

DOE/RL-95-78
Revision 1

Copy No. 29

PUREX Facility Preclosure Work Plan



United States
Department of Energy
Richland, Washington

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PUREX Facility Preclosure Work Plan

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PUREX FACILITY
PRECLOSURE WORK PLAN

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FOREWORD

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The Hanford Facility is owned by the U.S. Government and operated by the U.S. Department of Energy, Richland Operations Office. Dangerous waste and mixed waste (containing both dangerous and radioactive components) are produced and managed on the Hanford Facility. Waste components are regulated in accordance with the *Resource Conservation and Recovery Act of 1976* and *Hazardous and Solid Waste Amendments of 1990*, and/or the *State of Washington Hazardous Waste Management Act of 1976* (as administered through the Washington State Department of Ecology's *Dangerous Waste Regulations*, Washington Administrative Code 173-303); or the *Atomic Energy Act of 1954*.

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For the purposes of the *Resource Conservation and Recovery Act of 1976*, the Hanford Facility is considered to be a single facility. A single dangerous waste permit identification number issued to the Hanford Facility by the U.S. Environmental Protection Agency and the Washington State Department of Ecology is Environmental Protection Agency/State Identification Number WA7890008967. This identification number encompasses a number of treatment, storage, and/or disposal units within the Hanford Facility. One of these treatment, storage, and/or disposal units is the PUREX Facility.

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The PUREX Facility is currently undergoing a phased closure. Thus, the *PUREX Facility Preclosure Work Plan* submittal differs from closure plans previously submitted by the U.S. Department of Energy, Richland Operations Office to the Washington State Department of Ecology, in that the closure process occurs in three distinct phases as part of the decommissioning process [i.e., transition, surveillance and maintenance, and disposition (*Hanford Federal Facility Agreement and Consent Order*, Section 8.0)]. Final closure will occur during the disposition phase. The phased decommissioning process is implemented because development of a complete closure plan during the transition phase is impractical and future land use determinations have not been identified.

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The *PUREX Facility Preclosure Work Plan* is prepared in accordance with the PUREX Facility transition phase as outlined in Section 8.0 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996). The objective of the transition phase is to place the PUREX Facility in a safe configuration with respect to human health and the environment. Following the transition phase activities, the PUREX Facility will begin the surveillance and maintenance phase of 10 or more years until disposition phase activities commence. The closure plan for the PUREX Facility will be prepared during the disposition phase. Revision 1 text is marked with change bars.

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For purposes of this documentation, the PUREX Facility does not include the PUREX Storage Tunnels. The PUREX Storage Tunnels are an operating storage unit (DOE/RL-90-24).

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GLOSSARY

ACRONYMS AND ABBREVIATIONS

| | | |
|----|---------------------|--|
| 6 | AFAN | ammonium fluoride-ammonium nitrate |
| 7 | ASF | ammonia scrubber feed |
| 8 | | |
| 9 | CERCLA | <i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i> |
| 10 | | |
| 11 | CFR | Code of Federal Regulations |
| 12 | CO _x | oxides of carbon |
| 13 | CRW | cladding removal waste |
| 14 | | |
| 15 | DOE | U.S. Department of Energy |
| 16 | DOE-RL | U.S. Department of Energy, Richland Operations Office |
| 17 | DQO | data quality objectives |
| 18 | DST | double-shell tank |
| 19 | | |
| 20 | Ecology | Washington State Department of Ecology |
| 21 | EPA | U.S. Environmental Protection Agency |
| 22 | | |
| 23 | NaNO ₂ | sodium nitrite |
| 24 | NaOH | sodium hydroxide |
| 25 | NEPA | <i>National Environmental Policy Act of 1969</i> |
| 26 | NO _x | oxides of nitrogen |
| 27 | NPH | normal paraffin hydrocarbon |
| 28 | NZAW | neutralized zirflex acid waste |
| 29 | | |
| 30 | PUREX | plutonium-uranium extraction |
| 31 | | |
| 32 | RCRA | <i>Resource Conservation and Recovery Act of 1976</i> |
| 33 | | |
| 34 | S&M | surveillance and maintenance |
| 35 | | |
| 36 | T | tower (generic term used for column, scrubber, etc.) |
| 37 | TK | tank |
| 38 | Tri-Party Agreement | Hanford Federal Facility Agreement and Consent Order |
| 39 | TSD | treatment, storage, and/or disposal |
| 40 | | |
| 41 | UNH | uranyl nitrate hexahydrate |
| 42 | | |
| 43 | WAC | Washington Administrative Code |
| 44 | | |
| 45 | | |
| 46 | | |

1 TERMS

2 Definitions are based on use throughout this document.

3 **Crib**--A porous underground structure for disposal of liquid waste.

4 **Dunnage**--The nonprocess structure component of process equipment assembly used
5 to support, maintain spacial configuration, and facilitate remote handling.

6 **Waste fission products**--Byproducts of nuclear fission, other than plutonium,
7 uranium, and neptunium that were produced by irradiation and extracted through
8 the PUREX process.

9 **Jumper**--A prefabricated, remotely installed, piping assembly used to make
10 intra-cell transfers between process equipment. The piping assembly could
11 contain connectors, valves, instrumentation, and counterweights.

12 **M**--Molar, or moles, of solute per liter of solution.

13 **Metathesis**--A process of reacting potassium hydroxide with residual fluorides
14 remaining on the fuel elements after the fuel elements have been decladded
15 with an ammonium fluoride-ammonium nitrate solution. This reaction complexes
16 the fluoride so the fluoride can be removed from the dissolvers to minimize
17 dissolver corrosion during the fuel dissolution process.

18 **Mixed waste**--A dangerous, extremely hazardous, or acutely hazardous waste that
19 contains both a nonradioactive hazardous component and source, special
20 nuclear, or by-product material subject to the *Atomic Energy Act of 1954*.

21 **N Reactor**--A graphite-moderated, water-cooled reactor that produced irradiated
22 fuel for processing at the PUREX Plant. The steam byproduct was used to
23 generate electricity.

24 **pH**--The negative log of the hydrogen ion concentration in a solution.

25 **PUREX**--plutonium-uranium extraction.

26 **PUREX Facility**--All buildings and structures that lie within, or adjacent, to
27 the double fenced area. For purposes of this documentation, the PUREX Storage
28 Tunnels (DOE/RL-90-24) are excluded.

29 **PUREX Plant**--The PUREX processing building, 202-A Building.

30 **Zirflex**--A buffered acidic ammonium fluoride process for the dissolution of
31 zirconium alloy cladding from irradiated reactor fuel assemblies.

METRIC CONVERSION CHART

Into metric units

Out of metric units

| If you know | Multiply by | To get | If you know | Multiply by | To get |
|------------------------|-------------------------------------|--------------------|----------------------|---------------------------------|------------------------|
| Length | | | Length | | |
| inches | 25.40 | millimeters | millimeters | 0.0393 | inches |
| inches | 2.54 | centimeters | centimeters | 0.393 | inches |
| feet | 0.3048 | meters | meters | 3.2808 | feet |
| yards | 0.914 | meters | meters | 1.09 | yards |
| miles | 1.609 | kilometers | kilometers | 0.62 | miles |
| Area | | | Area | | |
| square inches | 6.4516 | square centimeters | square centimeters | 0.155 | square inches |
| square feet | 0.092 | square meters | square meters | 10.7639 | square feet |
| square yards | 0.836 | square meters | square meters | 1.20 | square yards |
| square miles | 2.59 | square kilometers | square kilometers | 0.39 | square miles |
| acres | 0.404 | hectares | hectares | 2.471 | acres |
| Mass (weight) | | | Mass (weight) | | |
| ounces | 28.35 | grams | grams | 0.0352 | ounces |
| pounds | 0.453 | kilograms | kilograms | 2.2046 | pounds |
| short ton | 0.907 | metric ton | metric ton | 1.10 | short ton |
| Volume | | | Volume | | |
| fluid ounces | 29.57 | milliliters | milliliters | 0.03 | fluid ounces |
| quarts | 0.95 | liters | liters | 1.057 | quarts |
| gallons | 3.79 | liters | liters | 0.26 | gallons |
| cubic feet | 0.03 | cubic meters | cubic meters | 35.3147 | cubic feet |
| cubic yards | 0.76456 | cubic meters | cubic meters | 1.308 | cubic yards |
| Temperature | | | Temperature | | |
| Fahrenheit | subtract 32 then multiply by 5/9ths | Celsius | Celsius | multiply by 9/5ths, then add 32 | Fahrenheit |
| Force | | | Force | | |
| pounds per square inch | 6.895 | kilopascals | kilopascals | 1.4504×10^{-4} | pounds per square inch |

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

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1.0 INTRODUCTION

1 4 This preclosure work plan presents a description of the PUREX Facility,
2 5 the history of the waste managed, and addresses transition phase activities
3 6 that position the PUREX Facility into a safe and environmentally secure
4 7 configuration. For purposes of this documentation, the PUREX Facility does
5 8 not include the PUREX Storage Tunnels (DOE/RL-90/24). Information concerning
6 9 solid waste management units is discussed in the *Hanford Facility Dangerous*
7 10 *Waste Permit Application, General Information Portion* (DOE/RL-91-28,
8 11 Appendix 2D).

12 13 The *PUREX Facility Preclosure Work Plan* is prepared in accordance with
14 14 Section 8.0 of the *Hanford Federal Facility Agreement and Consent Order*
15 15 (Tri-Party Agreement) (Ecology et al. 1996). The *PUREX Facility Preclosure*
16 16 *Work Plan* submittal differs from closure plans previously submitted by the
17 17 U.S. Department of Energy, Richland Operations Office (DOE-RL) to the
18 18 Washington State Department of Ecology (Ecology), in that the closure process
19 19 occurs in three distinct phases as part of the decommissioning process [i.e.,
20 20 transition, surveillance and maintenance (S&M), and disposition (Ecology
21 21 et al. 1996)]. Final closure of the PUREX Facility will occur during the
22 22 disposition phase. A PUREX Facility closure plan will be prepared during the
23 23 disposition phase planning process, which follows an extended S&M phase. A
24 24 closure plan for the PUREX Storage Tunnels will be submitted to Ecology with
25 25 the PUREX Facility closure plan.

26 27 Planning documents supporting the transition phase activities include end
28 28 point criteria (WHC 1995a) and a S&M plan (WHC 1995b). On completion of the
29 29 transition phase activities, the PUREX Facility will enter the S&M phase.
30 30 Tri-Party Agreement negotiations during S&M and disposition phases will
31 31 address closure activities.

32 33 The PUREX Facility was designed and constructed to provide supplemental
34 34 fuel reprocessing capability to separate uranium, plutonium, and neptunium
35 35 products from irradiated reactor fuel. The PUREX Facility operated from 1956
36 36 to 1972, when operations were placed in a standby mode. Operation resumed
37 37 in 1983 after a backlog of irradiated fuel from N Reactor was accumulated.
38 38 In 1991, operations once again were placed in a standby mode. In
39 39 December 1992, DOE-Headquarters notified the DOE-RL that the PUREX Facility
40 40 would no longer operate and directed the DOE-RL to deactivate this facility.
41

42 43 Preclosure of the PUREX Facility vessel systems and removal of waste from
44 44 the canyon deck will occur in conjunction with the overall decommissioning of
45 45 the PUREX Facility. A vessel system is a treatment and/or storage vessel and
46 46 its ancillary equipment. The transition phase activities place the PUREX
47 47 Facility in a deactivated state where all regulated vessels are flushed until
48 48 solutions do not designate as dangerous waste. The preclosure phase of the
49 49 PUREX Facility relies on the successful completion of end-point criteria,
50 50 leaving the PUREX Facility in an 'as-left' state ensuring deactivation is
51 51 complete. The S&M phase will maintain the PUREX Facility in a safe and
52 52 environmentally secure configuration for 10 or more years for a planning
53 53 horizon. The disposition phase will address final closure activities [for

1 portions of the PUREX Facility identified in the Part A, Form 3, Permit
2 Application (DOE/RL-88-21)] in accordance with *Dangerous Waste Regulations*,
3 Washington Administrative Code (WAC) 173-303. If required, postclosure care
4 requirements would be integrated with the post-remediation groundwater
5 monitoring requirements established for the 200-PO-1 operable unit.
6

7 This phased approach to closure allows for an expedient full deactivation
8 of the PUREX Facility in a manner that is safe and cost effective, while
9 minimizing the risk to human health and the environment, per
10 WAC 173-303-610(2).

