the CWL at this time; the small quantities of radioactive materials currently seen in the CWL are the result of residual contamination from past process leaks.

Five potentially discarded chemical products were identified in the screening of the sample data. These chemicals are discussed below. Based on the considerations in this section and the data presented in the previous sections, it is concluded that the CWL does not contain any discarded chemical products.

5.3.1.1 Hydrogen Fluoride. Hydrogen fluoride is used as a complexing reagent for photometric analyses in PUREX laboratory operations. Interviews with laboratory personnel provided no evidence that hydrogen fluoride had been disposed to the CWL stream. Hydrogen fluoride is a compound postulated to be present based upon ionic pairings of wastestream analytes. As previously noted there are no laboratory drains connected to the CWL.

Fluoride appeared in six of the six samples taken of the wastewater stream. The concentration of fluoride in all samples of the wastewater ranged from 125 to 158 ppb, with an average concentration of 135. The threshold value for hydrogen fluoride based on water supplied to PUREX is 143 ppb as presented in Section 5.2 of the "parent" document of WHC-EP-0342. As the average concentration of fluorides seen in this wastewater stream is less than the threshold value, these data will not be considered in the designation of the wastestream as it is likely that hydrogen fluoride postulated to be present in these wastestream samples is due to the presence of fluorides in the facility water supply.

5.3.1.2 Acetone. Acetone has been used in PUREX in laboratory operations. Interviews with laboratory personnel provided no evidence that acetone had been disposed of into the CWL. As previously noted there are no laboratory drains connected to the CWL.

Table 5-1. Inorganic Chemistry for PUREX CWL. (sheet 2 of 2)

NOTES:

Statistics based on a single datum are noted by an asterisk (*). With the exception of hydrogen ion and hydroxide, others report the upper limit of the one-tailed 90% confidence interval. Hydrogen ion is based on the lower limit of the one-tailed 90% confidence interval for pH sets with mean values below 7.25 and on the upper limit of the one-tailed 90% confidence interval for pH data sets with mean values of 7.25 or higher. The hydroxide magnitude is equal to 1.00E-20 equivalents per gram (Eq/g)**2 divided by the hydrogen ion value (in Eq/g).

Ion concentrations in Eq/g are based on the statistic. Conversions include scale (ppb to g/g), molecular weight (constituent form to ionic form), and equivalents (charges per ion). The column headed "Normalized" shows normalized concentrations (also in Eq/g) calculated by increasing concentrations of cations, excluding Hydrogen ion, or anions, excluding hydroxide, by the normalization factor. The normalization factor is the larger of the cation total, including Hydrogen ion, or anion total, including hydroxide, divided by the smaller total.

Substance names may include MB (monobasic), DB (dibasic), TB (tribasic) to identify the equivalents of hydrogen ion that have been neutralized from polycrotic weak acids to form their conjugate bases.

Substances are formulated in the order listed. The column headed "%" is the percent of the substance in the waste (gms/100gms). Substances formulated with oxygen are based on the residual concentration of the counterion. Other substance concentrations are based on the limiting residual concentration of the cation or anion. The columns headed "Cation Out" and "Anion Out" indicate the residual concentrations (in Eq/g) of each ion after a substance concentration has been calculated.

Table 5-1. Inorganic Chemistry for PUREX CWL. (sheet 1 of 2)

Constituent	ppb	Ion	Eq/g	Normalized
Charge Normalization:				
Barium	3.17E+01	Ba+2	4.61E-10	
Boron	2.49E+01	B4O7-2	1.15E-09	3.66E-09
Calcium	1.95E+04	Ca+2	9.71E-07	
Chloride	1.16E+03	Cl-1	3.28E-08	1.04E-07
Copper	1.12E+01	Cu+2	3.54E-10	
Fluoride	1.46E+02	F-1	7.66E-09	2.43E-08
Iron	5.30E+01	Fe+3	2.84E-09	
Magnesium	4.47E+03	Mg+2	3.68E-07	
Manganese	7.05E+00	Mn+2	2.57E-10	
Nitrate	6.28E+02	NO3-1	1.01E-08	3.22E-08
Potassium	7.72E+02	K+1	1.97E-08	
Silicon	2.56E+03	SiO3-2	1.82E-07	5.79E-07
Sodium	2.20E+03	Na+1	9.58E-08	
Strontium	1.00E+02	Sr+2	2.28E-09	
Sulfate	1.08E+04	SO4-2	2.25E-07	7.15E-07
Uranium	5.34E-01	UO2+2	4.49E-12	
Zinc	8.43E+00	Zn+2	2.58E-10	
Hydrogen Ion (from pH 7.9)		H+	(1.30E-11)	
Hydroxide Ion (from pH)		OH-	(7.72E-10)	
Cation total			1.46E-06	
Anion total			4.60E-07	
Anion normalization factor:	3.177			

Substance Formation: Substance	%	Cation out	Anion out
Copper(II) chloride	2.38E-06	0.00E+00	1.04E-07
Uranyl nitrate	8.84E-08	0.00E+00	3.22E-08
Iron(III) fluoride	1.07E-05	0.00E+00	2.15E-08
Potassium fluoride	1.15E-04	0.00E+00	1.77E-09
Barium chloride	4.80E-06	0.00E+00	1.03E-07
Sodium fluoride	7.42E-06	9.40E-08	0.00E+00
Zinc nitrate	2.44E-06	0.00E+00	3.19E-08
Magnesium chloride	4.92E-04	2.65E-07	0.00E+00
Magnesium nitrate	2.51E-04	2.33E-07	0.00E+00
Calcium tetraborate	3.57E-05	9.68E-07	0.00E+00
Magnesium sulfate	1.40E-03	0.00E+00	4.82E-07
Sodium metasilicate	5.74E-04	0.00E+00	4.85E-07
Manganese(II) metasilicate	1.68E-06	0.00E+00	4.85E-07
Strontium sulfate	2.10E-05	0.00E+00	4.80E-07
Calcium sulfate	3.27E-03	4.88E-07	0.00E+00

The process evaluation included a review of process diagrams and operating procedures. It should be noted that there are no drains in PUREX which connect to the CWL. The processes contributing to the PUREX Plant CWL are the flow of raw cooling water and steam through the cooling and heating coils of the vessels listed in Table 2-1. Because there are no other normal or routine entry paths to this wastestream, the evaluation was quite straightforward.

Additionally, waste handling practices at the PUREX Plant were reviewed. The PUREX Plant has a very aggressive program for waste: handling, training certification, oversight, and technical support, which ensures that hazardous wastes are disposed of properly. Administrative controls are discussed in Section 2.3.1.4.

When a potentially listed source was identified, the process was evaluated to determine if the process resulted in the generation of a listed waste.

5.2.2 Sampling Data

Sampling data were used as screening tools to enhance and support the results of the process evaluation. This step compares the results of the sampling data to the WAC 173-303-9903 and -9904 lists. If a constituent was cited on one or both of these lists, an engineering evaluation was performed to determine if the constituent had entered the wastestream as a discarded chemical product or came from a dangerous waste source.

Screening organic constituents is a relatively simple procedure because analytical data for organic constituents are reported as substances and are easily compared to the WAC 173-303-9903 and -9904 lists. It is not as simple to screen inorganic analytical data because inorganic data are reported as ions or elements rather than as substances. For example, an analysis may show that a wastestream contains the cations sodium and calcium along with the anions chloride and nitrate. The possible combinations of substances include sodium chloride, sodium nitrate, calcium chloride, and calcium nitrate. In a situation with many cations and anions, however, the list of possible combinations is extensive.

A procedure was developed by the Westinghouse Hanford for combining the inorganic constituents into substances. This screening procedure is described in the *Wastestream Designation for Liquid Effluent Analytical Data* (WHC 1990b) and is intended to be a tool in the evaluation of a wastestream. The listing of the inorganic substances developed by this screening procedure is not intended to be an indication that the substance was discharged to the wastestream, only that the necessary cations and anions are present and an investigation should be conducted to determine how they entered the wastestream.

Table 5-1 gives the result of the inorganic constituent combining procedure. The attached footnotes define column headings and assumptions.

Products that contained nonactive components such as water, however, were designated if the sole active ingredient in the mixture was listed in WAC 173-303-9903.

- The constituent results from a spill of unused chemicals. (A spill of a discarded chemical product would cause a wastestream to be designated during the time that the discharge is occurring. The approach taken is that the current wastestream would not be designated unless a review of past spill events indicates that the spills are predictable, systematic events that are ongoing or are reasonably anticipated to occur in the future. In this report, the evaluation of this criterion is based on a review of spill data reported according to the *Comprehensive Environmental Response, Compensation, and Liability Act*.

- The constituent is discarded in the form of a residue resulting from cleanup of a spill of an unused chemical on the discarded chemical products list. (A chemical product that is used in a process and then released to the wastestream is not a discarded chemical product. Off-specification, unused chemicals, and chemicals that have exceeded a shelf life but have not been used are considered discarded chemical products.)

5.1.2 Dangerous Waste Sources

A list of dangerous waste sources is contained in WAC 173-303-9904, pursuant to WAC 173-303-082. There are three major categories of sources in WAC 173-303-9904. The first is nonspecific sources from routine operations occurring at many industries. The second is specific sources (e.g., wastes from ink formulation, etc.). The third is state sources which are limited to polychlorinated biphenyl (PCB) contaminated transformers and capacitors resulting from salvaging, rebuilding, or discarding activities.

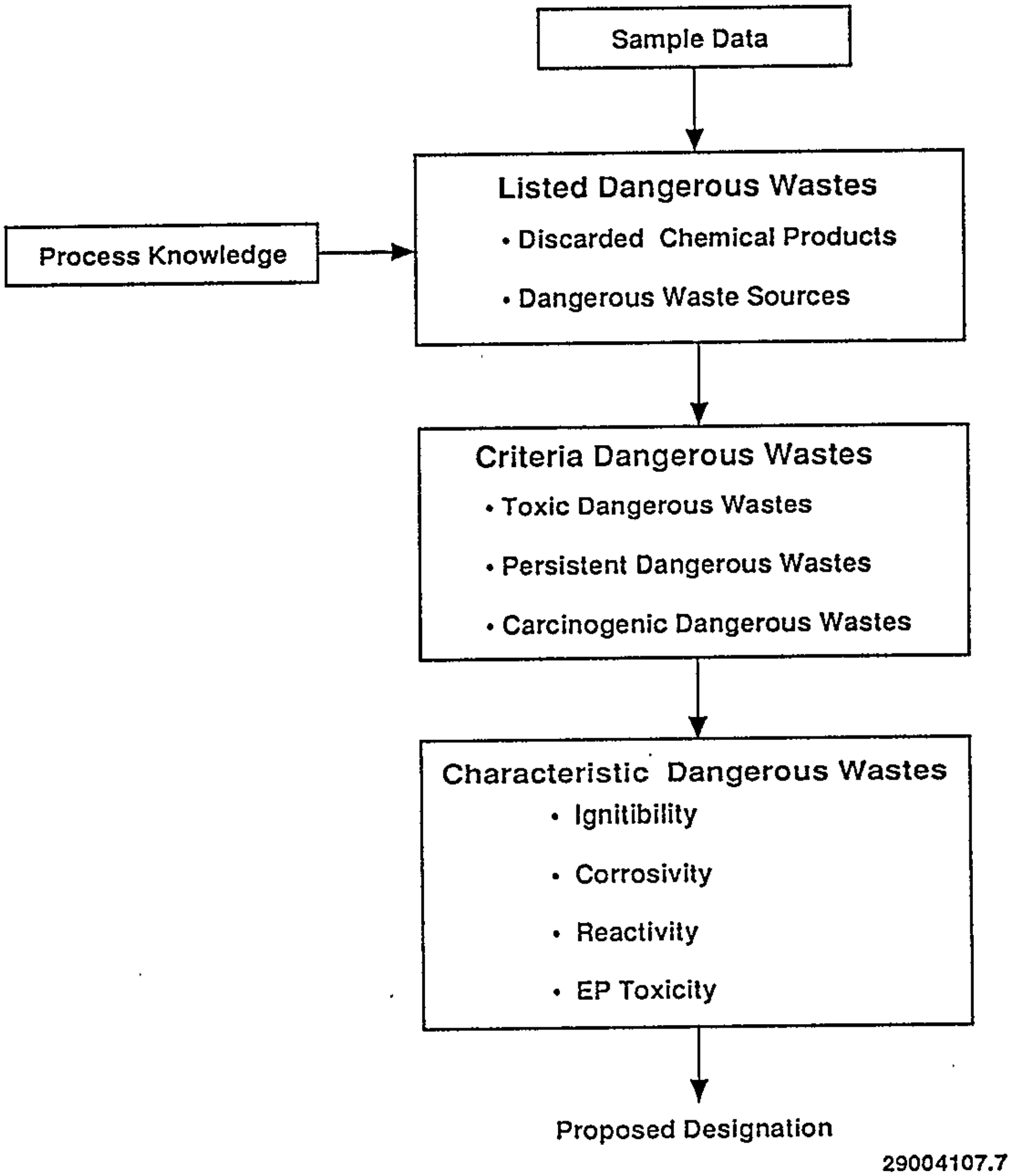
5.2 LISTED WASTE DATA CONSIDERATIONS

The proposed designation of the wastestream described in this report is based on an evaluation of process and sampling data. The following sections describe the types of information used in this designation.

5.2.1 Process Evaluation

The process evaluation began with a thorough review of the processes contributing to the wastestream. Processes were reviewed and compared with the dangerous waste source list (no chemicals are discarded into the stream.) This process evaluation is necessary because the stream could be a listed waste if a listed waste were known to have been added at any upstream location, even if a listed constituent was not detected at the sample point.

Figure 5-1. Designation Strategy.



5.0 DESIGNATION

This section proposes that the PUREX Plant CWL wastestream not be designated a dangerous waste. This proposed designation uses data from both the effluent source description and sample data (Chapters 2.0 through 4.0) and complies with the designation requirements of WAC 173-303-070.

The procedure for determining whether a waste is a dangerous or extremely hazardous waste is contained in WAC 173-303-070. This procedure is illustrated in Figure 5-1 and includes the following:

- Dangerous Waste Lists (WAC 173-303-080)
- Dangerous Waste Criteria (WAC 173-303-100)
- Dangerous Waste Characteristics (WAC 173-303-090).

The designation process involves two types of methods. Process knowledge such as the sources of the stream, all additions to the stream, and pathway are reviewed. Sample data are also incorporated to check for potential or existing listed dangerous waste components covered in WAC 173-303-080 through WAC 173-303-083.

