

Data Quality Objectives Summary Report for Characterization of the 202-A Building (PUREX Canyon)

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Richland, Washington

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Document Type: ENV

Program/Project: CP D&D

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Date Published
September 2007

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EXECUTIVE SUMMARY

The 202-A Building, herein after referred to as the Plutonium-Uranium Extraction (PUREX) Canyon, Data Quality Objectives (DQO) process identifies the sampling and analytical requirements necessary to support future detailed evaluation of alternatives via a coordinated *Resource Conservation and Recovery Act of 1976 (RCRA)* and *Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)* process, for final disposition of the PUREX Canyon. Viable alternatives for the disposition of the Hanford Site canyon facilities, including the PUREX Canyon, were identified in a CERCLA feasibility study (FS) process performed for the 221-U Facility (DOE-RL 2001) for the Canyon Disposition Initiative (CDI). The 221-U Canyon was the first canyon structure to undergo the CERCLA process and has paved the way for the additional canyon facilities on the Hanford Site. However, the PUREX Canyon differs from the 221-U Canyon in that, although the CERCLA process will be used to disposition the building, the PUREX Canyon also contains RCRA units that must be addressed in accordance with TSD closure standards.

The scope of this DQO Process is limited to the PUREX Canyon and material/equipment contained within the building. Associated stacks, filters, solvent handling, ancillary structures, and storage tunnels external to the PUREX Canyon are not addressed in this DQO. This DQO focuses solely on the PUREX Canyon because it provides the greatest potential source of contaminant volumes and concentrations and the physical structure poses the greatest challenge for disposition decisions. A proposed path forward for disposition of the PUREX Storage Tunnels and other ancillary structures will be documented in the PUREX Zone Closure Implementation Plan (ZCIP) or equivalent document.

Three key information inputs to the evaluation of the disposition alternatives are: (1) the nature and extent of radionuclide and chemical contamination within the structure, (2) the structural integrity of the building itself, and (3) the structural design of the building. Contaminant information is necessary to ensure the safety of workers, to evaluate contaminated equipment and building materials against disposal criteria, and to assess the potential for contaminant migration out of the facility. Structural integrity data will help to decide the viability of the leave-in-place

alternatives. Structural design information will help to decide the viability of the full and partial removal alternatives.

The PUREX Canyon DQO Process has developed a sampling and analytical strategy to: (1) characterize the structural integrity of the facility and structural design, and (2) determine the nature and distribution of the contaminants of potential concern (COPCs) within the facility.

The structural integrity and structural design will be assessed using a formal engineering process, which consists of review of available documents, site inspections, and structural analysis followed by a formal assessment. The assessment will be used for the following purposes:

- To evaluate current capacities of the building structural systems to safely resist loadings during and after entombment operations, and;
- To evaluate the flow paths into and out of the canyon during and after entombment, and;
- To evaluate the structural design of the building to aid in assessing the most practical method of dismantlement, in the event that complete removal and disposal of the building is the chosen alternative.

The information needed for performing this assessment is in Table 3-1. These tables outline the information needs, available information and its source, and information/data that will require collection.

This structural integrity and design information, along with structural analysis of the load capacity of the soils below the PUREX Canyon and the concrete members of the building, will be assessed in the structural evaluation report.

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TERMS

ALARA	as low as reasonably achievable
ANN	aluminum nitrate nonahydrate
ARAR	applicable or relevant and appropriate requirement
ASD	ammonia scrubber distillate
bgs	below ground surface
CAS	Chemical Abstract Service
CDI	Canyon Disposition Initiative
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
CFR	<i>Code of Federal Regulations</i>
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DQO	data quality objective
DR	decision rule
DS	decision statement
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
HLW	high-level waste
IDW	investigation-derived waste
NPH	normal paraffin hydrocarbon
OU	operable unit
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PSQ	principal study question
PUREX	Plutonium-Uranium Extraction (Plant)
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
REDOX	Reduction-Oxidation (Plant)
RESRAD	RESidual RADioactivity
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
STOMP	subsurface transport over multiple phases
SVOC	semivolatile organic compound
TBP	tri-butyl phosphate
TOC	total organic carbon
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i>
TSD	treatment, storage, and disposal
UNH	uranyl nitrate hexahydrate
URP	uranium recovery process
VOA	volatile organic analysis
WAC	<i>Washington Administrative Code</i>
ZCIP	PUREX Zone Closure Implementation Plan

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
Length			Length		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	Meters	meters	3.281	feet
yards	0.914	Meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			Area		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			Mass (weight)		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			Volume		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			Radioactivity		
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

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1.0 STEP 1 -- STATE THE PROBLEM

The purpose of data quality objective (DQO) Step 1 is to state the problem clearly and concisely and to ensure that the focus of the study is unambiguous. This chapter provides background information on the subject building and concludes with the Problem Statements.

1.1 INTRODUCTION

This summary report has been developed to support the remedial investigation/feasibility study (RI/FS) and remedial action decision-making processes for the Plutonium-Uranium Extraction (PUREX) Canyon. The PUREX Canyon will be remediated under a coordinated *Resource Conservation and Recovery Act of 1976* (RCRA) and *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) approach.

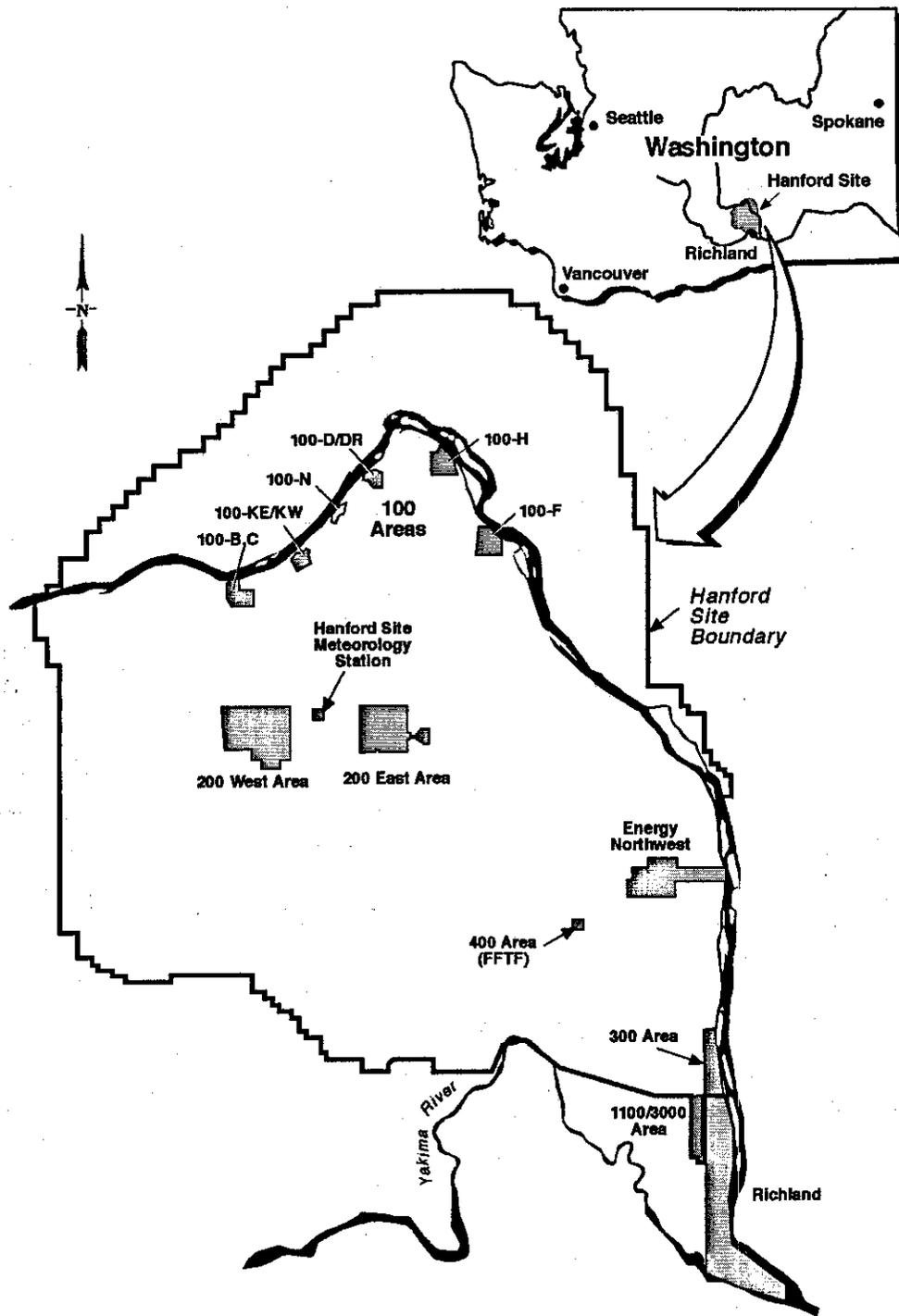
The Washington State Department of Ecology (Ecology) Publication No. 94-49, *Guidance on Sampling and Data Analysis Methods* and the U.S. Environmental Protection Agency (EPA) publication EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection* were used during this DQO process to support the selection of an appropriate sampling approach. Table 1 of the Ecology guidance summarizes approaches for sampling and data analysis considered acceptable to Ecology. This guidance shows that a focused sampling approach may be used to investigate a site that is known to be contaminated, and contaminated regions may be identified for sampling and analysis.

The PUREX Canyon contains 10 RCRA permitted treatment or treatment and storage tank systems and an additional 35 storage tank systems. A tank system includes the tank (vessel) and its ancillary equipment. The 35 storage tank systems within the PUREX Canyon were used specifically to support transition phase activities in the mid-1990's. The tanks once used in this process have been drained and flushed and are awaiting final disposition. All 45 tank systems were flushed as part of transition phase activities.

The PUREX Canyon also contains two solid mixed waste storage areas: a section of the canyon deck adjacent to D Cell, and the F17 position in F Cell. These storage areas have been identified as a "containment building" subject to the RCRA requirements of 40 CFR 265, Subpart DD, as prescribed in *Washington Administrative Code* (WAC) 173-400 interim status facility standards. A steel open top skid containing concrete chips from the floor of E-Cell is stored in F-Cell. The solid mixed waste in the canyon could consist of contaminated discarded canyon process equipment, jumpers (or isolated components thereof) or other material from the various onsite sources.

A map of the Hanford Site is provided in Figure 1-1 and depicts the 200 Areas and vicinity. Figures 1-2 and 1-3 identify the location of the PUREX Canyon in the 200 East Area, as well as a cutaway view of the building.

Figure 1-1. Location of the Hanford Site and the 200 East Area.



G05100006.2

Figure 1-2. PUREX Plant Site Plan - 200 East Area.

PUREX Plant Site Plan

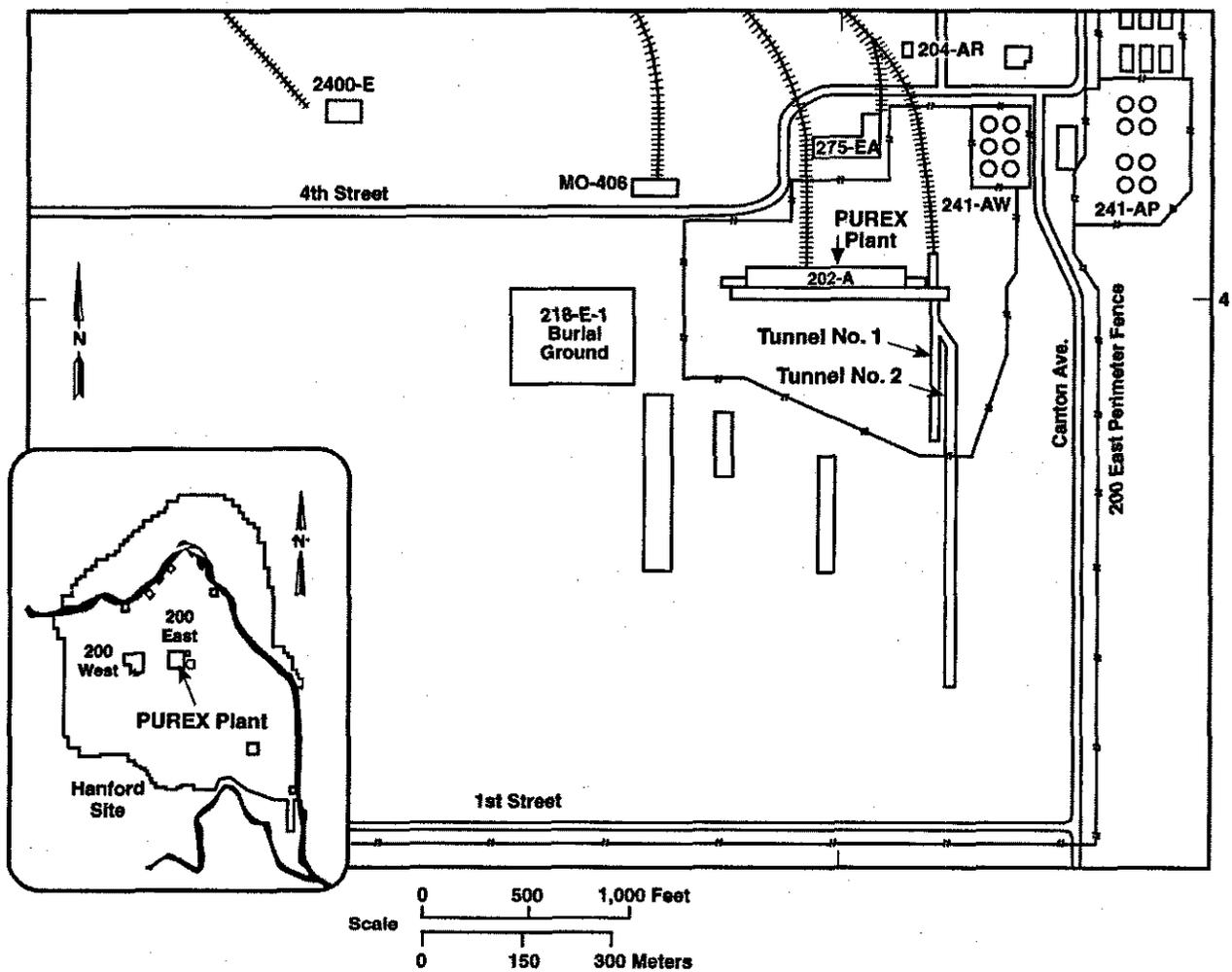
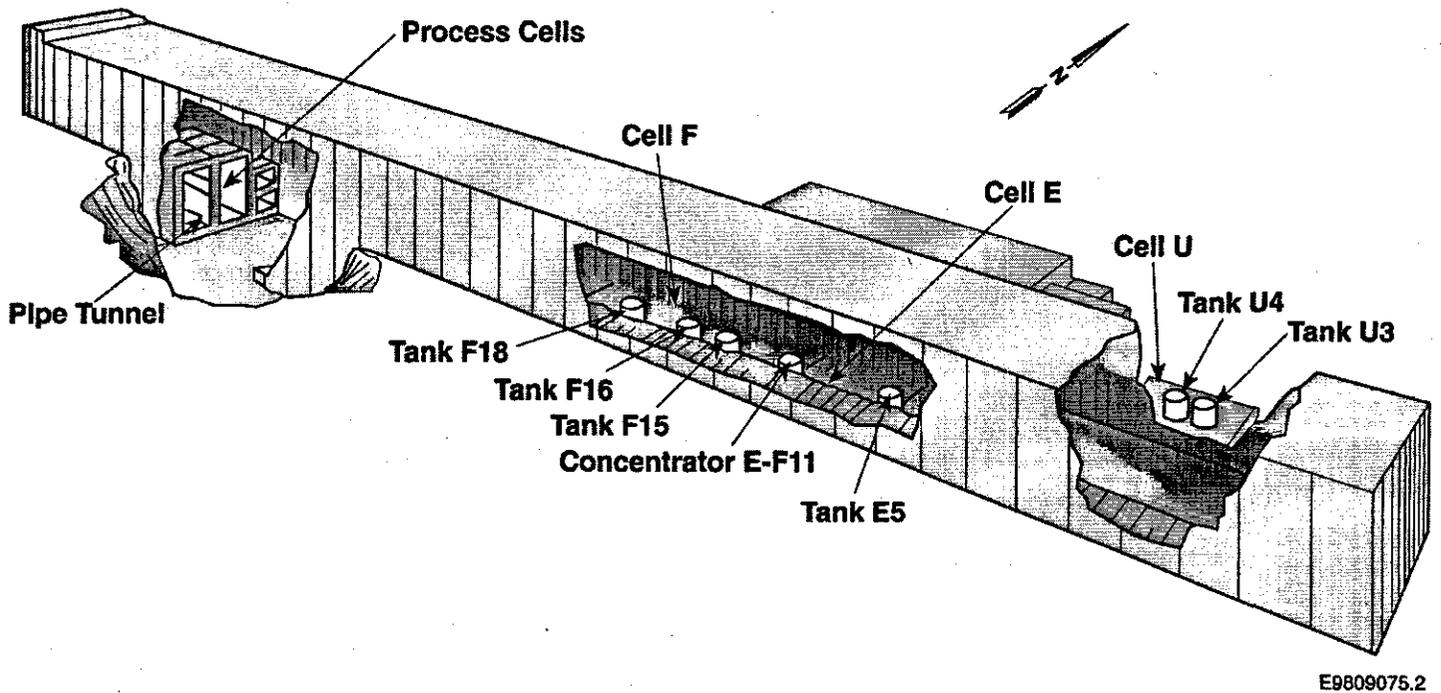


Figure 1-3. PUREX Plant Cutaway View.

PUREX Plant Cutaway View (202-A Building)



1.2 PROJECT PURPOSE

The purpose of the PUREX Canyon (202-A Building) Data Quality Objectives (DQO) process is to identify the sampling and analytical requirements to support an evaluation of remedial alternatives for final disposition of the building. Potential alternatives range from removal and disposal of the building and all of its contents to a variety of entombment (i.e., leave-in-place) scenarios, including importation of waste from outside of the PUREX Canyon.

1.3 PROJECT SCOPE

The PUREX Facility refers to the 202-A Building and the surrounding ancillary structures. External to the PUREX Canyon are associated stacks, filters, solvent handling equipment, storage tunnels, and miscellaneous support structures. However, the scope of this DQO process is limited to the PUREX Canyon and the equipment within. It should be noted for clarity that the RCRA Part A permit application and other historical documentation for the PUREX Facility uses the term "PUREX Plant" in reference to the PUREX Canyon.

There are two tanks listed in the PUREX Plant Part A permit application that are excluded from the scope of this investigation, as these tanks are located outside of the canyon.

1.4 PROJECT OBJECTIVES

The primary objective of the PUREX Canyon DQO is to develop a sampling design that provides adequate information to enable quantitative evaluations of the PUREX Canyon baseline risk and of the disposition alternatives. Three key inputs to these evaluations are as follows:

- **Nature and extent of contamination** - radionuclide and non-radiological contaminant information is necessary to evaluate protection of human health and the environment, under all scenarios, and to evaluate contaminated equipment and building materials against disposal criteria.
- **Structural integrity of the building** - structural integrity data is necessary to determine the viability of the entombment alternatives. Entombment of the building will add additional stress to the structure therefore the structural integrity of the building must be evaluated to determine if the entombment alternatives are viable using the existing structure.
- **Building structural design** - information on the canyon building structure is necessary to determine the viability of the dismantling alternatives. Dismantling the building will require an evaluation of the structural design to evaluate the most efficient methods of deconstructing the building into sections that can physically be removed, treated as necessary, and transported to another location for disposal.

1.5 PROJECT ASSUMPTIONS

Project assumptions for the PUREX Canyon DQO process include the following:

- The DQO process will follow EPA/600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, as modified in this report format.
- The PUREX Canyon DQO will follow the format and logic presented in the 221-U Canyon DQO summary report to the extent practicable.
- The current and likely foreseeable future land use for the Central Plateau core zone is industrial-exclusive (e.g., an area suitable and desirable for treatment, storage and disposal of hazardous, dangerous, radioactive, non-radioactive wastes and related activities).
- The anticipated land use for the Central Plateau Core Zone will be DOE industrial exclusive-use for at least 50 years and industrial use afterwards for the foreseeable future.
- The DQO process will address likely response scenarios. These include:
 - No action
 - Decontaminate and leave in place
 - Full removal and disposal
 - Entombment with external waste disposal
 - Entombment with internal/external waste disposal
 - Close in place – standing structure
 - Close in place – partially demolish
- The lead agency for PUREX Canyon characterization is the U.S. Department of Energy – Richland Operations Office.
- The lead regulatory agency for the PUREX Canyon characterization is the Washington State Department of Ecology per Letter, D. R. Sherwood (U.S. EPA) and M. A. Wilson (Ecology) to L. McClain (DOE-RL), *Lead Regulatory Agency for 200 Area Canyons and 100/300/400/600 Area Facilities*, October 7, 1996.
- Ecology will be kept apprised of the progress and content of the DQO per their request in the April 16, 2007 DQO interview that, although a collaborative DQO process was not necessary for this project, they would like to be briefed during the process to keep them apprised of the progress and content of the DQO.
- In the event that a partial or full removal alternative is chosen as the final remedial path, additional characterization data may be required to ensure that the disposal facilities' waste acceptance criteria are met.

- Investigation derived waste (IDW) generated during PUREX Canyon characterization activities may be returned to the canyon (left over sample material from the lab), or left in the canyon (personal protective equipment, contaminated sampling equipment) to be dispositioned along with the building and equipment within.
- The PUREX Canyon is classified as a "key facility" per Section 8.1.2 of the Tri-Party Agreement Action Plan.
- An Agreement in Principle was issued in 1996 stating that "The CERCLA process will be utilized to determine the preferred alternative for U Plant, and on a case-by-case basis for the other canyon facilities." [Letter 038471, L. K. Bauer (DOE-RL) to D. R. Sherwood (U.S. EPA) and M. A. Wilson (Ecology), *Agreement in Principle Including Path Forward for Canyon Disposition Initiative, October 21, 1996.*]
- The scope of this DQO process is limited to the PUREX Canyon and the components within. For example, the following structures and equipment are not within the scope of this investigation:
 - Ancillary structures surrounding the PUREX Canyon
 - Tank TK-40 and Tank TK-P4
 - Stacks (other than those physically part of 202-A)
 - Fiberglass filter
 - Solvent handling area
 - Storage tunnels #1 and #2
- A proposed path forward for the ancillary structures listed above will be documented in the ZCIP or equivalent document.
- Asbestos is not included as a COPC for the PUREX Canyon however it will be considered during work planning activities, as it is a worker safety issue from an inhalation standpoint.
- Soils underlying the building will only be investigated directly under the footprint of the PUREX Canyon.

1.6 PROJECT ISSUES

Project issues include both the global issues that transcend the specific DQO process and the technical issues that are unique to the project. Both global and project technical issues have the potential to impact the sampling design or the DQOs for the project.

1.6.1 Global Issues

One global issue was identified during the interview meetings held with the U.S. Department of Energy, Richland Operations Office (RL), Ecology, and the EPA, which was the coordination of RCRA and CERCLA requirements associated with this project. Because a large portion of the

PUREX Canyon is an interim status RCRA permitted unit, and the CERCLA process is being used for disposition of the entire structure, consideration must be taken to ensure that both RCRA and CERCLA requirements are satisfied. This issue is not expected to change the sampling design presented in Step 7 of this DQO summary report.