11 The transition phase activities will place the PUREX Facility in a
12 deactivated state. The transition phase consists of completion of end point
13 criteria (WHC 1995b), flushing vessel systems until threshold levels are met,
14 and transfer of the lead and cadmium waste from the canyon deck to PUREX
15 Storage Tunnel Number 2. End point criteria are used to achieve a safe,
16 stable, and environmentally secure facility suitable for a low cost S&M
17 program. There are 10 treatment and/or storage vessel systems and 35 storage
18 vessel systems addressed in this preclosure work plan [refer to Part A
20 (DOE/RL-88-21)].

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2.0 FACILITY DESCRIPTION

This chapter describes the PUREX Facility and provides information on Hanford Facility security.

2.1 PUREX FACILITY DESCRIPTION

The PUREX Facility, Figures 2-1 and 2-2, is located in the southeast quadrant of the 200 East Area. The PUREX Facility includes all buildings and structures that lie within the double fenced area, except the 241-A-151 diversion box and the 302-A catch tank, which are part of the Double-Shell Tank (DST) System (DOE/RL-90-39). The PUREX Facility also includes the following structures located outside of the double fenced area: the 241-A-201 pump pit and the 295-AD instrument/sample shack located outside the east section of the fenced area; the 216-A-42D diversion box and the 216-A-42 diversion basin located approximately 549 meters east of the fenced area, which are associated with the chemical sewer discharge from the PUREX Facility. For purposes of this documentation, the PUREX Storage Tunnels (DOE/RL-90-24) are excluded.

The 202-A Building (referred to as the PUREX Plant) is a canyon-type building where irradiated reactor fuel was processed to separate the plutonium, uranium, and neptunium from the highly radioactive waste fission products formed during fuel irradiation. Construction of the PUREX Plant was completed in 1956. The PUREX Plant is approximately 91 meters above groundwater and does not lie within a 100- or 500-year floodplain (DOE/RL-91-28). (Processing information is presented in Chapter 3.0.)

Cutaway and sectional views of the PUREX Plant are shown in Figures 2-3 and 2-4, respectively. The PUREX Plant is a reinforced concrete structure 306 meters long, 36 meters wide (at its maximum), and 30 meters high with about 12 meters of this height below ground level. The PUREX Plant consists of three main structural components: (1) a thick-walled (for radiation shielding) concrete canyon containing remotely operated process equipment (in cells below ground level); (2) the pipe and operating, sample, and storage galleries; and (3) a steel-frame attached annex that includes offices, process control rooms, laboratories, and building services. Three cranes are located in a craneway above the canyon. The portion of the canyon below ground level is subdivided into a row of 12 process cells that are paralleled on the south side by an exhaust air tunnel and a hot (radioactive) pipe trench through which intercell radioactive solution transfers are made. The air tunnel exhausts the ventilation air from the cells to the main ventilation filters and the filtered air is discharged to the atmosphere via a 61-meter-tall stack.

The PUREX Plant canyon is 9.3 meters wide by 248 meters long. The upper canyon deck consists of removable concrete cover blocks that provide access to the process cells or the hot pipe trench. The cell cover blocks are 0.9-meter thick and the hot pipe trench cover blocks are 0.8-meter thick. The top of

1 the cover blocks is at a 218 meter elevation, which is approximately
2 2.5 meters above ground level.

3
4 The craneway is 8 meters above the canyon deck and extends almost the
5 full length of the canyon building. In the craneway are three, 36-metric ton,
6 bridge-type cranes (two master cranes and one slave crane) used to handle cell
7 cover blocks, remotely remove process equipment; and in the past, were used to
8 charge irradiated reactor fuel into the dissolvers and replace process
9 equipment. The crane cabs of the two master cranes are located behind a
10 shielding parapet wall. The slave crane can be controlled remotely from the
11 master west crane cab and has been used primarily to assist in removing large
12 equipment items from the process cells.

13
14 The pipe and operating gallery, which is the uppermost of the three
15 galleries that parallel, but are isolated from, the canyon, contains the
16 process instrument transmitter racks, electrical motor controls, steam and
17 cooling-water supply lines, and the piping and associated valving for
18 transferring nonradioactive process fluids used in the in-cell equipment.
19 The sample gallery contains the remote samplers for obtaining radioactive,
20 process-solution samples from the in-cell equipment. The storage gallery,
21 which is the lowermost gallery, provides storage space for miscellaneous,
22 nonradioactive spare parts and supplies.

23
24 A railroad spur enters the PUREX Facility (Figure 2-3) from the north and
25 extends into the east end of the PUREX Plant where the spur enters a vertical
26 door to an area designated as the railroad tunnel. Through this railroad
27 tunnel, irradiated reactor fuel was received for processing. The railroad
28 tunnel also provided building access for replacement equipment for the canyon
29 processing area. Access from the railroad tunnel to the canyon processing
30 area is through a horizontal door located in the ceiling of the railroad
31 tunnel. The reinforced concrete floor, walls, and roof of the railroad tunnel
32 that extend southward have been deleted from Figure 2-3 to show a cask car and
33 the extended railroad track.

34
35
36 **2.2 PUREX FACILITY TREATMENT AND STORAGE AREAS**

37
38 The activities addressed in this preclosure work plan involve the
39 following specific vessel systems within the PUREX Facility. A description of
40 the 'containment building' for the canyon deck and F Cell storage areas is
41 provided in Section 2.2.2.

42
43
44 **2.2.1 Treatment and/or Storage Vessel Systems**

45
46 There are 10 treatment and/or storage vessel systems and 35 storage
47 vessel systems [refer to Part A (DOE/RL-88-21)]. A vessel system is a
48 treatment and/or storage vessel and its ancillary equipment.

49
50 The 35 storage vessel systems were used specifically to support
51 transition phase activities. Because these vessels were used only for storage
52 of dangerous solutions (mainly flush solutions) until the solutions could be

1 treated and transferred to the DST System, these vessels are not described in
2 detail.

3
4 The following sections give a brief description of the six process
5 systems, specifying the vessel and ancillary equipment.

6
7 2.2.1.1 Tank E5 (cladding removal waste treatment system). Tank E5 is a
8 cylindrical, 19,873-liter capacity 304L stainless steel tank located in
9 E Cell. The tank shell is 2.8 meters in height, 3.1 meters in diameter, and
10 constructed with 1.4-centimeter-thick top and bottom walls and 0.8-centimeter-
11 thick side walls. The top of the tank contains 22 nozzles of various size to
12 accommodate ancillary equipment. Ancillary equipment associated with the tank
13 consists of the following:

14
15 • Two jumpers (304L stainless steel) that lead from tank E5 to the hot
16 pipe trench
17
18 • Hot pipe trench piping (Schedule 40 304L stainless steel) between the
19 tank and the discharge piping
20
21 • Discharge piping (Schedule 40 304L stainless steel) that runs from the
22 last jumper out (underground) to the 241-A-151 diversion box, which is
23 the interface point with the DST System.

24
25 The original tank, which was placed into service in 1956, was replaced
26 in 1986 because corrosion of the dunnage and support frame around the tank
27 caused a slight shift in the position of the tank. The current tank E5 has
28 been in service since 1986.

29
30 2.2.1.2 Tanks F15 and F16 (neutralized zirflex acid waste treatment system).
31 Tanks F15 and F16 are cylindrical, 19,419- and 19,870-liter, respectively,
32 capacity 304L stainless steel tanks located in F Cell. The construction is
33 the same as tank E5 discussed previously. The ancillary equipment associated
34 with the tanks consists of the following:

35
36 • Two jumpers (304L stainless steel), one from tank F15 to F16, the
37 other from tank F16 to the hot pipe trench
38
39 • Hot pipe trench piping (Schedule 40 304L stainless steel) between
40 the tanks and the discharge piping
41
42 • Discharge piping (Schedule 40 304L stainless steel) from the hot pipe
43 trench to the outside wall of the PUREX Plant and through encased
44 underground piping to the DST System.

45
46 Tanks F15 and F16 originally were placed into service in 1965.

47
48 2.2.1.3 Tank F18 (miscellaneous mixed waste treatment system). Tank F18 is a
49 cylindrical, 19,798-liter capacity 304L stainless steel tank located in
50 F Cell. Tank F18 is the same type of construction as tanks E5, F15, and F16.
51 The ancillary equipment consists of the following:

- Jumper (304L stainless steel) from tank F18 to the hot pipe trench
- Hot pipe trench piping (Schedule 40 304L stainless steel) between the tank and the discharge piping
- Discharge piping (Schedule 40 304L stainless steel) from the hot pipe trench to the 241-A-151 diversion box.

9 Tank F18 was placed in service in 1956.

10 2.2.1.4 Tank G7 and Concentrator E-F11 (headend waste treatment system).

11 Tank G7 is an oval, 50,827-liter capacity 304L stainless steel tank located in
12 G Cell. Tank G7 is 5 meters long, 3.2 meters wide, 4 meters tall, and
13 constructed with 0.9-centimeter-thick side walls and 1.4-centimeter-thick top
14 and bottom walls. The top of the tank contains 23 nozzles of various sizes to
15 accommodate ancillary equipment.

16 The ammonia waste concentrator, hereafter referred to as E-F11,
17 [E identifies a heat exchanger (e.g., condenser, concentrator, or steam
18 heater)], is located in F Cell. The E-F11 is constructed of 304L stainless
19 steel; has a capacity of 9,804 liters; is 5.2 meters tall; and has a central
20 draft tube, 76 centimeters in diameter, in the lower portion of the
21 concentrator connected on opposite sides to two cylindrical reboilers, each
22 1.4 meters in diameter. The reboilers are connected to the draft tube by
23 ducts at the top and bottom. A removable de-entrainment tower, 1.7 meters in
24 diameter and 3.8 meters tall, is connected to the top of the draft tube with a
25 bolted flange. Ancillary equipment for tank G7 and E-F11 includes the
26 following:

- Catch tanks A3-4, B3-4, C3-4 (8,000 liters each) and E3-2 (946 liters), each constructed of 304L stainless steel
- Accumulation tank F12 (19,870 liters), constructed of 304L stainless steel, and piping from the catch tanks to tank F12
- Hot pipe trench piping (Schedule 40 304L stainless steel) between vessels and discharge piping
- Various jumpers (304L stainless steel) that interconnect the vessels of the headend waste treatment system
- Discharge piping (Schedule 40 304L stainless steel) from the hot pipe trench to the outside wall of the PUREX Plant and through encased underground piping to the DST System.

46 Tank G7 originally was placed into service in 1956. The E-F11 was placed
47 into service in 1962 and was removed and replaced in 1970.

48 2.2.1.5 Tanks U3 and U4 (miscellaneous headend waste treatment system).

49 Tanks U3 and U4, 31,124- and 31,184-liter capacity, respectively, are
50 3.1 meters in diameter and 6.1 meters high. Both tanks are constructed of
51 304L stainless steel with a minimum thickness of 0.8-centimeter. Tanks U3
52

1 and U4 are located in the western half of U Cell, the acid storage vault,
2 which is located external of the PUREX Plant canyon area along the north wall
3 of the PUREX Plant. The U Cell is constructed primarily below ground level
4 with a removable concrete cover block roof at about 0.3-meter above ground
5 level. Ancillary equipment for tanks U3 and U4 includes the following:

- Drain piping (304L stainless steel) from laboratory sinks and hoods
- Transfer piping (304L stainless steel) from drain lines to tanks U3 and U4, and from tanks U3 and U4 to sumps SUA and SUB
- Overflow piping (304L stainless steel) that interconnect tanks U3 and U4
- Discharge piping (304L stainless steel) from tanks U3 and U4, through the north wall of the PUREX Plant adjacent to U Cell, across the ceiling of the storage gallery, through the PUREX Plant canyon wall, across D Cell, into the hot pipe trench, and back to D Cell
- Jumper (304L stainless steel) in D Cell that connects the discharge piping from tanks U3 and U4 to discharge piping in the hot pipe trench that leads out of the PUREX Plant
- Discharge piping (304L stainless steel) from the jumper in D Cell, through the hot pipe trench, out the south side of the PUREX Plant, to the 241-A-151 diversion box.

Tanks U3 and U4 were placed in service in 1956.

2.2.1.6 Tanks Q21 and Q22 (Q Cell aqueous makeup tanks). Tanks Q21 and Q22 are cylindrical, 81- and 968-liter, respectively, capacity 304L stainless steel tanks located in the Q Cell aqueous makeup unit (AMU). Tank Q21 is 45.7 centimeters in diameter and 61 centimeters tall. Tank Q22 is 106.7 centimeters in diameter and 121.9 centimeters tall. The Q Cell AMU is located in the west end of the storage gallery, on the second level of Q Cell. Ancillary equipment for tanks Q21 and Q22 are outlet lines (304L stainless steel) to the vessel vent header and tank Q5.