A separate procedure is used for "criteria" dangerous wastes in WAC 173-303-100 and "characteristic" wastes in WAC 173-303-090. Broad spectrum chemical analyses are compiled and compared with the limiting conditions given in the above references. If the effluent discharge rates and/or concentrations are below the posted limits, then the stream is not designated dangerous waste or extremely hazardous waste.

5.1 DANGEROUS WASTE LISTS

A waste is considered a listed dangerous waste if it either contains a discarded chemical product or originates from a dangerous waste source (per WAC 173-303-082). The proposed designation was based on a combination of process knowledge and sampling data.

5.1.1 Discarded Chemical Products

A wastestream constituent is a discarded chemical product (WAC 173-303-081) if it is listed in WAC 173-303-9903 and is characterized by one or more of the following descriptions.

- The listed constituent is the sole active ingredient in a commercial chemical product that has been discarded. Commercial chemical products that, as purchased, contained two or more active ingredients were not designated as discarded chemical products.

Table 4-3. Deposition Rate for PUREX CWL.

Flowrate: 5.23 E+08 L/mo		
Constituent	Kg/L*	Kg/mo*
Barium	3.05E-08	1.60E+01
Boron	1.81E-08	9.47E+00
Calcium	1.91E-05	9.99E+03
Chloride	1.05E-06	5.49E+02
Copper	1.05E-08	5.49E+00
Fluoride	1.35E-07	7.06E+01
Iron	4.75E-08	2.48E+01
Magnesium	4.39E-06	2.30E+03
Manganese	6.17E-09	3.23E+00
Nitrate	5.81E-07	3.04E+02
Potassium	7.48E-07	3.91E+02
Silicon	2.49E-06	1.30E+03
Sodium	2.13E-06	1.11E+03
Strontium	9.68E-08	5.06E+01
Sulfate	1.05E-05	5.49E+03
Uranium	5.12E-10	2.68E-01
Zinc	7.05E-09	3.69E+00
Acetone	1.05E-08	5.49E+00
Ammonia	5.07E-08	2.65E+01
2-Butanone	1.00E-08	5.23E+00
Butylated hydroxy toluene	1.00E-08	5.23E+00
Dichloromethane	5.33E-09	2.79E+00
TDS	6.62E-05	3.46E+04
TOC	1.10E-06	5.75E+02
Total Carbon	1.50E-05	7.85E+03
TOX (as Cl)	1.00E-08	5.23E+00
^{241}Am *	2.79E-15	1.46E-06
^{14}C *	3.86E-12	2.02E-03
^{129}I *	5.46E-14	2.86E-05
^{239,240}Pu *	2.13E-15	1.11E-06
^{90}Sr *	2.38E-13	1.24E-04
^{234}U *	2.15E-13	1.12E-04
^{238}U *	1.65E-13	8.63E-05

NOTES:

Data collected from October 1989 through March 1990.

Flow rate is the average of rates from Section 2.0.

Constituent concentrations are average values from the Statistics Report in Section 3.0.

Concentration units of flagged (*) constituents are reported as curies per liter.

Deposition rate units of flagged (*) constituents are reported as curies per month.

Table 4-2. Comparison of PUREX CWL to Background.

Constituent	PUREX CWL stream	200 East raw water	Laundry steam condensate
Arsenic (EP Toxic)	<5.00E+02		<5.00E+02
Barium	3.05E+01	2.80E+01	1.80E+01
Boron	1.81E+01		2.30E+01
Cadmium (EP Toxic)	<1.00E+02	2.40E+00	<2.00E+00
Calcium	1.91E+04	1.84E+04	7.65E+03
Chloride	1.05E+03	8.71E+02	1.35E+03
Chromium (EP Toxic)	<5.00E+02		<5.00E+02
Copper	1.05E+01	1.06E+01	8.17E+02
Fluoride	1.35E+02		7.50E+01
Iron	4.75E+01	6.36E+01	2.06E+03
Lead (EP Toxic)	<5.00E+02		1.55E+01
Magnesium	4.39E+03	4.19E+03	1.82E+03
Manganese	6.17E+00	9.80E+00	1.57E+01
Mercury (EP Toxic)	<2.00E+01		<2.00E+01
Nitrate	5.81E+02	9.96E+02	
Potassium	7.48E+02	7.95E+02	3.27E+02
Selenium (EP Toxic)	<5.00E+02		<5.00E+02
Silicon	2.49E+03		1.75E+03
Silver (EP Toxic)	<5.00E+02		<5.00E+02
Sodium	2.13E+03	2.26E+03	8.85E+02
Strontium	9.61E+03		3.92E+01
Sulfate	1.05E+04	1.06E+04	5.50E+03
Uranium	5.12E-01	7.26E-01	3.45E-01
Zinc	7.05E+00	2.00E+01	3.02E+01
Acetone	1.05E+01		1.10E+01
Ammonia	5.07E+01		6.92E+01
2-Butanone	1.00E+01		
Butylated hydroxytoluene	1.00E+01		
Dichloromethane	5.33E+00		
Alkalinity (Method B)	6.03E+04		2.95E+04
Conductivity (μS)	1.47E+02	9.32E+01	6.32E+01
Ignitability (°F)	2.10E+02		2.06E+02
pH (dimensionless)	7.79E+00	7.41E+00	6.98E+00
Reactivity Cyanide (mg/kg)	<1.00E+02		<1.00E+02
Reactivity Sulfide (mg/kg)	<1.00E+02		<1.00E+02
TDS (mg/L)	6.62E+04		2.70E+04
Temperature (°C)	1.79E+01	1.64E+01	6.63E+01
TOC (mg/kg)	1.10E+03	1.36E+03	
Total Carbon (mg/kg)	1.50E+04		4.53E+03
TOX (μg (Cl)/ml)	1.00E+01		2.52E+01
^{241}Am (pCi/L)	2.79E-03		5.77E-03
^{14}C (pCi/L)	3.86E+00		
^{129}I (pCi/L)	5.46E-02		1.19E-01
^{239}Pu and ^{240}Pu (pCi/L)	2.13E-03		
^{239}Pu			7.82E-03
^{90}Sr (pCi/L)	2.38E-01		1.80E-01
^{234}U (pCi/L)	2.15E-01		8.90E-02
^{238}U (pCi/L)	1.65E-01		9.39E-02

Table 4-1. Evaluation of PUREX CWL.

Constituent	Result[a]	SV1[b]	SV2[c]
Barium	3.0E-02	5.0E+00 g	
Chloride	1.1E+00	2.5E+02 h	
Copper	1.1E-02	1.0E+00 h	
Fluoride	1.4E-01	2.0E+00 g	
Iron	4.8E-02	3.0E-01 h	
Manganese	6.2E-03	5.0E-02 h	
Nitrate	5.8E-01	4.5E+01 e	
Sulfate	1.0E+01	2.5E+02 h	
Zinc	7.0E-03	5.0E+00 h	
^{241}Am (pCi/L)	2.8E-03	4.0E+00 e	3.0E+01
^{14}C (pCi/L)	3.9E+00	3.0E+03 e	7.0E+04
^{129}I (pCi/L)	5.5E-02	1.0E+02 e	5.0E+02
^{239,240}Pu (pCi/L)[1]	2.1E-03	4.0E+01 e	3.0E+01
^{90}Sr (pCi/L)	2.4E-01	5.0E+01 e	1.0E+03
^{234}U (pCi/L)	2.1E-01		5.0E+02
^{238}U (pCi/L)	1.7E-01		6.0E+02
TDS	6.6E+01	5.0E+02 h	

NOTES:

[a]Units of results are mg/L unless indicated otherwise. The results are the mean values reported in the Statistics table of Chapter 3.

[b]Screening Value 1 (SV1) lists the value first, basis second and an asterisk (*) third if the result exceeds the regulatory value. The basis is the proposed primary MCL (e), the proposed secondary MCL (f), the primary MCL (g), or the secondary MCL (h). The value is the smaller of two MCLs: the proposed primary MCL (or the primary MCL as a default) or the proposed secondary MCL (or the secondary MCL as a default). See WHC-EP-0342, "Hanford Site Stream-Specific Reports", August 1990.

[c]Screening Value 2 (SV2) lists the value first and an asterisk (*) second if the result exceeds the SV2). These values are derived concentration guides obtained from Appendix A of WHC-CM-7-5, "Environmental Compliance Manual", Revision 1, January 1990.

[1]The SV1 value for 239 is used to evaluate ^{239}Pu/^{240}Pu.

4.0 DATA OVERVIEW

This section compares the wastestream sampling data set with the background (see Chapter 3.0), and with drinking water standards and derived concentration guides. This section also provides estimates of radionuclide and chemical deposition rates for the CWL.

4.1 DATA COMPARISON

Table 4-1 gives a comparison of CWL constituent concentrations with EPA drinking water standard (SV1) values and DOE derived concentration guide (SV2) limits in ppm units. It should be noted that the drinking water standards and the derived concentration guide limits cover only part of the constituents present. Other constituents are covered by limiting conditions given in Chapter 5.

The inorganic constituents in Table 4-1 correspond to raw water impurities and some process equipment corrosion products.

Radionuclide concentrations given in Table 4-1 are less than the posted drinking water limit values.

Table 4-2 presents a comparison of PUREX CWL stream constituents to Raw Water and Steam Condensate background levels.

Process knowledge indicates that the CWL should be very similar to the raw water background, since no chemicals are added to the stream, with the exception of the corrosion inhibitor that was added to the steam condensate component. Increases did apparently occur in copper, iron, manganese, aluminum, beryllium, cadmium, di-n-butyl phthalate, and nickel.

Increases in the metallic analytes may be explained by corrosion. Carbon steels, which are in common use in Hanford Site facilities, including those used for water treatment, contain up to 1.65% manganese and 0.4% copper. Various carbon and stainless steels may also contain chromium, aluminum, and nickel (Jastrzebski 1976).

4.2 STREAM DEPOSITION RATES

Table 4-3 gives the stream constituent deposition rates in terms of kilograms per month. These data are determined from average stream concentrations and the posted flowrate on Table 4-3.

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Table 3-4. 200 East Sanitary Water--Organic Data (1987-1988)[a].

Constituent/Parameter [all ppb, exceptions noted]	200 East[b]		
	N[c]	AVG	STD DEV
1,1,1-Trichloroethane	1	<DL[c]	NA
1,1 Dichloroethylene	1	<DL	NA
1,2,-Dichloroethane	1	<DL	NA
1,3,5-Trimethylbenzene	1	<DL	NA
Benzene	1	<DL	NA
Bromodichloromethane	5	1.76E+00	6.68E-01
Bromoform	5	<DL	NA
Carbon Tetrachloride	1	<DL	NA
Chlorodibromomethane	5	<DL	NA
Chloroform	5	2.65E+01	1.27E+01
Difluorodichloromethane	2	<DL	NA
Ethlylbenzene	1	<DL	NA
o-Xylene	1	<DL	NA
p-Chlorotoluene	1	<DL	NA
p-Dichlorobenzene	1	<DL	NA
Tetrachloroethylene	1	<DL	NA
Toluene	1	<DL	NA
Trichloroethylene	1	<DL	NA
Vinyl Chloride	1	<DL	NA

[a]The data given in this table were compiled by Hanford Environmental Health Foundation (HEHF). Data sets included first quarter 1987 and quarterly 1988 data. The total trihalomethane concentration for the 200 and 300 Areas appear in the *Hanford Water Quality Surveillance Report for CY 1988* (Somers 1989) and the HEHF, *Hanford Water Quality Surveillance Report for CY 1989*, HEHF-76 (Thurman 1990).

[b]N is defined as the number of test results available for a particular analyte; N may reflect both single and multiple data sets. For N = 1 the sole available data entry is listed as "avg."

[c]See companion table for organic detection limits as compiled from HEHF data.

DL = detection limit
ppb = parts per billion.

Table 3-3. Summary of 200 East Area Raw Water and Sanitary Water Data (1985-1988).

Constituent/Parameter [all ppb, exceptions noted]	Raw Water[a] (1986-1987)			Sanitary Water[b] (1985-1988)		
	N[c]	AVG	STD DEV	N	AVG	STD DEV
Arsenic				4	<5.00E+00	NA
Barium	5	2.80E+01	3.40E+00	4	*1.05E+02	1.00E+01
Cadmium	5	2.40E+00	8.94E-01	4	<5.00E-01	NA
Calcium	5	1.84E+04	1.47E+03			
Chromium				4	<1.00E+01	NA
Chloride	5	8.71E+02	2.37E+02	4	3.05E+03	6.76E+02
Conductivity-field (μS)	5	9.32E+01	4.61E+01			
Copper	5	1.06E+01	1.34E+00	4	*2.50E+01	1.00E+01
Color (units)				4	<5.00E+00	NA
Iron	5	6.36E+01	2.57E+01	4	*8.25E+01	5.19E+01
Fluoride				4	*1.13E+02	2.50E+01
Lead				4	<5.00E+00	NA
Magnesium	5	4.19E+03	4.83E+02			
Manganese	5	9.80E+00	3.49E+00	4	<1.00E+01	NA
Mercury				4	<5.00E-01	NA
Nickel	5	1.04E+01	8.94E-01			
Nitrate (as N)	5	9.96E+02	8.79E+02	4	*3.72E+02	5.44E+02
pH (dimensionless)	5	7.41E+00	1.18E+00			
Potassium	5	7.95E+02	6.24E+01			
Selenium				4	<5.00E+00	NA
Silver				4	<1.00E+01	NA
Sodium	5	2.26E+03	2.42E+02	4	2.28E+03	1.26E+02
Sulfate	5	1.06E+04	9.97E+02	4	1.68E+04	3.37E+03
Temperature-field (C)	5	1.64E+01	5.84E+00			
TOC (μg/g)	5	1.36E+03	2.53E+02			
TDS (mg/L)				4	8.10E+01	1.69E+01
Trichloromethane	5	1.18E+01	4.02E+00			
Uranium	4	7.26E-01	2.22E-01			
Zinc	5	2.00E+01	2.12E+01	4	<1.00E+02	NA
Radionuclides (pCi/L)						
Alpha Activity	4	8.85E-01	5.30E-01			
Beta Activity	4	4.47E+00	1.76E+00			

NOTES: Averages denoted by an asterisk include a mix of above- and below-detection limit in computations when the actual values are below the detection limit.

See companion table for inorganic detection limits as compiled from Hanford Environmental Health Foundation.

[a]Compiled from "Substance Toxicity Evaluation of Waste Data Base," provided by F. M. Jungfleisch (this data is an update of the data presented in Preliminary Evaluation of Hanford Liquid Discharges to Ground, Westinghouse Hanford Company (Jungfleisch 1988).