1.6.2 Project Technical Issues

Technical issues associated with the project include the following:

- Accessibility of some areas/components that may require sampling (e.g., process cells)
- Health and safety concerns during sampling activities (e.g., dose rates, contamination)
- The presence of embedded steel members and larger aggregate in the high-density concrete used to construct the PUREX Canyon, which may impede concrete core drilling activities.

1.6.3 Listed Waste Issue

During PUREX Facility transition phase activities in the 1990s, Ecology and EPA identified a concern regarding RCRA listed waste constituents in the PUREX Canyon tank systems. Wastes that could have designated as listed waste were introduced into the PUREX Canyon tank systems from laboratory operations that placed small quantities of solvents into the PUREX process. In addition, PUREX Hot Shop operations used chlorinated solvents that were subsequently sent to the PUREX tank systems. The laboratory and Hot Shop chemicals of interest from a listed waste perspective include acetone, xylene, toluene, butanol, and 1,1,1-trichloroethane (TCA).

Resolution to this listed waste issue is addressed in a letter, James R. Rasmussen, USDOE, and James E. Mecca, USDOE, to Roger F. Stanley, Ecology, and Douglas R. Sherwood, EPA, *Resolution of Permitting and Interim Status Compliance Related Issues Associated with Transition of the Plutonium-Uranium Extraction (PUREX) Facility*, dated October 28, 1994. Ecology and EPA responded by letter, Moses Jaraysi, Ecology, and Dan Duncan, EPA, to James R. Rasmussen, USDOE, and James E. Mecca, USDOE, *Re: Resolution of Permitting and Interim Status Compliance Related Issues Associated with Transition of the Plutonium-Uranium Extraction (PUREX) Facility*, dated February 21, 1995. Agency agreements made to address the issue are as follows:

1. EPA and Ecology agreed that the levels of listed dangerous waste constituents may be negligible.
2. EPA and Ecology concurred that listed waste codes will not be added to the PUREX Plant Part A permit application. However, listed waste COPCs must be addressed in the final disposition plans for the facility.
3. Actions at the time of final disposition may include adding listed waste constituents to the sampling plan, assessing alternative treatment technologies for hazardous debris, etc.

It should be noted that all of the identified listed waste 'chemicals of interest' are retained in the final COPC list for the PUREX Canyon (Table 1-8).

1.7 PLANT OPERATING HISTORY

The PUREX Facility, constructed in 1954 and 1955, is located in the southeast corner of the 200 East Area. The PUREX Canyon was used for the recovery of uranium and plutonium from irradiated reactor fuel. Liquid processes were used to separate the plutonium and uranium. The PUREX Canyon, also referred to as the 202-A Building, is a reinforced concrete structure approximately 306 m (1,004 ft) long, 36 m (118 ft) wide (at its maximum) and 31 m (102 ft) high with approximately 12 m (39 ft) of the height below grade. The PUREX Canyon consists of three main structural components: (1) a thick-walled, concrete canyon containing remotely operated process equipment (in cells below grade); (2) the pipe and operating, sample, and storage galleries; and (3) an annex that included offices, process control rooms, laboratories, and building services.

1.7.1 Plant History

The PUREX Facility began operations in 1956. Due to process efficiencies, all standard irradiated uranium from the 100 Areas production reactors was sent to the PUREX Facility, beginning in 1958. Additionally in 1958, the PUREX Canyon began the recovery of neptunium 237 on an occasional batch basis from its normal product stream. Beginning in 1963, the PUREX Canyon was modified to enable the processing of various fuel types including fuel from N Reactor. N Reactor fuel elements took more time to dissolve, hence slowing product recovery productivity. During 1965 and 1966, the PUREX Facility processed powered thorium oxide fuel targets that had been irradiated for the production of uranium-233. When the REDOX Plant closed in 1967, the PUREX Facility became the sole operating processing facility on the Hanford Site.

In September of 1972, the PUREX Facility entered a shutdown period that lasted 11 years. During this time, A Tank Farms waste tanks were cleaned out, and maintenance and upgrades were performed at the PUREX Facility. In 1983, the PUREX Facility reopened at a decreased production rate. Following a safety violation, the PUREX Facility closed in 1988 for six weeks. The PUREX Facility closed again in 1988 for nearly a year after steam pressures fell below levels necessary to support backup safety equipment. Additional equipment repairs and improvements to waste handling systems also occurred during that closure period. After a stabilization run lasting only a few weeks, the PUREX Facility again closed in early 1990 to prepare additional environmental and safety documentation and facility upgrades. In October of that year, the PUREX Facility was placed on standby status by the Secretary of Energy. A final closure order was issued by DOE in December 1992.

1.7.2 Process Information

1.7.2.1 Introduction

The PUREX process was an advanced solvent extraction process that replaced the Reduction-Oxidation (REDOX) process. The PUREX process used a recyclable salting agent, nitric acid (which greatly lessened costs and the amount of waste generated), and tri-butyl phosphate (TBP) in a normal paraffin hydrocarbon (NPH) solution as a solvent. TBP/NPH proved to be a much safer and more effective solvent than methyl isobutyl ketone (REDOX's solvent) for recovering uranium and plutonium from nitric acid solutions of irradiated uranium (DOE/RL-92-04).

The main purpose of the PUREX Facility was to extract, purify, and concentrate plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors. The chemical separation processes were based on dissolving fuel rods in nitric acid and conducting multiple purification operations on the resulting aqueous nitrate solution. The driving forces for the separations consisted of concentration changes, temperature changes, and chemical additions (DOE/RL-92-04).

With the exception of the feed preparation and dissolution processes, which operated in batch operation, the PUREX process was continuous. Figure 1-6 illustrates the PUREX process. The process steps include the following (DOE/RL-92-04):

- Feed decladding, dissolution, and preparation
- Separation cycles of uranium, plutonium, neptunium, and fission products
- Further purification cycles of the uranium, plutonium, and neptunium
- Solvent recovery, treatment, and recycle
- Nitric acid recovery, fractionalization, and recycle
- Back-cycle waste treatment system and process condensate recycle.

Individual PUREX process operations, including their respective waste collection and treatments, are described in greater detail below.

1.7.2.2 Feed Preparation and Fuel Dissolution

The first step in the PUREX process involved preparing the uranium feed for processing. Irradiated uranium slugs, rich with plutonium, were transferred from the 100 Area to the 200 North Area via shielded rail car for a 45- to 60-day period of intermediate storage in large tanks containing water. After the necessary period of storage or cooling, the slugs were sent via rail car to the PUREX Canyon.

The uranium slugs initially were coated with an aluminum alloy jacket or cladding (early years) and later a zirconium alloy (containing small amounts of tin and iron) cladding (Zircaloy) for protection. After the coated slugs were delivered to the PUREX facility, a boiling sodium hydroxide/sodium nitrate solution was used to remove the aluminum alloy jackets, or a boiling solution of ammonium fluoride/ammonium nitrate was used to remove the Zircaloy cladding from fuels. Additional amounts of nitrate often were added to react with the ammonia and suppress the hydrogen that evolved during decladding operations (HW-31000-DEL; WHC-SP-0479, *PUREX Technical Manual*).

Uranium metal reacted with the fluoride of the decladding dissolution (ammonium fluoride/ammonium nitrate) solution to form insoluble uranium tetra- and hexafluoride compounds. To avoid losses of the uranium metal, water was added to dilute the decladding solution to the maximum dissolver tank volume at the end of the digestion period. To recapture the uranium complexed with fluoride, a potassium hydroxide solution was added to metathesize the uranium fluoride compounds to uranium dioxides. The resulting supernatant was routed to the metathesis solution storage tank to be used again. The remaining solids (heel) were washed with water to remove any residual fluoride anions before the uranium fuel was dissolved (HW-31000-DEL; WHC-SP-0479).

These operations produced gaseous, liquid, and solid waste streams. Varying amounts of uranium, plutonium, and fission products were found in these waste streams. The dissolved off-gases were collected and routed to the off-gas treatment system. The liquid/solid waste generated by the feed preparation process included the coating removal waste, the acid wash from the dissolvers, and the dissolved or slurried centrifuge cake from the oxidizing operation. All of these waste streams were considered to be high-level radioactive wastes. The slurry (liquids/solids) waste stream was washed with water. A rare earth nitrate/lanthanum/neodymium nitrate mixture was added to coprecipitate the plutonium and uranium. Concentrated sodium hydroxide was added to the mixture to oxidize the uranium and plutonium residuals. The slurry mixture then was physically separated by centrifugation. The supernatant was sent to the waste treatment system while the solids either were dissolved with a nitric acid/aluminum nitrate nonahydrate solution and routed to the metals feed tank or were slurried with water to the waste treatment system for metathesis with a spent potassium hydroxide solution and centrifuged. The supernatant of this separation was routed to the A Tank Farm, while the solids were dissolved in nitric acid, neutralized, and then routed directly to the A Tank Farm (HW-31000-DEL; WHC-SP-0479).

After the jackets/claddings were removed from the uranium slugs, the slugs were rinsed in a dilute nitric acid solution to remove residual alkalinity. The rinse water, containing small amounts of uranium and plutonium, also was directed to the A Tank Farm. Aluminum nitrate nonahydrate (ANN) was added just before the dissolving solution to complex any remaining fluoride anions. The uranium slugs then were dissolved in concentrated nitric acid, creating a metal solution containing primarily uranyl nitrate hexahydrate (UNH), oxidized plutonium as soluble nitrates, and fission products. The nitric acid served two purposes. First, it dissolved the uranium-rich sludge into an aqueous phase. Second, it acted as a salting agent, reducing the solubility of the UNH in the aqueous phase and increasing its solubility during the first separation via extraction column. The dissolved metal solution was jetted to the feed storage tank and sampled. Final adjustment included pH neutralization and concentration by evaporation of the resulting solution. This concentrated feed solution then was sent to the first-cycle extraction column. The dissolved off-gases were vented and routed to the off-gas waste treatment system (HW-31000-DEL; WHC-SP-0479).

Off-gases including ammonia, hydrogen, and nitrous oxides, containing various radionuclides including iodine-129 and iodine-131, were emitted during the decladding, metathesis, and dissolution operations. These gases were collected and routed through an off-gas treatment system that was composed of three dissolvers/condensers that recovered nitric acid, each in

series with an ammonia scrubber, an off-gas heater, a silver reactor, filters, and a back-up treatment facility before exiting out the 291-A Stack (HW-31000-DEL; WHC-SP-0479).

The three dissolver towers were actually water-cooled condensers. Each tower also functioned as a first-stage off-gas scrubber, removing some ammonia and fission products. However, nitric acid was recovered mainly from the dissolver's condensate stream. The condensate from the dissolvers was routed to the ammonia scrubber catch tank. The off-gases continued from each of the dissolvers to respective ammonia scrubbers. Ammonia was removed by the condensate and also routed to the ammonia scrubber catch tank (HW-31000-DEL; WHC-SP-0479).

The remaining off-gases that were not condensed were heated and sent through a silver reactor to capture the radioiodine by a reaction with silver nitrate, forming silver iodide. Off-gases from the silver reactor passed through several fiberglass and sand filters that removed radioactive particulates. The resulting off-gases then were routed through the back-up facility. The back-up facility process was located in the 293-A Building. Off-gases were treated with hydrogen peroxide in two acid absorber towers (XA and XB) in series to remove additional amounts of nitrogen oxides. A portion of the returning condensate served as a scrubbing solution, while the remainder was recycled into the PUREX process via the 206-A Building (nitric acid recovery/recycle operations) as nitric acid. The gaseous emissions then were discharged to the atmosphere through the 291-A Stack. Volatile radioisotopes that may have been present in the gases discharged to the atmosphere include trace amounts of xenon and krypton (HW-31000-DEL; WHC-SP-0479).

The ammonia scrubber distillate (ASD) stream was the result of the first step in fuel dissolution, which produced large quantities of gaseous ammonia. The ammonia was scrubbed from the off-gas with water to prevent the ammonia from being released to the atmosphere. Condensate from the three dissolver towers, their respective ammonia scrubbers, and the back-up facility all were collected in the ammonia catch tank. The resulting ammonia solution was boiled to concentrate the ammonia and radionuclides for disposal to underground storage tanks. The condensed vapor became the ASD stream. The ASD stream was routed to a concentrator and then a condenser. The resulting off-gases were heated, routed through another silver reactor to remove radioactive iodine, mixed with the ventilation exhaust from the 202-A (PUREX Canyon) Building, routed through additional filters, and released to the atmosphere via the 291-A Stack. The condensate from the condenser was sampled for strontium-90 content. If the sample proved to be within discharge limits, it was routed to 200-PW-2 OU waste sites 216-A-36A and 216-A-36B (cribs). If the liquid effluent was not within regulatory discharge limits, it was either reworked or neutralized with caustic (concentrated sodium hydroxide) and routed as ammonia scrub waste to the A Tank Farm underground storage tanks for final disposal (HW-31000-DEL; WHC-SP-0479).

Additional liquid waste generated by the off-gas treatment systems, including the 291-A Stack drainage, various condensed process drainages, and liquid effluents from the silver reactor, condensers, and filters, was collected and routed to the nitric acid recovery and/or back cycle waste treatment system (HW-31000-DEL; WHC-SP-0479).

1.7.2.3 Solvent Extraction

The prepared feed (dissolved metal solution) entered the first extraction column or contamination column at the midpoint. To increase the amount of separation, the packed column, essentially full of the organic phase, was pulsed from the bottom of the column. The organic phase counter-currently passed the aqueous phase that descended from the top of the column. This first column had a dual purpose. First, the uranium, plutonium, and neptunium were extracted into the organic phase (TBP/NPH) in the bottom portion of the column. Second, fresh aqueous (nitric acid) solution entered the column from the top and scrubbed impurities from the organic phase in the upper portion of the column. The nitric acid served as the salting agent and scrub solution in the first column. A stream of sodium nitrite also entered the bottom of the first extraction column. The sodium nitrite was used to make the neptunium extractable into the organic phase. The organic phase, rich with product, exited from the top of the first column to a feed collection tank before entering the second extraction column. The first column extracted approximately 99.9 percent of the fission products. This aqueous waste stream was routed to the waste concentration/acid recovery operations and subjected to further processing before final disposal to the underground storage tanks. Figure 1-4 illustrates the PUREX process (HW-31000-DEL; WHC-SP-0479).

The TBP/NPH solution, rich with uranium, plutonium, and neptunium, left the first extraction column and continued to a feed collection tank before entering the second extraction column (column 1BX). In the collection tank (TK-J3) the organic product stream was mixed with recycled organic waste streams from the final (second and third) plutonium cycles, final neptunium purification cycles, and a uranium scrub solution (organic phase) from column 1BS. The second extraction column or partition column essentially was full of the aqueous phase. The organic phase entered the second column from the bottom portion, and the aqueous scrub solution containing dilute nitric acid, ferrous sulfamate, and sulfamic acid descended from the top of the column. The sulfamate/sulfamic acid served to neutralize the nitrite previously added in the first column. Thus, as the organic stream rose through the column, the plutonium was partitioned from the uranium and neptunium (in the organic phase) to an aqueous phase. The plutonium stream was mixed with recovered nitric acid and routed through another extraction column (column 1BS) to purify the plutonium. Small amounts of uranium and neptunium were removed from the aqueous plutonium stream and the recovered acid stream in the organic phase because of the addition of concentrated nitric acid in the 1BS column. The recovered uranium then was recycled to the TK-J3 feed collection tank, prepared, and rerouted through the 1BX or plutonium-partitioning column. The purified aqueous plutonium stream from the 1BS column continued to the final (second and third) plutonium cycles. The organic stream from the plutonium partition column (column 1BX), which contained neptunium and uranium, was routed to the third extraction column (column 1C) (HW-31000-DEL; WHC-SP-0479).

In the third extraction column (column 1C), the remaining organic phase (containing the uranium and neptunium) was contacted with a new aqueous phase of low-salt content. The uranium and neptunium were stripped from the organic phase (TBP/NPH) to an aqueous phase. The aqueous uranium and neptunium solution was directed via steam jets to the 1CU concentrator. In the concentrator, the aqueous solution from column 1C was combined with the back-cycle condensate (product stream containing uranium) and together were steam stripped to remove the

entrained organic phase. When the volume of the aqueous solution was condensed, the aqueous solution was routed to the final uranium and neptunium cycles. The spent organic solvent was routed to the solvent system #1 feed tank for purification (HW-31000-DEL; WHC-SP-0479).

The primary waste stream generated by the first extraction cycle (extraction columns 1-3) was an aqueous stream containing fission products from the dissolved uranium fuel-element stream and spent solvent. The aqueous stream containing fission products exited out the bottom of the first extraction column and was sent to the waste concentrator within the waste treatment system for further treatment before final disposal in the underground storage tanks. Spent solvent from the separation process contained small amounts of uranium, plutonium, and fission products and was routed to the first solvent treatment system for purification before being recycled into the extraction process (HW-31000-DEL; WHC-SP-0479).

The final (second and third) plutonium cycle extraction columns operated similarly to the original solvent-extraction columns. The purified plutonium stream from the partition extraction and purification columns (columns 1BX and 1BS) was routed to the second plutonium cycle for further plutonium purification. The aqueous plutonium stream was routed into an evaporation/mixing tank (J-5) and oxidized by the addition of sodium nitrite and nitric acid. The plutonium solution then was routed into the first of four extraction columns. A nitric acid scrub solution and an organic TBP/NPH solution entered the column from the top and bottom, respectively. The plutonium was extracted to the organic phase and routed to the bottom of column 2B. In column 2B, plutonium was partitioned from uranium, neptunium, and fission products by converting the plutonium in the organic to an aqueous phase by the addition of hydroxylamine nitrate and hydrazine. Hydroxylamine nitrate served as a reductant, while the hydrazine was used to chemically neutralize the oxidizing power of the previously added sodium nitrite and concentrated nitric acid. The resulting aqueous stream of plutonium was purified and concentrated by the second plutonium cycle. This stream was collected in feed makeup tank TK-L3. Additional amounts of concentrated nitric acid and/or sodium nitrite were added to oxidize the plutonium. Plutonium was readily extracted into the organic phase (TBP/NPH) and partitioned from any uranium, neptunium, and fission productions in column 3A or the first column in the third plutonium cycle. The organic product solution from column 3A then was directed to column 3B (last column of the final plutonium cycle). In column 3B, the plutonium was extracted from the organic phase back to an aqueous phase by the addition of dilute nitric acid. The aqueous plutonium then was sent to the 3BP plutonium stripper and concentrator units where the volume was reduced and, thus, the plutonium was concentrated. After final purification and concentration operations, the plutonium product was routed to a different Hanford Site facility for final processing and shipment off-site (HW-31000-DEL; WHC-SP-0479).

The primary waste streams generated by the second and third plutonium cycles were aqueous streams containing impurities from the plutonium stream produced in the first extraction cycle, spent solvent also containing trace impurities from the plutonium stream, and off-gases from the stripper and concentrator. The aqueous streams were directed to the back-cycle waste treatment system for further treatment and were recycled back into the process. The spent solvent waste streams were recycled into the 1BX feed tank (TK-J3) and reincorporated into the feed entering the plutonium partition or column 1BX. In addition, the plutonium product stream was concentrated before shipping. All of the waste streams generated during the second and third

plutonium cycles received further treatment before disposal; therefore, no waste management units received wastes directly from this process (HW-31000-DEL; WHC-SP-0479).

The aqueous uranium-rich stream from column 1C and the 1CU concentrator in the first extraction cycle was directed through the final uranium cycle or additional purification cycles (similar to the first extraction cycle described above) to achieve the desired purity. Before the uranium entered the first extraction column, it was routed to a feed makeup tank (TK-K1), where concentrated nitric acid and hydrazine were added to neutralize any nitrite remaining in solution. The feed entered the first final cycle extraction column (column 2D) just above the mid-point, while hydroxylamine nitrate scrub solution used to separate plutonium from uranium was added from the top of the column. The column 2D extractant, recycled TBP/NPH solvent from the solvent treatment system 2, was pulsed into the bottom of the column. The partition of the uranium into the organic phase was accomplished by limiting the amount of organic phase present and scrubbing the solution with hydroxylamine nitrate, followed by demineralized water. The hydroxylamine nitrate reducing agent converted the plutonium remaining in the solution, ensuring that the plutonium remained in an aqueous solution while the uranium was extracted to an organic phase. The demineralized water reduced the acid content of the uranium product in the organic stream, which minimized corrosion of the final uranium cycle concentrator. The organic product stream then was directed to column 2E. Column 2E served the same purpose as did column 1C (to strip the uranium from an organic phase to an aqueous phase by adding dilute nitric acid). The aqueous uranium stream produced by the final uranium extraction cycle was routed to the 2EU concentrator, where it was steam stripped before final shipment. The purified uranium stream then was directed to a different Hanford Site facility, where the uranyl nitrate was calcinated to UO_3 for shipment off-site. Figure 1-4 illustrates the PUREX process flow (HW-31000-DEL; WHC-SP-0479).

Waste streams generated by the final uranium cycle were very similar to those produced by the second and third plutonium cycles. Aqueous wastes (containing neptunium) were directed to the back-cycle waste treatment system, and spent solvent was directed to the solvent recovery system 2 for treatment. In addition, the aqueous uranium product stream was steam stripped before final shipment. This produced a gaseous stream containing mainly water vapor and traces of uranium and spent solvent (TBP/NPH). All of the waste streams generated during the final uranium cycle received further treatment before disposal; therefore, no waste management units received wastes directly from this process (HW-31000-DEL; WHC-SP-0479).

The aqueous neptunium stream was sent to a collection tank and concentrated in concentrator E-F6 within the back-cycle waste treatment system. A portion of the concentrated waste was recycled to the first or HA column in the first extraction cycle. The rest of the concentrated waste (3WB) was directed to a feed tank within the neptunium recovery cycle. The neptunium recovery cycle or second neptunium cycle was a three-part transient process that was added to PUREX Plant operations in 1962. Phase I of the operation served to accumulate neptunium from the back-cycle waste streams. From the feed tank, the aqueous solution was pumped into column 2N, a dual-purpose extraction/scrub column containing a continuous organic phase. The neptunium and plutonium were reduced by the ferrous sulfamate and hydrazine scrub solution to extractable and inextractable forms. Thus neptunium and uranium were extracted into the organic (TBP/NPH) phase, and plutonium remained in the aqueous waste solution. Recycled solvent from solvent treatment system 1 entered below the extraction section

of the column and scrubbed entrained aqueous-phase contaminants from the organic products. The organic phase was routed to the bottom of column 2P. Column 2P (continuous with an aqueous solution of dilute nitric acid) stripped the neptunium from the uranium in the organic phase. The aqueous waste from column 2N containing plutonium was routed to a back-cycle waste collection tank, while the organic waste stream from column 2P was routed and recycled into the 1BX feed tank (HW-31000-DEL; WHC-SP-0479).

Phase II of the neptunium recovery operation was similar to phase I. The phases differed in that a solution of concentrated nitric acid was used as the feed into column 2N rather than the concentrated waste stream (3WB) that contained plutonium, uranium, neptunium, and fission products. Phase II purified and concentrated the neptunium by continually removing and reducing the amounts of uranium, plutonium, and fission products present. The resulting aqueous neptunium product from column 2P was sampled (HW-31000-DEL; WHC-SP-0479).