2.2.2 PUREX Plant Containment Building

The solid mixed waste storage areas located in the PUREX Plant consist of a section of the canyon deck adjacent to D Cell and the F17 position in F Cell. These storage areas are considered to be in a 'containment building' subject to the requirements of WAC 173-303-400 (40 CFR 265, Subpart DD). The solid mixed waste stored on the canyon deck, consisting of lead and cadmium, was moved to PUREX Storage Tunnel Number 2 as part of transition phase activities. The solid mixed waste in F Cell consists mainly of concrete and tank dunnage corrosion products. A qualified registered professional engineer has certified that the PUREX Plant canyon area meets the required design standards as specified in 40 CFR 265.1101(a) (Giller 1992).

1 Limited activities are planned for the containment building as part of
2 the preclosure work plan.

3

4

5 **2.3 SECURITY INFORMATION**

6

7 The entire Hanford Facility is a controlled-access area. The Hanford
8 Facility maintains around-the-clock surveillance for the protection of
9 government property, classified information, and special nuclear materials.
10 The Hanford Patrol maintains a continuous presence of protective force
11 personnel to provide additional security. All personnel accessing Hanford
12 Facility areas must have a DOE-issued security identification badge indicating
13 the appropriate authorization. Personnel also could be subject to a random
14 search of items carried into or out of the Hanford Facility.

15

16 Hanford Facility personnel receive training on security regulations in
17 the form of required security education and on-the-job training. Methods for
18 ensuring personnel compliance with security requirements and provisions for
19 security training are maintained on the Hanford Facility.

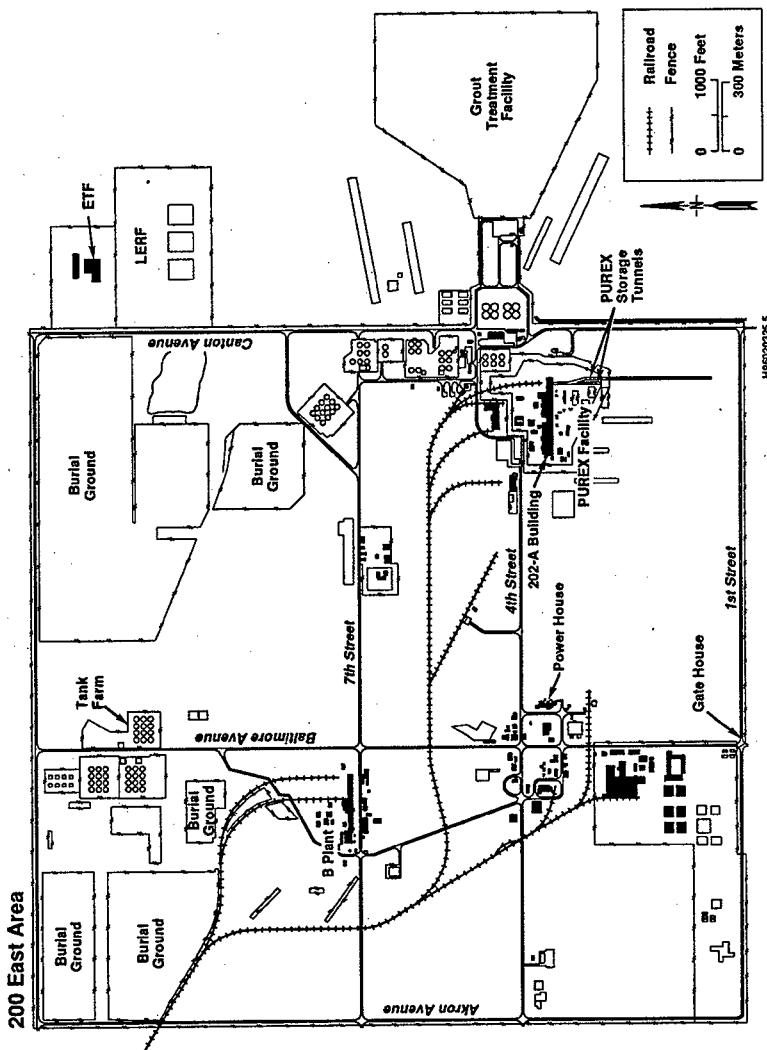
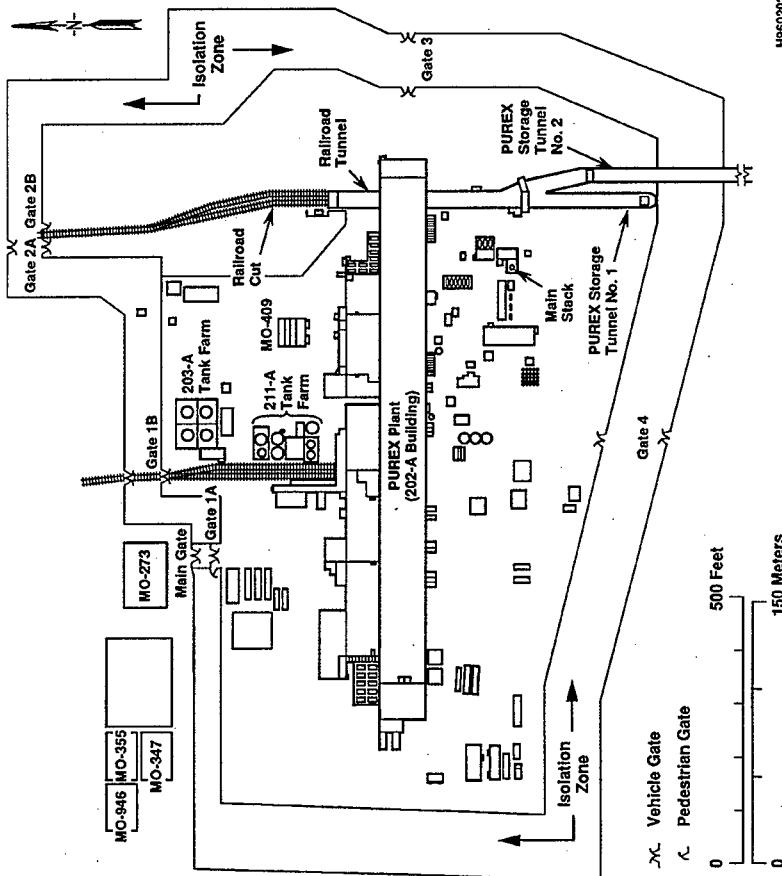


Figure 2-1. 200 East Area.

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Note: For purposes of this documentation, the PUREX Storage Tunnels (DOE/RL-90-24) are excluded.

Figure 2-2. PUREX Facility.

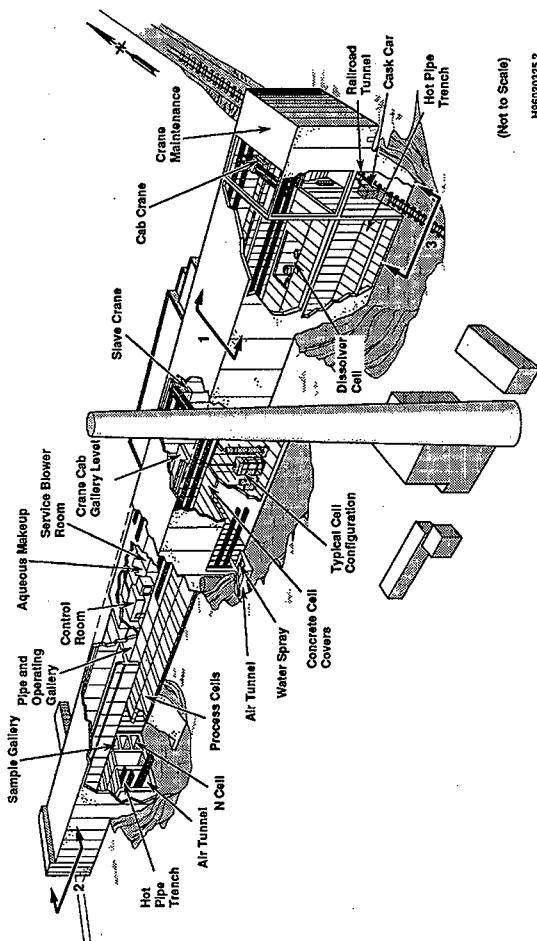


Figure 2-3. PUREX Plant (Building 202-A).

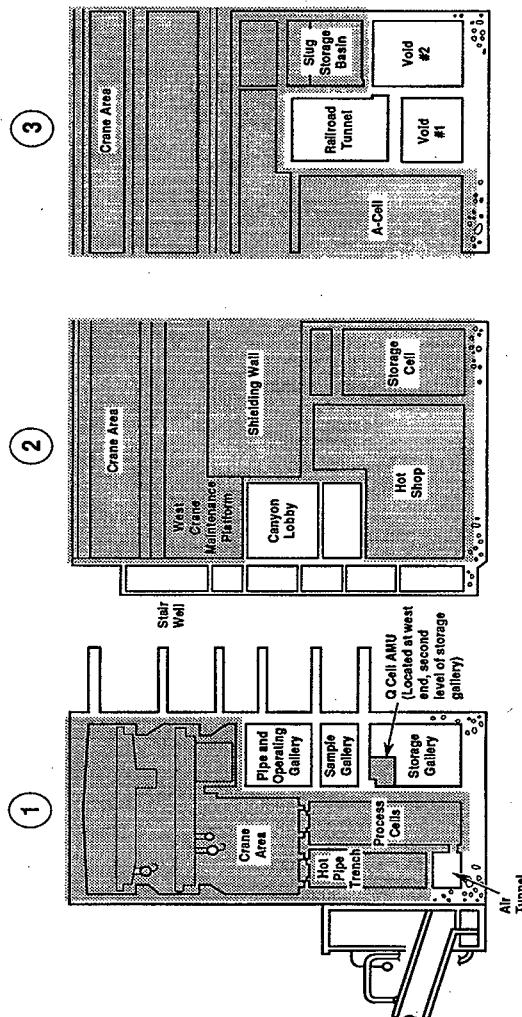


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3.0 PROCESS INFORMATION

This chapter describes the waste streams and the waste treatment systems associated with the PUREX process.

3.1 PUREX PROCESS DESCRIPTION

Irradiated reactor fuel was processed to extract, purify, and concentrate uranium, plutonium, and neptunium produced from the reactor fuel. The main process components provided for the chemical decladding and dissolution of the fuel elements, and separation and purification of uranium, plutonium, and neptunium by solvent extraction. Process support systems recovered and stored nitric acid and organic solvents, and provided other treatment and storage of gaseous, liquid, and solid waste.

3.2 VESSEL SYSTEMS

Waste treatment conducted in vessel systems in the PUREX Plant made liquid waste generated during the PUREX process acceptable for storage in the DST System (DOE/RL-90-39). The corrosion acceptance criteria of the DST System includes a pH greater than 12.0 and a nitrite concentration greater than 0.011 M. Generally, the treatment involved raising the pH with sodium hydroxide (NaOH) and adding sodium nitrite (NaNO₂) to obtain the necessary conditions to inhibit corrosion of the carbon steel tanks in the DST System. The following sections discuss the processes and the vessels associated with each process. Table 3-1 lists all permitted vessels, their associated process, and chemical additions made during processing.

3.2.1 Cladding Removal Waste Treatment System

Three types of mixed waste streams were generated during decladding operations. These three mixed waste streams, collectively called cladding removal waste (CRW), include the following.

- Decladding waste--This waste was generated when the zirconium cladding was removed from the irradiated fuel elements. Ammonium fluoride-ammonium nitrate (AFAN) dissolved the fuel cladding by complexing the zirconium metal jacket, leaving the uranium, plutonium, and neptunium metal in the dissolver.
- Spent metathesis waste--After the zirconium was removed from the fuel rods, uranium and plutonium fluoride compounds generated during decladding operations were metathesized using a solution of potassium hydroxide. The spent potassium hydroxide solution constituted the metathesis waste.