[b]Compiled from Hanford Sanitary Water Quality Surveillance, for calendar years 1985, 1986, 1987, and 1988 (Somers 1986, 1987, 1988, 1989).

[c]N is defined as the number of test results available for a particular analyte. N may reflect both single and multiple data sets.

ppb = parts per billion.
pCi/L = picoCuries/liter.
TOC = total organic carbon.
TOX = total organic halides.
TDS = Total Dissolved Solids.
μS = microsiemen.
μg = microgram.

Table 3-2. Statistics for PUREX CWL. (sheet 2 of 2)

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
^{90}Sr (pCi/L)	3	1	DL	2.38E-01	7.80E-02	3.85E-01	3.63E-01
^{234}U (pCi/L)	3	0	n/a	2.15E-01	2.60E-02	2.64E-01	2.59E-01
^{238}U (pCi/L)	3	0	n/a	1.65E-01	1.19E-02	1.88E-01	1.87E-01

NOTES:

Mean values, standard errors, confidence interval limits and maxima are in ppb (parts per billion) unless indicated otherwise.

The column headed MDA (Minimum Detectable Amount) is the number of results in each data set below the detection limit.

The column headed Method shows the MDA replacement method used: replacement by the detection limit (DL), replacement of single-valued MDAs by the log-normal plotting position method (LM), or replacement of multiple valued MDAs by the normal plotting position method (MR).

The column headed "90%CILim" (90% Confidence Interval Limit) is the lower limit of the one-tailed 90% confidence interval for all ignitability data sets and pH data sets with mean values below 7.25. For all other data sets it is the upper limit of the one-tailed 90% confidence interval.

The column headed "Maximum" is the minimum value in the data set for ignitability, the value furthest from 7.25 for pH, and the maximum value for all other analytes.

Table 3-2. Statistics for PUREX CWL. (sheet 1 of 2)

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
Arsenic (EP Toxic)	6	6	n/a	<5.00E+02	0.00E+00	<5.00E+02	<5.00E+02
Barium	6	0	n/a	3.05E+01	8.06E-01	3.17E+01	3.20E+01
Barium (EP Toxic)	6	6	n/a	<1.00E+03	0.00E+00	<1.00E+03	<1.00E+03
Boron	6	1	LM	1.81E+01	4.60E+00	2.49E+01	3.90E+01
Cadmium (EP Toxic)	6	6	n/a	<1.00E+02	2.79E-06	<1.00E+02	<1.00E+02
Calcium	6	0	n/a	1.91E+04	2.26E+02	1.95E+04	1.99E+04
Chloride	6	0	n/a	1.05E+03	7.64E+01	1.16E+03	1.30E+03
Chromium (EP Toxic)	6	6	n/a	<5.00E+02	0.00E+00	<5.00E+02	<5.00E+02
Copper	6	5	DL	1.05E+01	5.00E-01	1.12E+01	1.30E+01
Fluoride	6	0	n/a	1.35E+02	6.84E+00	1.46E+02	1.58E+02
Iron	6	0	n/a	4.75E+01	3.70E+00	5.30E+01	6.00E+01
Lead (EP Toxic)	6	6	n/a	<5.00E+02	0.00E+00	<5.00E+02	<5.00E+02
Magnesium	6	0	n/a	4.39E+03	5.69E+01	4.47E+03	4.60E+03
Manganese	6	3	DL	6.17E+00	6.01E-01	7.05E+00	8.00E+00
Mercury (EP Toxic)	6	6	n/a	<2.00E+01	6.96E-07	<2.00E+01	<2.00E+01
Nitrate	6	1	LM	5.81E+02	3.19E+01	6.28E+02	7.00E+02
Potassium	6	0	n/a	7.48E+02	1.57E+01	7.72E+02	8.11E+02
Selenium (EP Toxic)	6	6	n/a	<5.00E+02	0.00E+00	<5.00E+02	<5.00E+02
Silicon	6	0	n/a	2.49E+03	5.02E+01	2.56E+03	2.58E+03
Silver (EP Toxic)	6	6	n/a	<5.00E+02	0.00E+00	<5.00E+02	<5.00E+02
Sodium	6	0	n/a	2.13E+03	5.01E+01	2.20E+03	2.29E+03
Strontium	6	0	n/a	9.68E+01	2.21E+00	1.00E+02	1.03E+02
Sulfate	6	0	n/a	1.05E+04	2.13E+02	1.08E+04	1.13E+04
Uranium	3	0	n/a	5.12E-01	1.16E-02	5.34E-01	5.26E-01
Zinc	6	1	LM	7.05E+00	9.36E-01	8.43E+00	1.00E+01
Acetone	6	5	DL	1.05E+01	5.00E-01	1.12E+01	1.30E+01
Ammonia	6	5	DL	5.07E+01	6.67E-01	5.17E+01	5.40E+01
2-Butanone	6	5	DL	1.00E+01	3.48E-07	1.00E+01	1.00E+01
Butylated hydroxy toluene	1	0	n/a	1.00E+01	n/a	n/a	1.00E+01
Dichloromethane	6	5	DL	5.33E+00	3.33E-01	5.83E+00	7.00E+00
Alkalinity (Method B)	6	0	n/a	6.03E+04	1.02E+03	6.18E+04	6.50E+04
Conductivity (μS)	6	0	n/a	1.47E+02	4.74E+00	1.54E+02	1.67E+02
Ignitability (°F)	6	0	n/a	2.10E+02	1.09E+00	2.09E+02	2.06E+02
pH (dimensionless)	6	0	n/a	7.79E+00	6.49E-02	7.89E+00	8.06E+00
Reactivity Cyanide (mg/kg)	6	6	n/a	<1.00E+02	2.79E-06	<1.00E+02	<1.00E+02
Reactivity Sulfide (mg/kg)	6	6	n/a	<1.00E+02	2.79E-06	<1.00E+02	<1.00E+02
TDS	6	0	n/a	6.62E+04	3.57E+03	7.14E+04	7.90E+04
Temperature (°C)	6	0	n/a	1.79E+01	1.50E+00	2.01E+01	2.37E+01
TOC	2	1	DL	1.10E+03	0.00E+00	1.10E+03	1.10E+03
Total Carbon	6	0	n/a	1.50E+04	3.88E+02	1.56E+04	1.63E+04
TOX (as Cl)	6	1	LM	1.00E+01	4.47E-01	1.07E+01	1.10E+01
^{241}Am (pCi/L)	3	2	DL	2.79E-03	1.09E-03	4.84E-03	4.93E-03
^{14}C (pCi/L)	2	1	DL	3.86E+00	7.75E-01	6.25E+00	4.64E+00
^{129}I (pCi/L)	2	1	DL	5.46E-02	3.06E-02	1.49E-01	8.52E-02
^{239,240}U (pCi/L)	3	1	DL	2.13E-03	7.19E-04	3.49E-03	3.14E-03

3.1.2 Background Data

The PUREX CWL supply is 200 East Area raw water and steam produced at the powerhouse. Therefore, 200 East Area raw water and PUREX condensed steam (steam condensate) would provide good background data. Although the condensed steam has not been sampled, the 200 East Area sanitary water from which the steam is made has been sampled. The ionic substances in the boiler water feed should not be carried over into the CWL supply. Therefore, only the organic data from the 200 East Area sanitary water are relevant.

3.2 DATA PRESENTATION

Table 3-2 provides the analytical results and associated statistical data. Footnotes explain the column headings.

Table 3-3 presents the chemical composition of the 200 East Area raw water background. Table 3-4 contains the organic data for the 200 East Area sanitary water.

Table 3-1. Procedures for PUREX CWL Samples. (sheet 3 of 3)

LEAD#	50943B	50967B
CofC#	50944	50968
Volatile organics (GC/MS)	X	X
LEAD#	50943T	50967T
CofC#	50945	50969
Volatile organics (GC/MS)	X	X
LEAD#	50943E	50967E
CofC#	50946	50970
Atomic emission spectroscopy	X	X
Ignitability	X	X
Mercury (mixed matrix)	X	X
Reactive cyanide	X	X
Reactive sulfide	X	X

NOTES:

Procedures that were performed for a given sample are identified by an "X". Procedure references appear with the data.

LEAD# is the Liquid Effluent Analytical Data number that appears in the data reports. CofC# is the chain-of-custody number.

Abbreviations:

GC = gas chromatography.
LDL = low-detection limit.
MS = mass spectrometry.

Table 3-1. Procedures for PUREX CWL Samples. (sheet 2 of 3)

LEAD#	50725E	50748E	50764E	50903E
CofC#	50728	50751	50767	50906
Atomic emission spectroscopy	X	X	X	X
Ignitability	X	X	X	X
Mercury (mixed matrix)	X	X	X	X
Reactive cyanide	X	X	X	X
Reactive sulfide	X	X	X	X

LEAD#	50943	50967
CofC#	50943	50967
Alkalinity	X	X
Alpha counting		
^{241}Am		
Ammonia	X	X
Arsenic	X	X
Atomic emission spectroscopy	X	X
Beta counting		
^{14}C		
Conductivity-field	X	X
Cyanide	X	X
Direct aqueous injection (GC)	X	X
Fluoride (LDL)	X	X
Gamma energy analysis		
Hydrazine	X	X
Ion chromatography	X	X
Lead	X	X
Low-energy photon detection		
Mercury	X	X
pH-field	X	X
Plutonium isotopes		
Selenium	X	X
Semivolatile organics (GC/MS)	X	X
Strontium beta counting		
Sulfide	X	X
Suspended solids	X	X
Temperature-field	X	X
Thallium	X	X
Total carbon	X	X
Total dissolved solids	X	X
Total organic carbon	X	X
Total organic halides (LDL)	X	X
Total radium alpha counting		
Tritium		
Uranium		
Uranium isotopes		
Volatile organics (GC/MS)	X	X

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 3 of 9)

Constituent	Sample #	Date	Method	Result
Nitrate	50725	10/25/89	IC	6.00E+02
Nitrate	50748	11/02/89	IC	7.00E+02
Nitrate	50764	11/14/89	IC	<5.00E+02
Nitrate	50903	1/26/90	IC	6.00E+02
Nitrate	50943	2/16/90	IC	5.00E+02
Nitrate	50967	2/22/90	IC	6.00E+02
Potassium	50725	10/25/89	ICP	7.78E+02
Potassium	50748	11/02/89	ICP	8.11E+02
Potassium	50764	11/14/89	ICP	7.24E+02
Potassium	50903	1/26/90	ICP	7.09E+02
Potassium	50943	2/16/90	ICP	7.29E+02
Potassium	50967	2/22/90	ICP	7.40E+02
Selenium (EP Toxic)	50725E	10/25/89	ICP	<5.00E+02
Selenium (EP Toxic)	50748E	11/02/89	ICP	<5.00E+02
Selenium (EP Toxic)	50764E	11/14/89	ICP	<5.00E+02
Selenium (EP Toxic)	50903E	1/26/90	ICP	<5.00E+02
Selenium (EP Toxic)	50943E	2/16/90	ICP	<5.00E+02
Selenium (EP Toxic)	50967E	2/22/90	ICP	<5.00E+02
Silicon	50725	10/25/89	ICP	2.56E+03
Silicon	50748	11/02/89	ICP	2.54E+03
Silicon	50764	11/14/89	ICP	2.26E+03
Silicon	50903	1/26/90	ICP	2.58E+03
Silicon	50943	2/16/90	ICP	2.55E+03
Silicon	50967	2/22/90	ICP	2.43E+03
Silver (EP Toxic)	50725E	10/25/89	ICP	<5.00E+02
Silver (EP Toxic)	50748E	11/02/89	ICP	<5.00E+02
Silver (EP Toxic)	50764E	11/14/89	ICP	<5.00E+02
Silver (EP Toxic)	50903E	1/26/90	ICP	<5.00E+02
Silver (EP Toxic)	50943E	2/16/90	ICP	<5.00E+02
Silver (EP Toxic)	50967E	2/22/90	ICP	<5.00E+02
Sodium	50725	10/25/89	ICP	2.29E+03
Sodium	50748	11/02/89	ICP	2.23E+03
Sodium	50764	11/14/89	ICP	2.08E+03
Sodium	50903	1/26/90	ICP	2.17E+03
Sodium	50943	2/16/90	ICP	2.03E+03
Sodium	50967	2/22/90	ICP	1.97E+03
Strontium	50725	10/25/89	ICP	1.00E+02
Strontium	50748	11/02/89	ICP	1.03E+02
Strontium	50764	11/14/89	ICP	1.01E+02
Strontium	50903	1/26/90	ICP	9.00E+01
Strontium	50943	2/16/90	ICP	9.10E+01
Strontium	50967	2/22/90	ICP	9.60E+01
Sulfate	50725	10/25/89	IC	1.10E+04
Sulfate	50748	11/02/89	IC	1.03E+04
Sulfate	50764	11/14/89	IC	1.00E+04
Sulfate	50903	1/26/90	IC	1.13E+04
Sulfate	50943	2/16/90	IC	1.02E+04
Sulfate	50967	2/22/90	IC	1.02E+04

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 4 of 9)

Constituent	Sample #	Date	Method	Result
Uranium	50725	10/25/89	FLUOR	5.21E-01
Uranium	50748	11/02/89	FLUOR	5.26E-01
Uranium	50764	11/14/89	FLUOR	4.89E-01
Zinc	50725	10/25/89	ICP	5.00E+00
Zinc	50748	11/02/89	ICP	<5.00E+00
Zinc	50764	11/14/89	ICP	9.00E+00
Zinc	50903	1/26/90	ICP	6.00E+00
Zinc	50943	2/16/90	ICP	8.00E+00
Zinc	50967	2/22/90	ICP	1.00E+01
Acetone	50725	10/25/89	VOA	1.30E+01
Acetone	50725	10/25/89	ABN	<1.00E+01
Acetone	50725B	10/25/89	VOA	<1.00E+01
Acetone	50725T	10/25/89	VOA	<1.00E+01
Acetone	50748	11/02/89	VOA	<1.00E+01
Acetone	50748	11/02/89	ABN	<1.00E+01
Acetone	50748B	11/02/89	VOA	<1.00E+01
Acetone	50748T	11/02/89	VOA	<1.00E+01
Acetone	50764	11/14/89	VOA	<1.00E+01
Acetone	50764	11/14/89	ABN	<1.00E+01
Acetone	50764B	11/14/89	VOA	<1.00E+01
Acetone	50764T	11/14/89	VOA	<1.00E+01
Acetone	50903	1/26/90	VOA	<1.00E+01
Acetone	50903	1/26/90	ABN	<1.00E+01
Acetone	50903B	1/26/90	VOA	<1.00E+01
Acetone	50903T	1/26/90	VOA	<1.00E+01
Acetone	50943	2/16/90	VOA	<1.00E+01
Acetone	50943	2/16/90	ABN	<1.00E+01
Acetone	50943B	2/16/90	VOA	<1.00E+01
Acetone	50943T	2/16/90	VOA	<1.00E+01
Acetone	50967	2/22/90	VOA	<1.00E+01
Acetone	50967	2/22/90	ABN	<1.00E+01
Acetone	50967B	2/22/90	VOA	<1.00E+01
Acetone	50967T	2/22/90	VOA	1.90E+01
Ammonia	50725	10/25/89	ISE	5.40E+01
Ammonia	50748	11/02/89	ISE	<5.00E+01
Ammonia	50764	11/14/89	ISE	<5.00E+01
Ammonia	50903	1/26/90	ISE	<5.00E+01
Ammonia	50943	2/16/90	ISE	<5.00E+01
Ammonia	50967	2/22/90	ISE	<5.00E+01
2-Butanone	50725	10/25/89	VOA	1.00E+01
2-Butanone	50725B	10/25/89	VOA	1.40E+01
2-Butanone	50725T	10/25/89	VOA	<1.00E+01
2-Butanone	50748	11/02/89	VOA	<1.00E+01
2-Butanone	50748B	11/02/89	VOA	<1.00E+01
2-Butanone	50748T	11/02/89	VOA	<1.00E+01
2-Butanone	50764	11/14/89	VOA	<1.00E+01
2-Butanone	50764B	11/14/89	VOA	<1.00E+01
2-Butanone	50764T	11/14/89	VOA	<1.00E+01