Phase III was the transfer of the concentrated neptunium from column 2P either to anion-exchange columns for purification or to tank TK-J2 for storage. The neptunium was transferred by air jet to either location. Once approximately 90 percent had been transferred, the neptunium recovery operations reverted to Phase I (HW-31000-DEL; WHC-SP-0479).

The final step of neptunium treatment was purification. The aqueous neptunium solution was air jetted to a feed receiver tank and then to the 2PN stripper/concentrator tank. In this tank, recycled nitric acid was added. The tank also served as an interface between the continuous neptunium recovery operations and the batch-wise purification process. The neptunium/nitric acid solution was routed to the stripper/concentrator, which removed any entrained or dissolved organic from the 2PN stream and reduced the volume by a factor of approximately 4.5. This concentrated solution was then routed to the 3XF feed tank, where the neptunium was reduced by the addition of hydrazine and use of the 3X anion exchange column. The anion exchange column contained Amberlite IRA-99 resin¹ that required pretreatment, including degassing and washing with nitric acid and hydrazine. The neptunium then was loaded onto the resin bed. The remaining solution was routed to a waste collection tank (TK-Q5). Plutonium was adsorbed onto the resin and would be carried through with the neptunium if not selectively removed. Thus, a scrub solution containing ferrous sulfamate and concentrated nitric acid was applied to the column to remove the plutonium, while hydrazine was added to keep the neptunium bonded to the anionic resin. To remove any remaining fission products, another scrub solution was applied to the column. This solution contained concentrated nitric acid and fluoride to remove the fission products, ANN to reduce the corrosivity of the fluoride, and hydrazine to maintain the resin/neptunium bond. A third scrub solution (concentrated nitric acid) was applied to the column to remove residual amounts of fluoride. All scrub effluents were collected in tank TK-Q5. Sodium nitrite was added to the waste collection tank to neutralize the hydrazine. This solution then was routed back to the waste collection tank in the back-cycle waste treatment system (HW-31000-DEL; WHC-SP-0479).

¹ Amberlite is a registered trademark of Rohm and Haas Company, Philadelphia, Pennsylvania.

1.7.2.4 Solvent Recovery

With repeated use, the organic solvent (TBP/NPH) used by the PUREX process degraded and became contaminated. Because of the high cost of fresh solvent and of disposing of used solvent, it was necessary to regenerate and reuse the spent TBP/NPH. Two solvent treatment systems were used to treat the spent solvent and minimize the contamination of the uranium product by impurities in the solvent or cross-contamination with the plutonium product. Thus, the organic waste streams from the initial extraction cycle columns, second and third plutonium extraction columns, and the back-cycle waste treatment systems were routed to solvent treatment system 1 because of their levels of contamination. The organic waste stream from the final uranium cycle was routed to solvent treatment system 2 because of its level of purity. The impurities removed from spent PUREX solvent included organic degradation products (dibutyl phosphate and monobutyl phosphate), entrained solids (nitrates/aqueous phase salts), fission products, and uranium, neptunium, and plutonium contaminants from column processes (HW-31000-DEL; WHC-SP-0479).

To remove these contaminants, an alkaline (sodium carbonate-potassium permanganate) wash was performed batch-wise in a wash tank of each solvent treatment system. To enhance separation of the aqueous and organic phases, these tanks were packed with Raschig² rings, which allowed more contact between the phases. The aqueous waste stream from the solvent treatment system 1 wash tank was routed to a waste collection tank before disposal in underground tanks. The aqueous waste solution from the solvent treatment system 2 wash tank either was rerouted to be used in the solvent treatment system 1 operations or was sent to a waste collection tank before final disposal in underground storage tanks. The organic stream from the wash tanks was directed to columns 1O and 2O, where a dilute solution of nitric acid was used, recirculated, and reused to scrub entrained impurities. The nitric acid scrub stream was recirculated/reused for approximately 24 hours. After the 24-hour period, the scrub solution from column 1O was routed to a waste collection tank for ultimate disposal in underground storage tanks, and the scrub solution from column 2O was routed to column 1O to be used as scrub solution. The purified organic solvent from column 1O was sent to a solvent receiver tank and routed to columns HA, 1BS, 2A, 3A, or 2N pending process solvent requirements. The purified solvent from column 2O was sent to a different solvent receiver tank and routed to column 2D pending process solvent requirements (HW-31000-DEL; WHC-SP-0479).

1.7.2.5 Acid Recovery

The PUREX Plant was provided with support structures for the recovery of the salting agent (nitric acid). More than 80 percent of the nitric acid present in the aqueous waste streams from the solvent extraction operations was reclaimed in a reusable form. By recovering the nitric acid instead of neutralizing it and routing it to storage in underground storage tanks, large amounts of caustic, nitric acid, and waste storage space were achieved. Recovered acid streams were received by the 206-A Building (nitric acid recovery/recycle operations) from three main sources within the PUREX Plant. Nitric acid was recovered from off-gases generated during metal dissolution at each of the three dissolver towers (water-cooled condensers) that functioned as

² Raschig is a trademark of Raschig GmbH, Ludwigshafen, Germany.

first-stage off-gas scrubbers, ammonia scrubber catch tanks, and the back-up facility located in the 293-A Building. (There the off-gases were treated with hydrogen peroxide in two acid absorber towers [XA and XB] in series.) The second main source of nitric acid recycled from the PUREX Plant occurred when acid was driven off during process waste concentration and denitration operations conducted within the back-cycle waste treatment system. The third main source of recovered nitric acid was that recovered in the UO_3 Plant and transferred back to the nitric acid recovery system (206-A Building) via railroad tank cars (HW-31000-DEL; WHC-SP-0479).

Nitric acid fractionation operations concentrated the acid from the main sources for reuse in the PUREX Plant. It also destroyed residual ammonium nitrate from the absorption of ammonia in the back-up facility. The acid solutions from the various absorbers were routed to collection tank TK-F3 and then sent to tank TK-U5, where blending with the nitric acid recovered in the UO_3 Plant occurred before the solutions were directed to the T-U6 tower. The fractionator was a 14-tray bubble-cap tower, operated under vacuum to reduce corrosion rates. The dilute acid feed was pumped into the column above the midpoint. The reboiler section operated with a constant boiling mixture of 50 percent nitric acid. Acid vapors from the reboiler passed upward through the bubble caps and were absorbed by the descending solution. The resulting overhead vapor (99.5 percent steam) exited the top of the tower and was condensed in the E-U6-1 condenser and directed to the back-cycle waste system feed tank. The bottom of the acid fractionation tower was routed to the sample gallery for temporary storage before it was reused in the PUREX Plant (HW-31000-DEL; WHC-SP-0479).

1.7.2.6 Waste Treatment

After the PUREX Plant resumed operations in November 1983, the back-cycle waste treatment system collected and treated all of the aqueous PUREX waste before it was released to the atmosphere. Before 1983, some of the low-level process distillates and condensates were released without being recycled or treated. Three distinct groups of liquid process waste resulted from PUREX Plant operations, and different handling and disposal procedures were employed for each of these waste groups (HW-31000-DEL; WHC-SP-0479).

High-activity waste resulted from the cladding dissolution, metal dissolution, and first extraction column (HA) waste. This waste was sent to high-level waste collection tank TK-F7, concentrated in E-F6, and sampled. Sugar was used to denitrate the waste, and dilution water (recycled from condensate from the E-F5 condenser) was added to improve nitric acid recovery from the high-level wastes and suppress ruthenium volatilization in the form of ruthenium tetroxide. If recoverable levels of plutonium and/or uranium were present, the waste was routed to the waste rework handling tank TK-F8 and boiled/refluxed for at least 21 days in the E-F9 condenser. The rework waste then was transferred batch-wise to tank TK-E6 for blending with the feed and was recycled through the PUREX extraction operations. However, if the waste contained only fission products, it was routed from the E-F6 concentrator to the underground storage tanks for disposal. The off-gases from the high-level waste concentrators passed upwards through the two mist eliminators located in the deentrainment tower and finally to the nitric acid recovery equipment. The condensate formed in the upper mist eliminators was returned to the solution section of the concentrator (HW-31000-DEL; WHC-SP-0479).

The acid and water vapors that exited the waste concentrator via the concentrator tower and deentrainer were routed to the back-cycle waste acid absorber (T-F5), where nitric acid was recovered. The acid absorber was a 15-tray bubble-cap tower that ran at atmospheric pressure. The nitric acid was recovered by a counter-current flow of vapors and a water reflux stream. The off-gases (99.5 percent steam) of the adsorption tower passed to a condenser where the condensate was recycled as dilution water back into the waste feed tank. The bottoms of the absorption tower (concentrated nitric acid) were directed to the absorber receiver tank (TK-F3) and combined with the acid product from the XA and XB acid absorbers of the dissolved off-gas treatment system. This acid product then was routed to the nitric acid recovery operation in the 206-A Building for further purification (HW-31000-DEL; WHC-SP-0479).

The second type of aqueous waste generated by PUREX operations consisted of cooling water, used sanitary water including laundry, kitchen, and bathroom facilities, and chemical sewers. This stream was routed to various ditches and ponds for disposal.

The third type of aqueous waste generated by PUREX operations was low-level waste. Low-level wastes included the 291-A Stack drainage, various condensed process drainages, and liquid effluents from the silver reactor, condensers, and filters. Additional low-level liquid wastes were generated by nitric acid recovery/storage, uranium pretreatment and storage, the back-cycle waste treatment system, process condensates (the concentration stages of the PUREX process), and process drainages from all other operations conducted within the PUREX Facility. In the last years of operation, these wastes were reworked, neutralized, and routed to underground storage tanks for disposal. However, from 1955 until 1988, the low-level wastes were combined and treated, usually by redistillation or concentration. After redistillation, the aqueous waste was sampled to ensure that it met cribbing tolerances. If the low-level waste was within tolerances, the waste was routed to a drainage receiver tank or a condensate receiver tank (200-E-58) for storage and neutralization or final disposal to the 216-A Cribs. However, if the aqueous waste was not within cribbing tolerances, it was rerouted to a collection/feed tank within the waste handling-rework operation and reprocessed in hopes of achieving cribbable tolerances or was sent directly to underground storage tanks for disposal. The 216-A Cribs that received process discharge from the PUREX Plant include 200-PW-2 OU waste sites 216-A-10, 216-A-5, 216-A-3, 216-A-22, 216-A-28, and 216-A-45 (cribs). The 216-A-1 Crib and 216-A-18, 216-A-19, and 216-A-20 Trenches received the same type of waste from earlier start-up and cold runs in which nonirradiated uranium was used (HW-31000-DEL; WHC-SP-0479).

Table 1-1 lists the main chemical processes used in the PUREX Canyon, as well as the chemicals that were used in each process. Figure 1-4 shows graphical representations of the PUREX Canyon processes and the corresponding waste streams that were generated.

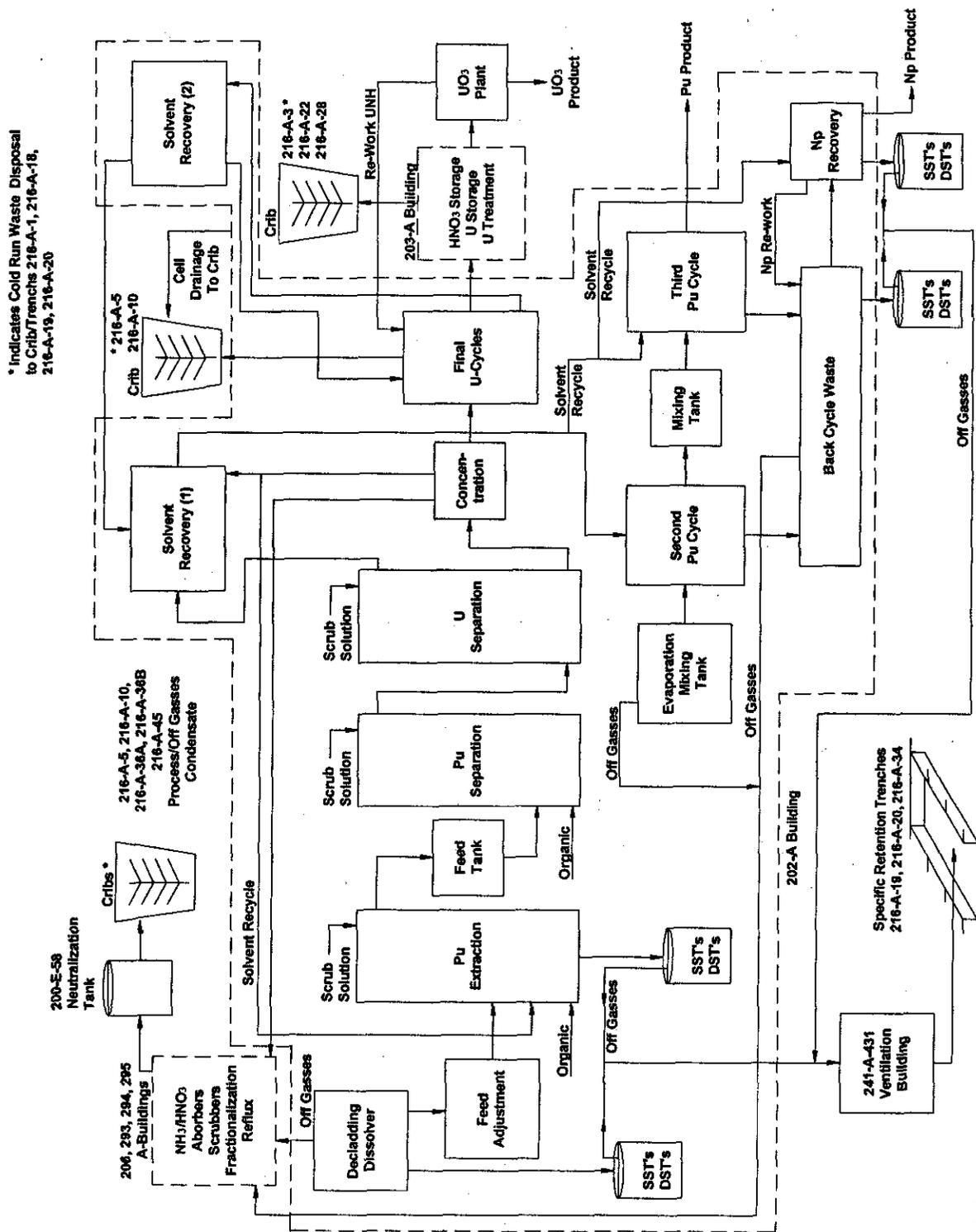
Table 1-1. PUREX Process Chemicals. (2 pages)

Process	Chemical Inputs
Metal dissolution and feed preparation	Aluminum nitrate nonahydrate Nitric acid Hydrogen peroxide
Dissolver offgas treatment and ammonia scrubber waste concentration	Ammonium hydroxide Ammonium fluoride
Cladding waste cycle	Ammonium fluoride/ammonium nitrate Aluminum nitrate nonahydrate Potassium hydroxide Sodium hydroxide Sodium nitrite
Decontamination and partition cycle	Sodium nitrite Normal paraffin hydrocarbon Tributyl phosphate Nitric Acid Ferrous sulfamate Sulfamic acid
Uranium cycle	Normal paraffin hydrocarbon Tributyl phosphate Hydrazine Nitric acid Hydroxylamine nitrate
Plutonium cycle	Normal paraffin hydrocarbon Tributyl phosphate Sodium nitrite Hydrazine Nitric acid Hydroxylamine nitrate Sucrose
Neptunium recovery and purification cycle	Normal paraffin hydrocarbon Tributyl phosphate Hydrazine Ferrous sulfamate Nitric acid Hydroxylamine nitrate
Backcycle waste system	Nitric acid
Solvent recovery	Normal paraffin hydrocarbon Tributyl phosphate Sodium carbonate Potassium permanganate Nitric acid Sodium nitrite Sodium hydroxide
Waste concentration and treatment	Sodium hydroxide Sodium nitrite Aluminum nitrate nonahydrate Nitric acid
Acid recovery	Aluminum nitrate nonahydrate Nitric acid
Aqueous makeup	Nitric acid Cadmium nitrate

Table 1-1. PUREX Process Chemicals. (2 pages)

Process	Chemical Inputs
	Sodium nitrite Sodium hydroxide
Uranium storage tanks	Uranyl nitrate hexahydrate Nitric acid
Chemical tanks	Normal paraffin hydrocarbon Tributyl phosphate
Effluent discharge systems	Potassium hydroxide Sodium hydroxide Sodium nitrite

Figure 1-4. Plant Processes and Waste Streams at the Plutonium Uranium Extraction Plant.



PUREX-01.DWG

1.8 DATA QUALITY OBJECTIVE TEAM MEMBERS, KEY DECISION MAKERS, AND REGULATORY MILESTONES

Tables 1-2, 1-3, and 1-4 identify the DQO team members, DQO key decision makers and their appointed designees, and the proposed project schedule, respectively. The team members listed below are those individuals who contributed to the development of the PUREX Canyon DQO process. The DQO team members participated in the seven-step DQO process briefings and reviews, and the DQO key decision makers or designees provided external review of the results of the process.

Table 1-2. PUREX Canyon Data Quality Objectives Team Members.

Name	Organization	Area of Expertise (Role)
Bauer, Roy	Fluor Hanford, Inc.	Interview and workshop facilitator/DQO SME
Fort, Dave	Fluor Hanford, Inc.	Engineering
Haas, Chris	Polestar Applied Technology, Inc.	Document production lead
Jacobs, Ed	Fluor Hanford, Inc.	Project Management
Mills, Matt	Polestar Applied Technology, Inc.	Historical documentation reviewer
Narquis, Cliff	Fluor Hanford, Inc.	Environmental Quality Assurance
Nazarali, Alex	Fluor Hanford, Inc.	Radiological Control
Robertson, Julie	Fluor Hanford, Inc.	Regulatory Lead – PUREX Characterization
Ruck, Fred	Fluor Hanford, Inc.	CERCLA subject matter expert
Steffen, Jim	Fluor Hanford, Inc.	Engineering
Stevens, Mike	Fluor Hanford, Inc.	Director, D&D and Remediation Projects
Zinsli, Lloyd	Fluor Hanford, Inc.	PUREX Facility Operations SME

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act.

DQO = data quality objective.

ECO = environmental compliance officer.

PUREX = Plutonium-Uranium Extraction.

S&M = surveillance and maintenance.

SME = subject matter expert.

Table 1-3. PUREX Canyon DQO Decision Makers and Designees. (2 Pages)

Name	Organization
Matt McCormick	DOE-RL
Wade Woolery	DOE-RL
Ron Skinnerland	Ecology

Table 1-3. PUREX Canyon DQO Decision Makers and Designees. (2 Pages)

Name	Organization
Rick Bond	Ecology
Jennifer Ollero	Ecology
Nick Ceto	EPA
Craig Cameron	EPA

DOE-RL = U. S. Department of Energy, Richland Operations Office.
EPA = U.S. Environmental Protection Agency.

There are no regulatory milestones associated with the PUREX Canyon DQO. Table 1-4 outlines the proposed schedule for completion of the PUREX Canyon DQO, based on the FH baseline schedule.

Table 1-4. Proposed Project Schedule.

Task	Timeframe
Management briefings, DQO interviews, project scoping	February – April 2007
DQO process	April – July 2007
Document review and comment; RL and Ecology briefings	July – September 2007
DQO summary report completion	September 30, 2007

DQO = data quality objective.

1.9 EXISTING SOURCES OF DATA

Table 1-5 presents a list of the references and data sources reviewed during the project scoping process. This information was reviewed to gain as much knowledge as possible regarding PUREX Canyon operations. This information also formed the basis for selection of the contaminants on the master COPC list.

Table 1-5. Existing Documents and Data Sources for the PUREX Canyon. (4 Pages)

Reference	Summary
<i>Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-2 Uranium-Rich Process Waste Group Operable Unit, BHI-01411 Rev 0, L.C. Hulstrom, (BHI 2000a)</i>	Information pertaining to COPCs.
<i>Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities Through June 1958, HW-57649 (Baldrige 1958)</i>	Summary of radioactive wastes discharged to major disposal sites in the 200 East Area through June 1958.

Table 1-5. Existing Documents and Data Sources for the PUREX Canyon. (4 Pages)

Reference	Summary
<i>Index of CPD Crib Building Numbers Designs of CPD Radioactive Liquid Waste Disposal Sites, HW-55176 (GE 1958)</i>	References to PUREX liquid waste disposal sites that include design sketches.
<i>Properties and Environmental Impact of Ammonia Scrubber Discharge Waste to the 216-A-36B Crib, WHC-EP-0100 (WHC 1988)</i>	Characterization data of the discharge of waste materials from the ammonia scrubber to the 216-A-36B Crib.
<i>PUREX Plant Source Aggregate Area Management Study Report, DOE/RL-92-04 (DOE-RL 1993c)</i>	Waste unit descriptions including cribs, French drains, septic tanks, and drain fields, trenches and ditches, ponds, catch tanks, settling tanks, diversion boxes, underground tank farms designed for high-level liquid wastes, and the lines and encasements that connect them. Waste sites are described separately.
<i>PUREX Facility Preclosure Work Plan, DOE/RL-95-78 Rev. 0 (DOE-RL 1995c)</i>	Information regarding end state of permitted tanks subsequent to flushing activities that took place as part of transition of the facility.
<i>A Brief History of the PUREX and UO3 Facilities, WHC-MR-0437 (WHC 1993)</i>	Historical data regarding plant operations, plant upsets, and general history.
<i>Part A Dangerous Waste Permit, PUREX Plant, DOE/RL-88-21, as amended (DOE-RL 2002)</i>	Information regarding RCRA-permitted tanks, and areas within the PUREX Canyon.
<i>PUREX Plant Final Safety Analysis Report, Revisions 3, 4, and 5, SD-HS-SAR-001 (Manry and Prosk 1985)</i>	Chronology of significant events that took place at PUREX.
<i>Summary of Liquid Radioactive Wastes Discharged to the Ground -- 200 Areas July 1952 Through June 1954, HW-33591 (Heid and Paas 1954)</i>	Summarizes radioactive contamination discharged to the ground from separation facilities.
<i>Radioactive Contamination in Liquid Wastes Discharged to Ground Separation Facilities Through December 1957, HW-55593 (Bernard 1958)</i>	Summarizes radioactive contamination discharged to the ground from separation facilities through December 1957.
<i>Radioactive Contamination in Liquid Wastes Discharged to Ground at the Separations Facilities Through December 1959, HW-64375 (GE 1960)</i>	Summarizes radioactive contamination discharged to the ground from separation facilities through December 1959.