1 • Metathesis rinse waste--Water was added to the dissolvers to rinse the
2 remaining metathesis solution from the fuel and to dilute the residual
3 metathesis solution and decladding solution that remained in the heel.
4 The resulting solution constituted the metathesis rinse waste.
5

6 All three CRW mixed waste streams were jetted to tank E5 for treatment
7 (Figure 3-1). Before being transferred to tank E5, the decladding and
8 metathesis waste solutions were transferred from tank E3 to one of two
9 centrifuges (E2 and E4) to remove residual plutonium and uranium solids. This
10 recovery process was intended solely to recover plutonium and uranium product
11 and was not a dangerous waste treatment activity.
12

13 Decladding waste was treated by adding NaOH and NaNO₂ to the waste in
14 tank E5 to meet the DST System corrosion specifications. The line to the DST
15 System was flushed with water after waste transfers.
16

17 The decladding waste treatment reaction caused approximately 10 to
18 20 percent of the ammonia in solution to be released. Ammonia gas was
19 scrubbed from the offgas treatment system and treated (Section 3.2.4).
20

21 Metathesis waste normally arrived at tank E5 with a pH greater than 12,
22 which met the DST System pH specifications. The waste was sampled and sodium
23 nitrite was added. Sodium hydroxide was added only if the pH was below the
24 DST System specifications. The transfer to the DST System was followed by a
25 water flush.
26

27 Metathesis rinse waste was treated in a manner similar to the decladding
28 waste in that NaOH and NaNO₂ were added to tank E5. The treated waste was
29 sampled before being transferred to the DST System, and the line was flushed
30 with water.
31

32 3.2.2 Neutralized Zirflex Acid Waste Treatment System 33

34 Tanks F15 and F16 were used to treat highly radioactive, concentrated
35 acid solutions, known as neutralized zirflex acid waste (NZAW), generated from
36 the solvent extraction process. The NZAW contained the waste fission products
37 separated from the first decontamination cycle.
38

39 The NZAW was received in tank F15 in approximately 9,800-liter batches
40 for treatment (Figure 3-2). The solution was sampled and, if the solution did
41 not have to be reworked because of high plutonium content, the solution was
42 declared waste, heated, and treated with a sugar (sucrose) solution, which was
43 added to the tank over a 16- to 24-hour period. The resulting reaction
44 between the nitric acid and the sugar solution produced oxides of nitrogen
45 (NO_x) and carbon, and oxides of carbon (CO_x). These offgases were routed to
46 the F5 acid absorber where approximately 25 percent of the NO_x was recovered
47 as nitric acid for reuse in the process.
48

49 After initial treatment in tank F15, the NZAW was transferred to
50 tank F16. Sugar denitration was completed, if necessary, and the waste was
51 treated with NaOH and NaNO₂, sampled, and transferred to the DST System.
52

1 3.2.3 Miscellaneous Mixed Waste Treatment System
2

3 Tank F18 received miscellaneous mixed waste solutions from the following
4 areas: canyon cell floor sumps; drainage from the vessel vent system,
5 condenser vent system, and sampler headers; hot shop maintenance cell
6 solutions; sample gallery floor drains; and bottoms from E-F11. Solutions
7 were pumped or jetted to tank F18 from their point of origin (Figure 3-3).
8 Transfer piping is located in the reinforced concrete hot pipe trench.
9

10 Before receiving solutions in tank F18, the heel had to be acidified (at
11 least 0.3 M nitric acid) to keep plutonium and uranium nitrates from
12 precipitating. Keeping these compounds in solution was necessary to allow for
13 representative sampling for nuclear material accountability and was required
14 to meet a criticality specification.
15

16 Once the heel had been acidified, solutions could be received in
17 tank F18. Samples were taken when the level in tank F18 reached 13,200 to
18 15,100 liters. If the contents of tank F18 did not have to be reworked
19 because of high plutonium concentrations, the solution was declared waste,
20 appropriate amounts of NaOH and NaNO₂ were added, and the waste was sent to
21 the DST System.
22

23
24 3.2.4 Headend Ammonia Waste Treatment System
25

26 A solution of AFAN was used in the dissolvers to chemically declad
27 zirconium-clad fuel from N Reactor (Section 3.2.1). During the decladding
28 operation, ammonia was scrubbed from the offgases by water to form an aqueous
29 ammonium hydroxide solution.
30

31 During fuel decladding and solids metathesis, approximately 70 percent of
32 the ammonium compounds charged to the dissolvers were evolved as ammonia gas,
33 most of which was absorbed in dissolver condensate or scrubbed from the
34 dissolver offgas with water. The remaining ammonia remained in the CRW until
35 treated in tank E5 and transferred to the DST System. During treatment of the
36 cladding removal waste in tank E5, approximately 10 to 20 percent of the
37 ammonium ion content was released as ammonia gas, which was scrubbed with
38 water. The ammonia scrubber solutions from the three dissolver offgas systems
39 and the E Cell operations were combined. This stream contained ammonium
40 hydroxide and low levels of radionuclides.
41

42 Before August 1987, the ammonia scrubber waste solution was concentrated
43 in E-F11 in F Cell to remove carry-over waste fission products, and the
44 overhead condensate was discharged to 216-A-36B crib (Figure 3-1). The
45 ammonia scrubber waste treatment process was rerouted to transfer the ammonia
46 solution to the DST System.
47

48 The ammonia generated in the headend dissolvers was scrubbed from the
49 offgas and the scrub solution was collected in catch tanks A3-4, B3-4,
50 and C3-4 and combined with the aqueous discharge from the E Cell ammonia
51 offgas scrubber in accumulation tank F12. After the ammonia scrubber system
52 was rerouted, the ammonia waste collected in tank F12 was transferred to

1 tank G7. Chemical additions were made to adjust pH and nitrite concentration
2 to DST System specifications (Figure 3-4). The treated waste was transferred
3 to the DST System.

4
5 The E-F11 concentrator was used during PUREX Plant transition phase to
6 evaporate some of the flush solution waste water normally sent to the
7 DST System. The distillate (nonregulated) was discharged to the atmosphere
8 via the PUREX Plant main stack (291-A-1). The concentrate generated in E-F11
9 was treated with NaOH and NaNO₂ in tank F18 before being transferred to the
10 DST System.

11
12
13 3.2.5 Miscellaneous Headend Treatment System

14
15 Tanks U3 and U4 (Figure 3-5), located in the western half of U Cell,
16 received miscellaneous mixed waste solutions from the headend (reactor fuel
17 receiving and dissolution portion). Waste sources, both regulated and
18 nonregulated, include the following:

19
20 • Washdown (radiological decontamination) of railcars in the railroad
21 tunnel via floor drains and sump collection system
22
23 • Analytical laboratory sink and hood drains
24
25 • 206-A Fractionator Building sumps
26
27 • Drain from the 291-A-1 main stack
28
29 • Various analytical laboratory heating, ventilation, and air
30 conditioning vent drains
31
32 • U Cell sumps SUA and SUB
33
34 • Other tank systems on a case-by-case basis.
35

36 The most diversified categories of dangerous waste received into tanks U3
37 and U4 originated from the analytical laboratory. However, the combined
38 quantities of these various dangerous waste components was only a small
39 (estimated to be less than 5 percent) fraction of the total volume of mixed
40 waste stored and treated in this tank system.

41
42 The majority of the waste stream received in tanks U3 and U4 was
43 nonregulated, potential radioactively contaminated water and was jettied or
44 pumped from the point of generation to either tank U3 or U4. An exception was
45 waste (from the analytical laboratory) that drained by gravity from the
46 laboratory area to one of the vessels. The standard activity was to fill one
47 tank, sample and treat the waste in that tank while the other tank began to
48 fill. Thus, each tank in turn received and treated miscellaneous dangerous
49 waste.

50

1 As with the liquid waste treated in the waste tanks described in the
2 preceding sections, 'treatment' of the miscellaneous headend waste was done
3 solely to address the corrosive characteristic of the waste so the waste would
4 be compatible with the carbon steel containment of the DST System. To comply
5 with the waste acceptance criteria of the DST System, the waste was treated
6 with NaOH to adjust the pH and NaNO₂ to meet the nitrite requirements.
7

8

9 3.3 TRANSITION PHASE VESSEL SYSTEMS

10 During the transition phase, tanks Q21 and Q22 were permitted for
11 treatment and storage when the tanks were found to contain corrosive
12 solutions. The treatment in tanks Q21 and Q22 consisted of a one-time
13 addition of NaOH to neutralize the corrosive solutions. These tanks were not
14 flushed or sampled because both tanks have bottom drains, which left no heel.
15 The tanks were drained to tank F18 and the waste transferred to the
16 DST System.
17

18 An additional 35 vessels were permitted for storage during transition
19 activities, when a determination was made that corrosive solutions had been
20 stored in the vessels. These vessel systems were drained, or flushed and
21 sampled, and the waste transferred to the DST System.
22

23

24 3.4 PUREX PLANT CONTAINMENT BUILDING

25 Since December 7, 1987, discarded, contaminated process equipment removed
26 from the canyon area, which contained lead and cadmium, has been stored on the
27 hot pipe trench side of the canyon deck adjacent to D Cell. To date, the
28 location of the stored mixed waste has been administratively restricted to the
29 area adjacent to D Cell, and inside F Cell (F17 position). As part of
30 transition phase activities, the mixed waste stored on the canyon deck
31 adjacent to D Cell has been moved to PUREX Storage Tunnel Number 2.
32

33 The waste stored in position F17 within F Cell consists of concrete
34 debris collected from the floor of E Cell. The concrete material was
35 retrieved from the floor during the replacement of tank E3. The debris,
36 approximately 1.0 cubic meters and weighing approximately 4,100 kilograms, is
37 contained in a 1.2 x 1.8 x 0.6-meter carbon steel scrap hopper (skip). The
38 debris contains regulated quantities of chromium and approximately 400 grams
39 of plutonium. The estimated dose rate of the skip is 500 Rad/hour.
40

41 Weekly surveillance of the air pressure differential between the inside
42 and the outside of the containment building fulfills the 'inspection'
43 requirements {WAC 173-303-400 [40 CFR 265.1101(c)(4)]}. The canyon area is
44 maintained at a negative air pressure compared to ambient air pressure. The
45 existence of an air pressure differential between the inside and outside of
46 the structure verifies that no large openings exist in the building. In the
47 event that small openings in the building were present, the flow of air would
48 be inward. These factors ensure that adequate containment exists.
49