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 5 of 9)

Constituent	Sample #	Date	Method	Result
2-Butanone	50903	1/26/90	VOA	<1.00E+01
2-Butanone	50903B	1/26/90	VOA	1.30E+01
2-Butanone	50903T	1/26/90	VOA	2.10E+01
2-Butanone	50943	2/16/90	VOA	<1.00E+01
2-Butanone	50943B	2/16/90	VOA	<1.00E+01
2-Butanone	50943T	2/16/90	VOA	<6.00E+00
2-Butanone	50967	2/22/90	VOA	<1.00E+01
2-Butanone	50967B	2/22/90	VOA	<9.00E+00
2-Butanone	50967T	2/22/90	VOA	1.20E+01
Butylated hydroxy toluene	50943	2/16/90	ABN	1.00E+01
Dichloromethane	50725	10/25/89	VOA	<5.00E+00
Dichloromethane	50725B	10/25/89	VOA	9.00E+00
Dichloromethane	50725T	10/25/89	VOA	9.00E+00
Dichloromethane	50748	11/02/89	VOA	<5.00E+00
Dichloromethane	50748B	11/02/89	VOA	<5.00E+00
Dichloromethane	50748T	11/02/89	VOA	8.00E+00
Dichloromethane	50764	11/14/89	VOA	<5.00E+00
Dichloromethane	50764B	11/14/89	VOA	<5.00E+00
Dichloromethane	50764T	11/14/89	VOA	<5.00E+00
Dichloromethane	50903	1/26/90	VOA	7.00E+00
Dichloromethane	50903B	1/26/90	VOA	<5.00E+00
Dichloromethane	50903T	1/26/90	VOA	<4.00E+00
Dichloromethane	50943	2/16/90	VOA	<5.00E+00
Dichloromethane	50943B	2/16/90	VOA	<5.00E+00
Dichloromethane	50943T	2/16/90	VOA	<5.00E+00
Dichloromethane	50967	2/22/90	VOA	<5.00E+00
Dichloromethane	50967B	2/22/90	VOA	5.00E+00
Dichloromethane	50967T	2/22/90	VOA	<5.00E+00
Tetrahydrofuran	50725	10/25/89	VOA	<1.00E+01
Tetrahydrofuran	50725B	10/25/89	VOA	<1.00E+01
Tetrahydrofuran	50725T	10/25/89	VOA	<1.00E+01
Tetrahydrofuran	50748	11/02/89	VOA	<1.00E+01
Tetrahydrofuran	50748B	11/02/89	VOA	1.00E+01
Tetrahydrofuran	50748T	11/02/89	VOA	<1.00E+01
Tetrahydrofuran	50764	11/14/89	VOA	<1.00E+01
Tetrahydrofuran	50764B	11/14/89	VOA	<1.00E+01
Tetrahydrofuran	50764T	11/14/89	VOA	<1.00E+01
Tetrahydrofuran	50903	1/26/90	VOA	<1.00E+01
Tetrahydrofuran	50903B	1/26/90	VOA	<1.00E+01
Tetrahydrofuran	50903T	1/26/90	VOA	<8.00E+00
Tetrahydrofuran	50943	2/16/90	VOA	<1.00E+01
Tetrahydrofuran	50943B	2/16/90	VOA	<1.00E+01
Tetrahydrofuran	50943T	2/16/90	VOA	<1.00E+01
Tetrahydrofuran	50967	2/22/90	VOA	<1.00E+01
Tetrahydrofuran	50967B	2/22/90	VOA	<1.00E+01
Tetrahydrofuran	50967T	2/22/90	VOA	<6.00E+00
Trichloromethane	50725	10/25/89	VOA	<5.00E+00
Trichloromethane	50725B	10/25/89	VOA	<5.00E+00

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 6 of 9)

Constituent	Sample #	Date	Method	Result
Trichloromethane	50725T	10/25/89	VOA	<5.00E+00
Trichloromethane	50748	11/02/89	VOA	<5.00E+00
Trichloromethane	50748B	11/02/89	VOA	<5.00E+00
Trichloromethane	50748T	11/02/89	VOA	<3.00E+00
Trichloromethane	50764	11/14/89	VOA	<5.00E+00
Trichloromethane	50764B	11/14/89	VOA	<4.00E+00
Trichloromethane	50764T	11/14/89	VOA	<4.00E+00
Trichloromethane	50903	1/26/90	VOA	<5.00E+00
Trichloromethane	50903B	1/26/90	VOA	<5.00E+00
Trichloromethane	50903T	1/26/90	VOA	<5.00E+00
Trichloromethane	50943	2/16/90	VOA	<5.00E+00
Trichloromethane	50943B	2/16/90	VOA	5.00E+00
Trichloromethane	50943T	2/16/90	VOA	<3.00E+00
Trichloromethane	50967	2/22/90	VOA	<5.00E+00
Trichloromethane	50967B	2/22/90	VOA	7.00E+00
Trichloromethane	50967T	2/22/90	VOA	<4.00E+00
Alkalinity (Method B)	50725	10/25/89	TITRA	5.90E+04
Alkalinity (Method B)	50748	11/02/89	TITRA	5.80E+04
Alkalinity (Method B)	50764	11/14/89	TITRA	5.90E+04
Alkalinity (Method B)	50903	1/26/90	TITRA	6.50E+04
Alkalinity (Method B)	50943	2/16/90	TITRA	6.00E+04
Alkalinity (Method B)	50967	2/22/90	TITRA	6.10E+04
Conductivity (µS)	50725	10/25/89	COND-Fld	1.35E+02
Conductivity (µS)	50748	11/02/89	COND-Fld	1.40E+02
Conductivity (µS)	50764	11/14/89	COND-Fld	1.43E+02
Conductivity (µS)	50903	1/26/90	COND-Fld	1.54E+02
Conductivity (µS)	50943	2/16/90	COND-Fld	1.67E+02
Conductivity (µS)	50967	2/22/90	COND-Fld	1.43E+02
Ignitability (°F)	50725E	10/25/89	IGNIT	2.12E+02
Ignitability (°F)	50748E	11/02/89	IGNIT	2.12E+02
Ignitability (°F)	50764E	11/14/89	IGNIT	2.08E+02
Ignitability (°F)	50903E	1/26/90	IGNIT	2.12E+02
Ignitability (°F)	50943E	2/16/90	IGNIT	2.06E+02
Ignitability (°F)	50967E	2/22/90	IGNIT	2.12E+02
pH (dimensionless)	50725	10/25/89	PH-Fld	8.06E+00
pH (dimensionless)	50748	11/02/89	PH-Fld	7.69E+00
pH (dimensionless)	50764	11/14/89	PH-Fld	7.64E+00
pH (dimensionless)	50903	1/26/90	PH-Fld	7.76E+00
pH (dimensionless)	50943	2/16/90	PH-Fld	7.70E+00
pH (dimensionless)	50967	2/22/90	PH-Fld	7.90E+00
Reactivity Cyanide (mg/kg)	50725E	10/25/89	DSPEC	<1.00E+02
Reactivity Cyanide (mg/kg)	50748E	11/02/89	DSPEC	<1.00E+02
Reactivity Cyanide (mg/kg)	50764E	11/14/89	DSPEC	<1.00E+02
Reactivity Cyanide (mg/kg)	50903E	1/26/90	DSPEC	<1.00E+02
Reactivity Cyanide (mg/kg)	50943E	2/16/90	DSPEC	<1.00E+02
Reactivity Cyanide (mg/kg)	50967E	2/22/90	DSPEC	<1.00E+02
Reactivity Sulfide (mg/kg)	50725E	10/25/89	DTITRA	<1.00E+02
Reactivity Sulfide (mg/kg)	50748E	11/02/89	DTITRA	<1.00E+02

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 7 of 9)

Constituent	Sample #	Date	Method	Result
Reactivity Sulfide (mg/kg)	50764E	11/14/89	DTITRA	<1.00E+02
Reactivity Sulfide (mg/kg)	50903E	1/26/90	DTITRA	<1.00E+02
Reactivity Sulfide (mg/kg)	50943E	2/16/90	DTITRA	<1.00E+02
Reactivity Sulfide (mg/kg)	50967E	2/22/90	DTITRA	<1.00E+02
TDS	50725	10/25/89	TDS	7.90E+04
TDS	50748	11/02/89	TDS	5.50E+04
TDS	50764	11/14/89	TDS	5.90E+04
TDS	50903	1/26/90	TDS	7.20E+04
TDS	50943	2/16/90	TDS	6.40E+04
TDS	50967	2/22/90	TDS	6.80E+04
Temperature (°C)	50725	10/25/89	TEMP-Fld	1.72E+01
Temperature (°C)	50748	11/02/89	TEMP-Fld	1.45E+01
Temperature (°C)	50764	11/14/89	TEMP-Fld	1.36E+01
Temperature (°C)	50903	1/26/90	TEMP-Fld	2.37E+01
Temperature (°C)	50943	2/16/90	TEMP-Fld	1.91E+01
Temperature (°C)	50967	2/22/90	TEMP-Fld	1.94E+01
TOC	50725	10/25/89	TOC	<1.70E+03
TOC	50748	11/02/89	TOC	<1.30E+03
TOC	50764	11/14/89	TOC	<1.10E+03
TOC	50903	1/26/90	TOC	<1.20E+03
TOC	50943	2/16/90	TOC	<1.40E+03
TOC	50967	2/22/90	TOC	1.10E+03
Total Carbon	50725	10/25/89	TC	1.63E+04
Total Carbon	50748	11/02/89	TC	1.45E+04
Total Carbon	50764	11/14/89	TC	1.47E+04
Total Carbon	50903	1/26/90	TC	1.36E+04
Total Carbon	50943	2/16/90	TC	1.56E+04
Total Carbon	50967	2/22/90	TC	1.54E+04
TOX (as Cl)	50725	10/25/89	LTOX	1.00E+01
TOX (as Cl)	50748	11/02/89	LTOX	1.00E+01
TOX (as Cl)	50764	11/14/89	LTOX	<8.00E+00
TOX (as Cl)	50903	1/26/90	LTOX	1.10E+01
TOX (as Cl)	50943	2/16/90	LTOX	1.00E+01
TOX (as Cl)	50967	2/22/90	LTOX	1.10E+01
^{241}Am (pCi/L)	50725	10/25/89	AEA	<2.07E-03
^{241}Am (pCi/L)	50748	11/02/89	AEA	<1.37E-03
^{241}Am (pCi/L)	50764	11/14/89	AEA	4.93E-03
^{14}C (pCi/L)	50748	11/02/89	LSC	<3.09E+00
^{14}C (pCi/L)	50764	11/14/89	LSC	4.64E+00
^{129}I (pCi/L)	50748	11/02/89	LEPD	<2.40E-02
^{129}I (pCi/L)	50764	11/14/89	LEPD	8.52E-02
^{239,240}Pu (pCi/L)	50725	10/25/89	AEA	3.14E-03
^{239,240}Pu (pCi/L)	50748	11/02/89	AEA	<7.40E-04
^{239,240}Pu (pCi/L)	50764	11/14/89	AEA	2.52E-03
^{90}Sr (pCi/L)	50725	10/25/89	Beta	3.63E-01
^{90}Sr (pCi/L)	50748	11/02/89	Beta	<9.49E-02
^{90}Sr (pCi/L)	50764	11/14/89	Beta	2.57E-01
^{234}U (pCi/L)	50725	10/25/89	AEA	2.59E-01

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 8 of 9)

Constituent	Sample #	Date	Method	Result
^{234}U (pCi/L)	50748	11/02/89	AEA	1.69E-01
^{234}U (pCi/L)	50764	11/14/89	AEA	2.17E-01
^{238}U (pCi/L)	50725	10/25/89	AEA	1.87E-01
^{238}U (pCi/L)	50748	11/02/89	AEA	1.46E-01
^{238}U (pCi/L)	50764	11/14/89	AEA	1.62E-01

NOTES:
Sample# is the number of the sample. See Section 3.0 for corresponding chain-of-custody number.
Date is the sampling date.
Results are in ppb (parts per billion) unless otherwise indicated.

The following table lists the methods that are coded in the method column.