Table 1-5. Existing Documents and Data Sources for the PUREX Canyon. (4 Pages)

Reference	Summary
<i>Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities Through December 1958</i> , HW-59359 (Baldrige 1959)	Summarizes radioactive contamination discharged to the ground from separation facilities through December 1958.
<i>Lead Regulatory Agency for 200 Area Canyons and 100/300/400/600 Area Facilities</i> , Letter from EPA (Sherwood) and Ecology (Wilson) to USDOE (Ms. Linda McClain) (Wilson and Sherwood 1996)	Documents the fact that the PUREX Plant will have regulatory oversight by the Washington State Department of Ecology.
<i>Agreement In Principle (AIP) Including Path Forward For Canyon Disposition Initiative (CDI)</i> , Letter from Linda K. Bauer, Assistant Manager for ER (USDOE) to EPA (Sherwood) and Ecology (Wilson) (Bauer 1996)	Documents that the PUREX Canyon may utilize the CERCLA process for final disposition.
<i>200 Areas Disposal Sites for Radioactive Liquid</i> , ARH-947 (Curren 1972)	Information pertaining to COPCs.
<i>Radiological History Of The PUREX Facility 1955 to 1989</i> (Hodges 1989)	Provides information pertaining to historical radiological contamination events in the PUREX Plant.
<i>PUREX Technical Manual</i> , HW-31000-DEL (GE 1955)	Process information on PUREX Plant facilities, chemicals used or stored, and operations and maintenance information including process effluent sampling/analysis methods and theory behind the materials, chemicals, and equipment used during the PUREX process.
<i>200 Areas Remedial Investigation/Feasibility Study Implementation Plan-Environmental Restoration Program</i> , DOE/RL-98-28 (DOE-RL 1999)	Background waste site information and generic strategy for 200 Area waste site investigations.
<i>Final Hanford Comprehensive Land -Use Plan Environmental Impact Statement</i> , DOE/EIS-0222-F (DOE 1999)	Land-use plan for the Hanford Site.
<i>Structural Calculations Supporting the Final Feasibility Study for the Canyon Disposition Initiative, 221-U Facility</i> , HNF-8379 (HNF 2001)	Reference material that may apply to the structural evaluation for the PUREX Canyon.
<i>PUREX Plant Final Safety Analysis Report, SD-HS-SAR-001</i> (SD-HS-SAR-001 1985)	Chronology of significant events that took place at PUREX.
<i>200 East Groundwater Aggregate Area Management Study Report</i> , DOE/RL-92-19 (DOE-RL 1993a)	Hydrogeology report.
<i>PUREX Technical Manual</i> , WHC-SP-0479 (WHC 1989)	Information pertaining to operations and input chemicals.

Table 1-5. Existing Documents and Data Sources for the PUREX Canyon. (4 Pages)

Reference	Summary
<i>PUREX Plant Process Condensate Stream-Specific Report</i> , WHC-EP-0342, Addendum 12 (WHC 1990b)	Process information on PUREX Plant facilities, chemicals used or stored, and operations and maintenance information.
<i>PUREX Plant Ammonia Scrubber Condensate Stream-Specific Report</i> , WHC-EP-0342, Addendum 14 (WHC 1990a)	Process information on PUREX Plant facilities, chemicals used or stored, and operations and maintenance information.
<i>Hanford Site Atlas</i> , BHI-01119, Rev. 1 (BHI 1998)	Site maps.
<i>Remedial Investigation DQO Summary Report for the 200-PW-2 Uranium-Rich Process Waste Group Operable Unit</i> , BHI-01411, (BHI 2001b)	Information pertaining to COPCs.
<i>Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-4 Operable Unit</i> , CP-14176 (CP 2002a)	Information pertaining to COPCs.
<i>Data Quality Objectives Summary Report for the Designation of the 200-PW-2 and 200-PW-4 Investigation Derived Wastes</i> , CP-14682 (CP 2002b)	Information pertaining to COPCs.
<i>200-CW-1 Operable Unit Data Quality Objectives</i> , BHI-01239 (BHI 1999)	Information pertaining to COPCs.
<i>PUREX Deactivation End Points</i> , WHC-SD-WM-TPP-053 (WHC 1997)	Provides references to many documents that detail the transition phase of the PUREX Canyon. This information includes radiological survey reports, details of hazardous chemicals removed from the plant, and building structural information.
<i>Data Quality Objectives Summary Report for the 221-U Canyon Disposition Alternatives</i> , BHI-01091 (BHI 1997)	The PUREX DQO incorporates the format of the 221-U DQO to the extent practicable.
Internal Memo, R. L. Hobart (B&W Hanford Co.) to W. A. Peiffer (B&W Hanford Co.), <i>PUREX Facility Plutonium and Fission Product Residual Estimates</i> , 17000-97-007, dated February 10, 1997 (WHC 1997a)	Plutonium, uranium, and mixed fission product inventory estimates for the PUREX Canyon
Internal Memo, R. W. Bailey (B&W Hanford Co.) to J. J. McGuire (B&W Hanford Co.), <i>Surveillance and Maintenance Plan for the Plutonium Uranium Extraction Facility</i> , BWHC-9760225, dated October 29, 1997 (BWHC 1997)	Information pertaining to hazardous material and/or waste remaining in the PUREX Canyon

1.10 CONTAMINANTS OF POTENTIAL CONCERN

A master list of COPCs was developed for the PUREX Canyon by first identifying all the possible contaminants (i.e., feed, process, laboratory, maintenance, waste) that may have been associated with plant operations, based primarily on historical process operation information. This relatively large list of COPCs (Table 1-6) was evaluated to exclude contaminants based on practical factors (e.g., short radionuclide half-life, process knowledge) and risk information (i.e., toxicological criteria or low/absent risk). Table 1-7 presents the COPCs excluded and the reasons for their exclusion. Table 1-8 presents the final COPC list with the excluded contaminants removed from the list.

In addition to specific COPCs, the laboratory will be instructed to report any additional contaminants detected while performing the various chemical analyses capable of determining many constituents simultaneously, (e.g., ICP, GC/MS, GEA, AEA). These may be reported as tentatively identified compounds (TICs), estimated elemental concentrations, or as part of a standard suite of results. It is acknowledged that many of these "opportunistic" or "method-based" results may be flagged as estimates due to lack of rigorous laboratory calibration or other QC. Nevertheless the estimated values may be of adequate quality to support some decisions.

Table 1-6. Master Radiological and Chemical Contaminants of Potential Concern. (3 Pages)

PUREX Canyon COPCs.			
<i>Radiopaque Contaminants of Potential Concern</i>			
Americium-241	Curium-244	Plutonium-238	Tellurium-129m
Americium-242	Curium-245	Plutonium-239/240	Tellurium-129
Americium-243	Europium-152	Plutonium-241/242	Thorium-232
Antimony-123	Europium-154	Praseodymium-143	Tin-113
Antimony-125	Europium-155	Praseodymium-144	Tin-123m
Barium-137	Iodine-129	Promethium-147	Tin-123
Barium-137m	Iodine-131	Radium-226	Tin-125
Barium-140	Lanthanium-140	Radium-228	Tin-126
Cadmium-113m	Neodymium-147	Rhodium-106	Tritium (Hydrogen-3)
Carbon-14	Neptunium-237	Ruthenium-103	Uranium-232
Cerium-141	Neptunium-239	Ruthenium-106	Uranium-233/234
Cerium-144	Nickel-59	Samarium-149	Uranium-235/236
Cesium-134	Nickel-63	Samarium-151	Uranium-238
Cesium-135	Niobium-93m	Selenium-79	Yttrium-90
Cesium-137	Niobium-95	Strontium-89	Yttrium-91
Cobalt-60	Niobium-96	Strontium-90	Zirconium-93
Curium-242	Niobium-98	Technetium-99	Zirconium-95
Curium-243	Palladium-107		
<i>Inorganic Contaminants of Potential Concern</i>			

Table 1-6. Master Radiological and Chemical Contaminants of Potential Concern. (3 Pages)

PUREX Canyon COPCs.			
Aluminum	Anionic resins (sulfates)	Chromium	Lanthanum
Aluminum fluoride	Antimony	Chromium nitrate	Lanthanum fluoride
Aluminum nitrate	Arsenic	Copper	Lanthanum hydroxide
Aluminum nitrate nonahydrate (ANN)	Barium	Cyanide(s)	Lanthanum nitrate
Aluminum nitrate (mono basic)	Beryllium	Ferric ammonium sulfate	Lead
Aluminum silicate	Bismuth	Ferric hydroxide	Lead oxide
Aluminum sulfate	Bismuth subnitrate/oxynitrate	Ferric nitrate	Magnesium
Ammonia	Bismuth orthophosphate	Ferrous ammonium sulfate	Magnesium nitrate
Ammonium cerium nitrate	Borate(s)	Ferro/ferric cyanide	Manganese
Ammonium hydroxide	Cadmium	Ferrous sulfamate	Manganese oxide
Ammonium iron fluoride	Calcium	Fluoride	Manganese nitrate
Ammonium iron sulfate	Calcium carbonate (lime)	Hydrochloric acid	Mercury
Ammonium lanthanum nitrate	Calcium nitrate	Hydrofluoric acid	Molybdenum
Ammonium oxalate	Cerium	Hydroiodic acid	Nickel
Ammonium fluoride/ammonium nitrate (AFAN)	Cerium phosphate	Hydrogen	Nickel sulfate
Ammonium fluorosilicate	Cesium nitrate	Hydrogen peroxide	Nitrate
Ammonium sulfate	Cesium phosphate	Hydroxide	Nitrite
	Chloride	Iron	Nitric acid
	Chromic acid	Iron sulfate	

Table 1-6. Master Radiological and Chemical Contaminants of Potential Concern. (3 Pages)

PUREX Canyon COPCs.			
<i>Inorganic Contaminants of Potential Concern (cont)</i>			
Ozone	Potassium nitrate	Sodium metabisulfate	Sulfate
Peroxide	Potassium permanganate	Sodium nitrate	Sulfite
Phosphate	Ruthenium oxide	Sodium nitrite	Sulfuric acid
Phosphoric acid	Selenium	Sodium oxalate	Tin
Phosphotungstic acid (PTA)	Silicon	Sodium silicate	Tungsten
Plutonium	Silver	Sodium sulfate	Uranium
Plutonium fluoride	Sodium	Sodium hydrogen sulfate	Uranium dioxide
Plutonium dioxide	Sodium aluminate	Sodium phosphate	Uranium trioxide
Plutonium nitrate	Sodium bicarbonate	Disodium phosphate	Uranyl nitrate
Plutonium peroxide	Sodium carbonate	Sodium pyrophosphate	Vanadium
Potassium	Sodium chloride	Sodium uranyl carbonate	Zinc
Potassium carbonate	Sodium dichromate	Disodium uranyl oxide	Zinc nitrate
Potassium chloride	Sodium fluoride	Strontium (metal)	Zinc phosphate
Potassium dichromate	Sodium hexametaphosphate	Strontium carbonate	Zirconium
Potassium hydroxide	(Calgon)	Strontium nitrate	Zirconium carbonate gel
Potassium fluoride	Sodium hydroxide	Sulfamic acid	Zirconyl nitrate
<i>Organic Chemical Contaminants of Potential Concern</i>			
Acetic acid	1,1-dichloroethane (1,1-DCA)	Methoxydiglycol	Sodium gluconate
Acetone	1,2-dichloroethane (1,2-DCA)	Methoxytriglycol	Sodium tetraphenyl boron
AMSCO	1,1-dichloroethylene (1,1-DCE)	Methyl n-butyl ketone (MBK 2-Hexanone)	Sugar
Benzene	Dimethylnitrosamine	2-Methylnonane	Sulfonic acid (Chloro)
Benzaldehyde	3,5-Dimethylpyridine	Methyl n-propyl ketone (MPK 2-Pentanone)	Tartaric acid
Benzyl alcohol	Dodecane	Mono-2-ethylhexyl phosphoric acid	Tetrachloroethylene (PCE)
Bromodichloromethane	Ethoxytriethylene glycol	Monobutyl phosphate	Tetradecane
Butanol (butyl alcohol)	Ethyl ether (ethanol)	n-butyl benzene	Tetrahydrofuran (THF)
2-butanone (methyl ethyl ketone/MEK)	Ethylene diamine tetraacetate (EDTA)	n-Nitrodimehylamine	Thenoyltrifluoroacetone
2-Butoxyethanol	Ethylene glycol	Normal paraffin hydrocarbons	Thymolphthalein
Butoxydiglycol	Ethylbenzene	Oxalate	Toluene
Butoxyglycol	Heptadecane	p-Dichlorobenzene	Tributyl phosphate (TBP)
Butoxytriethylene glycol	Hexadecane	Pentadecane	1,1,1-trichloroethane (1,1,1-TCA)
Butyraldehyde (butanal)	Hexanoic acid (caproic acid)	Pentacosodium diethylene triamine penta acetate (DTPA)	Trichloroethylene (TCE)
Carbon tetrachloride	Hydraulic fluids (greases)	Phenol	Tridecane
Cis/trans-1,2-dichloroethylene	Hydroxyacetic acid	Polychlorinated biphenyls (PCBs)	Triglyme
Chlorobenzene	Hydroxyquinoline	Pyridine	Tris (hydroxymethyl) amino methane
Chloroform (trichloromethane)	Isopropyl alcohol (2-Propanol)		Trisodium nitrilo triacetate (NTA)
Citrate	Kerosene		Trisodium hydroxyethyl ethylene - diamine triacetate (HEDTA)
di(2-ethylhexyl) phosphoric acid	Lard Oil		Vinyl chloride
Dibutyl phosphate (DBP)	Methanol		Xylene
	Methylene chloride		

The analytical approach employed for this project generally targets the significant risk drivers that are representative of the waste constituents present. The general suite-type analytical techniques (method-based) yield results on many metals and organic compounds, providing a cost-effective approach for the known toxic materials that could be present.

The COPCs in the following categories were dropped from further consideration:

- Short-lived radionuclides with half-lives of less than 3 years
- Radionuclides that constitute less than 1% of the fission product inventory and for which historical sampling indicates non-detection
- Naturally occurring isotopes that were not created as a result of Hanford Site operations

- Constituents with atomic mass numbers greater than 242 that represent less than 1 percent of the actinide activities
- Progeny radionuclides that build insignificant activities within 50 years and/or for which parent/progeny relationships exist that facilitate progeny estimation
- Constituents that would be neutralized and/or decomposed by facility processes
- Chemicals in a gaseous state that cannot accumulate
- Chemicals used in minute quantities (laboratory chemicals) relative to the bulk production chemicals (feed chemicals) consumed in the normal processes; these chemicals have no suspected introduction to the waste streams except in incidental quantities; chemicals identified as listed waste 'chemicals of interest' have not been excluded
- Chemicals that are not persistent in the environment, because of volatilization, biological degradation, or other natural mitigating features
- Chemical substances that are not found on the tables in Ecology Publication No. 94-145, *Model Toxics Control Act Cleanup Levels & Risk Calculations (CLARC) Version 3.1*, and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.

Table 1-7 includes the list of COPCs that were excluded and the specific rationale of exclusions for each radionuclide/nonradionuclide.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Radionuclides	
Americium-242	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Americium-243	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Antimony-123	Stable.
Antimony-125	Short-lived radionuclide (half-life <3 years).
Barium-137	Stable.
Barium-137m	Short-lived daughter of Cs-137 (which is a final COC).
Barium-140	Short-lived radionuclide (half-life <3 years).
Cadmium-113m	Less than 1% of Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Cerium-141	Short-lived radionuclide (half-life <3 years).
Cerium-144	Short-lived radionuclide (half-life <3 years).

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Cesium-134	Short-lived radionuclide (half-life <3 years).
Cesium-135	Constituent generated at less than 5E-05 times the Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Curium-242	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Curium-243	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Curium-244	Constituent with atomic mass number greater than or equal to 242 that represents less than 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production). May be reported via americium isotopic analysis.
Curium-245	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Iodine-131	Volatile gas emission; short-lived radionuclide (half-life <3 years).
Lanthanum-140	Short-lived radionuclide (half-life <3 years).
Neodymium-147	Short-lived radionuclide (half-life <3 years).
Neptunium-239	Short-lived radionuclide (half-life <3 years).
Nickel-59	Activity will be <5% of Ni-63 (final COC) activity and (based on ORIGEN2 modeling of Hanford reactor production) and may be estimated from that isotope.
Niobium-93m	Constituent generated at less than 5E-05 times the Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Niobium-95	Short-lived radionuclide (half-life <3 years).
Niobium-96	Short-lived radionuclide (half-life <3 years).
Niobium-98	Short-lived radionuclide (half-life <3 years).
Palladium-107	Constituent generated at less than 5E-05 times the Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Plutonium-241	Not detected by normal Pu analysis, can infer from final COPCs Am-241, Pu-238, and Pu-239/240 results.
Plutonium-242	Constituent with atomic mass number greater than or equal to 242 that represents << 1% of the actinide activity (based on ORIGIN2 modeling of Hanford reactor production).
Praseodymium-143	Short-lived radionuclide (half-life <3 years).
Praseodymium-144	Short-lived radionuclide (half-life <3 years).
Promethium-147	Short-lived radionuclide (half-life <3 years).
Rhodium-106	Short-lived radionuclide (half-life <3 years).
Ruthenium-103	Short-lived radionuclide (half-life <3 years).
Ruthenium-106	Short-lived radionuclide (half-life <3 years).
Samarium-149	Stable.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Samarium-151	Less than 1% of Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Selenium-79	Constituent generated at less than 5E-05 times Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Strontium-89	Short-lived radionuclide (half-life <3 years).
Tellurium-129m	Short-lived radionuclide (half-life <3 years).
Tellurium-129	Short-lived radionuclide (half-life <3 years).
Tin-113	Short-lived radionuclide (half-life <3 years).
Tin-123m	Short-lived radionuclide (half-life <3 years).
Tin-123	Short-lived radionuclide (half-life <3 years).
Tin-125	Short-lived radionuclide (half-life <3 years).
Tin-126	Constituent generated at less than 5E-05 times the Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production). (GEA will be reported if detected)
Uranium-232	Less than 2E-03 times the U-238 (final COPC) activity (based on ORIGEN2 modeling of Hanford reactor production).
Uranium-233	Measurement cannot resolve U-233 + U-234 isotopes, reported as final COPCs U-234 or U-233/234.
Uranium-236	Measurement cannot resolve U-235 + U-236 isotopes, reported as final COPCs U-235.
Yttrium-90	Short-lived daughter of Sr-90 (which is a final COPC).
Yttrium-91	Short-lived radionuclide (half-life <3 years).
Zirconium-93	Constituent generated at less than 5E-05 times the Sr-90/Cs-137 activity (based on ORIGEN2 modeling of Hanford reactor production).
Zirconium-95	Short-lived radionuclide (half-life <3 years).

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
<i>Inorganics</i>	
Aluminum	The CLARC 3.1 Tables (Ecology 94-145), regulated by WAC 173-340, list only a method to calculate the soil concentration protective of groundwater. 45.2 mg Al/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is doubtful that the concentration of Al in the PUREX Canyon could contribute 11,000 mg Al/kg soil (DOE/RL-94-24, <i>Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes</i>). Routine analyte reported by ICP analysis.
Bismuth	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Borate	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Calcium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Carbonate	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Cerium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Cesium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Hydrogen	Gas.
Hydroxide	Assessed via pH determination.
Iodine	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Iron	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists only a method to calculate the soil concentration protective of groundwater. 1320 mg Fe/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is unlikely that the concentration of Fe in the PUREX Canyon could contribute 32,600 mg Fe/kg soil. (DOE/RL-94-24) Routine analyte reported by ICP analysis.
Lanthanum	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Magnesium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Manganese	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 4.9E+05 mg Mn/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 50.2 mg Mn/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is doubtful that the concentration of Mn in the PUREX Canyon could contribute 512 mg Mn/kg soil. (DOE/RL-94-24) Routine analyte reported by ICP analysis.
Molybdenum	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 1.75E+04 mg Mo/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 16.3 mg Mo/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is doubtful that the concentration of Mo in the PUREX Canyon could contribute 0.33 mg Mo/kg soil. (DOE/RL-94-24) Routine analyte reported by ICP analysis.
Ozone	Gas.
Peroxide	Has degraded to oxygen gas.
Phosphotungstic acid (PTA)	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. PTA has degraded to phosphate (final COPC) and will be measured as such. See also tungsten.
Plutonium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Specific isotopes considered under "radionuclides".
Potassium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Ruthenium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Radiological ruthenium oxide compounds were formed and released during fuel dissolution at PUREX. This gas was captured by silver reactors in PUREX. As ruthenium has a half-life less than 2 years, and oxide is a gas, the compound has degraded and would not be present on an analysis.
Silicon	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Sodium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Strontium	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 2.1E+06 mg Sr/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 2920 mg Sr/kg soil is the calculated number. It is unlikely that the concentration of nonradioactive Sr will exceed this value. This is a routine analyte reported by ICP analysis which will be evaluated as part of the overall RI data analysis.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Sulfamates	Has degraded to sulfate which is retained as a COPC. This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340.
Sulfite	Used in minimal quantities at Hanford. Degraded to sulfate which is retained as a COPC.
Tin	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 2.1E+06 mg Sn/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 2.5E+04 mg Sn/kg soil is the calculated number. It is unlikely that the concentration of Sn in the PUREX Canyon could exceed this value. This is a routine analyte reported by ICP analysis which will be evaluated as part of the overall RI data analysis.
Tungsten	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Uranium	Radiological analysis will supersede any chemical analysis performed for this constituent.
Vanadium	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 2.45E+04 mg V/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 2.24E+03 mg V/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is doubtful that the concentration of V in the PUREX Canyon could contribute 85.1 mg V/kg soil. (DOE/RL-94-24) Routine analyte reported by ICP analysis.
Zinc	The CLARC 3.1 Tables (Ecology 94-145) regulated by WAC 173-340 lists a Method C noncarcinogen value of 1.05E+06 mg Zn/kg soil. The CLARC 3.1 Tables also lists a method to calculate the soil concentration protective of groundwater. 5.97E+03 mg Zn/kg soil is the calculated number. However, the background concentration far exceeds this value. Thus, WAC 173-340 defers to the soil background concentration of this inorganic substance. It is doubtful that the concentration of Zn in the PUREX Canyon could contribute 67.8 mg Zn/kg soil. (DOE/RL-94-24) Routine analyte reported by ICP analysis.
Zirconium	This inorganic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
<i>Organics</i>	
Acetate	Food-grade chemical (vinegar). The pH will be determined in the laboratory. This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340.
Benzyl alcohol	Not likely to be present in toxic and/or flammable concentrations.
Benzylaldehyde	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Bromodichloromethane	This organic was used in minimal quantities during laboratory operations. Should it be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260 (volatile organics).
Butanol (butyl alcohol)	Degradation product of TBP used in various processes and experiments including PUREX operations. (HW-19140, WHC 1990, Addendum 12). Should this organic compound be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260 (volatile organics).
2-Butoxyethanol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Butoxydiglycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Butoxyglycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Butoxytriethylene glycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Butyraldehyde (butanal)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Citrate	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
di(2-ethylhexyl) phosphoric acid	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Dibutyl phosphate (DBP)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This compound is a degradation product of tributyl phosphate and is unlikely to be present in toxic or high concentrations. Will degrade to phosphate and be detected in those analytical measurements.
Dimethylnitrosamine	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
3,5-Dimethylpyridine	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Ethanol (ethyl alcohol)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Very soluble in water; likely to have migrated or vaporized if exposed; reasonably biodegradable. Available and used as food-grade materials and not likely to be present in toxic and/or flammable concentrations.
Ethoxytriethylene glycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Ethylene-diamine tetraacetic acid (EDTA)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Ethylene glycol	Miscible with water (completely dissolves), thus it is subject to biodegradation, and somewhat mobile in soil (Wade 1991, <i>Organic Chemistry</i>).
Ethyl ether	Very soluble in water; likely to have migrated or vaporized if exposed; reasonably biodegradable. Should it be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260).
Heptadecane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Degradation products would be identified by TPH analyses.
Hexadecane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Degradation products would be identified by TPH analyses.
Hexanoic acid (caproic acid)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Hydroxyacetic acid	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Has degraded to acetate and hydroxides. Acetate is a food-grade chemical (vinegar). The pH will be determined in the laboratory.
Hydroxyquinoline	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Isopropyl alcohol (2-propanol)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Very soluble in water; likely to have vaporized if exposed; reasonably biodegradable.
Lard oil	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Food-grade chemical with no applicable regulatory action levels.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Methanol	Very soluble in water; likely to have vaporized if exposed; reasonably biodegradable. Should it be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260).
Methoxydiglycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Methoxytriglycol	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Methyl n-butyl ketone (MBK/2-hexanone)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
2-Methylnonane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Methyl n-propyl ketone (MPK/2-pentanone)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Mono-2-ethylhexyl phosphoric acid	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Will degrade to phosphate and be detected in those analytical measurements.
Monobutyl phosphate	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This compound is a degradation product of tributyl phosphate and is unlikely to be present in toxic or high concentrations. Will degrade to phosphate and be detected in those analytical measurements.
n-Nitrodimethylamine	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Oxalate	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
p-Dichlorobenzene	This organic was used in minimal quantities during laboratory operations. Should it be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260 (volatile organics).
Pentadecane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Degradation products would be identified by TPH analyses.
Pentasodium diethylene triamine penta acetate (DTPA)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Pyridine	This organic was used in minimal quantities during laboratory operations. Should it be present above detectable limits, it will be detected by the analytical laboratory during analysis 8260 (volatile organics).