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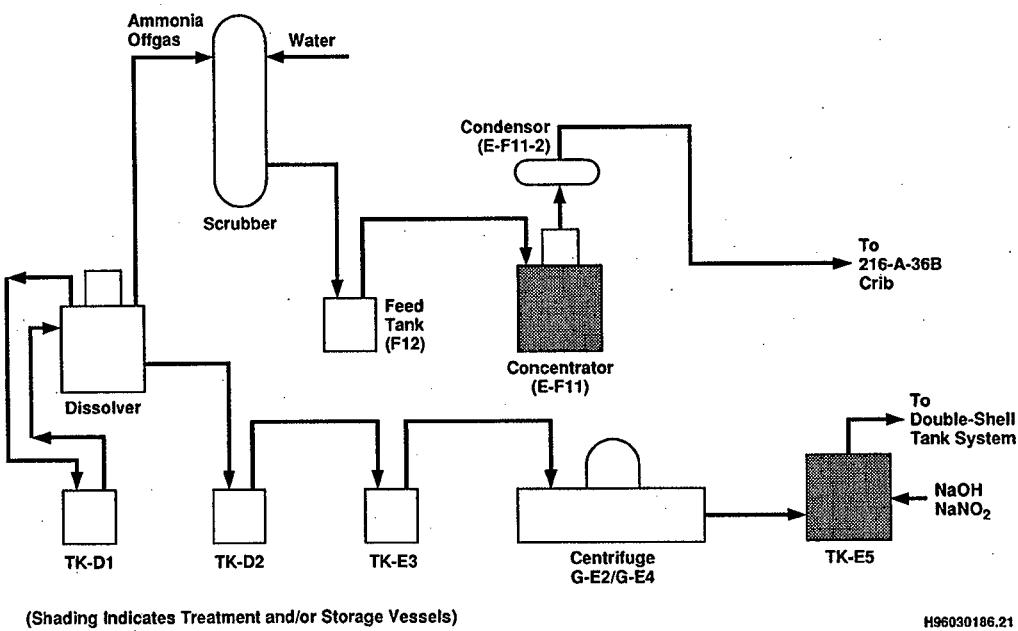
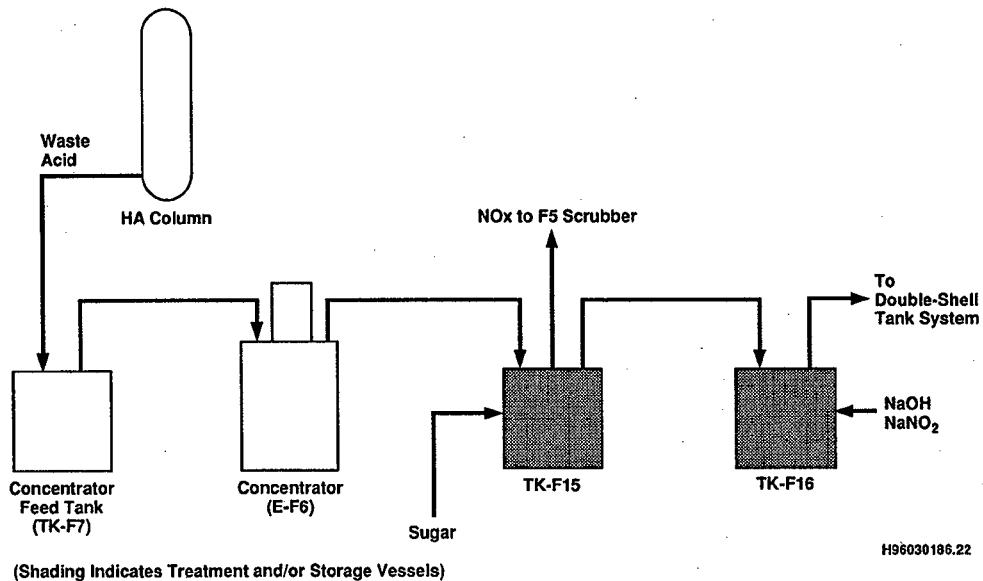
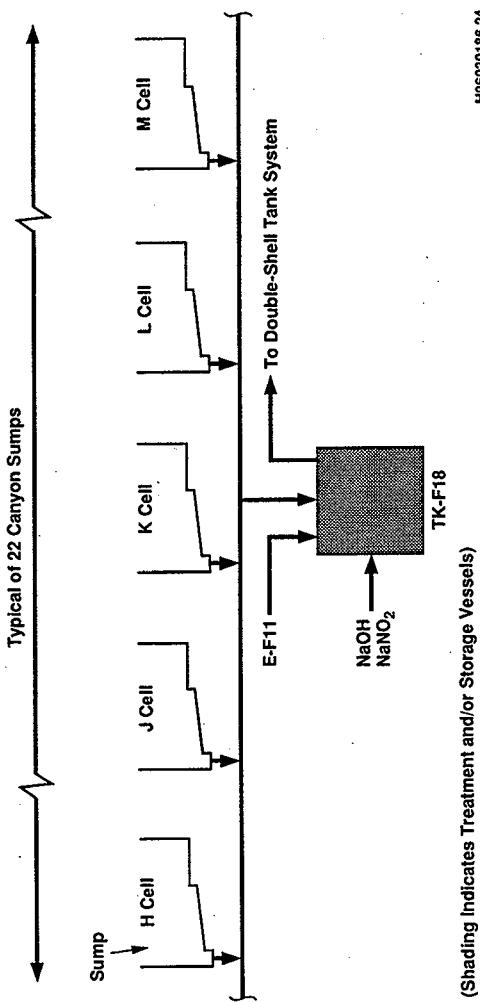


Figure 3-1. E-F11 and Tank E5 Waste Stream (before August 1987).

Figure 3-2. Tanks F15 and F16 Waste Stream.

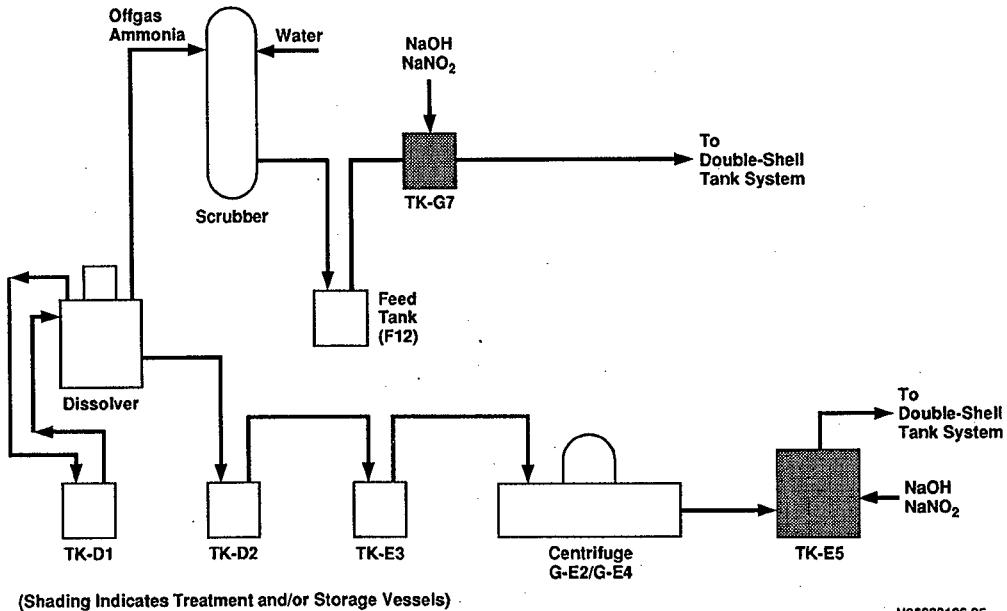




(Shading Indicates Treatment and/or Storage Vessels)

Figure 3-3. Tank F18 Waste Stream.

Figure 3-4. E-F11 and Tank E5 Waste Stream (August 1987 to Deactivation).



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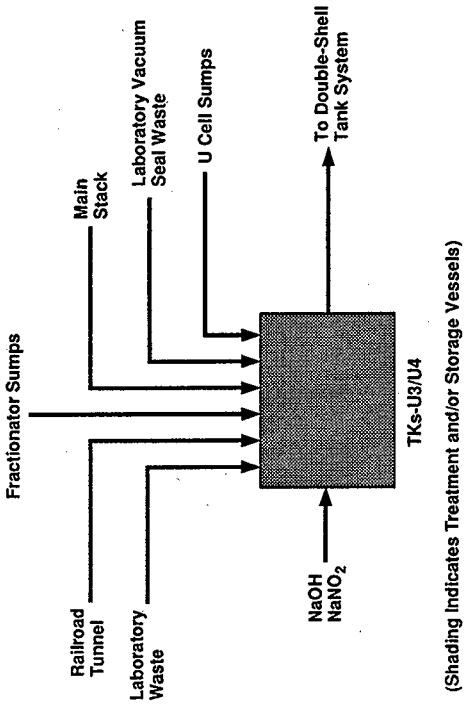


Figure 3-5. Tanks U3 and U4 Waste Stream.

Table 3-1. PUREX Plant Process and Main Chemicals. (sheet 1 of 2)

| Vessel | Process | Main chemicals | |
|--|---|---|---|
| TK-D5 TK-E6 | Metal dissolution and feed preparation | ANN HNO ₃ | aluminum nitrate nonahydrate nitric acid |
| E-F11 | Dissolver offgas treatment and ammonia scrubber waste concentration | NH ₃ OH | ammonium hydroxide |
| TK-E5 | Cladding waste cycle | AFAN ANN KOH *NaOH *NaNO ₂ | ammonium fluoride/ammonium nitrate aluminum nitrate nonahydrate potassium hydroxide sodium hydroxide sodium nitrite |
| TK-H1 T-H2 TK-J3 T-J6 T-J7 | Decontamination and partition cycle | NaNO ₂ NPH TBP HNO ₃ Fe(NH ₂ SO ₃) ₂ NH ₂ SO ₃ H | sodium nitrite normal paraffin hydrocarbon tri-butyl phosphate nitric acid ferrous sulfamate sulfamic acid |
| TK-K1 T-K2 T-K3 TK-K6 | Uranium cycle | NPH TBP N ₂ H ₄ HNO ₃ HN | normal paraffin hydrocarbon tri-butyl phosphate hydrazine nitric acid hydroxylamine nitrate |
| T-L2 TK-L3 T-L4 | Plutonium cycle | NPH TBP NaNO ₂ HNO ₃ N ₂ H ₄ HN | normal paraffin hydrocarbon tri-butyl phosphate sodium nitrite nitric acid hydrazine hydroxylamine nitrate |
| TK-J21 T-J22 T-J23 TK-Q21 TK-Q22 | Neptunium recovery and purification cycle | NPH TBP N ₂ H ₄ Fe(NH ₂ SO ₃) ₂ HNO ₃ HN | normal paraffin hydrocarbon tri-butyl phosphate hydrazine ferrous sulfamate nitric acid hydroxylamine nitrate |
| E-H4 TK-J1 | Backcycle waste system | HNO ₃ | nitric acid |

Table 3-1. PUREX Plant Process and Main Chemicals. (sheet 2 of 2)

| Vessel | Process | Main chemicals | |
|---|--|---|---|
| TK-G1 TK-G2 T-G2 TK-G5 TK-G8 TK-R1 TK-R2 T-R2 TK-R7 | Solvent recovery | NPH TBP Na ₂ CO ₃ KMnO ₄ HNO ₃ NaNO ₂ NaOH | normal paraffin hydrocarbon tri-butyl phosphate sodium carbonate potassium permanganate nitric acid sodium nitrite sodium hydroxide |
| TK-F15 TK-F16 TK-F18 | Waste concentration and treatment | Sugar NaOH *NaNO ₂ ANN HNO ₃ | sodium hydroxide sodium nitrite aluminum nitrate nonahydrate nitric acid |
| TK-F3 TK-F4 T-F5 Tk-U3 TK-U4 | Acid recovery | ANN HNO ₃ | aluminum nitrate nonahydrate nitric acid |
| TK-156 | Aqueous makeup | HNO ₃ | nitric acid |
| TK-P4 | Uranium Storage Tanks (203-A Tank Farm) | UNH HNO ₃ | uranyl nitrate hexahydrate nitric acid |
| TK-40 | Chemical Tanks (211-A Tank Farm) | NPH TBP | normal paraffin hydrocarbon tri-butyl phosphate |
| TK-G7 | Effluent discharge systems | *KOH *NaOH *NaNO ₂ | temporary temporary temporary |
| TK-M2 | Other | HNO ₃ | nitric acid |

* Chemicals added only when solution was transferred to DST System
(i.e., PDD, ASD effluent streams).

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4.0 WASTE CHARACTERISTICS

This chapter describes the waste and associated activities with the vessel systems within the PUREX Facility. Discussion is limited to those permitted dangerous and/or mixed waste treatment and/or storage vessels.

4.1 VESSEL SYSTEMS

The vessel systems were each identified as part of 12 loops (Figures 4-1 through 4-12) designated for flushing. Flush solutions were cascaded within each vessel. Samples were taken in a tank at the end of the flush loop. In addition to the 12 flush loops, tanks F4, M2, P4, and U3, individually were flushed and sampled. Tanks 40, Q21, and Q22 were not sampled because the tanks have bottom drains, which left no heel.

For each vessel within a flush loop, screening samples were taken of flushes until laboratory results indicated the waste no longer exhibited dangerous waste characteristics. After screen sampling was completed, sampling was conducted in accordance with RCRA protocol and the data quality objectives (DQOs) (WHC 1995c). The DQOs for this sampling effort define the sampling and analysis necessary to support the flushing of the vessel systems that are WAC 173-303 regulated.

Regulated dangerous waste constituents within the mixed waste varied by loop. The primary dangerous waste constituents removed during transition phase activities were cadmium, chromium, and nitric acid. Radioactive components of the mixed waste are attributed to past processing activities. If the flush solution was designated as a dangerous waste, the system was flushed and sampled until results indicated the flush solution no longer designated as dangerous waste. Sampling results are listed in Table 4-1.

4.2 CONTAINMENT BUILDING

Elemental lead used as weights, counterweights, and/or radiation shielding and elemental cadmium, used as radiation shielding, was stored on the canyon deck of the containment building. As part of the transition phase activities, the lead and cadmium waste was moved to storage in PUREX Storage Tunnel Number 2. Additionally, F Cell contains chromium, which is a corrosion product of stainless steel and nitric acid. The chromium is contained within concrete debris, collected from the floor of E Cell. Interim storage in F Cell was chosen as the best stabilization method for this material because interim storage was environmentally sound, considered personnel safety, and was cost effective. The waste in F Cell will remain in place through the S&M phase, and will be dispositioned during closure.