Code	Analytical Method	Reference
ABN	Semivolatile Organics (GC/MS)	USEPA-8270
AEA	^{241}Am	UST-20Am01
AEA	Curium Isotopes	UST-20Am/Cm01
AEA	Plutonium Isotopes	UST-20Pu01
AEA	Uranium Isotopes	UST-20U01
ALPHA	Alpha Counting	EPA-680/4-75/1
ALPHA-Ra	Total Radium Alpha Counting	ASTM-D2460
BETA	Beta Counting	EPA-680/4-75/1
BETA	^{90}Sr	UST-20Sr02
COLIF	Coliform Bacteria	USEPA-9131
COLIFMF	Coliform Bacteria (Membrane Filter)	USEPA-9132
COND-Fld	Conductivity-Field	ASTM-D1125A
COND-Lab	Conductivity-Laboratory	ASTM-D1125A
CVAA	Mercury	USEPA-7470
CVAA/M	Mercury-Mixed Matrix	USEPA-7470
DIGC	Direct Aqueous Injection (GC)	UST-70DIGC
DIMS	Direct Aqueous Injection (GC/MS)	"USEPA-8240"
DSPEC	Reactive Cyanide (Distillation, Spectroscopy)	USEPA-CHAPTER 7
DTITRA	Reactive Sulfide (Distillation, Titration)	USEPA-CHAPTER 7
FLUOR	Uranium (Fluorometry)	ASTM-D2907-83
GEA	Gamma Energy Analysis Spectroscopy	ASTM-D3649-85
GFAA	Arsenic (AA, Furnace Technique)	USEPA-7060
GFAA	Lead (AA, Furnace Technique)	USEPA-7421
GFAA	Selenium (AA, Furnace Technique)	USEPA-7740
GFAA	Thallium (AA, Furnace Technique)	USEPA-7841
IC	Ion Chromatography	EPA-600/4-84-01
ICP	Atomic Emission Spectroscopy (ICP)	USEPA-6010
ICP/M	Atomic Emission Spectroscopy (ICP)-Mixed Matrix	USEPA-6010
IGNIT	Pensky-Martens Closed-Cup Ignitability	USEPA-1010
ISE	Fluoride-Low Detection Limit	ASTM-D1179-80-B
ISE	Ammonium Ion	ASTM-D1426-D
LALPHA	Alpha Activity-Low Detection Limit	EPA-680/4-75/1
LEPD	^{129}I	UST-20I02

Table B-1. Present PUREX Cooling Water Sample Data. (sheet 9 of 9)

The following table lists the methods that are coded in the method column.

LSC	^{14}C	UST-20C01
LSC	Tritium	UST-20H03
LTOX	Total Organic Halides-Low Detection Limit	USEPA-9020
PH-Fld	pH-Field	USEPA-9040
PH-Lab	pH-Laboratory	USEPA-9040
SPEC	Total and Amenable Cyanide (Spectroscopy)	USEPA-9010
SPEC	Hydrazine-Low Detection Limit (Spectroscopy)	ASTM-D1385
SSOLID	Suspended Solids	SM-208D
TC	Total Carbon	USEPA-9060
TDS	Total Dissolved Solids	SM-208B
TEMP-Fld	Temperature-Field	Local
TITRA	Alkalinity-Method B (Titration)	ASTM-D1067B
TITRA	Sulfides (Titration)	USEPA-9030
TOC	Total Organic Carbon	USEPA-9060
TOX	Total Organic Halides	USEPA-9020
VOA	Volatile Organics (GC/MS)	USEPA-8240

Analytical Method Acronyms:
AA = atomic absorption spectroscopy.
GC = gas chromatography.
MS = mass spectrometry.
ICP = inductively-coupled plasma spectroscopy.

References:

ASTM--"1986 Annual Book of ASTM Standards", American Society for Testing and Materials, Philadelphia, Pennsylvania.

EPA--Various methods of the U.S. Environmental Protection Agency, Washington, D.C.

UST--Methods of the United States Testing Company, Incorporated, Richland, Washington.

SM--"Standard Methods for the Examination of Water and Wastewater", 16th ed., American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, D.C.

USEPA--"Test Methods for Evaluating Solid Waste Physical/Chemical Methods", 3rd ed., SW-846, U.S. Environmental Protection Agency, Washington, D.C.

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APPENDIX C

HISTORICAL SAMPLE DATA

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Table C-1. Past PUREX Cooling Water Chemical Data.

Analyte	08/22/85	05/07/86	07/10/86	11/20/86	03/10/87
Alpha activity (LDL, pCi/L)	7.51 E-01	1.33 E+00	1.34 E+00	3.99 E-01	7.35 E-01
Beta activity (pCi/L)	2.17 E+01	1.56 E+01	3.30 E+02	2.22 E+01	1.51 E+01
Aluminum	BDL	BDL	BDL	BDL	BDL
Barium	3.40 E+01	3.20 E+01	3.20 E+01	3.10 E+01	2.90 E+01
Beryllium	7.50 E+00	BDL	BDL	BDL	BDL
Cadmium	6.50 E+00	BDL	BDL	BDL	BDL
Calcium	1.92 E+04	2.24 E+04*	1.79 E+04	2.01 E+04	2.06 E+04
Chloride	9.60 E+02	6.26 E+02	1.05 E+03	9.32 E+02	1.21 E+03
Conductivity-field (µS)	1.19 E+02	1.43 E+01	1.42 E+02	1.31 E+02	1.12 E+02
Copper	BDL	BDL	BDL	BDL	BDL
Di-n-butyl phthalate	1.40 E+01	BDL	BDL	BDL	BDL
Iron	1.73 E+02	BDL	1.78 E+02	1.34 E+02	4.22 E+02
Magnesium	4.51 E+03	BDL	4.29 E+03	4.54 E+03	4.84 E+03
Manganese	2.20 E+01	BDL	2.90 E+01	1.10 E+01	2.80 E+01
Nickel	1.05 E+01	BDL	BDL	BDL	BDL
Nitrate	BDL	BDL	1.19 E+03	5.89 E+02	5.07 E+02
pH-field	8.28 E+00	8.15 E+00	6.18 E+00	5.40 E+00	5.28 E+00
Potassium	8.35 E+02	8.92 E+02	8.46 E+02	7.95 E+02	8.23 E+02
Sodium	2.93 E+03	2.58 E+03	2.56 E+03	2.20 E+03	2.17 E+03
Sulfate	9.03 E+03	1.18 E+04	8.93 E+03	1.11 E+04	1.30 E+04
Temperature-field (celsius)	3.35 E+01	1.99 E+01	3.14 E+01	1.40 E+01	1.00 E+01
TOC	1.32 E+03	1.44 E+03	1.79 E+03	1.09 E+03	1.01 E+03
TOC	1.35 E+03	1.54 E+03			
TOX (LDL)	BDL	BDL	BDL	2.62 E+01	BDL
Uranium	6.60 E-01	5.40 E-01	6.22 E-01	5.72 E-01	5.91 E-01
Zinc	3.70 E+01	BDL	9.00 E+00	1.20 E+01	2.60 E+01

* = Dilution
BDL = Below detection limit.

Radioactive Component Analysis Considerations

Understanding the radiological sample results generated routinely at the Hanford Site is complicated by the traditional methods of reporting the results. These methods, although not ideal, are a direct outgrowth of the methods used to detect radionuclides, the physics of radioactive decay, and the ubiquity of ionizing radiation.

Radioactive decay is a random process: each radioactive nucleus has a certain probability of decaying during a certain period of time, and will either decay or not decay. Radioactivity is quantified by counting the number of decays observed during a measured period of time. Consequently, any measurement of radioactive decay rate includes a considerable amount of random error (experimental uncertainty). Specifically, the standard deviation of a measurement is equal to the square root of the number of decays expected during the counting period. The standard deviation can be approximated as the square root of the number of counts actually observed. Background radiation, which is always present, follows the same statistical rules as the radioactivity being measured.

To avoid reporting background radiation as radioactivity in a sample, each analysis consists of two counting periods of the same length. In the first, the background radiation is counted. In the second, the sample to be analyzed is inserted into the instrument, and the background and sample are counted together. The measured radioactivity of the sample is then the difference between the second and first measurements, divided by the time period. Since the radiation production is a random process, it is possible for an individual measurement of the background to be greater than another measurement of the background plus the radioactivity of a sample, leading to a negative measured radioactivity for the sample. (Indeed, if the sample has negligible radioactivity, such negative results will occur about half of the time.)

Since it is physically impossible for a sample to actually contain a negative concentration of radioactive species, negative results have traditionally been reported as "less than" values. Similarly, counting results so low as to make it unclear whether any radioactivity was present in the sample have also often been reported as "less than" values. On some occasions, however, small positive results (below the confidence interval reported in "less than" results) have been reported as real numbers. Although the historical data resulting from such reporting methods are not as well suited as they might be for evaluating what has happened in the past, the data did serve their primary function for process control and environmental protection at the time they were generated.

Radiological Surveillance Results

The following tables present available radiological data on CWL discharges from 1976 through 1988. The data were obtained from monthly composite samples of the effluent actually released to the environment. The samples were obtained by a flow proportional sampler, and composited monthly using data from the CWL flow instrumentation. The data have been published on a yearly or quarterly basis, and made available to the public. The data have also been published in the *Wastestream Characterization Report*.

At the end of 1984, a change was made in the reporting of plutonium in liquid effluents released to the environment. Before that time, plutonium releases were reported in grams per liter. Subsequent to that time, they were reported in micro-Curies per liter. In producing the following table, the reported concentrations were multiplied by 1,000,000 to yield pico-Curies per liter (pCi/l) after 1984, and micro-grams per liter before 1985. The pre-1985 plutonium results can be converted to pico-Curies per liter by multiplying by the specific activity of ^{239}Pu, which is 61,400 pCi/μg.

The graphs that follow the tables present the same data in graphic form. In the graphs, both "less than" results and real results are connected with lines. Each real result is marked with a plus sign ("+"). Thus, the graph for ^{241}Am shows only an upper bound for the actual emissions of ^{241}Am through the CWL (all of the data are "less than" results). Similarly, the graph for uranium shows only two instances in which uranium was actually detected in the CWL (February 1977 and May 1985). The rest of the line on the uranium graph is merely an upper bound for the actual emissions of uranium through the CWL. In the graphical presentation the plutonium data are all in pico-Curies per liter.

Table C-2. PUREX Cooling Water Radiological Release History.
(sheet 1 of 4)

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PC PUREX Cooling Water

Date	VOLUME	ALPHA	BETA	SR-90	CS-137	PM-147	U(GROSS)	H-3	AM-241	PU-239
7601	7.93E+07		<3.70E+01				<3.85E+01			<5.75E-05
7602	8.08E+07		<4.81E+01				<3.85E+01			<9.45E-05
7603	8.26E+07		<4.60E+01				<1.47E+02			<1.13E-04
7604	5.96E+07		<8.20E+01				<2.80E+01			2.20E-04
7605	5.72E+07		<3.00E+01				<4.50E+01			<1.30E-04
7606	7.22E+07		<5.10E+01				<3.84E+01			<2.20E-04
7607	1.02E+08		<4.70E+01				<3.85E+01			<1.63E-04
7608	9.45E+07		<3.97E+01				<3.87E+01			<9.25E-05
7609	8.74E+07		<3.58E+01				<3.87E+01			<1.95E-04
7610	8.21E+07		<3.70E+01				<3.85E+01			<7.20E-05
7611	7.64E+07		<1.67E+01				<3.85E+01			<4.40E-05
7612	1.11E+08		<2.22E+01				<3.85E+01			<9.47E-05
7701	8.88E+07		<3.10E+01				<3.85E+01			2.03E-04
7702	1.12E+08		<3.10E+01				3.85E+01			<9.82E-05
7703	1.15E+08		<2.76E+02				<3.84E+01			8.13E-04
7704	6.39E+07		<6.41E+02				<3.85E+01			<9.58E-05
7705	1.23E+08		<2.10E+02				<3.85E+01			<5.60E-04
7706	1.09E+08		<3.23E+01				<3.84E+01			<1.87E-04
7707	1.23E+08		<3.55E+01				<3.85E+01			<1.72E-04
7708	1.35E+08		<1.22E+02				<3.80E+01			<1.54E-02
7709	1.36E+08		<5.20E+01				<3.85E+01			<3.16E-04
7710	1.69E+08		<4.60E+01				<3.85E+01			<3.00E-04
7711	1.40E+08		<5.90E+01				<3.84E+01			<2.77E-03
7712	1.47E+08		<3.18E+01				<3.85E+01			<6.09E-04
7801	1.59E+08		7.27E+01				<3.84E+01			1.10E-04
7802	1.12E+08		1.25E+02				<3.99E+01			2.76E-04
7803	9.01E+07		<5.86E+01				<3.85E+01			<1.36E-04
7804	9.24E+07		<5.38E+01				<3.85E+01			1.31E-04
7805	1.36E+08		<1.02E+02				<3.85E+01			1.79E-04
7806	1.08E+08		<3.48E+01				<3.85E+01			2.00E-04
7807	1.58E+08		<7.30E+01				<3.81E+01			<1.61E-04
7808	1.22E+08		6.07E+01				<3.84E+01			<1.21E-04
7809	1.75E+08		<4.58E+01				<3.84E+01			<1.59E-04
7810	1.28E+08		<4.24E+01				<3.82E+01			<1.20E-04
7811	1.03E+08		<4.28E+01				<3.82E+01			<2.10E-04
7812	9.57E+07		<3.58E+01				<3.85E+01			<9.00E-05
7901	4.11E+08		1.90E+01				<1.00E+03			<1.48E-04
7902	3.71E+08		<2.01E+01				<1.00E+03			<1.24E-04
7903	3.73E+08		<1.82E+01				<1.00E+03			<5.21E-05
7904	3.85E+08		<1.06E+01				<1.00E+03			1.78E-04
7905	3.72E+08		<3.07E+01				<1.00E+03			<5.60E-05
7906	4.27E+08		<3.05E+01				<1.00E+03			<6.51E-05
7907	6.44E+08		<1.69E+01				<1.00E+03			<4.38E-05
7908	6.17E+08		<1.20E+01				<1.00E+03			1.44E-04
7909	8.25E+08		<1.48E+01				<1.00E+03			<4.17E-05

Table C-2. PUREX Cooling Water Radiological Release History.
(sheet 2 of 4)