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC	Rationale for Exclusion
Sodium gluconate	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Available as a food-grade material. Minimum potential for presence in toxic level quantities.
Sodium tetraphenyl boron	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Sugar	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This is a food-grade material with no applicable regulatory action levels.
Sulfonic acid (chloro)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This chemical has degraded to sulfate and chlorine, which are both listed as COPCs.
Tartaric acid	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Tetradecane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Degradation products would be identified by TPH analyses.
Tetrahydrofuran	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. This compound is unlikely to be present in toxic or high concentrations.
Thenoyltrifluoroacetone	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. No direct standard analytical technique available.
Thymolphthalein	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Laboratory indicator. Typically used in drop quantities as <1% solutions. No analytical or toxicity issues identified.
Tridecane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. Degradation products would be identified by TPH analyses.
Triglyme	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and after an additional search of available information, it has been determined that there is no data available to calculate a toxicity or cancer risk factor.
Tris (hydroxymethyl) amino methane	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. No direct standard analytical technique available.
Trisodium nitrilo triacetate (NTA)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. No direct standard analytical technique available.
Trisodium hydroxyethyl ethylene-diamine triacetate (HEDTA)	This organic substance is not found on the CLARC 3.1 Tables (Ecology 94-145) and therefore is not regulated by WAC 173-340. No direct standard analytical technique available.

Table 1-7. PUREX Canyon COPC Exclusions and Justifications. (11 Pages)

COPC		Rationale for Exclusion			
COPC	=	contaminant of potential concern.	RI	=	remedial investigation.
GEA	=	gamma energy analysis.	TPH	=	total petroleum hydrocarbons.
ICP	=	inductively coupled plasma.	VOA	=	volatile organic analysis.
PUREX	=	Plutonium-Uranium Extraction (Plant).			

Table 1-8 lists the COPCs to be considered during the PUREX Canyon DQO process.

Table 1-8. PUREX Canyon Contaminants of Potential Concern. (2 Pages)

Radioactive	Metals/General Inorganics	Organics
Americium-241	Antimony	1,1-dichloroethane (DCA)
Carbon-14	Arsenic	1,2-dichloroethane (DCA)
Cesium-137	Barium	1,1,1-trichloroethane (TCA)
Cobalt-60	Beryllium	Acetone
Europium-152	Cadmium	Benzene
Europium-154	Chromium (total)	Butanol
Europium-155	Chromium (VI)	Carbon tetrachloride
Hydrogen-3 (tritium)	Copper	Cis/trans-1,2-dichloroethylene
Iodine-129	Lead	Chlorobenzene
Neptunium-237	Mercury	Chloroform
Nickel-63	Nickel	Ethylbenzene
Plutonium-238	Selenium	Methyl ethyl ketone (MEK, 2-butanone)
Plutonium-239/240	Silver	Methylene chloride
Radium-226	Ammonia/ammonium	n-butyl benzene
Radium-228	Chloride	Tetrachloroethylene (PCE)
Strontium-90	Cyanide	Trichloroethylene (TCE)
Technetium-99	Fluoride	Toluene
Thorium-232	Nitrate/nitrite	Xylene
Tritium	Phosphate	AMSCO ^a
Uranium-233/234	Sulfate	Dodecane ^a
Uranium-235/236		Hydraulic fluids (Greases)
Uranium-238		Kerosene ^a
		Normal paraffin hydrocarbons ^a
		Phenol
		Polychlorinated biphenyls (PCBs)
		Tributyl phosphate and derivatives (mono, di)

^a Analyzed as kerosene total petroleum hydrocarbons

1.11 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND PRELIMINARY REMEDIATION GOALS

The PUREX Canyon contains a combination of RCRA treatment, storage, and/or disposal (TSD) units and past practice areas³. RCRA TSD units within the PUREX Canyon have closure requirements identified in WAC 173-303-610(2), WAC 173-303-640(8), and 40 CFR 265.1102, incorporated by reference at WAC 173-303-400(3). Areas managed under past practice requirements will have remediation requirements developed through the applicable or relevant and appropriate requirement (ARAR) process. These closure requirements and remediation requirements will be coordinated through the feasibility study process.

ARARs are environmental regulations that are pertinent to the proposed remedial action. Potential ARARs identified for the remedial actions within the 200 Areas are presented in the Implementation Plan (DOE/RL-98-28).

Table 1-9 defines the preliminary ARARs identified for the PUREX Canyon DQO process to assist in the development of data analytical needs. ARARs associated with potential alternative actions will be further refined in the feasibility study. The DQO process does not set preliminary remediation goals (PRGs) however, preliminary PRGs are used to ensure proper analytical detection limits are used.

Table 1-9. List of Potentially Applicable or Relevant and Appropriate Requirements to Define Analytical Detection Limits. (2 Pages)

Depth of Contamination	Potentially Applicable or Relevant and Appropriate Requirements	Preliminary Remediation Goals
<i>Radionuclides Inside the 200 Area land-use Boundary (Industrial Land Use)^a</i>		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human Health; 10 ⁻⁴ to 10 ⁻⁶ risk range per CERCLA in 40 CFR 300, interpreted by EPA as 15 mrem/yr above background; OSWER 9200.4-18 (TBC) guidance on cleanup levels. Ecological – DOE/EH-0676, 2004, RESRAD-Biota	Contaminant-specific; RESRAD modeling ^b
Deep zone (>4.6 m [>15 ft] bgs)	4 mrem/yr above background to groundwater, or no additional groundwater degradation. ^c	Maximum contamination levels, state and Federal ambient water quality control criteria;

³ The TPA Action Plan, Section 5.5 explains the rationale for coordination between past-practice units and closely associated TSD units. Although the PUREX Canyon is technically not a past-practice unit (it is a 'key' facility). The Tri-Parties are contemplating action for this key facility under Section 7.0, which is the past-practice unit process.

Table 1-9. List of Potentially Applicable or Relevant and Appropriate Requirements to Define Analytical Detection Limits. (2 Pages)

Depth of Contamination	Potentially Applicable or Relevant and Appropriate Requirements	Preliminary Remediation Goals
		alternatively, site-specific modeling
<i>Nonradiological Constituents Inside the 200 Area land-use Boundary (Industrial Land Use)^a</i>		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human Health - WAC 173-340-745(5) Method C	Chemical specific (with contaminant-specific variations)
	Ecological - WAC 173-340-7493 (Table 749-3)	Chemical specific
Deep zone (>4.6 m [>15 ft] bgs)	WAC 173-340-747(4) Method B criteria	Fixed parameter three-phase partitioning model (Equation 747-1); alternatively, site-specific modeling using STOMP model

^aThe Final Hanford Comprehensive Land Use Plan Environmental Impact Statement (DOE/EIS-0222-F) as modified by the Risk Framework.

^bThe RESidual RADioactivity dose model (RESRAD) use has been used for similar waste sites and will be used as a minimum for direct exposure. If more appropriate models are developed, they will be evaluated for use.

^cRadionuclide standards are not final and will be agreed upon in the ROD.

bgs = below ground surface.

STOMP = PNNL-11216, STOMP -- Subsurface Transport Over Multiple Phases: Application Guide.

1.12 CONCEPTUAL EXPOSURE MODEL

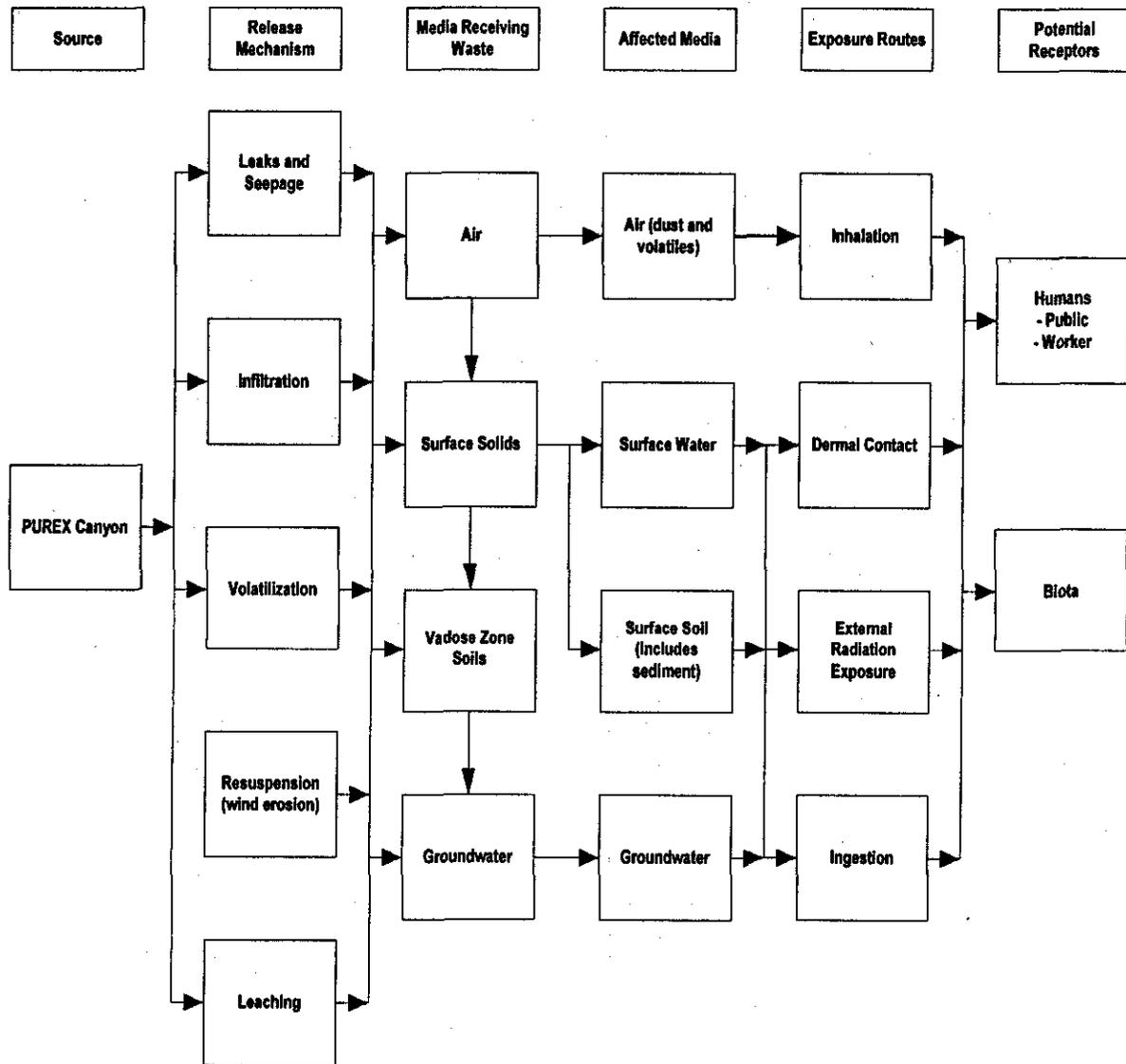
The conceptual model identifies site workers, the general public, and biota as potential receptors for contaminants that may be released from the PUREX Canyon. Exposure pathways illustrate how contaminated materials may potentially reach human and ecological receptors. A complete exposure pathway includes sources of contamination, contaminant release/transport mechanisms, contaminated media, exposure routes, and potential receptors.

Potential baseline risks (that is, the potential risks that may be associated with the PUREX Canyon if no remedial action were undertaken) are evaluated by linking land-use assumptions with exposure pathways to create exposure scenarios for potential receptors. The conceptual exposure model for the PUREX Canyon is shown graphically in Figure 1-5. It shows the exposure pathways to be evaluated for a determination of the risks to site workers, the general public (including inadvertent intruders), and ecological receptors (biota).

The baseline conceptual model for potential human exposure to PUREX Canyon contamination assumes a continued industrial land use for the facility. For conservatism, the model further assumes that none of the current health and safety controls (e.g., access limitations, shielding, and exposure monitoring) are enforced, no demolition or decontamination activities are completed, and the entire PUREX Canyon is used by industrial workers who have no knowledge of the facility history or risks. Under these completely uncontrolled conditions, the workers would have access to all areas within the facility, and worker exposure to radioactive and chemical contamination could occur through external exposure, dermal contact, inhalation, and

ingestion. Following the WAC 173-340-745(1)(a)(i) characteristics for industrial property, this baseline conceptual exposure model assumes minimal potential for general public exposure (access restrictions and no living quarters on industrial property) or environmental exposure (extensive paved/covered areas and operational disturbances would preclude biota use). Given these assumptions, the primary potential receptor for the baseline PUREX Canyon risk assessment is the industrial worker. Therefore, the information collected as a result of this DQO and sampling and analysis plan (SAP) will be modeled using the industrial worker scenario.

Figure 1-5. PUREX Canyon Baseline Conceptual Exposure Model.



1.13 STATEMENT OF THE PROBLEM

Table 1-10 provides a concise statement of the problem.

Table 1-10. Concise Problem Statements.

Problem Statement #1:

In order to support disposition alternative decision-making for (1) the building, (2) the systems contained within the canyon, and (3) the soils underlying the building, data regarding the nature and extent of contamination is required.

Problem Statement #2:

A structural integrity evaluation will be conducted to assess whether or not the building structure can support entombment of waste or clean fill material. Therefore, data regarding the structural integrity of the building are required in order to evaluate the use of the building for long-term entombment of waste.

Problem Statement #3:

A structural design evaluation will be conducted to assess the most effective methods of dismantling and removing the building to a disposal facility. Data regarding the structural design of the building are required in order to evaluate dismantling alternatives for the building.

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2.0 STEP 2 -- IDENTIFY THE DECISION

The purpose of DQO Step 2 is to define the Principal Study Questions (PSQ) that need to be resolved to address the problems identified in DQO Step 1 and the Alternative Actions that would result from resolution of the PSQs. The PSQs and Alternative Actions then are combined into Decision Statements that express a choice among the Alternative Actions. The following section presents the PSQs, Alternative Actions, and resulting Decision Statements.

2.1 PRINCIPAL STUDY QUESTIONS

The PSQs (Table 2-1) are basic DQO questions that require review of existing measurements or collection of new measurements (e.g., physical, chemical, or radiological data) to resolve the problem statements (Table 1-10).

Table 2-1. Principal Study Questions.

PSQ #	Principal Study Question
1	Are building ^a areas radiologically contaminated?
2	Are building areas chemically contaminated?
3	Is building equipment ^b radiologically contaminated?
4	Is building equipment chemically contaminated?
5	Do areas in the building contain an accumulation of residual material that could potentially classify as HLW if disposed?
6	Does the process equipment contain residual material that could potentially classify as HLW if disposed?
7	Are underlying soils radiologically contaminated?
8	Are underlying soils chemically contaminated?
9	Is the building structural integrity sufficient to support entombment of waste or clean fill?
10	Is data regarding the building structural design available to allow an evaluation of the dismantlement alternatives?

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

HLW = high-level waste.

PSQ = principal study question.

2.2 ALTERNATIVE ACTIONS

Table 2-2 identifies the Alternative Actions that could be taken after the PSQs have been resolved. The DQO process also includes a qualitative assessment of the severity of the consequences of taking an Alternative Action, if it is incorrect. This assessment is performed to assist in later decision-making in Step 6 for the selection of a sampling design based on professional judgment or a statistically-derived sampling design.

Table 2-2. Alternative Actions. (2 Pages)

PSQ #	Principal Study Question	Alternative Actions
1	Are building ^a areas radiologically contaminated?	1a – Evaluate the building ^a areas remedial alternatives in a feasibility study.
		1b – Evaluate the building areas for closure with no remedial action.
2	Are building areas chemically contaminated?	2a – Evaluate the building areas remedial alternatives in a feasibility study.
		2b – Evaluate the building areas for closure with no remedial action.
3	Is building equipment ^b radiologically contaminated?	3a – Evaluate the building equipment ^b remedial alternatives in a feasibility study.
		3b – Evaluate the building equipment for closure with no remedial actions.
4	Is building equipment chemically contaminated?	4a – Evaluate the building equipment remedial alternatives in a feasibility study.
		4b – Evaluate the building equipment for closure with no remedial actions.
5	Do areas in the building contain an accumulation of residual material that could potentially classify as HLW if disposed?	5a – Evaluate the residual inventory in the building areas (as potential HLW) for remedial alternatives in a feasibility study.
		5b – Evaluate the residual inventory in the building areas (as potential HLW) for closure with no remedial action.
6	Does the process equipment contain residual material that could potentially classify as HLW if disposed?	6a – Evaluate the process equipment residual inventory (as potential HLW) remedial alternatives in a feasibility study.
		6b – Evaluate the process equipment residual inventory (as potential HLW) for closure with no remedial actions.
7	Are underlying soils radiologically contaminated?	7a – Evaluate the remedial alternatives for soils underlying the building in a feasibility study.
		7b – Evaluate the soils underlying the building for closure with no remedial action.
8	Are underlying soils chemically contaminated?	8a – Evaluate the remedial alternatives for soils underlying the building in a feasibility study.
		8b – Evaluate the soils underlying the building for closure with no remedial action.
9	Is the building structural integrity sufficient to support entombment of waste or clean fill?	9a – Evaluate structural analysis processes.
		9b – Assume capable by inspection.
10	Is data regarding the building structural design available to allow an evaluation of the dismantlement alternatives?	10a – Evaluate available D&D processes for impact on structure.
		10b – Assume capable by inspection.

Table 2-2. Alternative Actions. (2 Pages)

PSQ #	Principal Study Question	Alternative Actions
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^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

HLW = high level waste.

PSQ = principal study question.

The PSQs and Alternative Actions from Tables 2-1 and 2-2 are then combined into Decision Statements that express a choice among the Alternative Actions. Table 2-3 presents the task-specific PSQs, Alternative Actions, and resulting Decision Statements. This table also provides a qualitative assessment of the consequences of taking an Alternative Action if it is incorrect. This assessment takes into consideration human health and the environment (air, land, water, flora/fauna) and political, economic, and legal ramifications. The consequences are expressed as low, moderate, or severe.

Table 2-3. Summary of Data Quality Objectives Problem Statement Information. (5 Pages)

PSQ #	Alternative Action #	Alternative Action	Error if Alternative Action is Incorrect	Consequence of Error	Severity of Consequences
PSQ #1: Are building^a areas radiologically contaminated?					
1	1a	Evaluate the building areas remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	1b	Evaluate the building areas for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #1: Determine if the building areas radiological contamination exceeds the action levels.					
PSQ #2: Are building areas chemically contaminated?					
2	2a	Evaluate the building areas remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe

Table 2-3. Summary of Data Quality Objectives Problem Statement Information. (5 Pages)

PSQ #	Alternative Action #	Alternative Action	Error if Alternative Action is Incorrect	Consequence of Error	Severity of Consequences
	2b	Evaluate the building areas for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #2: Determine if the building areas chemical contamination exceeds the action levels.					
PSQ #3: Is building equipment ^b radiologically contaminated?					
3	3a	Evaluate the process equipment remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	3b	Evaluate the process equipment for closure with no remedial actions.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #3: Determine if the process equipment radiological contamination exceeds the action levels.					
PSQ #4: Is building equipment chemically contaminated?					
4	4a	Evaluate the process equipment remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	4b	Evaluate the process equipment for closure with no remedial actions.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #4: Determine if the process equipment chemical contamination exceeds the action levels.					
PSQ #5: Do areas in the building contain residual material that could potentially classify as HLW if disposed?					

Table 2-3. Summary of Data Quality Objectives Problem Statement Information. (5 Pages)

PSQ #	Alternative Action #	Alternative Action	Error if Alternative Action is Incorrect	Consequence of Error	Severity of Consequences
5	5a	Evaluate the residual inventory in the building areas (as potential HLW) for remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	5b	Evaluate the residual inventory in the building areas (as potential HLW) for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #5: Determine if residual material that could potentially classify as HLW if disposed is present in areas within building areas.					
PSQ #6: Does the process equipment contain residual material that could potentially classify as HLW if disposed?					
6	6a	Evaluate the process equipment residual inventory (as potential HLW) remedial alternatives in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	6b	Evaluate the process equipment residual inventory (as potential HLW) for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #6: Determine if residual material that could potentially classify as HLW if disposed is present in the process equipment.					
PSQ #7: Are underlying soils radiologically contaminated?					
7	7a	Evaluate the remedial alternatives for soils underlying the building in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe

Table 2-3. Summary of Data Quality Objectives Problem Statement Information. (5 Pages)

PSQ #	Alternative Action #	Alternative Action	Error if Alternative Action is Incorrect	Consequence of Error	Severity of Consequences
	7b	Evaluate the soils underlying the building for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #7: Determine if the underlying soil radiological contamination exceeds the action levels.					
PSQ #8: Are underlying soils chemically contaminated?					
8	8a	Evaluate the remedial alternatives for soils underlying the building in a feasibility study.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	8b	Evaluate the soils underlying the building for closure with no remedial action.	Potential for leaving contamination in place unabated.	Financial impacts to the budget; impacts to the environment.	Potentially Moderate
Decision Statement #8: Determine if the underlying soil chemical contamination exceeds the action levels.					
PSQ #9: Is the building structural integrity sufficient to support entombment of waste or clean fill?					
9	9a	Evaluate structural analysis processes.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	9b	Assume capable by inspection.	Potential for incorrect remedial action alternative to be chosen.	Impacts to the environment.	Potentially Moderate
Decision Statement #9: Determine if the building structural integrity is sufficient to support entombment alternatives based on existing knowledge versus analysis.					
PSQ #10: Is data regarding the building structural design available to allow an evaluation of the dismantlement alternatives?					