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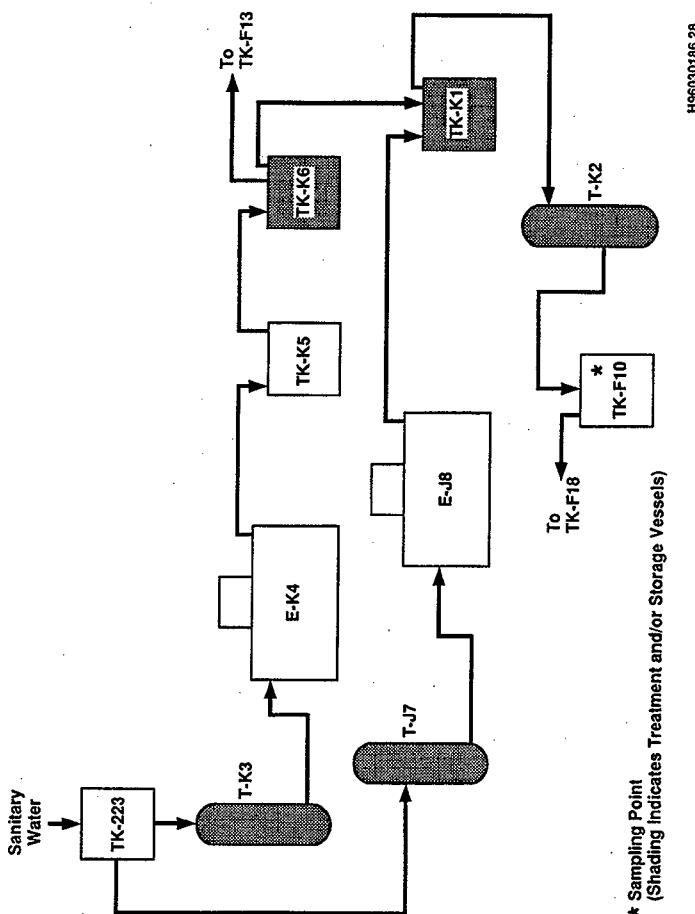


Figure 4-1. Flush K Cell Vessels.

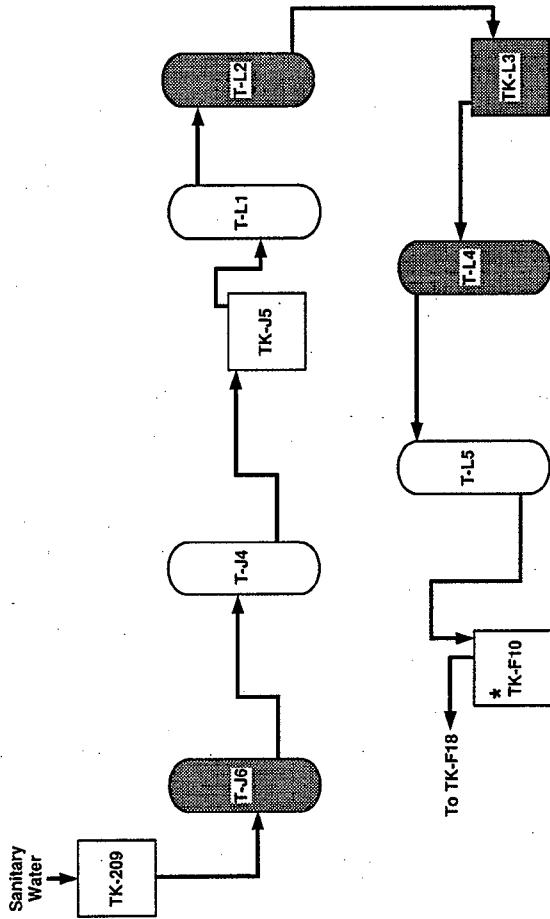


Figure 4-2. Flush L Cell Vessels.

* Sampling Point
(Shading Indicates Treatment and/or Storage Vessels)

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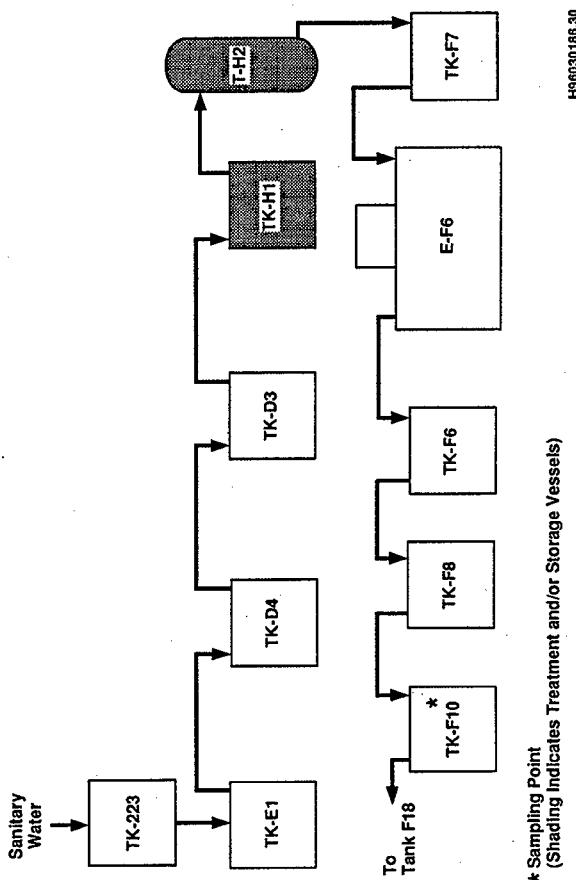
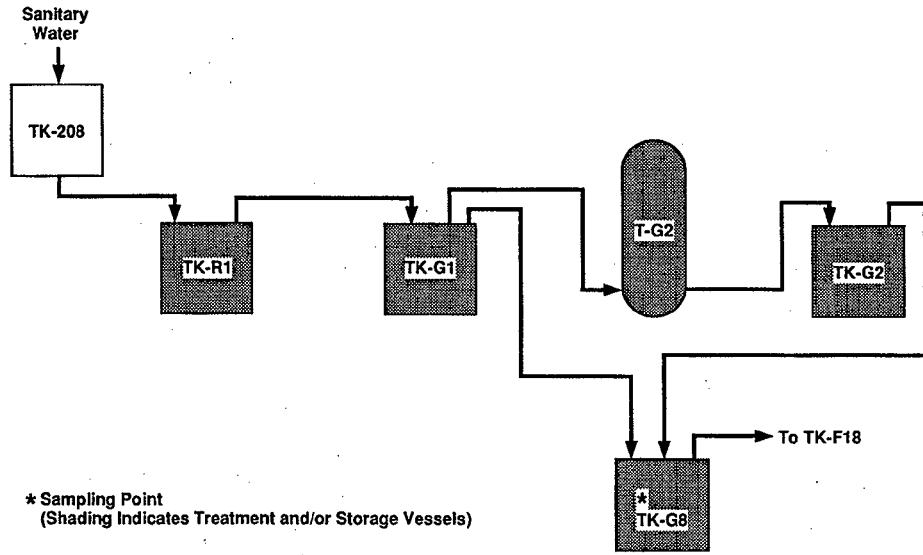


Figure 4-3. Flush Headend Feed Vessels, H1, H2, and F Cell Vessels.

Figure 4-4. Flush G and R Cell Vessels (Part 1).



H96030186.12

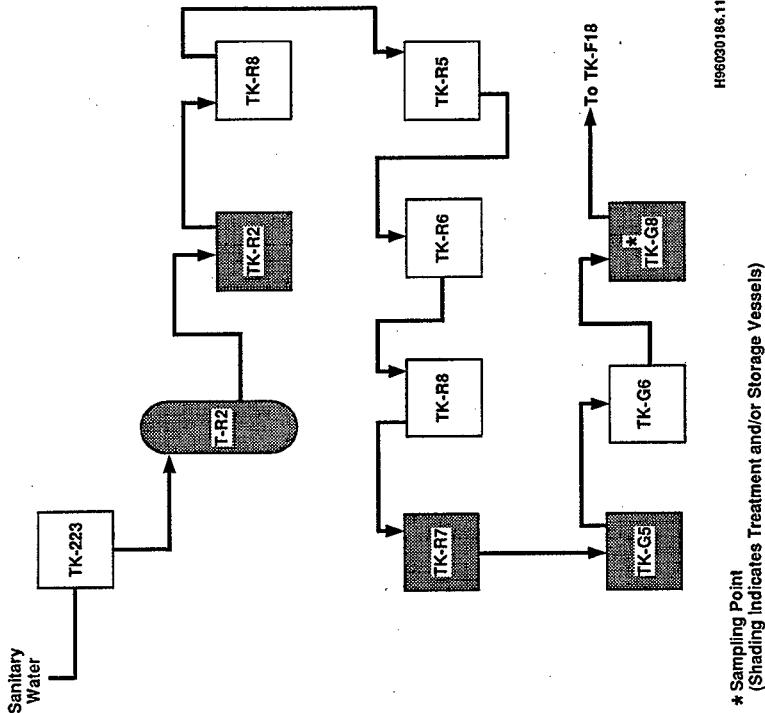


Figure 4-5. Flush G and R Cell Vessels (Part 2).

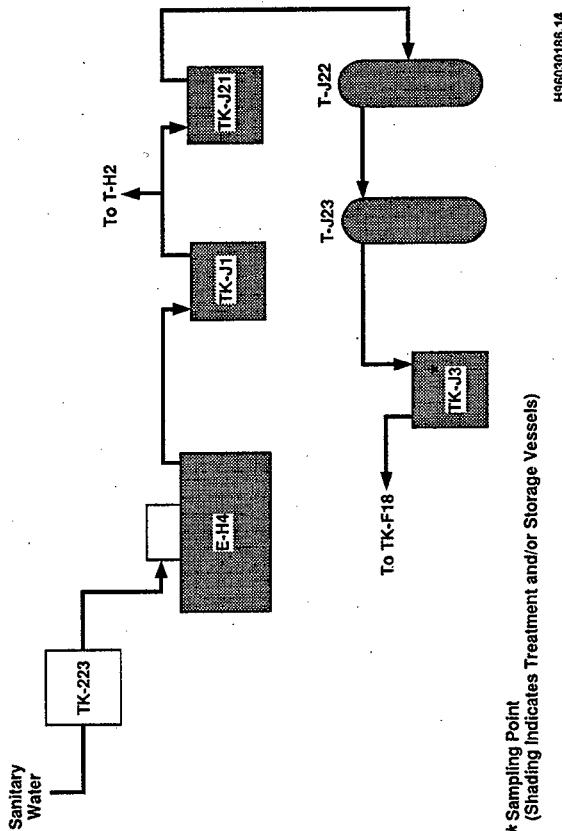


Figure 4-6. Flush Backcycle Waste and Neptunium Package Vessels.

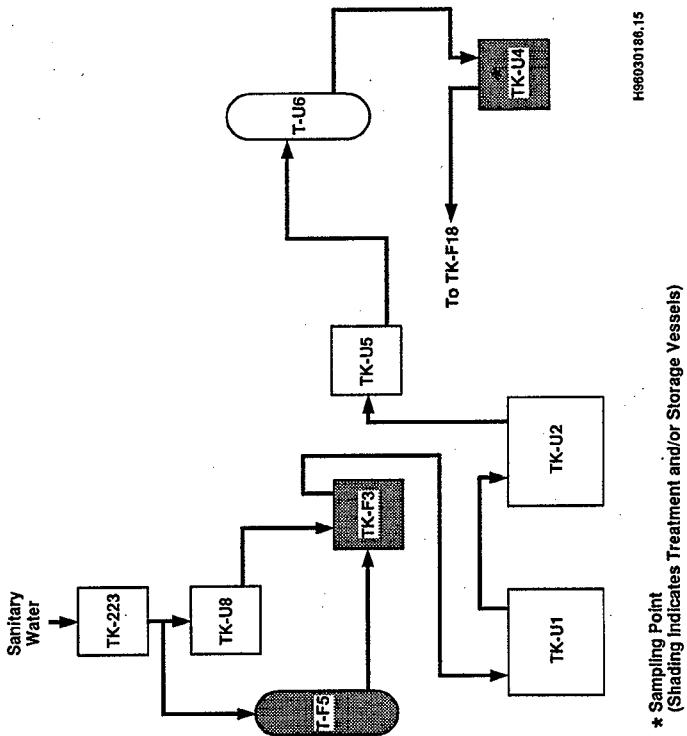
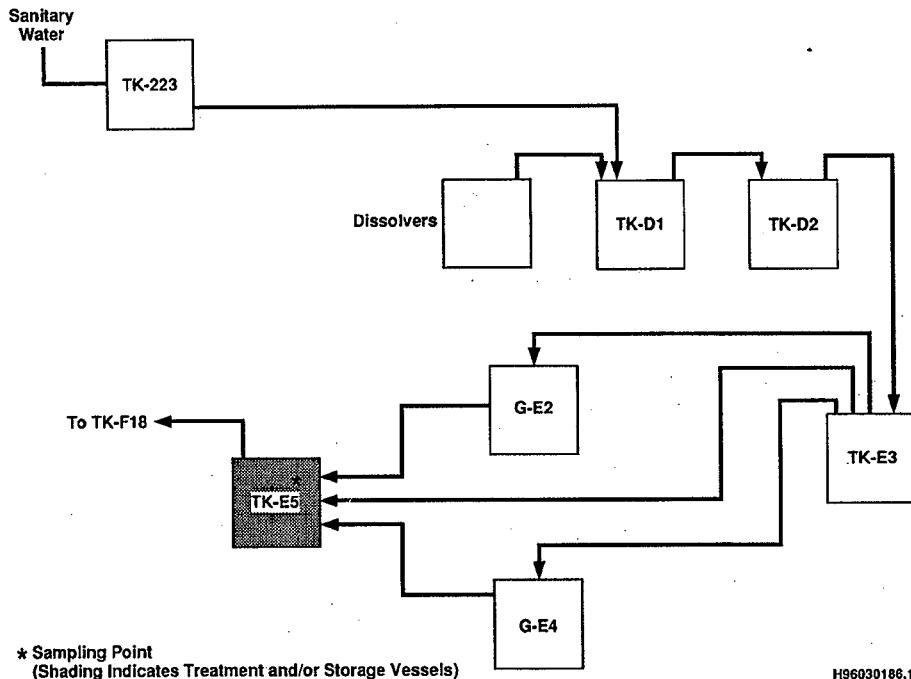


Figure 4-7. Flush U Cell Vessels.