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PC PUREX Cooling Water

Date	VOLUME	ALPHA	BETA	SR-90	CS-137	PM-147	U(GROSS)	H-3	AM-241	PU-239
7910	5.01E+08		1.50E+01				<1.00E+03			<5.86E-05
7911	3.52E+08		6.57E+00				<1.00E+03			<2.07E-05
7912	4.30E+08		<1.96E+01				<1.00E+03			<8.79E-05
8001	1.20E+08		<3.36E+02	4.16E+01	2.40E+02					<4.05E-05
8002	1.28E+08		<3.74E+01	2.69E+01						<1.01E-04
8003	2.92E+08		<3.14E+01	<8.40E+00	<3.80E+01					<5.21E-05
8004	2.75E+08		<3.27E+01	<1.50E+01	<3.80E+01					<4.72E-05
8005	3.99E+08		<1.54E+01	<1.10E+01	1.40E+02					<4.61E-05
8006	4.37E+08		<1.55E+01	<1.10E+01	<5.30E+01					<2.82E-05
8007	4.40E+08		<1.70E+01		<4.00E+01					<4.89E-05
8008	4.28E+08		4.40E+00							<1.58E-04
8009	3.44E+08		5.60E+00							3.09E-05
8010	3.46E+08		1.40E+01							<1.53E-05
8011	4.08E+08		1.11E+01	<7.00E+00	<4.00E+00					2.35E-05
8012	3.38E+08		1.56E+01	3.40E+00	<4.00E+01					<1.43E-04
8101	3.19E+08		1.02E+01	<6.00E+00						1.73E-05
8102	3.32E+08		2.30E+01	<7.00E+00						1.94E-05
8103	5.87E+08		6.30E+00	<3.00E+00	<1.00E+01					4.89E-06
8104	2.99E+08		8.30E+00	<1.00E+01	<4.00E+01					7.82E-06
8105	3.82E+08		<5.90E+00	<3.00E+00	<4.00E+01					1.06E-05
8106	5.30E+06		9.34E+01	<1.00E+01	<4.00E+01					2.44E-05
8107	5.12E+08		<5.50E+00	<1.00E+01	<4.00E+01					3.26E-05
8108	4.47E+08		3.30E+00	<9.00E+00	<4.00E+01					<1.25E-05
8109	4.60E+08		9.80E+00	<6.00E+00	<4.00E+01					<8.53E-05
8110	1.77E+08		<5.50E+00	<1.00E+01						<2.02E-05
8111	7.15E+07		2.40E+01	2.80E+01	2.20E+02					1.38E-04
8112	2.00E+08		9.30E+00	<7.00E+00	1.60E+02					2.43E-05
8201	8.18E+07	<1.51E+00	4.60E+00							
8202	1.47E+08	<5.10E+00	3.40E+01							
8203	2.60E+08	<3.10E+00	<1.30E+01							
8204	1.64E+08	<2.80E+00	<5.80E+00	1.00E+01	<3.00E+02					
8205	1.85E+08	<2.60E+00	<1.60E+01							
8206	3.72E+08	<2.10E+01	<1.27E+02	<1.00E+01	1.60E+02					
8207	3.86E+08	2.56E+01	1.69E+00							
8208	4.32E+08	<5.40E+00	<1.37E+01							
8209	5.15E+08	<2.30E+00	2.95E+01							
8210	1.03E+09	<4.10E+00	<4.20E+01							
8211	1.83E+08	<2.20E+00	<1.00E+01							
8212	2.96E+08	<2.30E+00	<1.50E+01	<5.00E+00	<5.00E+01					
8301	3.24E+08	3.27E+02	1.36E+02	1.50E+01	5.70E+01					
8302	1.12E+08	<4.80E+00	<7.30E+00							
8303	2.28E+08	<6.20E+00	<1.46E+01							
8304	2.23E+08	<3.00E+00	<1.00E+01					<2.00E+02		
8305	4.01E+08	4.00E+01	1.71E+01					2.10E+02		
8306	4.54E+08	<3.00E+00	<3.30E+01					<9.00E+01		

Table C-2. PUREX Cooling Water Radiological Release History.
(sheet 3 of 4)

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PC PUREX Cooling Water

Date	VOLUME	ALPHA	BETA	SR-90	CS-137	PM-147	U(GROSS)	H-3	AM-241	PU-239
8307	2.87E+08	<3.00E+00	<3.89E+01				<1.00E+00	<2.00E+02		
8308	5.58E+08	<2.85E+00	<2.10E+01					3.50E+02		
8309	4.57E+08	<5.60E+00	<1.26E+01				<1.00E+00	2.90E+03		
8310	6.01E+08	<2.60E+00	<3.10E+01	<1.00E+02	<6.00E+01		<5.00E+00	<2.00E+02		
8311	1.47E+09	<3.50E+00	<1.03E+02	<6.00E+00			1.60E+01	<2.00E+02		
8312	1.18E+09	3.00E+01	<6.10E+01							
8401	1.55E+09	<6.70E+00	<8.30E+00	<1.92E+01	<1.00E+02			2.10E+02		
8402	5.20E+08	<3.20E+00	<2.50E+01	<1.33E+01	<1.40E+02			<1.00E+00		
8403	1.46E+09	<9.20E+00	5.44E+02	<2.00E+01	<6.37E+01	<2.00E+02	<1.00E+00	2.50E+02		
8404	9.55E+08	<2.80E+00	<7.20E+00	<1.50E+01	<4.70E+01	<2.00E+02		<1.00E+00		
8405	9.74E+08	2.82E+01	<4.19E+01	<2.70E+01	<7.00E+01	<2.00E+02	<1.00E+00	<5.00E+02		
8406	9.38E+08	<6.80E+00	<3.40E+01	<2.20E+01	<4.40E+01	<2.00E+02	<1.00E+00	<1.00E+00		
8407	1.08E+09	<5.19E+01	<6.20E+01	<3.10E+01	<4.30E+01	<2.00E+02	<1.00E+00	9.10E+04		
8408	1.31E+09	<8.30E+00	5.65E+01	<1.60E+01	<4.30E+01	<9.00E+01	<6.00E+01	1.71E+03		
8409	9.88E+08	<1.54E+00	1.19E+02	<3.00E+01	5.90E+02	<9.00E+01	<1.00E+00	6.80E+02		
8410	3.13E+08	<3.50E+00	1.21E+02	<2.30E+01	<4.50E+01	1.30E+02	<3.00E+00	6.70E+02		
8411	7.52E+08	<2.40E+00	<6.10E+01	<5.70E+01	<4.60E+01	1.10E+02	<1.00E+00	4.50E+03		
8412	9.81E+08	<2.60E+01	<3.08E+02	<3.00E+01	<4.60E+01	<4.00E+02	<1.00E+00	<3.00E+02		
8501	1.10E+09	<4.70E+00	8.00E+02	<4.00E+01	4.52E+01	<4.00E+02		8.10E+03		
8502	8.08E+08	<4.40E+00	1.00E+03	<3.50E+01	<4.70E+01	<7.00E+02		2.50E+03		
8503	9.55E+08	<3.30E+00	1.55E+02	<1.80E+01	5.20E+01	<3.60E+02		1.80E+03		
8504	9.61E+08	<1.42E+00	9.23E+02	<2.00E+01	<4.60E+01	<2.00E+02		3.10E+03		
8505	7.95E+08	<3.93E+00	8.90E+01	<3.00E+01	<4.40E+01	<4.00E+02		1.10E+04		
8506	7.71E+08	<1.45E+00	8.90E+01	<1.50E+01	<4.20E+01	5.30E+02		9.50E+02		
8507	1.47E+09	<3.00E+00	1.93E+02	<2.00E+01	<4.60E+01	<2.00E+02		1.70E+03		
8508	1.23E+09	<1.70E+00	2.70E+01	<2.80E+01	<4.22E+01	1.40E+02		<5.00E+02		
8509	1.15E+09	<7.20E+00	8.00E+01	<1.80E+01	<4.80E+01	<7.00E+01		5.40E+03		
8510	8.74E+08	8.90E+01	9.80E+01	<2.90E+01	<6.00E+01	1.20E+02		1.20E+04		
8511	1.18E+09	2.70E+02	<5.20E+01	<3.90E+01	<4.20E+01	1.00E+02		1.50E+04		
8512	9.97E+08	<4.90E+00	<1.90E+01	<1.80E+01	<5.00E+01	3.80E+02		2.50E+02		
8601	8.70E+08	7.74E+00	2.96E+02	<1.60E+01	<4.20E+01			1.40E+03		
8602	1.00E+09	1.88E+01	4.38E+01	<2.20E+01	<4.50E+01			1.20E+03		
8603	1.27E+09	<6.70E+00	2.81E+01	<2.00E+01	<4.40E+01			<1.00E+03		
8604	1.38E+09	<2.20E+00	<5.20E+01	<2.50E+01	<5.00E+01			<5.00E+02		
8605	9.27E+08	<2.50E+00	<3.20E+01	<4.90E+01	<4.60E+01			<5.00E+02		
8606	1.16E+09	<4.40E+00	1.89E+02	1.20E+01	<4.00E+01			4.60E+03		
8607	1.59E+09	1.36E+01	1.54E+02	<2.70E+01	<4.50E+01			1.50E+05		
8608	1.40E+09	9.80E+00	2.33E+02	<4.00E+01	<6.00E+01			8.60E+02		
8609	6.57E+08	<7.80E+00	7.90E+01	<2.60E+01	<6.70E+01			<3.00E+02		
8610	3.16E+08	<3.20E+00	<2.90E+01	1.63E+01	<7.00E+01			<4.10E+03		
8611	1.72E+08	<1.43E+01	<5.30E+01	<7.30E+01	<1.55E+02			5.90E+02		
8612	1.86E+08	<1.88E+00	<3.40E+01	<2.10E+01	<4.50E+01			5.00E+02		
8701	1.99E+08	<2.44E+00	<6.70E+01	4.60E+01	<5.20E+01			1.40E+03		
8702	2.40E+08	<6.90E+00	<4.60E+01	<2.70E+01	<4.60E+01			5.00E+02		
8703	5.42E+08	6.80E+00	6.00E+01	<1.90E+01	<4.40E+01			2.70E+02		

Table C-2. PUREX Cooling Water Radiological Release History. (sheet 4 of 4)

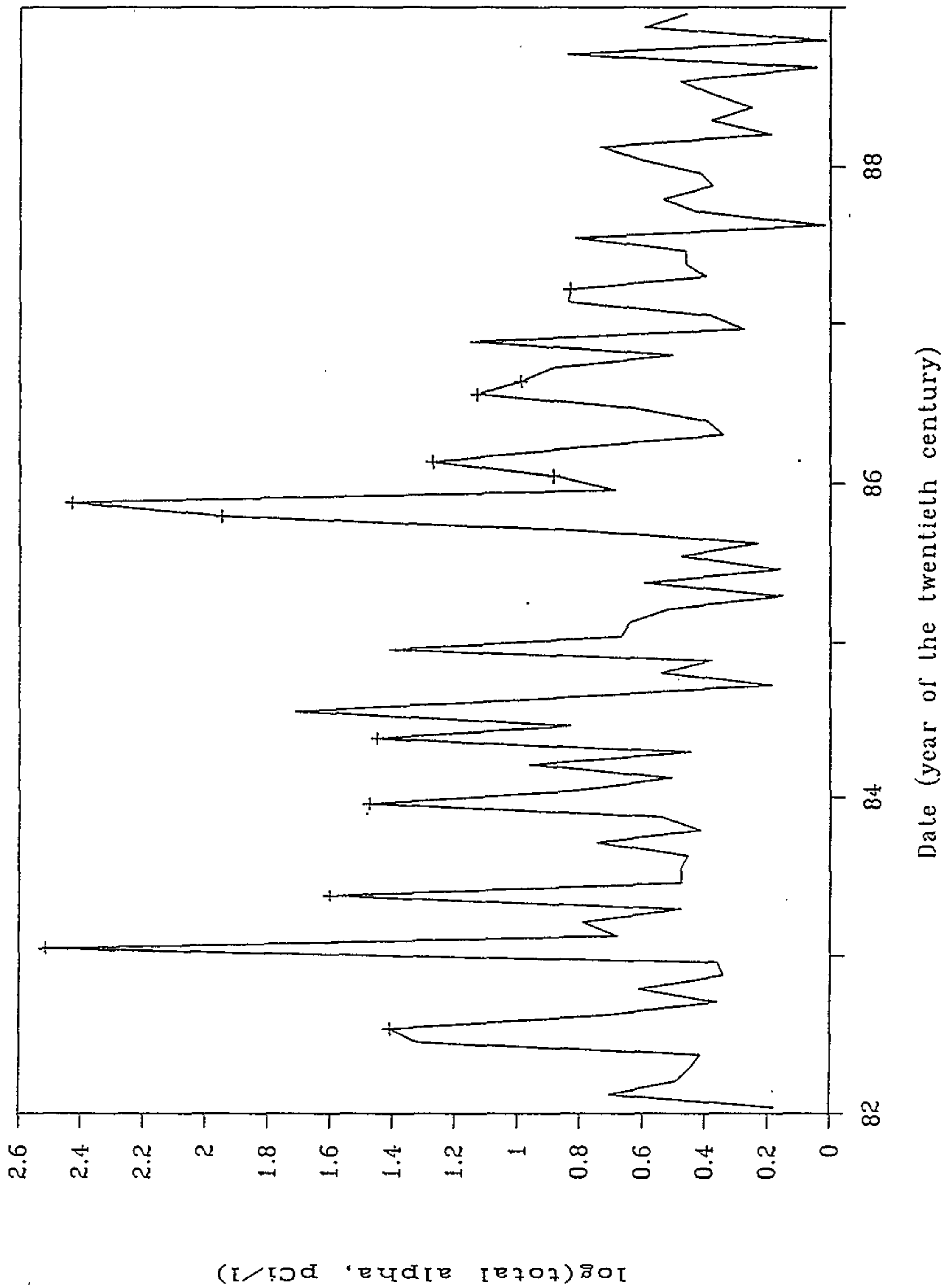
Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PC PUREX Cooling Water