Table 2-3. Summary of Data Quality Objectives Problem Statement Information. (5 Pages)

PSQ #	Alternative Action #	Alternative Action	Error if Alternative Action is Incorrect	Consequence of Error	Severity of Consequences
10	10a	Evaluate available D&D processes for impact on structure.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe
	10b	Assume capable by inspection.	Potential for incorrect remedial action alternative to be chosen.	Financial impacts to the budget; construction hazards for worker safety; impacts to the environment; additional waste generation.	Potentially Moderate to Severe

Decision Statement #10: Determine if building structural design information is available to support an evaluation of dismantlement alternatives based on existing knowledge versus analysis.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

HLW = high-level waste.

PSQ = principal study question.

PUREX = Plutonium-Uranium Extraction.

2.3 DECISION STATEMENTS

Table 2-4 lists each of the ten Decision Statements associated with this project.

Table 2-4. Decision Statements.

DS #	Decision Statement
1	Determine if the building ^a areas radiological contamination exceeds the action levels.
2	Determine if the building areas chemical contamination exceeds the action levels.
3	Determine if the building equipment ^b radiological contamination exceeds the action levels.
4	Determine if the building equipment chemical contamination exceeds the action levels.
5	Determine if residual material that could potentially classify as HLW if disposed is present in areas within building areas.
6	Determine if residual material that could potentially classify as HLW if disposed is present in the process equipment.
7	Determine if the underlying soil radiological contamination exceeds the action levels.
8	Determine if the underlying soil chemical contamination exceeds the action levels.
9	Determine if the building structural integrity is sufficient to support entombment alternatives based on existing knowledge versus analysis.
10	Determine if building structural design information is available to support an evaluation of dismantlement alternatives based on existing knowledge versus analysis.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

DS = Decision Statement.

HLW = high-level waste.

PUREX = Plutonium-Uranium Extraction (Plant).

3.0 STEP 3 -- IDENTIFY THE INPUTS TO THE DECISION

The purpose of DQO Step 3 is to identify the types of data needed to resolve each of the decision statements identified in DQO Step 2. The data may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., practical quantitation limit, precision, and accuracy) are also provided in this step for any new data that need to be collected.

Table 3-1 lists the titles of the tables that follow in Step 3. An introductory description to the remaining tables is provided prior to each of the tables within this step.

Table 3-1. Inputs to the Decision Tables.

Table Number	Title
3-2	Required Information and Basis
3-3	Basis for Setting Preliminary Action Level
3-4	Information Required to Resolve the Decision Statements
3-5	Details on Identified Computational Methods
3-6	Potentially Appropriate Survey and/or Analytical Methods
3-7a	Analytical Performance Requirements for Radionuclides
3-7b	Analytical Performance Requirements for Nonradionuclides

3.1 INFORMATION REQUIRED TO RESOLVE DECISION STATEMENTS

Table 3-2 summarizes the evaluation of information (data) needs required to resolve each of the decision statements (Table 2-4) and identify whether the data already exist. For the data that are identified as existing, a qualitative assessment has been provided as to whether or not the data are of sufficient quality to resolve the corresponding decision statements.

A logic flow diagram is presented in Figure 3-1 to illustrate the information review process used to identify whether data exist, and whether or not the data are of sufficient quality to resolve the corresponding decision statements. The existing documentation reviewed is listed in Table 1-9 of this DQO summary report. The main source of information was the PUREX Deactivation End Point document (WHC 1997). This document provided information pertaining to deactivation end points that were established, and the associated tasks completed, during deactivation phase activities in the mid-1990's. This document also lists many (hundreds) references to supporting documents (i.e., laboratory analytical data, radiological survey reports, work plans) that provide the details regarding the activity performed and the end state of each location or tank system. This data, as it pertains to this investigation, is summarized in Appendix A of this DQO summary report.

The intent of the end point tasks was to provide areas and equipment within the PUREX Canyon with end points that would leave the facility in a stable configuration for the surveillance and maintenance phase. Many of the end points involved isolating systems, evaluating building structural integrity, removing hazardous material and waste, and documenting and stabilizing remaining radiological contamination. In addition, canyon tank systems were drained and flushed of process solutions and chemicals.

Information to support the qualitative assessment of the data quality and quantity are presented in Section 3.1.1.

3.1.1 Information to Support Quality Decisions

The following assumptions are intended to support the quality decisions listed in Table 3-2. A qualitative assessment was provided as to whether or not the data are of sufficient quality to resolve the corresponding decision statements. The assumptions listed below support this assessment.

- Radiological survey data associated with areas in the canyon is not considered to be of sufficient quality to support a baseline risk assessment without further surveys or sampling. Because the radiological survey data was gathered over 10 years ago, and because of the manner in which the surveys were performed in relation to current needs, this information can only provide an indication of locations that may be of interest for additional surveys or sampling (i.e., areas of elevated contamination or dose rate). In addition, there exists a potential for migration of contamination within the building.
- Some radiological surveys are listed in the end point document as having been performed and documented during deactivation phase activities. However, some of the radiological survey reports could not be located during the records review phase of the DQO process.
- RCRA tank systems in the PUREX Canyon were flushed to remove residual process chemicals. The tank systems that contained a heel after flushing activities were performed were sampled and analyzed for chemical constituents by RL, and independently by Ecology. The sampling was performed per *Sampling and Analysis Plan for the PUREX Canyon Vessel Systems* (WHC-SD-CP-PLN-027), approved in 1995. The flushing and sampling process is detailed in the *PUREX Facility Preclosure Work Plan* (DOE/RL-95-78). Existing analytical data associated with the RCRA-protocol sampling effort for these tank systems is available and is assumed to meet characterization needs.
- Analytical data for radionuclides was not collected for the tank systems in the canyon that underwent flushing. However, since these tank systems were flushed and drained to a minimal heel, radiological contamination levels are expected to be low.
- Non-process tanks (e.g., tanks formerly containing feed chemicals) were drained or verified to be empty during transition phase activities.
- Chemical contaminant data for building structures is limited to a listing of hazardous waste and materials that were left in place after deactivation phase activities were

concluded (Appendix A). The majority of these materials are inherent to the building structure (e.g., mercury vapor lamps, mercury in switches, lead shielding). Information on other areas that may contain chemical contamination (e.g., areas of known spills of process solutions, discolored areas on concrete surfaces) is not available.

- Existing engineering drawings, historical building construction documentation, and building design information is assumed to be sufficient to support evaluations of the building structural integrity and structural design.

Figure 3-1. Required Information Logic Diagram.

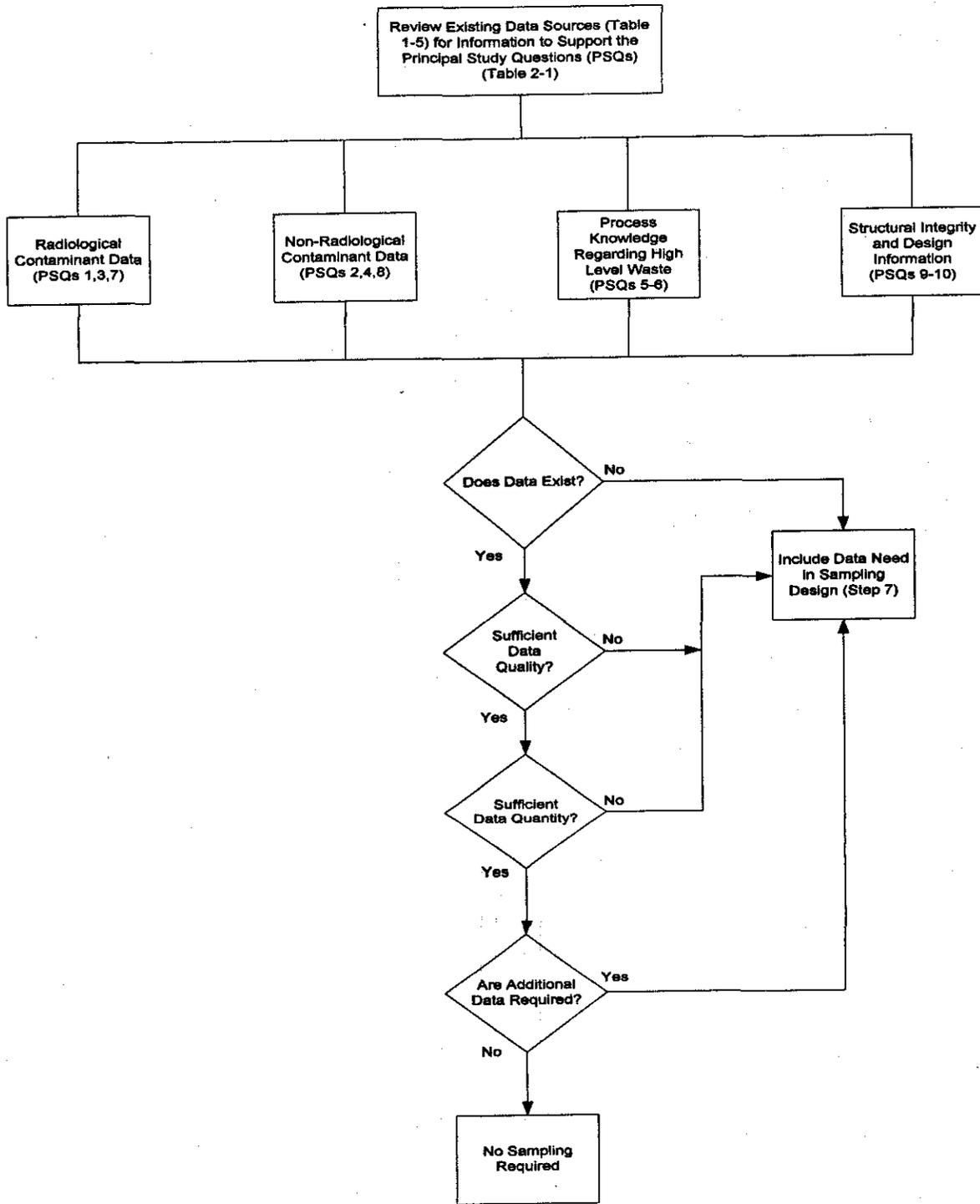


Table 3-2. Required Information and Reference Sources. (6 Pages)

Area	Do data exist? (Y/N)		Sufficient data quantity and/or data quality? (Y/N)		Are additional data required? (Y/N)		Reference Sources
	Rad	Chem	Rad	Chem	Rad	Chem	
Radiological and Chemical Data Needed for Building Areas							
<i>Process Areas</i>							
Canyon Backcycle	Y	Y	N	Y ^c	Y	Y	<i>PUREX Deactivation End Points, WHC-SD-WM-TPP-053 (WHC 1997)</i> <i>Internal Memo, R. L. Hobart (B&W Hanford Co.) to W. A. Peiffer (B&W Hanford Co.), PUREX Facility Plutonium and Fission Product Residual Estimates, 17000-97-007, dated February 10, 1997 (WHC 1997a)</i> <i>Surveillance and Maintenance Plan for the Plutonium Uranium Extraction Facility, DOE/RL-98-35 (RL 1995)</i> <i>Radiological History Of The PUREX Facility 1955 to 1989 (Hodges 1989)</i>
Canyon Cladding	Y	Y	N	Y ^c	Y	Y	
Canyon Pool Cell & Slug Storage Basin	Y	Y	N	Y ^c	Y	Y	
E-Cell	Y	Y	N	Y ^c	Y	Y	
F-Cell	Y	Y	N	Y ^c	Y	Y	
L-Cell	Y	Y	N	Y ^c	Y	Y	
M-Cell	Y	Y	N	Y ^c	Y	Y	
M-Cell Pipe Chase	Y ^a	Y	N	Y ^c	Y	Y	
M-Cell Vault	Y	Y	N	Y ^c	Y	Y	
N-Cell	Y ^a	Y	N	Y ^c	Y	Y	
N-Cell Room Exhaust	Y ^a	Y	N	Y ^c	Y	Y	
PR Room	Y ^a	Y	N	Y ^c	Y	Y	
PR Room Exhaust	Y	Y	N	Y ^c	Y	Y	
PR Room Gloveboxes	Y	Y	N	Y ^c	Y	Y	
Q-Cell Control Room	Y ^a	Y	N	Y ^c	Y	Y	
Q-Cell Gloveboxes	Y	Y	N	Y ^c	Y	Y	
Q-Cell AMU	Y	Y	N	Y ^c	Y	Y	
Q-Cell Maintenance Hood Room	Y	Y	N	Y ^c	Y	Y	
Q-Cell Vault Room	Y	Y	N	Y ^c	Y	Y	
R-Cell	Y	Y	N	Y ^c	Y	Y	
R-Cell Equipment	Y ^a	Y	N	Y ^c	Y	Y	
R-Cell Exterior	Y	Y	N	Y ^c	Y	Y	

Table 3-2. Required Information and Reference Sources. (6 Pages)

Area	Do data exist? (Y/N)		Sufficient data quantity and/or data quality? (Y/N)		Are additional data required? (Y/N)		Reference Sources	
	Rad	Chem	Rad	Chem	Rad	Chem		
U-Cell	Y ^a	Y	N	Y ^c	Y	Y	<p><i>PUREX Deactivation End Points, WHC-SD-WM-TPP-053 (WHC 1997)</i></p> <p>Internal Memo, R. L. Hobart (B&W Hanford Co.) to W. A. Peiffer (B&W Hanford Co.), <i>PUREX Facility Plutonium and Fission Product Residual Estimates, 17000-97-007, dated February 10, 1997 (WHC 1997a)</i></p> <p><i>Surveillance and Maintenance Plan for the Plutonium Uranium Extraction Facility, DOE/RL-98-35 (RL 1995)</i></p> <p><i>Radiological History Of The PUREX Facility 1955 to 1989 (Hodges 1989)</i></p>	
U-Cell Equipment	Y	Y	N	Y ^c	Y	Y		
White Room	Y ^a	Y	N	Y ^c	Y	Y		
White Room HVAC	Y	Y	N	Y ^c	Y	Y		
White Room Systems	Y	Y	N	Y ^c	Y	Y		
<i>Process Support Areas</i>								
Hot Pipe Trench	Y	Y	N	Y ^c	Y	Y		
Ventilation Tunnel	Y	Y	N	Y ^c	Y	Y		
<i>Service Rooms and Galleries</i>								
East, West, Slave Cranes	Y	Y	N	Y ^c	Y	Y		
Canyon C-Cell Deck Access Airlock	Y	Y	N	Y ^c	Y	Y		
Canyon F-Cell Deck Viewing Window	Y	Y	N	Y ^c	Y	Y		
Canyon Lobby	Y ^a	Y	N	Y ^c	Y	Y		
Compressor Room	Y	Y	N	Y ^c	Y	Y		
Process and Instrument Air	Y	Y	N	Y ^c	Y	Y		
Head End, Central, Power Control Rooms and Offices	Y ^a	Y	N	Y ^c	Y	Y		
Maintenance Shops	Y	Y	N	Y ^c	Y	Y		
SWP Lobby	Y	Y	N	Y ^c	Y	Y		
East Mezzanine Canyon Support Rooms	Y ^a	Y	N	Y ^c	Y	Y		
East Switch Gear Room	Y	Y	N	Y ^c	Y	Y		
Hot Shop	Y ^a	Y	N	Y ^c	Y	Y		
Laboratory	Y	Y	N	Y ^c	Y	Y		

Table 3-2. Required Information and Reference Sources. (6 Pages)

Area	Do data exist? (Y/N)		Sufficient data quantity and/or data quality? (Y/N)		Are additional data required? (Y/N)		Reference Sources
	Rad	Chem	Rad	Chem	Rad	Chem	
P&O Gallery	Y	Y	N	Y ^c	Y	Y	<i>PUREX Deactivation End Points</i> , WHC-SD-WM-TPP-053 (WHC 1997)
P&O Gallery Systems	Y	Y	N	Y ^c	Y	Y	
PIV Room	Y ^a	Y	N	Y ^c	Y	Y	Internal Memo, R. L. Hobart (B&W Hanford Co.) to W. A. Peiffer (B&W Hanford Co.), <i>PUREX Facility Plutonium and Fission Product Residual Estimates</i> , 17000-97-007, dated February 10, 1997 (WHC 1997a)
Sample Gallery	Y ^a	Y	N	Y ^c	Y	Y	
Sample Gallery Chemical Headers	Y	Y	N	Y ^c	Y	Y	
Sample Gallery Decontamination Hood	Y	Y	N	Y ^c	Y	Y	
Sample Gallery Hood HVAC	Y	Y	N	Y ^c	Y	Y	<i>Surveillance and Maintenance Plan for the Plutonium Uranium Extraction Facility</i> , DOE/RL-98-35 (RL 1995)
Sample Gallery Hood HVAC Station	Y	Y	N	Y ^c	Y	Y	
Sample Gallery Iodine Monitors	Y	Y	N	Y ^c	Y	Y	<i>Radiological History Of The PUREX Facility 1955 to 1989</i> (Hodges 1989)
Sample Gallery Load-in Hoods	Y	Y	N	Y ^c	Y	Y	
Sample Gallery N-Cell Halon Fire System	Y	Y	N	Y ^c	Y	Y	
Sample Gallery PDD Neutralization	Y	Y	N	Y ^c	Y	Y	
Sample Gallery Room Exhaust	Y	Y	N	Y ^c	Y	Y	
Sample Gallery Waste Compactor	Y ^a	Y	N	Y ^c	Y	Y	
Storage Gallery	Y ^a	Y	N	Y ^c	Y	Y	
Storage Gallery Systems	Y	Y	N	Y ^c	Y	Y	
Process Blower Room	Y	Y	N	Y ^c	Y	Y	
Service Blower Room	Y	Y	N	Y ^c	Y	Y	
West Switch Gear Room	Y	Y	N	Y ^c	Y	Y	
202-A Ventilation	Y	Y	N	Y ^c	Y	Y	
PR Elevator	Y	Y	N	Y ^c	Y	Y	

Table 3-2. Required Information and Reference Sources. (6 Pages)

Area	Do data exist? (Y/N)		Sufficient data quantity and/or data quality? (Y/N)		Are additional data required? (Y/N)		Reference Sources	
	Rad	Chem	Rad	Chem	Rad	Chem		
202-A Facility Exterior	Y ^a	Y	N	Y ^c	Y	Y		
202-A Pump/Trap Pits	Y ^a	Y	N	Y ^c	Y	Y		
AMU	Y ^a	Y	N	Y ^c	Y	Y		
<i>Other Areas</i>								
Canyon Deck	Y ^a	Y	N	Y ^c	Y	Y		
Railroad Tunnel	Y	Y	N	Y ^c	Y	Y		
Radiological and Chemical Data Needed for Building Equipment								
AMU Tanks	^b	Y	^b	Y	^b	N	<i>PUREX Facility Preclosure Work Plan, DOE/RL-95-78 Rev. 0 (DOE-RL 1995c)</i>	
Backcycle Waste and Neptunium Package Tanks	Y	Y	Y	Y	N	N		
Canyon F11 System Tanks	Y	Y	Y	Y	N	N	<i>PUREX Deactivation End Points, WHC-SD-WM-TTP-053 (WHC 1997)</i>	
F-Cell Tanks	Y	Y	Y	Y	N	N		
Canyon G&R Cell Tanks	Y	Y	Y	Y	N	N		
Canyon Head End Feed Tanks	Y	Y	Y	Y	N	N		
Canyon K-Cell Tanks	Y	Y	Y	Y	N	N		
Canyon L-Cell Tanks	Y	Y	Y	Y	N	N		
Canyon Other Tanks	Y	Y	Y	Y	N	N		
Canyon Tank TK-J2	Y	Y	Y	Y	N	N		
Canyon Tanks/Tanks-D5, E6, F15 & F16	Y	Y	Y	Y	N	N		
Cladding Waste Tanks	Y	Y	Y	Y	N	N		
M-Cell Tanks	Y	Y	Y	Y	N	N		
M-Cell Vault Tanks	Y	Y	N	N	Y	Y		
M-Cell Pipe Chase Tanks	Y	Y	N	N	Y	Y		
N-Cell Glovebox Tanks	Y	Y	N	N	Y	Y		
P&O Gallery Tanks	Y	Y	N	N	Y	Y		
PR Room Glovebox	Y	Y	Y	Y	N	N		

Table 3-2. Required Information and Reference Sources. (6 Pages)

Area	Do data exist? (Y/N)		Sufficient data quantity and/or data quality? (Y/N)		Are additional data required? (Y/N)		Reference Sources
	Rad	Chem	Rad	Chem	Rad	Chem	
Tanks							
Q-Cell Loadout Tanks	Y	Y	N	N	Y	Y	
Q-Cell Vault Tanks	Y	Y	N	N	Y	Y	
Sample Gallery Process Support Tanks	Y	Y	N	N	Y	Y	
U-Cell Support Tanks	Y	Y	Y	Y	N	N	
U-Cell Tanks	Y	Y	Y	Y	N	N	
White Room Tanks	Y	Y	Y	Y	N	N	
Radiological and Chemical Data Needed for Soils Underlying the PUREX Canyon							
Soils Underlying the PUREX Canyon	Y	Y	N	N	Y	Y	<i>Radiological History Of The PUREX Facility 1955 to 1989 (Hodges 1989)</i> <i>A Brief History of the PUREX and UO3 Facilities, WHC-MR-0437 (WHC 1993)</i> <i>PUREX Plant Final Safety Analysis Report, Revisions 3, 4, and 5, SD-HS-SAR- 001 (Manry and Prosk 1985)</i>
Data Needed to Support an Evaluation of the Structural Integrity of the PUREX Canyon							
Building Structure (i.e., concrete, rebar)	Y		Y		N		<i>PUREX Deactivation End Points, WHC-SD-WM- TPP-053 (WHC 1997)</i>
Soil Physical Properties (i.e., compaction)	Y		Y		N		Engineering drawings; building construction documentation
Data Needed to Support an Evaluation of the Structural Design of the PUREX Canyon							
Building Structure	Y		Y		N		<i>PUREX Deactivation End Points, WHC-SD-WM- TPP-053 (WHC 1997)</i> Engineering drawings

^aInformation was gathered during deactivation phase activities however, no documentation can be located.

^bAMU tanks contained non-radiologically contaminated process feed chemicals.

^cInformation exists for hazardous materials that are inherent to the building (e.g., lead shielding, mercury switches, sodium vapor light bulbs), however insufficient data exists for spills of chemical solutions in the building.

3.2 BASIS FOR SETTING THE PRELIMINARY ACTION LEVEL

The preliminary action level is the threshold value that provides the criterion for choosing between alternative actions. Table 3-3 identifies the basis (i.e., regulatory threshold or risk-based) for establishing the preliminary action level for each of the COPCs. The numerical value for the action level is defined in DQO Step 5.

Table 3-3. Basis for Setting Preliminary Action Level.

DS #	Contaminant of Potential Concern/Considerations	Basis for Setting Preliminary Action Level/Threshold
1, 3, 7	Radiological COPCs	Radiological action levels for shallow zone soils based on RESRAD analyses for the applicable scenarios. Deep zone action levels will be determined using STOMP or another model.
2, 4, 8	Nonradiological COPCs	WAC 173-340-7492* (ecological), WAC 173-340 Method C (direct exposure) and WAC 173-340 Method B (groundwater) cleanup levels with contaminant-specific variations; RCRA TSD closure standards in WAC 173-303.
5, 6	Radiological COPCs and process knowledge indicating material that could potentially classify as HLW is disposed.	Process knowledge, radiological COPCs, and criteria specified in DOE Order 435.1.
9, 10	Existing design information and structural testing; soil physical properties	Not applicable; there are not action levels associated with structural design and structural integrity.