Figure 4-8. Flush Cladding Waste Vessels.

F4-8



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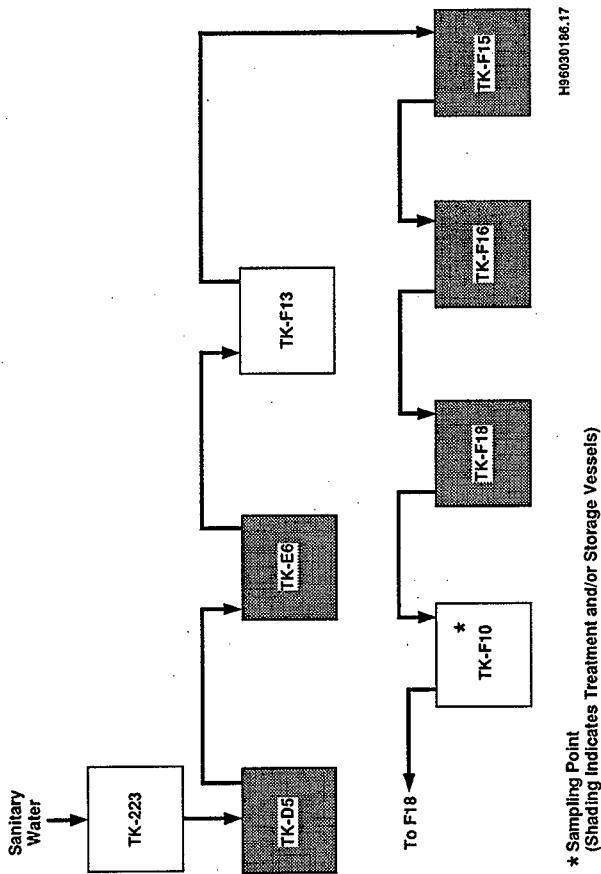


Figure 4-9. Flush Tank D5, Tank E6, Tank F13, Tank F15, and Tank F16 Vessels.

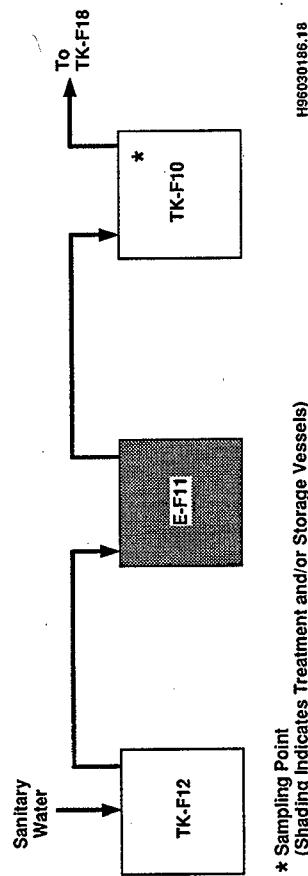
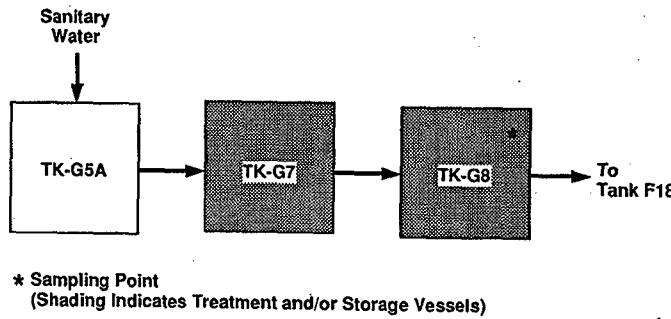


Figure 4-10. Flush F11 System Vessels.

Figure 4-11. Flush Tank G5A, Tank G7, and Tank G8 Vessels.

F4-11



H96030186.19

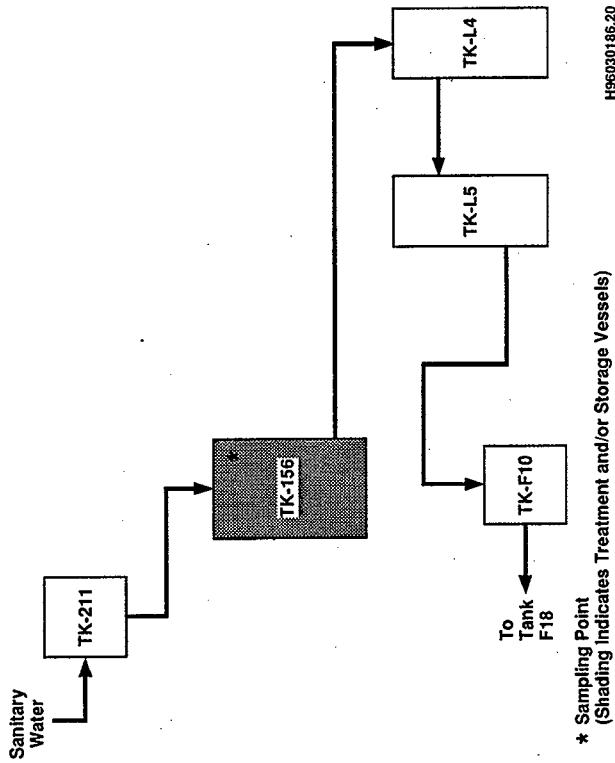


Figure 4-12. Flush Aqueous Makeup Tank 156.

Table 4-1. Vessel Systems Analytical Data. (sheet 1 of 4)

| Vessels ¹ | Sample no. | Cadmium (mg/L) | Chromium (mg/L) | Lead (mg/L) | Barium (mg/L) | Silver (mg/L) | Arsenic (mg/L) | Selenium (mg/L) | Mercury (mg/L) | pH (mg/L) | TOC (mg/L) |
|--|--------------------|----------------|-----------------|-------------|---------------|---------------|----------------|-----------------|----------------|---------------------------|------------|
| Dangerous waste designation threshold | | 1.0 | 5.0 | 5.0 | 100.0 | 5.0 | 5.0 | 1.0 | 0.2 | 2 < pH < 12.5 | 100,000 |
| K-Cell Vessels (Complete) (<u>T-J7, E-J8, TK-K1, T-K2, T-K3, E-K4, TK-K5, TK-K6</u>) | **R6331 | 0.06 | 0.336 | <0.6 | 0.342 | <0.06 | <0.005 | <0.005 | <0.005 | 2.73 | 203 |
| L-Cell Vessels (Complete) (<u>T-J6, T-J4, TK-J5, T-L1, T-L2, TK-L3, T-L4, T-L5, TK-F10</u>) | *BODVL1 *BOFBT5 | 0.165 | 0.784 | 0.027 | 0.358 | 0.004 | 0.001 | 0.001 | 0.015 | 1.47 2.39 ₂ | 256 |
| Headend Feed Vessels, H1, H2, and F-Cell Vessels (Complete) (<u>TK-E1, TK-D4, TK-D3, TK-H1, T-H2, TK-F7, E-F6, TK-F26, TK-F8</u>) | **BODVL7 | <0.1 | 1.4 | <1.1 | <5.0 | <1.0 | <0.125 | <0.25 | <0.005 | 2.57 | 91.8 |
| G and R Cell Vessels (Part I) (Complete) (<u>TK-R1, TK-G1, T-G2, TK-G2</u>) | **R6636 | 0.678 | 1.06 | <0.6 | <0.3 | <0.06 | <0.005 | 0.0065 | <0.005 | 7.62 | 444 |
| G and R Cell Vessels (Part II) (Complete) (<u>T-R2, TK-R2, TK-R8, TK-R5, D-R6, TK-R7, TK-G5, D-G6</u>) | **R6714 | <0.11 | 0.616 | <1.1 | <0.55 | <0.11 | <0.25 | <0.25 | <0.25 | 10.67 | 2100 |
| Backcycle Waste and Neptunium Package Vessels (Complete) (<u>E-H4, TK-J1, TK-J21, T-J22, I-J23, TK-J3</u>) | **R6990 | <0.01 | 0.867 | <0.1 | 0.291 | <0.01 | <0.25 | <0.25 | <0.005 | 2.89 | 171 |
| U-Cell Vessels (Complete) (<u>TK-U8, T-F5, TK-F3, TK-U1, TK-U2, TK-U5, T-U6, TK-U4</u>) | *95013-01.B06 | 0.34(U) | 0.73(B) | 3.4(U) | 0.39(B) | 0.5(U) | 0.1(U) | 0.1(U) | 0.05(U) | 2.94 | 0.025(U) |
| Cladding Waste Vessels (Complete) (<u>TK-D1, TK-D2, TK-E3, G-E2, G-E4, TK-E5</u>) | **R6995 | <0.6 | 0.396 | <0.6 | <0.3 | <0.06 | <0.25 | <0.25 | <0.005 | 9.44 | 29.7 |
| <u>TK-D5, TK-E6, TK-F13, TK-F15, and TK-F16</u> Vessels (Complete) | *BOFBT9 | 0.074 | 0.215 | 0.041 | 0.121 | 0.002 | 0.001 | 0.001 | 0.009 | 2.33 | 144 |
| F11 System Vessels (Complete) (<u>TK-F12, E-F11</u>) | *BOFBT2 | 0.0038 | 0.0421 | 0.0413 | 0.021 | 0.002 | 0.001 | 0.001 | 0.0019 | 5.86 | 160 |

Table 4-1. Vessel Systems Analytical Data. (sheet 2 of 4)

| Vessel ¹ | Sample no. | Cadmium (mg/L) | Chromium (mg/L) | Lead (mg/L) | Barium (mg/L) | Silver (mg/L) | Arsenic (mg/L) | Selenium (mg/L) | Mercury (mg/L) | pH (mg/L) | TOC (mg/L) |
|---------------------------------------|------------|--------------------|-----------------|-------------|---------------|---------------|----------------|-----------------|----------------|---------------|------------|
| Dangerous waste designation threshold | | 1.0 | 5.0 | 5.0 | 100.0 | 5.0 | 5.0 | 1.0 | 0.2 | 2 < pH < 12.5 | 100,000 |
| TK-F18 | *BOHNW9 | 0.24 (U) | 0.41 (U) | 4.0 (U) | 0.33 (B) | 0.59 (U,N) | 0.15 (U) | 0.14 (U) | 0.010 (U) | 9.49 | 3.7 |
| Tank U3 | *BOHNW6 | 0.24 (U) | 0.41 (U) | 4.0 (U) | 0.24 (B) | 0.59 (U,N) | 0.15 (U) | 0.14 (U) | 0.010 (U) | 10.59 | 24.9 |
| TK-G5A, (TK-G7,TK-G8) (Complete) | *BODPS6 | 0.289 | 0.737 | 0.370 | 0.329 | 0.038 | 0.012 | 0.010 | .001 | 11.39 | 1.07 |
| ANU Tank 156 (Complete) | *BODPS2 | 0.0038 | 8.69 | 0.037 | 0.038 | 0.0038 | 0.0012 | 0.0016 | 0.001 | 2.66 | 2.9 |
| | *BDDV14 | 0.018 ² | | | | | | | | | |
| Tank M2 (Complete) | *BOFB18 | 0.0023 | 0.0037 | 0.038 | 0.033 | 0.006 | 0.0009 | 0.0008 | 0.0009 | 6.75 | 3.02 |
| Tank F4 (Complete) | *BOFBV1 | 0.027 | 0.615 | 0.038 | 0.059 | 0.214 | 0.002 | 0.0008 | 0.005 | 2.52 | 3.67 |
| Tank P4 (Complete) | *BOFBV4 | 0.0023 | 0.58 | 0.0585 | 0.0118(B) | 0.006(U) | 0.002(B) | 0.0008(U) | 0.00038 | 11.73 | 9.04 |