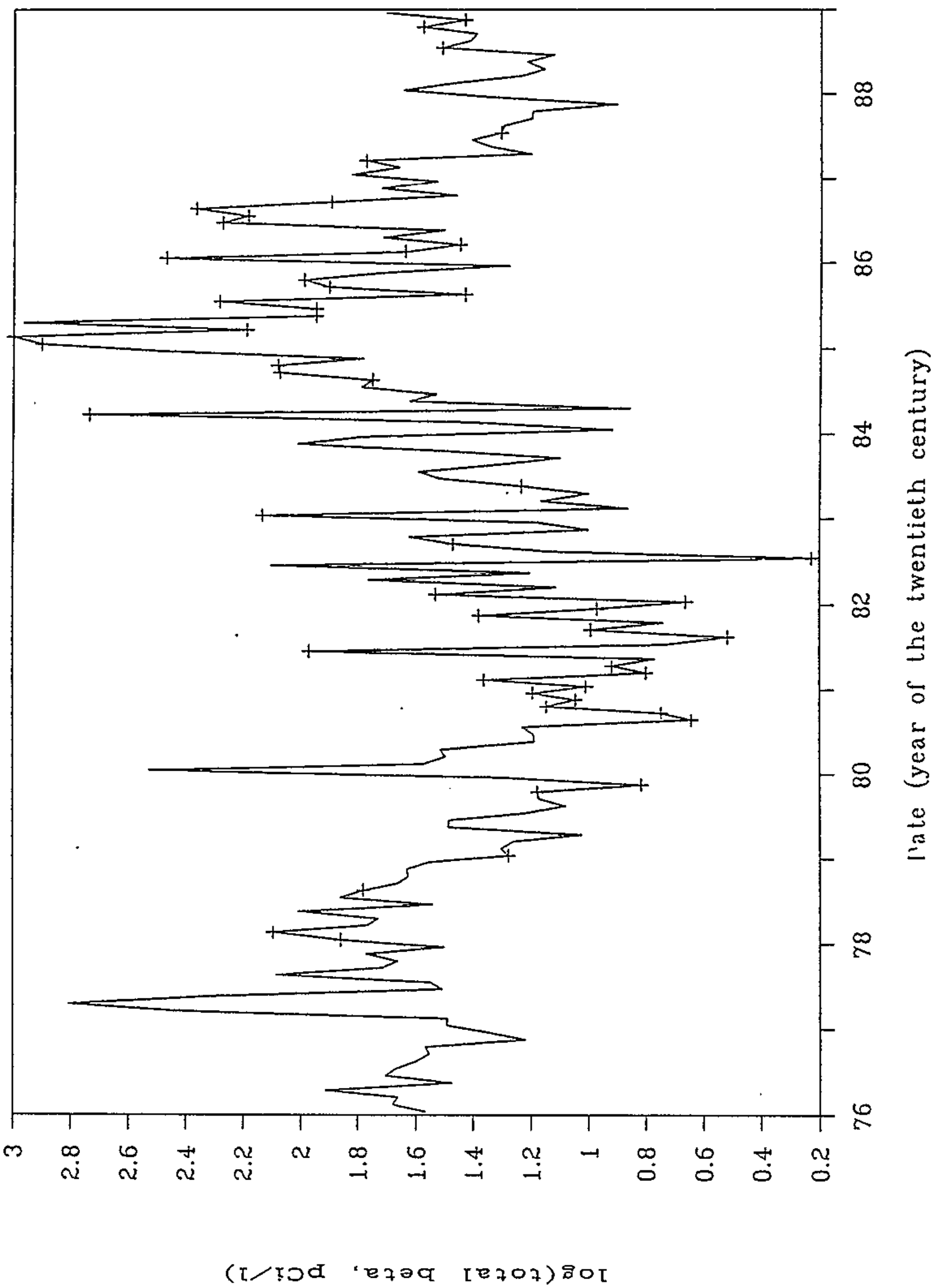
Date	VOLUME	ALPHA	BETA	SR-90	CS-137	PM-147	U(GROSS)	H-3	AM-241	PU-239
8704	1.15E+09	<2.50E+00	<1.60E+01	<2.60E+01	<5.00E+01			6.90E+02	<8.00E+02	7.83E+01
8705	7.49E+08	<2.90E+00	<2.20E+01	<2.90E+01	<4.40E+01			4.20E+02	<6.71E+02	1.41E+01
8706	6.95E+08	<2.90E+00	<2.58E+01	<1.80E+01	<4.84E+01			2.08E+02	<4.00E+02	1.19E+01
8707	1.32E+09	<6.56E+00	2.04E+01	<1.56E+01	<4.82E+01			2.23E+03	<7.00E+01	<9.00E+00
8708	9.90E+08	<1.04E+00	<1.99E+01	<1.37E+01	<4.87E+01			<4.50E+02	<8.00E+01	6.98E+01
8709	1.09E+09	<2.66E+00	<1.59E+01	<1.68E+01	<4.38E+01			2.04E+03	<8.00E+01	<3.86E+01
8710	3.38E+08	<3.43E+00	<1.58E+01	<2.05E+01	<4.34E+01			<4.50E+02	<5.00E+01	<1.11E+01
8711	3.29E+08	<2.38E+00	<8.06E+00	<3.21E+01	<4.34E+01			<4.50E+02	<7.01E+01	<1.00E+01
8712	1.94E+08	<2.62E+00	<2.25E+01	<1.72E+01	<4.23E+01			<4.50E+02	<6.00E+01	<1.00E+01
8801	2.18E+08	<4.08E+00	<4.45E+01	<3.47E+01	<5.13E+01			9.29E+02	<8.00E+01	<1.00E+01
8802	1.09E+09	<5.49E+00	<2.96E+01	<2.34E+01	<4.84E+01			<4.50E+02	<6.00E+01	<1.33E+01
8803	1.14E+09	<1.54E+00	<1.73E+01	<1.67E+01	<8.96E+01			9.62E+03	<2.06E+02	<9.15E+01
8804	2.31E+08	<2.41E+00	<1.44E+01	<2.38E+01	<4.62E+01			7.36E+02	<5.78E+01	<1.00E+01
8805	2.71E+08	<1.79E+00	<1.65E+01	<1.75E+01	<4.99E+01			<4.50E+02	<6.27E+01	<1.00E+01
8806	1.36E+09	<2.40E+00	<1.34E+01	<1.36E+01	<8.54E+01			7.61E+03	<6.43E+01	<1.00E+01
8807	6.86E+08	<3.03E+00	3.25E+01	<2.62E+01	<4.71E+01			<4.50E+02	<7.10E+01	<1.78E+01
8808	1.38E+09	<1.11E+00	<2.60E+01	<4.13E+01	<8.06E+01			1.65E+03	<6.96E+01	<1.74E+01
8809	8.93E+08	<6.94E+00	<2.47E+01	<2.95E+01	<8.94E+01			1.19E+03	<9.14E+01	<2.29E+01
8810	9.71E+08	<1.03E+00	3.79E+01	<2.40E+01	<5.44E+01			<2.05E+02	<5.60E+01	<1.40E+01
8811	1.24E+09	<3.93E+00	2.71E+01	<1.48E+01	<5.47E+01			4.39E+02	<4.53E+01	<1.13E+01
8812	5.90E+08	<2.89E+00	<5.13E+01	<2.54E+01	<5.51E+01			1.82E+03	<1.41E+02	<3.53E+01

Total volume: 8.07E+10

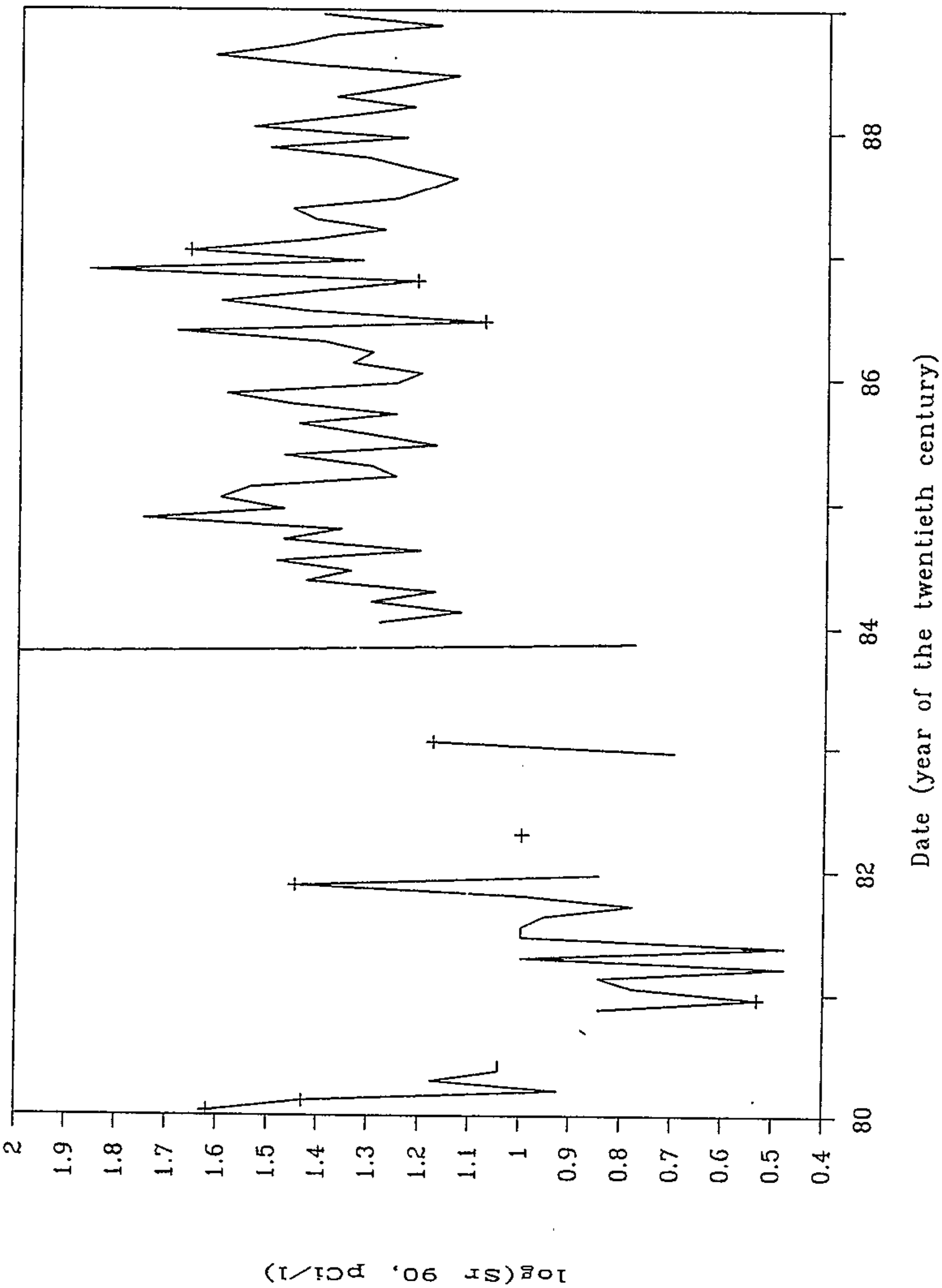
PUREX Plant CWL Radiological Release History.
Total Alpha.



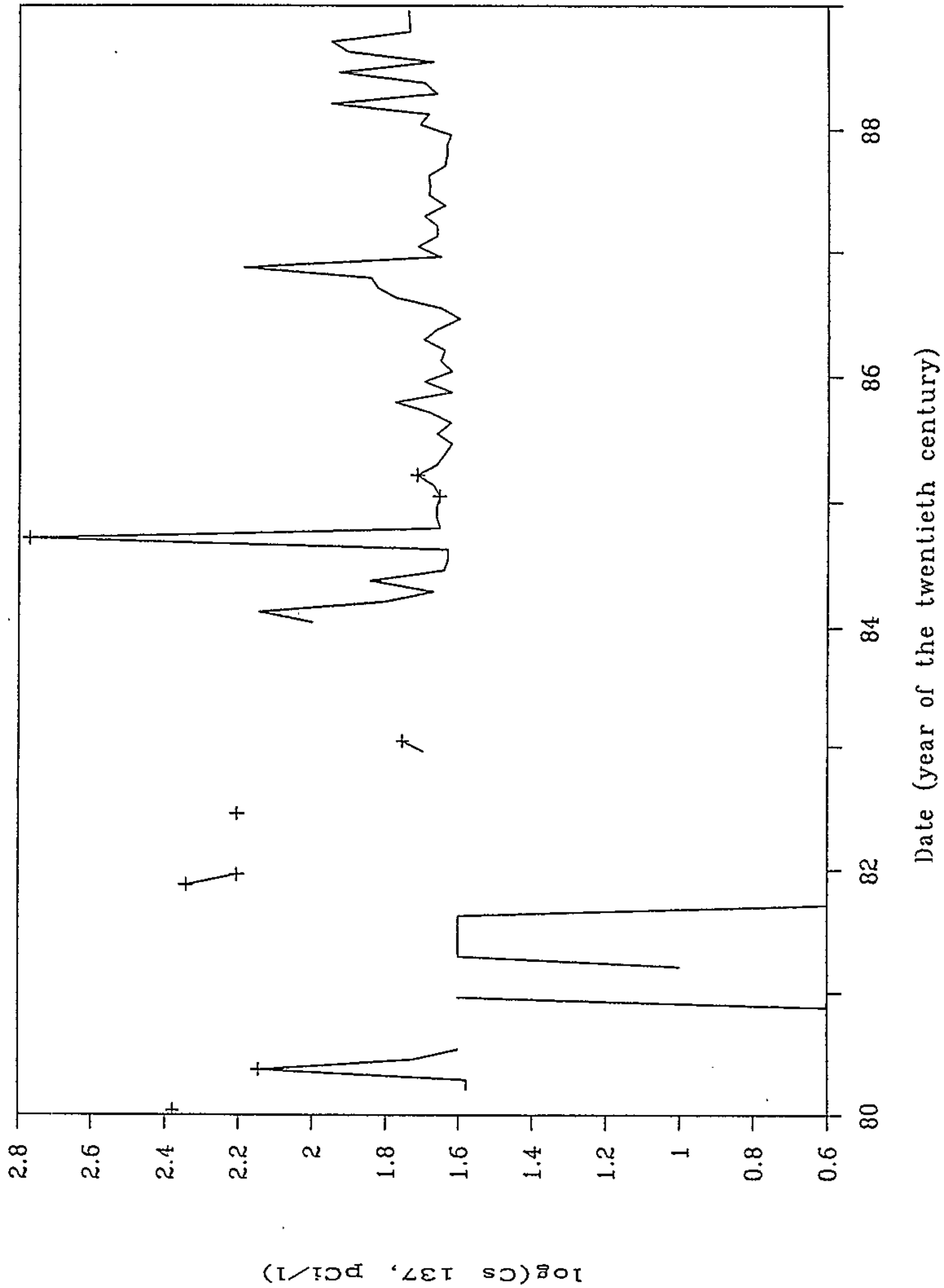
PUREX Plant CWL Radiological Release History.
Total Beta.