*WAC 173-340-7492 will apply only if the complete removal of the building is the chosen remedy and will apply to soils underlying the footprint of the canyon.

COPC = contaminant of potential concern.

DS = decision statement.

HLW = high-level waste.

RCRA = Resource Conservation and Recovery Act.

RESRAD = Residual Radioactivity (Model).

STOMP = PNNL-11216, *STOMP -- Subsurface Transport Over Multiple Phases: Application Guide*.

TSD = treatment, storage, and/or disposal (unit).

WAC = Washington Administrative Code.

3.3 COMPUTATIONAL AND SURVEY/ANALYTICAL METHODS

Table 3-2 identifies where existing data either do not exist or are of insufficient quality to resolve the decision statements (Table 2-4). Table 3-4 presents computational and/or surveying/sampling methods that could be used to obtain the required data.

Table 3-4. Information Required to Resolve the Decision Statements. (3 Pages)

DS #	Remedial Investigation Variable	Required Data	Computational Methods	Survey/Analytical Methods
1 and 3	Concentrations of radiological COPCs in building structures and equipment	<p>Bounding alpha, beta, and gamma COPC concentrations in building structures and equipment for evaluation against action levels.</p> <p>Location data (extent of COPCs within canyon boundaries).</p>	<p>Assessment of radiological survey data.</p> <p>RESRAD or RESRAD-Build – analytical modeling method for human health dose assessment.</p> <p>STOMP or other analytical code – analytical modeling through vadose zone to groundwater.</p>	<p>Field screening equipment^a.</p> <p>Sampling and laboratory analysis, as required.</p>
2 and 4	Concentrations of nonradiological COPCs in building structures and equipment	<p>Bounding chemical COPC concentrations in building structures and equipment for evaluation against action levels.</p> <p>Location data (extent of COPCs within canyon boundaries).</p>	<p>Direct comparison with WAC 173-340-7492^b (ecological), WAC 173-340 Method C (direct exposure) and WAC 173-340 Method B (groundwater) cleanup levels.</p> <p>STOMP or other analytical code – analytical modeling through vadose zone to groundwater.</p>	<p>Field screening equipment^a.</p> <p>Sampling and laboratory analysis.</p>
5 and 6	Residual material in building structures or equipment, that could potentially classify as HLW if disposed	Process knowledge; alpha, beta, and gamma COPC concentrations in building structures and process equipment.	Review of DOE Order 435.1 criteria for classifying HLW.	<p>Field screening equipment^a.</p> <p>Sampling and laboratory analysis.</p>
7	Concentrations of radiological COPCs in soils underlying the PUREX Canyon	Bounding alpha, beta, and gamma COPC concentrations in vadose zone soil for evaluation against action levels.	<p>RESRAD – analytical modeling method for human health dose assessment.</p> <p>STOMP or other analytical code – analytical modeling through vadose zone to groundwater.</p>	<p>Field screening with radiological detection equipment^a.</p> <p>Soil sampling and laboratory analysis.</p>

Table 3-4. Information Required to Resolve the Decision Statements. (3 Pages)

DS #	Remedial Investigation Variable	Required Data	Computational Methods	Survey/Analytical Methods
8	Concentrations of nonradiological COPCs in soils underlying the PUREX Canyon	Bounding nonradiological COPC concentrations in vadose zone soil for evaluation against action levels.	Direct comparison with WAC 173-340-7492 ^b (ecological), WAC 173-340 Method C (direct exposure) and WAC 173-340 Method B (groundwater) cleanup levels. STOMP or other analytical code – analytical modeling through vadose zone to groundwater.	Field screening equipment ^a . Soil sampling and laboratory analysis.
9	PUREX Canyon structural integrity	Structural integrity data to allow an evaluation of entombment alternatives.	Engineering calculations	Structural testing of concrete and rebar; compaction testing of underlying soils. Review of existing structural design information, documents, and engineering drawings.
10	PUREX Canyon structural design	Structural design information to allow an evaluation of dismantlement alternatives.	Engineering calculations	Structural testing of concrete and rebar; compaction testing of underlying soils. Review of existing structural design information, documents, and engineering drawings.

^aField screening techniques that will be considered for use are listed in Table 3-6.

^bWAC 173-340-7492 will only apply if the complete removal of the building is the chosen remedy and will apply to soils underlying the footprint of the canyon.

COPC = contaminant of potential concern.

DS = decision statement.

HLW = high level waste.

RESRAD = Residual Radioactivity (Model).

STOMP = PNNL-11216, *STOMP -- Subsurface Transport Over Multiple Phases: Application Guide*.

Table 3-5 presents details on the computational methods identified in Table 3-4. These details include the source and/or author of the computational method and information on how the method could be applied to this study.

Table 3-5. Details on Identified Computational Methods.

DS #	Computational Method	Source/Author	Application to Study	Satisfy Input Req't?
1-4 and 7-8	RESRAD or RESRAD-Build	Argonne National Laboratory	RESRAD will be used to estimate direct human radiation exposure to account for radioactive decay.	Yes
1-4 and 7-8	STOMP code (PNNL-11216) or other analytical codes	PNNL	Estimates the migration of all contaminants (radiological and nonradiological) through the vadose to groundwater. The model requires site-specific geohydrologic soil properties (e.g., hydraulic conductivity, and moisture). Other codes may be identified and used based on specific site conditions and requirements.	Yes
9-10	Engineering calculations, as required	NA	May be used to evaluate the structural integrity of the building with respect to the entombment alternatives, or to evaluate the structural design with respect to dismantlement alternatives.	Yes

DS = decision statement.
 NA = not applicable.
 PNNL = Pacific Northwest National Laboratory.
 RESRAD = Residual Radioactivity (Model).
 STOMP = PNNL-11216, STOMP -- Subsurface Transport Over Multiple Phases: Application Guide.

Table 3-6 identifies each of the survey and/or analytical methods that may be used to provide the required information needed to resolve each of the decision statements. The possible limitations associated with each of these methods also are provided.

Table 3-6. Potentially Appropriate Survey and/or Analytical Methods.

Media	Remediation Variable	Potentially Appropriate Survey/Analytical Method	Possible Limitations
Field Screening^a			
Soil, Concrete, Equipment	Radiological COPCs	NaI or HPGe detector	Access issues associated with some areas within the canyon, including the interior of the process cells and soils underlying the canyon.
Soil, Concrete, Equipment	Radiological COPCs	GM or PAM	Access issues associated with some areas within the canyon, including the interior of the process cells and soils underlying the canyon; hand-held detectors that will require an RCT to potentially be in close proximity to high dose rates or high levels of contamination.

Table 3-6. Potentially Appropriate Survey and/or Analytical Methods.

Media	Remediation Variable	Potentially Appropriate Survey/ Analytical Method	Possible Limitations
Soil, Concrete, Equipment	Alpha activity	Passive Neutron Counting System	Access issues associated with some areas within the canyon, including the interior of the process cells and soils underlying the canyon.
Soil, Concrete, Equipment	Gamma activity	Gamma-Ray Cameras	Sensitive to high background radiations; need to shield devices to obtain accurate measurements.
Laboratory Samples			
Soil, Liquid, Concrete	All COPCs	Laboratory analysis	Highly contaminated or high dose rate samples require use of onsite laboratories. Impacts associated with highly contaminated or high dose rate samples include high cost, reduced analyte lists, matrix effects, degraded detection limits, and long turnaround times. Lower contamination levels allow use of offsite laboratories, avoiding these limitations. Access issues associated with some areas within the canyon, including the interior of the process cells and soils underlying the canyon.

^aField screening techniques other than those listed in this table may be utilized. If other techniques are to be used, they will be documented in the sampling and analysis plan.

COPC = contaminant of potential concern.

GM = Geiger-Mueller counter.

HPGe = high-purity germanium.

NaI = sodium iodide.

PAM = portable alpha monitor.

RCT = Radiological Control Technician.

3.4 ANALYTICAL PERFORMANCE REQUIREMENTS

Tables 3-7a and 3-7b define the analytical performance requirements for the data that need to be collected to resolve each of the decision statements. These performance requirements include the practical quantitation limit and the precision and accuracy requirements for each of the COPCs.

Table 3-7a. Analytical Performance Requirements for Radionuclides. (2 Pages)

COPCs	CAS #	Preliminary Action Level ^a			Name/Analytical Technology ^c	Target Quantification Limits ^b		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		15 mrem/yr (pCi/g)	500 mrem/yr (pCi/g)	GW Protection (pCi/g)		Water (pCi/l)	Soil (pCi/g)				
Americium-241	14596-10-2	335	11,167	N/A	Americium isotopic - AEA	1	1	±20%	80-120%	±35%	65-135%
Carbon-14	14762-75-5	33,100	1,100,000	291	Carbon-14 - liquid scintillation	200	50	±20%	80-120%	±35%	65-135%
Cesium-137	10045-97-3	23.4	780	N/A	GEA	15	0.1	±20%	80-120%	±35%	65-135%
Cobalt-60	10198-40-0	4.90	164	N/A	GEA	25	0.05	±20%	80-120%	±35%	65-135%
Europium-152	14683-23-9	11.4	388	N/A	GEA	50	0.1	±20%	80-120%	±35%	65-135%
Europium-154	15585-10-1	10.3	345	N/A	GEA	50	0.1	±20%	80-120%	±35%	65-135%
Europium-155	14391-16-3	426	14,200	N/A	GEA	50	0.1	±20%	80-120%	±35%	65-135%
Iodine-129	15046-84-1	3,080	103,000	N/A	Iodine-129 - Low Energy Photon Spectroscopy	5	2	±20%	80-120%	±35%	65-135%
Neptunium-237	13994-20-2	59.2	1,980	N/A	Neptunium-237 - AEA	1	1	±20%	80-120%	±35%	65-135%
Nickel-63	13981-37-8	4,026	134,200	N/A	Nickel-63 - liquid scintillation	15	30	±20%	80-120%	±35%	65-135%
Plutonium-238	13981-16-3	470	15,700	N/A	Plutonium isotopic - AEA	1	1	±20%	80-120%	±35%	65-135%
Plutonium-239/240	Pu-239/240	425	14,200	N/A	Plutonium isotopic - AEA	1	1	±20%	80-120%	±35%	65-135%
Radium-226	13982-63-3	7.03	234	N/A	GEA	N/A	0.1	±20%	80-120%	±35%	65-135%
Radium-228	15262-20-1	8.15	272	N/A	GEA	N/A	0.2	±20%	80-120%	±35%	65-135%
Strontium-90	Rad-Sr	2,410	80,300	N/A	Total radioactive strontium - GPC	2	1	±20%	80-120%	±35%	65-135%
Technetium-99	14133-76-7	412,000	13,700,000	171	Technetium-99 - liquid scintillation	15	15	±20%	80-120%	±35%	65-135%

Table 3-7a. Analytical Performance Requirements for Radionuclides. (2 Pages)

COPCs	CAS #	Preliminary Action Level ^a			Name/Analytical Technology ¹	Target Quantitation Limits ²		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		15 inrem/yr ^b (pCi/g)	500 inrem/yr ^b (pCi/g)	GW Protection ^b (pCi/g)		Water (pCi/L)	Soil (pCi/g)				
Thorium-232	TH-232	4.8	160	N/A	Thorium isotopic - AEA (pCi) ICPMS (mg)	1	1	±20%	80-120%	±35%	65-135%
Tritium (H-3)	10028-17-8	66,900	2,230,000	4,100	Tritium - liquid scintillation	400	400	±20%	80-120%	±35%	65-135%
Uranium-233/234	13966-29-5	2,660	88,800	39.5	Uranium isotopic - AEA (pCi) ICPMS (mg)	1	1	±20%	80-120%	±35%	65-135%
Uranium-235/236	15117-96-1	101	3,370	3.92	Uranium isotopic - AEA (pCi) ICPMS (mg)	1	1	±20%	80-120%	±35%	65-135%
Uranium-238	U-238	504	16,800	38.1	Uranium isotopic - AEA (pCi) ICPMS (mg)	1	1	±20%	80-120%	±35%	65-135%

Table 3-7b. Analytical Performance Requirements for Nonradionuclides. (5 Pages)

COPCs	CAS #	Preliminary Action Level ^a			Name/Analytical Technology	Target Quantitation Limits ²		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C ^a (mg/kg)	GW Protection ^a (mg/kg)	Terrestrial Biota Protection ^a (mg/kg)		Water (mg/L)	Soil (mg/kg)				
Antimony	7440-36-0	1,400	N/A	5	Metals - 6010 - ICP	0.06	6	±	±	±	±
Arsenic	7440-38-2	87.5	20 ^b	20 ^b	Metals - 6010 - ICP	0.1	10	±	±	±	±
Barium	7440-39-3	245,000	282	132 ^b	Metals - 6010 ⁱ - ICP (trace)	0.01	1	±	±	±	±
Beryllium	7440-41-7	104 ^j	N/A	10	Metals - 6010 - ICP	0.005	0.5	±	±	±	±
Cadmium	7440-43-9	139 ^j	0.81 ^b	4	Metals - 6010 - ICP	0.005	0.5	±	±	±	±
					Metals - 6010 ⁱ - ICP (trace)	0.005	0.5	±	±	±	±

Table 3-7b. Analytical Performance Requirements for Nonradionuclides. (5 Pages)

COPCs	CAS #	Preliminary Action Level ^a			Name/Analytical Technology	Target Quantitation Limits ^c		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-346 Method C ^a (mg/kg)	GW Protection ^a (mg/kg)	Terrestrial Biota Protection ^a (mg/kg)		Water (mg/L)	Soil (mg/kg)				
Chromium (total)	7440-47-3	Unlimited	2,000	42	Metals - 6010 - ICP	0.01	1	±	±	±	±
Chromium VI	18540-29-9	21 ^j	7.7 ^k	42	Chromium (hex) - 7196 - colorimetric	0.01	0.5	±	±	±	±
Copper	7440-50-8	130,000	22 ^b	50	Metals - 6010 - ICP	0.025	2.5	±	±	±	±
Lead	7439-92-1	1,000 ^l	840 ^k	50	Metals - 6010 - ICP Metals - 6010 - ICP (trace)	0.1 0.01	10 1	± ±	± ±	± ±	± ±
Mercury	7439-97-6	1,050	0.33 ^h	0.33 ^a	Mercury - 7470 - CVAA Mercury - 7471 - CVAA	0.0005 N/A	N/A	± ±	± ±	± ±	± ±
Nickel	7440-02-0	70,000 ^m	130.4	30	Metals - 6010 - ICP	0.04	4	±	±	±	±
Selenium	7782-49-2	17,500	1 ^k	0.78 ^b	Metals - 6010 - ICP	0.1	10	±	±	±	±
Silver	7440-22-4	17,500	9.4 ^k	2	Metals - 6010 - ICP Metals - 6010 - ICP (trace)	0.02 0.005	2 0.5	± ±	± ±	± ±	± ±
<i>Inorganics</i>											
Ammonia/ ammonium	7664-41-7	Unlimited	Unlimited	N/A	Ammonia - 350.N ^a	0.05	0.5	±	±	±	±
Chloride	16887-00-6	N/A	N/A	N/A	Anions - 300.0 - IC	0.2	2	±	±	±	±
Cyanide	57-12-5	70,000	0.80	N/A	Total cyanide - 9010 - colorimetric	0.005	0.5	±	±	±	±
Fluoride	16984-48-8	210,000	16	N/A	Anions - 300.0 - IC	0.5	5	±	±	±	±
Nitrate	14797-55-8	Unlimited	40	N/A	Anions - 300.0 - IC	0.25	2.5	±	±	±	±
Nitrite	14797-65-0	350,000	4	N/A	Anions - 300.0 - IC	0.25	2.5	±	±	±	±

Table 3-7b. Analytical Performance Requirements for Nonradionuclides. (5 Pages)

COPCs	CAS #	Preliminary Action Level*			Name/Analytical Technology	Target Quantitation Limits†		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C (mg/kg)	GW Protection (mg/kg)	Terrestrial Biota Protection (mg/kg)		Water (mg/L)	Soil (mg/kg)				
Phosphate	14265-44-2	N/A	N/A	N/A	Anions - 300.0 - IC	0.5	5	§	§	§	§
Sulfate	14808-79-8	N/A	1,000	N/A	Anions - 300.0 - IC	0.5	5	§	§	§	§
<i>Organics</i>											
Acetone (2-propanone)	67-64-1	350,000	3.21	N/A	Volatile organics - 8260 - GCMS	0.02	0.02	§	§	§	§
Benzene	71-43-2	2,390	2.42	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Butyl benzene	104-51-8	N/A	N/A	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	N/A	N/A	N/A	N/A
Carbon tetrachloride	56-23-5	1,010	0.0031	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Chlorobenzene	108-90-7	70,000	1.4	40	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Chloroform	67-66-3	21,500	0.0382	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Dichloroethane; 1,1	75-34-3	350,000	4.37	N/A	Volatile organics - 8260 - GCMS	0.01	0.01	§	§	§	§
Dichloroethane; 1,2	107-06-2	1,440	0.00232	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Ethylbenzene	100-41-4	350,000	6.91	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	Unlimited	N/A	N/A	Volatile organics - 8260 - GCMS	0.01	0.01	§	§	§	§
Methylene chloride (dichloromethane)	75-09-2	17,500	0.0254	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§
Phenol	108-95-2	Unlimited	43.9	30	Semi-volatiles - 8270 - GCMS	0.01	0.33	§	§	§	§
PCBs	1336-36-3	10 ¹	0.21	0.65	PCBs - 8082 - GC	0.0005	0.0165	§	§	§	§
Tetrachloroethylene	127-18-4	2,570	0.0091	N/A	Volatile organics - 8260 - GCMS	0.005	0.005	§	§	§	§

Table 3-7b. Analytical Performance Requirements for Nonradionuclides. (5 Pages)

COPCs	CAS #	Preliminary Action Level ^a			Name/Analytical Technology	Target Quantitation Limits ^b		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C ¹ (mg/kg)	GW Protection (mg/kg)	Terrestrial Biota Protection ^c (mg/kg)		Water (mg/L)	Soil (mg/kg)				
Toluene	108-88-3	70,000	11.6	200	Volatile organics – 8260 – GCMS	0.005	0.005	±	±	±	±
Tributyl phosphate	126-73-8	N/A	N/A	N/A	Semi-volatiles – 8270 – GCMS	0.1	3.3	±	±	±	±
Trichlorethane; 1,1,1	71-55-6	Unlimited	57	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	±	±	±	±
Trichloroethylene	79-01-6	11,900	0.0263	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	±	±	±	±
Xylene (total)	1330-20-7	Unlimited	135	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	±	±	±	±
Total petroleum hydrocarbons – diesel to oil range (kerosene and normal paraffin hydrocarbons)	68334-30-5 and 8008-20-6	2,000 ¹	2,000 ¹	200	WTPH-DX	0.5	5	±	±	±	±
Hydraulic fluids (grease; heavy oils)	8008-20-6	2,000 ¹	2,000 ¹	N/A	WTPH-DX	2	200	±	±	±	±

Table 3-7b. Analytical Performance Requirements for Nonradionuclides. (5 Pages)

COPCs	CAS #	Preliminary Action Level ^a		Name/Analytical Technology	Target Quantitation Limits ^b		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C ^c (mg/kg)	GW Protection ^d (mg/kg)		Terrestrial Biota Protection ^e (mg/kg)	Water (mg/L)				

^a The preliminary action level is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the FS, finalized in the record of decision, and will drive remediation of the canyon.

^b 1.5 mrem/yr = nonradiological worker industrial exposure scenario; 2,000 hrs/yr onsite, 60% indoors, 40% outdoors. 500 mrem/yr = radiological worker industrial scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. GW = groundwater protection radionuclide values based on either RESRAD or STOMP modeling of drinking water exposure with the entire vadose zone presumed to be contaminated.

^c The laboratory is instructed to achieve water (liquid) and soil (solid) detection limits that are typical of published method performance as identified in the table. However, matrix-related effects (e.g. radioactivity, presence of chemical interferences, etc) may impact the laboratory's ability to achieve the targets in all cases.

^d WAC 173-340 Method C industrial soil values for direct exposure from the CLARC Version 3.1 tables, updated November 2001 (Ecology 94-145).

^e Calculated using WAC 173-340 Method B drinking water standards as inputs to the WAC 173-340 three-phase model for protection of drinking water (WAC 173-340-747[4], amended February 12, 2001), except as noted.

^f Value is the lowest concentration for each analyte (adjusted for background) from Tables 749-2 and 749-3 of WAC 173-340-900, amended February 12, 2001.

^g Precision and accuracy requirements as identified and defined in the referenced EPA procedures implemented by laboratory analysis and QA procedures. Cleanup value is less than Hanford Site soil background. Therefore, the soil background concentration is used as the preliminary action level.

^h All four-digit numbers refer to *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846).

ⁱ Calculated using WAC 173-340 air cleanup standards from WAC 173-340-750(3)(a)(ii)(B), page 210, equation 750-2, with Washington State Department of Health mass loading of particulates in air of 10⁻⁴ g/m³.

^j Calculated using standards for surface water protection (40 CFR 131, "Water Quality Planning and Management," and WAC 173-201A-040, "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances") as inputs to the WAC 173-340 three-phase model for protection of drinking water (WAC 173-340-747[4], February 12, 2001).

^k Based upon WAC 173-340 Method A values from Tables 740-1 and 745-1 of WAC 173-340-900, amended February 12, 2001.

^l Value based upon nickel or uranium soluble salts value.

^m From *Methods of Analysis of Water and Waste* (EPA-600/4-79-020).

AEA = alpha energy analysis
 CAS = Chemical Abstract Service
 CVAA = cold vapor atomic absorption
 GC = gas chromatograph
 GCMS = gas chromatograph/mass spectrometry
 GPC = gas proportional counter

IC = ion chromatography
 ICPMS = inductively coupled plasma mass spectrometer
 N/A = not applicable
 PCB = polychlorinated biphenyl
 TOC = total organic carbon

4.0 STEP 4 -- DEFINE THE BOUNDARIES OF THE STUDY

4.1 OBJECTIVE

The primary objective of DQO Step 4 is for the DQO team to identify the spatial, temporal, and practical constraints on the sampling design and to consider the consequences. This objective (in terms of the spatial, temporal, and practical constraints) ensures that the sampling design results in the collection of data that accurately reflect the true condition of the site and/or populations being studied.

4.2 DEFINE THE BOUNDARIES OF THE STUDY

Table 4-1 defines the population of interest to clarify what the samples are intended to represent. The characteristics that define the population of interest are also identified.

Table 4-1. Characteristics that Define the Population of Interest.

DS #	Population of Interest	Characteristics
<i>PUREX Canyon</i>		
1-6	Building ^a areas and equipment	Concentrations of chemical and radiological contaminants.
		Presence of residual material that could potentially classify as HLW if disposed.
7-8	Soils directly underlying the building footprint	Concentrations of chemical and radiological contaminants.
9-10	Building structural features; soils underlying the building	Structural integrity and design of the building; soil mechanics and physical properties.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

DS = decision statement.

HLW = high level waste.