Table 4-1. Vessel Systems Analytical Data. (sheet 3 of 4)

| Vessel ¹ | Benzene (mg/L) | Cuban tetrahydro (mg/L) | Chlorobenzene (mg/L) | Chloroform (mg/L) | 1,2-Dichloroethane (mg/L) | 1,1-Dichloroethylene (mg/L) | 2-Butanone (mg/L) | Tetrahydro ethylene (mg/L) | Vinyl chloride (mg/L) | Trichloroethylene (mg/L) |
|---|----------------|-------------------------|----------------------|-------------------|---------------------------|-----------------------------|-------------------|----------------------------|-----------------------|--------------------------|
| Dangerous waste designation threshold | 0.5 | 0.5 | 100 | 6.0 | 0.5 | 0.7 | 200 | 0.7 | 0.5 | 0.2 |
| K-Cell Vessels (Complete) (T-J-7, J-8, TK-K1, J-K2, T-K3, E-K4, TK-K5, TK-F6) | U | U | U | U | U | U | 0.034 | U | U | U |
| I-Cell Vessels (Complete) (J-J-6, J-4, TK-J5, J-1, J-2, TK-C3, T-4, T-L5, TK-F10) | U | U | U | U | U | U | 0.034 | U | U | U |
| Headend Feed Vessels, H1, H2, and F-Cell Vessels (Complete) (TK-E1, TK-P4, TK-C3, TK-H1, T-H2, TK-F7, E-F6, TK-F26, TK-F8) | U | U | U | U | U | U | 0.008(J,B) | U | U | U |
| G and R Cell Vessels (Part I) (Complete) (TK-R1, TK-G1, T-G2, TK-G2) | U | U | U | U | U | U | 0.062 | U | U | U |
| G and R Cell Vessels (Part II) (Complete) (TK-R2, TK-R2, TK-R8, TK-R5, D-R6, TK-R7, TK-G5, D-G6) | U | U | U | U | U | U | U | U | U | U |
| Backcycle Waste and Neptunium Package Vessels (Complete) (E-H4, TK-J1, TK-J21, T-J22, T-J23, TK-J3) | U | U | U | U | U | U | U | U | U | U |
| U-Cell Vessels (Complete) (TK-L9, T-F6, TK-S2, TK-C11, TK-D2, TK-F5, T-06, TK-C4) | U | U | U | U | U | U | U | 0.05(J) | U | U |
| Cladding Waste Vessels (Complete) (TK-D1, TK-D2, TK-E3, G-E2, G-E4, and TK-E5) | U | U | U | U | U | U | U | U | U | U |
| TK-D5, TK-E6, TK-F13, TK-F15, and TK-E6 | U | U | U | U | U | U | U | U | U | U |
| Vessels (Complete) | U | U | U | U | U | U | U | U | U | U |
| F11 System Vessels (Complete) (TK-F12, E-F11) | U | U | U | U | U | U | U | U | U | U |

Table 4-1. Vessel Systems Analytical Data. (sheet 4 of 4)

| Vessels ¹ | Benzene (mg/L) | Carbon tetrachloride (mg/L) | Chlorobenzene (mg/L) | Chloroform (mg/L) | 1,2 Dichloroethane (mg/L) | 1,1 Dichloroethylene (mg/L) | 2-Butanone (mg/L) | Tetrachloro ethylene (mg/L) | Trichloro ethylene (mg/L) | Vinyl chloride (mg/L) |
|---|-------------------|-----------------------------------|-------------------------|----------------------|---------------------------------|-----------------------------------|----------------------|-----------------------------------|---------------------------------|-----------------------------|
| Dangerous waste designation threshold | 0.5 | 0.5 | 100 | 6.0 | 0.5 | 0.7 | 200 | 0.7 | 0.5 | 0.2 |
| <u>TK-F18</u> | U | U | U | U | U | U | U | U | U | U |
| <u>Tank U3</u> | U | U | U | U | U | U | U | U | U | U |
| <u>TK-G5A, (TK-G7, TK-G8)</u> (Complete) | U | U | U | U | U | U | U | U | 0.012(J) | U |
| <u>AMU Tank 156</u> (Complete) | U | U | U | 0.006 | U | U | U | U | U | U |
| <u>Tank M2</u> (Complete) | U | U | U | U | U | U | U | U | U | U |
| <u>Tank F4</u> (Complete) | U | U | U | U | U | U | U | U | U | U |
| <u>Tank P4</u> (Complete) | U | U | U | U | U | U | U | U | U | U |

* Sample analyzed by Quanterra Laboratory.

** Sample analyzed by 222-S Laboratory.

¹ Underlining indicates permitted vessels (DOE/RL-88-21).

² Analytical results after refushing and resampling.

mg/L = milligrams per liter.

TOC = total organic carbon.

U = analyzed but not detected.

N = interference detected in matrix.

B = compound was found in the blank.

J = an estimated value for the target or tentatively identified compound.

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1 **5.0 GROUNDWATER**

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4 In accordance with the Tri-Party Agreement, groundwater in the 200 East
5 Area will be included in the 200-PO-1 operable unit and will be investigated
6 under *Comprehensive Environmental Response, Compensation, and Liability Act*
7 (CERCLA) of 1980. Therefore, groundwater investigation/remediation is not
8 addressed as part of this preclosure work plan. Work on the 200-PO-1 operable
9 unit will be coordinated with the final disposition process but will not occur
10 until the final groundwater operable unit work plan has been approved.

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1 6.0 TRANSITION PHASE STRATEGY

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3

4 This chapter describes the transition phase strategy and provides a
5 general description of the S&M phase and disposition phase activities.

6 Preclosure of the PUREX Facility vessel systems will occur in conjunction
7 with the overall decommissioning of the PUREX Facility. The transition phase
8 activities places the PUREX Facility in a deactivated state where all vessels
9 are flushed until the solutions do not designate as dangerous waste. Any
10 hazardous substances (e.g., lead shielding, etc.) left in place will be
11 identified during the transition phase and managed during the disposition
12 phase. The S&M phase will maintain the PUREX Facility in a safe and
13 environmentally secure configuration for 10 or more years for a planning
14 horizon. The disposition phase will address final closure activities [for
15 portions of the PUREX Facility identified in the Part A, Form 3, Permit
16 Application (DOE/RL-88-21)] in accordance with WAC 173-303. If required,
17 postclosure care requirements would be documented in a postclosure plan and
18 integrated with the post-remediation groundwater monitoring requirements
19 established for the 200-PO-1 operable unit.

21 This phased approach to closure allows for an expedient full deactivation
22 of the PUREX Facility in a manner that is safe and cost-effective, while
23 minimizing the risk to human health and the environment.

24 The transition phase activities will place the PUREX Facility in a
25 deactivated state. The transition phase consists of completion of end point
26 criteria (WHC 1995b), flushing vessel systems until threshold levels are met,
27 and transfer of the lead and cadmium waste from the canyon deck to PUREX
28 Storage Tunnel Number 2.

29 End point criteria are used to achieve a safe, stable, and
30 environmentally secure facility suitable for a low cost S&M program. End
31 points were created to ensure a thorough measure of completeness in preparing
32 the PUREX Facility for future decontamination and decommissioning. End point
33 criteria currently are being used to confirm completion of transition phase
34 activities and to substantiate the readiness for transition to the S&M phase
35 (Ecology et al. 1996; WHC 1995b).

36 6.1 SURVEILLANCE AND MAINTENANCE

37

38

39 During the S&M phase, the PUREX Facility will be unoccupied and locked.
40 There will be no active systems or utilities (except the electrical, lighting,
41 and heating, ventilation, and air conditioning systems) within the building.
42 The existing filtered exhaust systems that maintain a negative pressure within
43 the PUREX Plant will be consolidated into a single system monitored from a
44 remote location. The S&M plan (WHC 1995b) addresses compliance with RCRA and
45 WAC 173-303 requirements. The S&M plan outlines activities taken to address
46 monitoring of essential systems and to maintain the area in a safe condition
47 that presents no significant threat of release of hazardous substances into
48 the environment and no significant risk to human health and the environment

1 until final disposition is completed. The completion of these activities are
2 necessary before the final disposition of the PUREX Facility can be
3 implemented.

4

5

6 **6.2 DISPOSITION**

7 All aspects of closure not covered during the transition or S&M phases
8 will occur during the disposition phase (i.e., end state of the systems,
9 hazardous substances left in place, end state of the canyon structure, and
10 integration with the CERCLA remedial activities).

11

12

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1 7.0 TRANSITION PHASE ACTIVITIES

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3

4 This chapter describes the initial transition phase activities. Included
5 are specific activities that remove, or minimize, dangerous waste residuals
6 from each vessel system; and sampling and analysis information. The overall
7 transition phase strategy is described in Chapter 6.0.

8 The objective of the transition phase is to place the PUREX Facility in a
9 safe configuration with respect to human health and the environment.
10 Following the transition phase activities, the PUREX Facility will begin the
11 S&M phase of 10 or more years until disposition phase activities commence.
12 The closure plan for the PUREX Facility will be prepared during the
13 disposition phase.

14 7.1 REMOVAL OF DANGEROUS WASTE RESIDUE AND CONTAMINATED MATERIALS

15

16

17 Preclosure of the vessel systems includes the following activities:

- 18 • Removing residual solutions
- 19 • Flushing vessel systems until the heels do not exhibit dangerous waste
20 characteristics
- 21 • Conducting protocol sampling and analysis of final (record) flushes of
22 vessel systems as defined in Section 7.2.1
- 23 • Emptying vessels to the maximum extent practicable using existing
24 pumps and/or jets
- 25 • Emptying cell sumps to the normal heel using existing jets and/or
26 pumps
- 27 • Isolating (blanking) all liquid feed and/or drain lines to vessel
28 systems.

29 Following the completion of all vessel system flushing, the liquid level
30 in the vessels will be left at the lowest level possible (the residual heels
31 vary between approximately 70 and 400 liters) using existing jets and/or
32 pumps. All liquid feed and/or drain lines will be isolated after emptying the
33 vessel systems and cell sumps to prevent any inadvertent backflow of liquids.

34 The following transition phase activities minimizes the required S&M of
35 the containment building and will aid in the protection of human health and
36 the environment during the S&M phase.

37 All bare lead and cadmium on the canyon deck has been transferred to
38 PUREX Storage Tunnel 2 for long-term storage.

1 Some dangerous and/or mixed waste (F Cell) will remain in storage in the
2 containment building. Surveillance of the containment building is discussed
3 in Chapter 3.0, Section 3.4.

4
5 When transition activities are completed, the personnel entries will be
6 locked and appropriate warning signs (e.g., "Danger - Unauthorized Personnel
7 Keep Out" and "Radiation Zone") will be posted.

8
9
10 **7.2 SAMPLING AND ANALYSIS**

11
12 The vessel systems will be flushed until the heels do not exhibit
13 dangerous waste characteristics (WHC 1995d). Flushing the vessel systems
14 ultimately will lead to deactivation of the vessel systems that are regulated
15 by WAC 173-303.

16
17 The DQO planning process was used to develop the sampling and analysis
18 approach used during transition activities (WHC 1995c).

19
20 Soil sampling and analysis will occur as part of the corrective action
21 investigation process of the 200-PO-2 operable unit.

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1 **8.0 POSTCLOSURE PLAN**

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4 If waste is left in place, a postclosure plan will address disposition
5 scenarios. Groundwater contamination will be investigated and remediated
6 through the operable units under the CERCLA remedial investigation/feasibility
7 study process as specified in the Tri-Party Agreement.

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40 used for sampling and analysis of all PUREX Facility vessels),
41 Westinghouse Hanford Company, Richland, Washington.
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