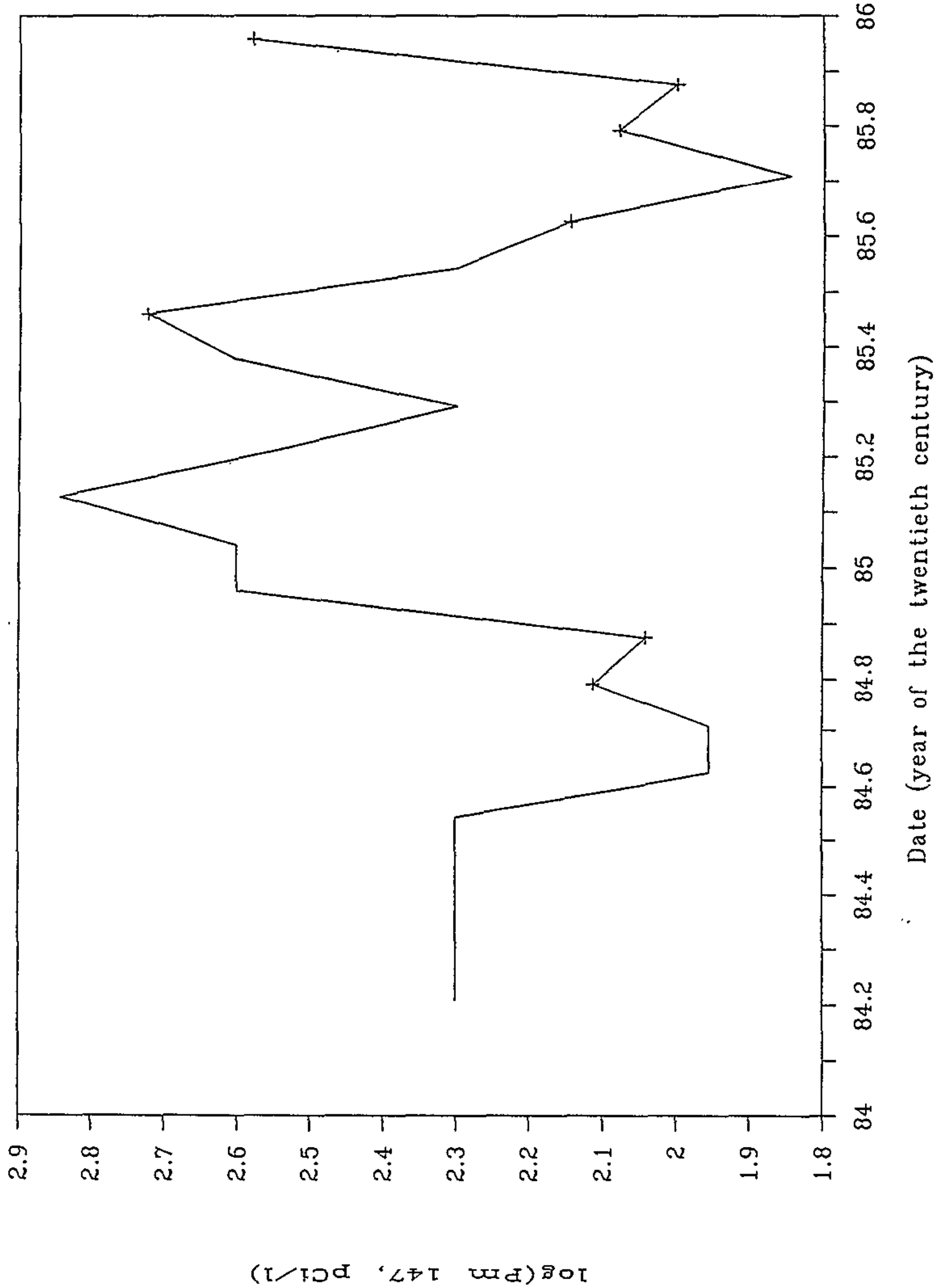
PUREX Plant CWL Radiological Release History.
Strontium 90.



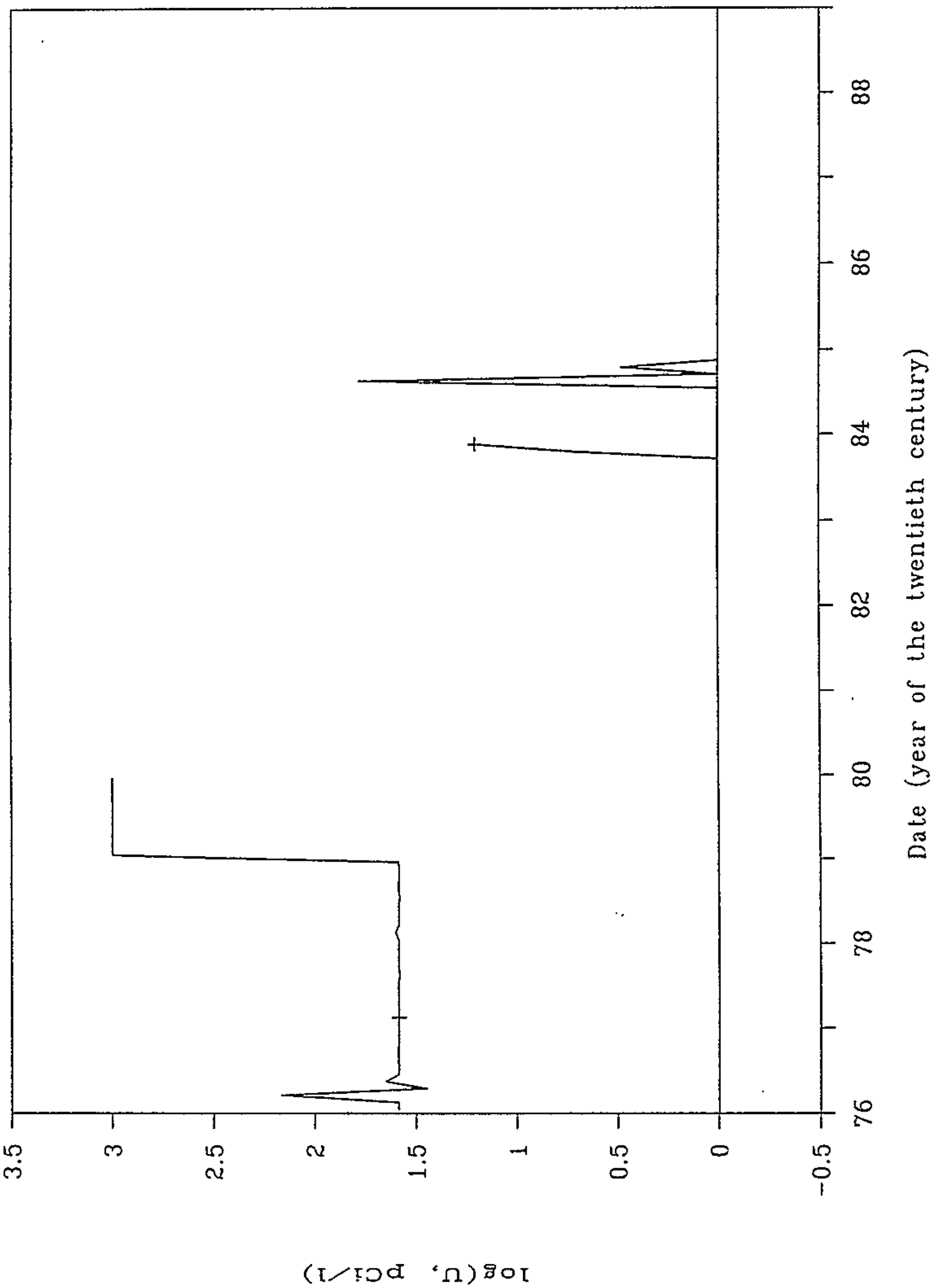
PUREX Plant CWL Radiological Release History.
Cesium 137.



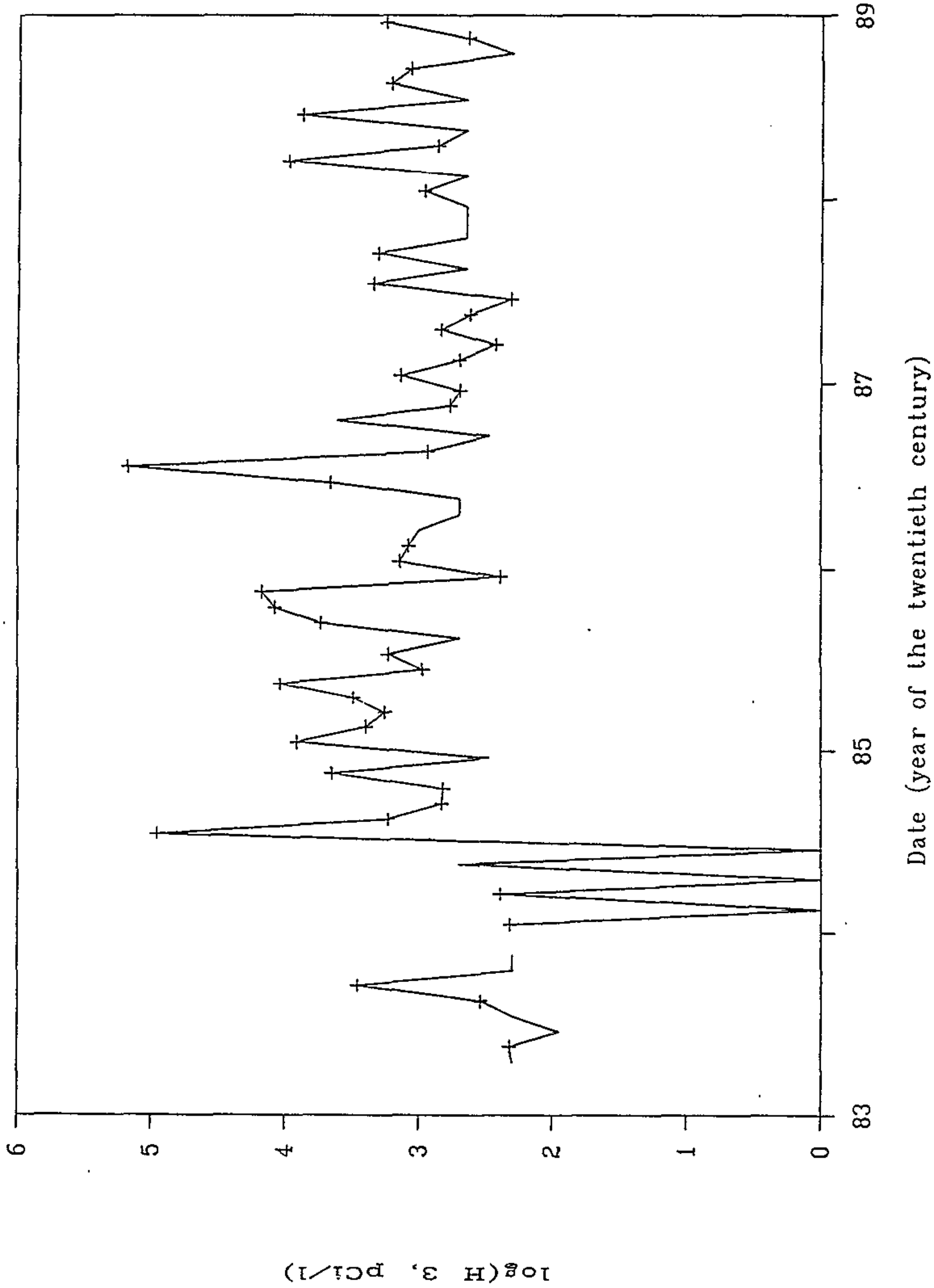
PUREX Plant CWL Radiological Release History.
Promethium 147.



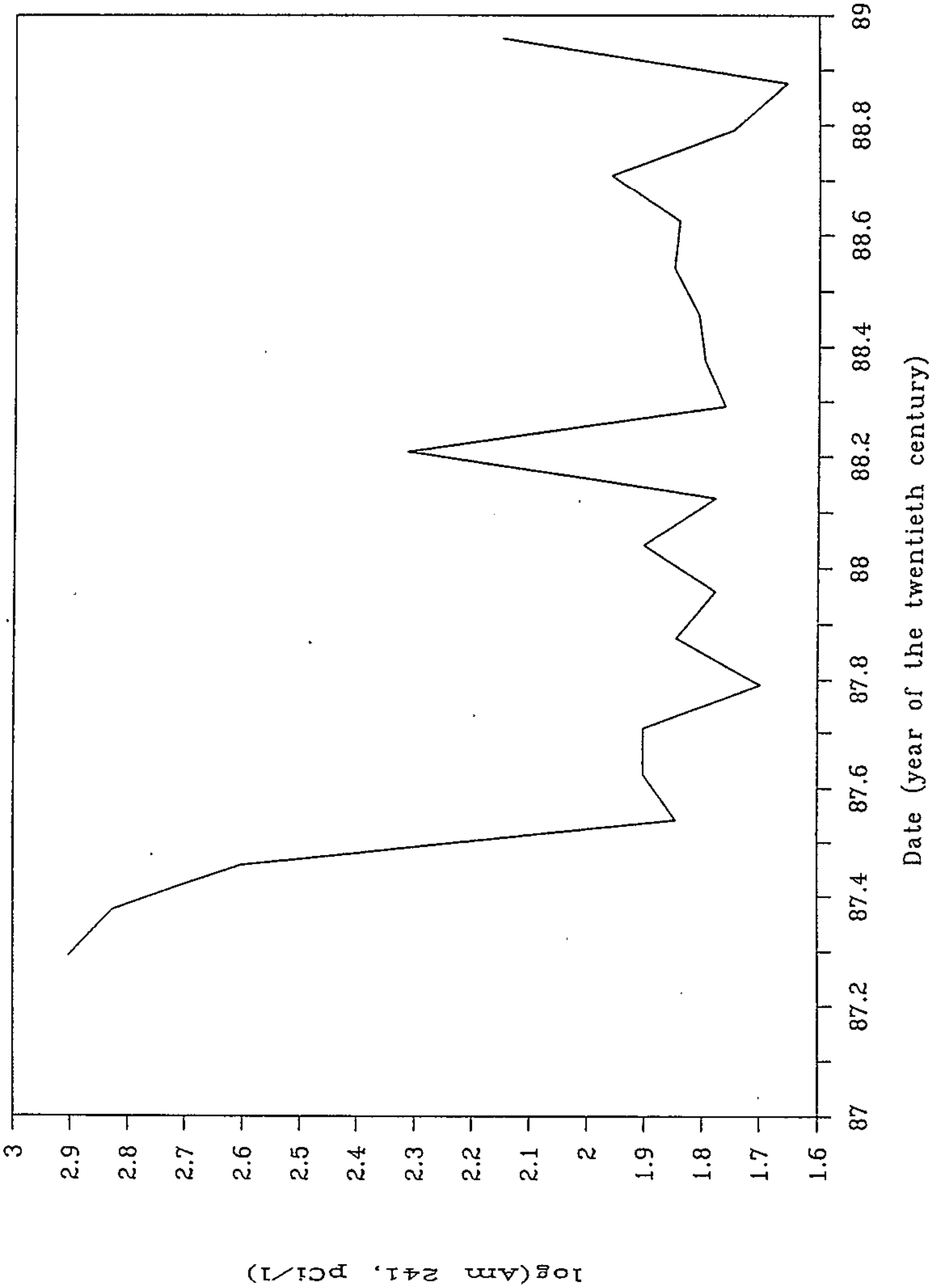
PUREX Plant CWL Radiological Release History.
Gross Uranium.



PUREX Plant CWL Radiological Release History.
Tritium.



PUREX Plant CWL Radiological Release History.
Americium 241.



PUREX Plant CWL Radiological Release History.
Plutonium 239.