Table 4-2 defines the spatial boundaries of the decision and the domain or geographic area (or volume) within which all decisions must apply (in some cases, this may be defined by the operable unit). The domain is a region distinctly marked by some physical features (i.e., volume, length, width, and boundary).

Table 4-2. Geographic Boundaries of the Investigation.

DS #	Geographic Boundaries of the Investigation
All	The geographic boundaries for the investigation are the boundaries of the building ^a , and the vadose zone soils underlying the building.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

DS = decision statement.

When appropriate, the population is divided into strata that have relatively homogeneous characteristics. The DQO team must systematically evaluate process knowledge, historical data, and building configurations to present evidence of a logic that supports alignment of the population into strata with homogeneous characteristics. Table 4-3 identifies the strata with homogeneous characteristics.

Table 4-3. Zones with Homogeneous Characteristics. (2 Pages)

DS #	Population of Interest	Zone	Homogeneous Characteristic Logic
1-6	Building ^a areas and equipment	Process areas	The process areas were exposed to the highest levels of radiological contamination in the facility. Leaks from process lines and spills from process tanks would have been contained within these areas and/or drained via floor drains.
		Canyon deck	The canyon deck was exposed to elevated levels of chemical and radiological contamination through spills and normal process operations.
		Process support areas	The hot pipe trench and the ventilation tunnel were exposed to high levels of radiation/contamination and are expected to retain significant levels of radiological and potentially chemical contamination. The ventilation tunnel was exposed to all of the potential airborne COPCs found in the process areas of the structure. The hot pipe trench transferred the process materials to the process cells. There was likely some amount of leakage within this trench however, the pipes have been flushed and are not expected to contain process solutions.
		Railroad tunnel	The railroad tunnel is expected to contain similar levels of contamination as the canyon deck. Materials and equipment were remotely unloaded from the rail cars by the crane and lifted to the area where they were needed. Contamination resulted from equipment leaks and exposure to the air space of the canyon deck and crane way.
		Service rooms and galleries	These rooms and galleries are in the service part of the building, including the electrical gallery, piping and operating gallery, storage gallery, etc. These areas are the parts of the building where personnel did routine maintenance and operating functions. In general, contamination protection was not required in these areas because the existing levels of contamination present limited exposure potential. The crane way is grouped with the service rooms and galleries, based on radionuclide survey information for that area, which states that the crane way was routinely decontaminated to allow maintenance activities to occur.

Table 4-3. Zones with Homogeneous Characteristics. (2 Pages)

DS #	Population of Interest	Zone	Homogeneous Characteristic Logic
7-8	Soil	Vadose zone soils underlying the building	The vadose zone soils underlying the building may contain radiological and nonradiological contaminants from leaks and spills within areas of the building that were released via a preferential pathway (e.g., cracks in lower floors or cells).
9-10	Structural integrity and design	Building structure and soil features	Structure and design information; soil compaction information.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.
 COPC = contaminant of potential concern.
 DS = decision statement.

The temporal boundaries of the decision are defined in Table 4-4.

Table 4-4. Temporal Boundaries of the Investigation.

DS #	Timeframe for Sample Collection	When to Collect Data
<i>Field Screening</i>		
All	NA	Avoid extreme hot or cold conditions due to impacts on worker efficiency and equipment effectiveness.
<i>Laboratory Samples</i>		
All	NA	Avoid extreme hot or cold conditions that have potential to impact sample integrity and sampling operations in the building ^a .

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.
 DS = decision statement.
 NA = not applicable.

4.3 SCALE OF DECISION MAKING

Table 4-5 defines the scale of decision making for each decision statement. The scale of decision making is defined as the smallest, most appropriate subsets of the population (sub-population) for which decisions will be made based on the spatial or temporal boundaries of the area under investigation.

Table 4-5. Scale of Decision Making.

DS #	Population of Interest	Geographic Boundary	Temporal Boundary		Spatial Scale of Decision Making
			Timeframe for Sample Collection	When to Collect Data	
1-6	Building* areas and equipment	The geographic boundaries for the investigation are the boundaries of the building.	NA	Avoid extreme hot or cold conditions that have potential to impact sample integrity and sampling operations in the building.	Individual building areas and equipment listed in Table 3-2
7-8	Soils underlying the building	The geographic boundaries for the investigation are the vadose zone soils beneath the building.	NA	Avoid extreme hot or cold conditions that have potential to impact sample integrity and sampling operations in the building.	Vadose zone soils
9-10	Building structural features	The geographic boundaries for the investigation are the boundaries of the building.	NA	Avoid extreme hot or cold conditions that have potential to impact sample integrity and sampling operations in the building.	Building as a whole

*Building refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

DS = decision statement.

NA = not applicable.

4.4 PRACTICAL CONSTRAINTS

Table 4-6 identifies the practical constraints that may impact the data collection effort. These constraints include physical barriers, difficult sample matrices, high radiation areas, or any other condition that will need to be taken into consideration in the design and scheduling of the sampling program.

Table 4-6. Practical Constraints on Data Collection.

Practical Constraints:

Areas within the building^a are high radiation and high contamination areas that may pose challenges to collecting samples in these areas because of ALARA and worker safety concerns.

Core drilling of the high density concrete used to construct the building can be a challenge.

Access to the soils under the building may be limited due to the presence of process equipment in the process cells. This may also limit the volume of sample material that may be recovered.

Physical access to cell floors, piping, and drain headers due to equipment present in the cells.

Degraded equipment and systems or equipment that has exceeded life time, qualification or PM intervals.

Other Constraints:

Industrial hygiene and safety constraints may be imposed during characterization sampling to ensure that ALARA issues are properly addressed when sampling contaminated areas of the building.

Laboratory constraints are expected when analyzing samples with high radiological dose rates. Samples in this category would be analyzed in an onsite laboratory. Impacts associated with high dose rate samples are expected in cost, holding times, degradation of detection limits, and possible reduction in the analyte lists.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

ALARA = as low as reasonably achievable.

PUREX = plutonium-uranium extraction (Plant).

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5.0 STEP 5 -- DEVELOP A DECISION RULE

The purpose of DQO Step 5 is initially to define the statistical parameter of interest (i.e., maximum, mean, or 95% upper confidence level) that will be used for comparison against the action level. The statistical parameter of interest specifies the characteristic or attribute that a decision-maker would like to know about the population. The preliminary action level for each of the COPCs is also identified in DQO Step 5. When this is established, a decision rule is developed for each decision statement in the form of an "IF...THEN..." statement that incorporates the parameter of interest, the scale of decision making, the preliminary action level, and the alternative actions that would result from resolution of the decision. Note that the alternative actions and scale of decision making were identified earlier in DQO Steps 2 and 4, respectively.

5.1 INPUTS NEEDED TO DEVELOP DECISION RULES

Tables 5-1, 5-2, and 5-3 present the information needed to formulate the decision rules in Section 5.2. This information includes the decision statements and alternative actions identified in DQO Step 2, the scale of decision making identified in DQO Step 4, and the statistical parameters of interest and preliminary action levels for each of the COPCs. Decision statements #9 and 10 are not applicable, as there are no action levels associated with these DSs.

Table 5-1. Decision Statements.

DS #	Decision Statement
1	Determine if the building ^a areas radiological contamination exceeds the action levels.
2	Determine if the building areas chemical contamination exceeds the action levels.
3	Determine if the building equipment ^b radiological contamination exceeds the action levels.
4	Determine if the building equipment chemical contamination exceeds the action levels.
5	Determine if residual material that could potentially classify as HLW if disposed is present in areas within building areas.
6	Determine if residual material that could potentially classify as HLW if disposed is present in the process equipment.
7	Determine if the underlying soil radiological contamination exceeds the action levels.
8	Determine if the underlying soil chemical contamination exceeds the action levels.
9	Determine if the building structural integrity is sufficient to support entombment alternatives based on existing knowledge versus analysis.
10	Determine if building structural design information is available to support an evaluation of dismantlement alternatives based on existing knowledge versus analysis.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

DS = Decision Statement.

HLW = high-level waste

N/A = Not applicable - there are no action levels associated with building structural integrity and design.

PUREX = Plutonium-Uranium Extraction.

Table 5-2. Inputs Needed to Develop Decision Rules. (2 pages)

DS #	COPC or Considerations	Parameter of Interest	Statistic	Scale of Decision Making	Preliminary Action Levels
1	Radiological COPCs	Population maximum	Maximum detected values	Building areas listed in Table 4-3	Dose based limit (15 - 500 mrem/yr). Compliance determined by detected radionuclide concentrations and modeling (RESRAD, RESRAD-Build, STOMP, or other).
3				Building equipment	
7				Vadose soils beneath the building	
2	Nonradiological constituents	Population maximum	Maximum detected values	Building areas listed in Table 4-3	WAC 173-340 and other regulatory levels (identified in Tables 3-7a and 3-7b).
4				Building equipment	
8				Vadose soils beneath the building	
5	Radiological COPCs and process knowledge indicating residual material that could potentially classify as HLW if disposed	NA	Radiological constituents in areas of the process that would meet the criteria for classification as HLW if disposed.	Building areas listed in Table 4-3	Criteria specified in DOE Order 435.1
6				Building equipment containing residual material that could potentially classify as HLW if disposed	
9	Building structural integrity information	NA	NA	Building structure	NA

Table 5-2. Inputs Needed to Develop Decision Rules. (2 pages)

DS #	COPC or Considerations	Parameter of Interest	Statistic	Scale of Decision Making	Preliminary Action Levels
10	Building structural design information (e.g., concrete, rebar) and soil physical state	NA	NA	Building structure and underlying soils	NA

COPC = contaminant of concern.

DS = decision statement.

HLW = high-level waste.

NA = not applicable.

RESRAD = Residual Radioactivity (Model).

STOMP = PNNL-11216, STOMP -- *Subsurface Transport Over Multiple Phases: Application Guide.*

The alternative actions identified in DQO Step 2 are summarized in Table 5-3.

Table 5-3. Alternative Actions. (2 Pages)

PSQ #	Alternative Actions
1	1a – Evaluate the building ^a areas remedial alternatives in a feasibility study.
	1b – Evaluate the building areas for closure with no remedial action.
2	2a – Evaluate the building areas remedial alternatives in a feasibility study.
	2b – Evaluate the building areas for closure with no remedial action.
3	3a – Evaluate the building equipment ^b remedial alternatives in a feasibility study.
	3b – Evaluate the building equipment for closure with no remedial action.
4	4a – Evaluate the building equipment remedial alternatives in a feasibility study.
	4b – Evaluate the building equipment for closure with no remedial actions.
5	5a – Evaluate the residual inventory in the building areas (as potential HLW) for remedial alternatives in a feasibility study.
	5b – Evaluate the residual inventory in the building areas (as potential HLW) for closure with no remedial action.
6	6a – Evaluate the process equipment residual inventory (as potential HLW) remedial alternatives in a feasibility study.
	6b – Evaluate the process equipment residual inventory (as potential HLW) for closure with no remedial actions.
7	7a – Evaluate the remedial alternatives for soils underlying the building in a feasibility study.
	7b – Evaluate the soils underlying the building for closure with no remedial action.
8	8a – Evaluate the remedial alternatives for soils underlying the building in a feasibility study.
	8b – Evaluate the soils underlying the building for closure with no remedial action.
9	9a – Evaluate structural analysis processes.
	9b – Assume capable by inspection.
10	10a – Evaluate available D&D processes for impact on structure.
	10b – Assume capable by inspection.

^aBuilding refers to the 202-A Building (PUREX Canyon) and all areas and equipment within.

^bEquipment refers to tanks, piping, etc. contained within the building.

HLW = high-level waste.

PSQ = principal study question.

5.2 DECISION RULES

The output of DQO Step 5 and the previous DQO steps are combined into "IF...THEN" decision rules that incorporate the parameter of interest, the scale of decision making, the action level, and the actions that would result from resolution of the decision. The decision rules are listed in Table 5-4. No decision rules have been established for PSQs 9 and 10, as there are no action levels associated with these PSQs.

Table 5-4. Decision Rules. (2 Pages)

DR #	Decision Rule
1	If the true maximum (as estimated by the maximum detected sample value) of the radionuclides in concrete samples from the respective building areas exceeds a direct exposure limit of 15 mrem/yr above background or a groundwater radiological dose greater than or equal to 4 mrem/yr above background (based on RESRAD, RESRAD-Build, or other modeling), then evaluate the remedial alternatives in a feasibility study. Otherwise evaluate for closure with no remedial action.
2	If the true maximum (as estimated by the maximum detected sample value) of the chemical COPCs in concrete samples from the respective building areas exceeds the PRGs in Table 3-7b, or values determined from STOMP or other modeling, then evaluate remedial alternatives in a feasibility study. Otherwise evaluate for closure with no remedial action.
3	If the true maximum (as estimated by the maximum detected sample value) of the radionuclides in the building equipment exceeds a direct exposure limit of 15 mrem/yr above background or a groundwater radiological dose greater than or equal to 4 mrem/yr above background based on RESRAD, STOMP, or other modeling, then evaluate remedial alternatives in a feasibility study. Otherwise evaluate for closure with no remedial action.
4	If the true maximum (as estimated by the maximum detected sample value) of the chemical COPCs in building equipment exceeds the PRGs in Table 3-7b or values determined from STOMP or other modeling, then evaluate remedial alternatives in a feasibility study. Otherwise evaluate for closure with no remedial action.
5	If process knowledge indicates the presence of, and specific radiological COPCs are detected in the building areas that could potentially classify as HLW if disposed, then evaluate remedial alternatives in a feasibility study. Otherwise, evaluate in accordance with DR 1.
6	If process knowledge indicates the presence of, and specific radiological COPCs are detected in the residual inventory in the process equipment that could potentially classify as HLW if disposed, then evaluate alternatives in a feasibility study. Otherwise, evaluate in accordance with DR 3.
7	If the true maximum (as estimated by the detected or maximum detected sample value, as applicable) of the radionuclides in the vadose zone soils beneath the building exceeds a direct exposure limits of 15 mrem/yr above background or a groundwater radiological dose greater than or equal to 4 mrem/yr ^a above background based on RESRAD, STOMP, or other modeling, then evaluate remedial alternatives in a feasibility study. Otherwise, evaluate for closure with no remedial action.
8	If the true maximum (as estimated by the detected or maximum detected sample value, as applicable) of the chemical COPCs in soils underlying the building exceeds the PRGs in Table 3-7b, then evaluate remedial alternatives in a feasibility study. Otherwise, evaluate for closure with no remedial action.

Table 5-4. Decision Rules. (2 Pages)

DR #	Decision Rule
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*Only applies to soils in the top 4.6 m (15 ft) below ground surface.

COPC = contaminant of potential concern.

DR = decision rule.

HLW = high-level waste.

RESRAD = Residual Radioactivity (Model).

STOMP = PNNL-11216, *STOMP -- Subsurface Transport Over Multiple Phases: Application Guide*.

6.0 STEP 6 – SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

Because analytical data can only estimate the true condition of the site under investigation, decisions that are made based on measurement data could potentially be in error (i.e., decision error). For this reason, the primary objective of DQO Step 6 is to determine which decision statements (if any) require a statistically based sample design. For those decision statements requiring a statistically based sample design, DQO Step 6 defines tolerable limits on the probability of making a decision error.

6.1 STATISTICAL VERSUS NONSTATISTICAL SAMPLING DESIGN

Table 6-1 provides a summary of the information used to support the selection between a statistical versus a nonstatistical sampling design for each decision statement. The factors that were taken into consideration in making this selection included the timeframe over which each of the decision statements applies, the qualitative consequences of an inadequate sampling design, and the accessibility of the site if resampling is required.

Table 6-1. Statistical Versus Nonstatistical Sampling Design.

DS #	Timeframe For Collection of Samples	Qualitative Consequences of Inadequate Sampling Design (Low/Moderate/Severe)	Resampling Access After Remedial Investigation (Accessible/Inaccessible)	Proposed Sampling Design (Statistical/Nonstatistical)
All	N/A	Low	Accessible	Nonstatistical

DS = decision statement.
 N/A = not applicable.

6.2 NONSTATISTICAL DESIGNS

Based on the extensive amount of historical process knowledge and analytical data associated with deactivation of the PUREX Canyon, a biased (or focused) sampling approach, which targets the maximum potential contamination within building areas, equipment, and soils underlying the structure is considered appropriate for the PUREX Canyon. Existing data, along with well-documented process knowledge, can reasonably be used to define areas of high likelihood for contamination. Although radiological conditions may have changed over the past 12 years based on the potential for migration within the building, worst case areas are not expected to have changed significantly over the course of time.

The nature of the building areas and equipment to be investigated in the remedial investigation supports the use of focused sampling, as identified in Ecology Publication No. 94-49, and EPA\240\R-02\005. These guidance documents define “focused sampling” as selective sampling of areas where potential or suspected contamination can reliably be expected to be found if a release of a hazardous substance has occurred.

In general, the "gray region" and tolerable limits on decision error are not developed in the DQO process for non-statistical sampling designs. However, it should be noted that there are two types of error that are associated with a biased, non-statistical sampling design. One type of error assumes measurements are underestimated and the other assumes that measurements are overestimated. Since there is extensive historical process knowledge regarding the PUREX Canyon, both of these types of error are not believed to warrant further consideration. Based on process knowledge, the levels of contamination are expected to be far above the action levels for an industrial land-use scenario; therefore, underestimating the levels of contamination in the building would not cause the No Action alternative to be chosen. Conversely, overestimating the levels of contamination in the building would not adversely impact the outcome of the feasibility study because the process would still drive remedial action.

7.0 STEP 7 – OPTIMIZE THE DESIGN

7.1 PURPOSE

The purpose of DQO Step 7 is to present alternative data collection designs that meet the minimum data quality requirements specified in DQO Steps 1 through 6. A selection process is then used to identify the most resource-effective data collection design that satisfies all of the data quality requirements. Table 6-1 differentiates between those Decision Rules that require a statistical sampling design from those that may be resolved using a non-statistical design. In the case of the PUREX Canyon, it was determined that a non-statistical sampling design (Table 7-1) would be utilized.

When determining an optimal design, the following activities should be performed.

- Review the DQO outputs from the previous DQO steps and the existing analytical and survey data (Appendix A).
- Develop general data collection design alternatives.
- Select the sampling design (e.g., techniques, locations, or numbers/volumes) that most effectively satisfies the project's goals.
- Document the operational details and theoretical assumptions of the selected design.

Typically, a series of sampling designs would be presented in Step 7 and a selection process would be used to identify the most resource-effective design that satisfies all of the data quality requirements. However, because the PUREX Canyon DQO is focused on collecting data that will be used to support the development of a baseline risk assessment, only one sampling design is presented in this step. The objectives of this sampling design are presented in Section 7.3.

7.2 WORKSHEETS FOR STEP 7 – OPTIMIZE THE DESIGN

Table 7-1 identifies information in relation to determining the data collection design.

Table 7-1. Determine Data Collection Design.

Decision	Statistical	Nonstatistical	Rationale
All	Not applicable	Nonstatistical sampling design	Biased (focused) data collection design is applicable to investigation, as historical data suggest that the highest levels of contamination are located in specific locations within the building. Consequences of erroneous decisions are not severe.

7.3 SAMPLING OBJECTIVES

The principal study questions identified in Table 2-1 result in sampling objectives. The objective of the sampling design is to provide the appropriate quantity and quality of data required to allow development of a baseline risk assessment, and an evaluation of each remedial action alternative with respect to the nine CERCLA criteria in a feasibility study. Based on the U Plant Canyon DQO (BHI 1997), sampling objectives for the PUREX Canyon include determining the maximum, bounding-case concentrations of chemical and radiological constituents in the building areas and process equipment, as well as the soils underlying the building. The sampling design is intended to provide the appropriate quality and quantity of data to support an evaluation of each alternative. The sampling design is presented in Table 7-2 of this DQO summary report.

7.4 SAMPLING DESIGN -- SUMMARY OF SAMPLING ACTIVITIES

A summary of the key features of the sampling design activities and the basis for the sampling design required to support development of a baseline risk assessment is presented in Table 7-2.

7.4.1 Overview of the PUREX Canyon Sampling Design

Analytical data that represent the maximum, bounding-case concentrations of radiological and chemical contamination that would be encountered in the building are required to ensure that the contaminants remaining in the facility do not pose an unacceptable risk to human health, or the environment. Data will be used to perform a baseline risk assessment in conjunction with the remedial investigation/feasibility study process, and to support the identification of a preferred alternative for final disposition of the building. Data will also be used to support RCRA TSD closures.

Sampling points for the building areas are based on the highest levels of contamination encountered in those areas of the building that are believed to contain the highest levels of contamination. These areas were chosen based on a review of historical documentation, process knowledge, and interviews with former employees. No sampling is proposed for the canyon process tank systems, as they were flushed and sampled during transition phase activities. Non-process tanks were drained or visually inspected during the transition phase to ensure that no contents remained.

This sampling design also includes a visual inspection and sample collection (if material is present) of areas in the canyon that may hold waste that could potentially classify as high-level waste if disposed. This inspection will support a qualitative assessment of the presence of high-level waste, based on process knowledge and the criteria presented in DOE Order 435.1.

Sampling of soils underlying the structure will be limited to those areas in the lowest level of the building that have cracks in the concrete (and contain visual indications of staining) that could have provided a preferential pathway for contaminants to enter the soil. The sampling design for the underlying soils would utilize a phased approach. The first phase would utilize visual inspection to locate cracks with areas of staining in the base mat. If suspect areas are located during the visual examination phase, the next phase would focus on concrete samples to

determine the depth of contaminant penetration. Finally, core samples through the base mat into the underlying soil to collect grab samples would be performed only if there is evidence that contamination has penetrated the 2 m- (6 foot-) thick base mat.

Table 7-2 details the key features of the PUREX Canyon sampling design.

Table 7-2. Key Features of the Sampling Design. (5 Pages)

Sample Collection Methodology	Key Features of Design	Basis for Sampling Design
<i>Building Areas (Alpha Contamination)</i>		
Radiological survey and concrete sampling for bounding case alpha contamination in building structure areas	<p>Perform a radiological survey of walls and floor of L-Cell for alpha contamination. Collect a concrete surface sample by drilling several co-located holes at the location with the highest survey reading to a depth of 0.64 cm (0.25 in.).</p> <p>Collect the three to four concrete samples. Each concrete sample will be labeled and provided to the laboratory for radiological analysis.</p> <p>Concrete sampling will be performed by drilling several co-located holes to collect enough concrete debris for analysis. A rod will be fixed to the side of the drill motor to act as a physical stop, thereby limiting the depth of penetration to 0.64 cm (0.25 in.).</p>	L-Cell contains the highest concentrations of residual plutonium based on past estimates and analytical data (BWHC 1997), and was chosen to represent the worst case conditions in the building for alpha contamination.
<i>Building Areas (Beta-Gamma Contamination)</i>		
Radiological survey and concrete sampling for bounding case beta-gamma contamination in building structure areas	<p>Perform a radiological survey of walls and floor of F-Cell for beta-gamma contamination. Collect a concrete surface sample by drilling several co-located holes at the location with the highest survey reading to a depth of 0.64 cm (0.25 in.).</p> <p>Collect the three to four concrete samples. Each concrete sample will be labeled and provided to the laboratory for radiological analysis.</p> <p>Concrete sampling will be performed by drilling several co-located holes to collect enough concrete debris for analysis. A rod will be fixed to the side of the drill motor to act as a physical stop, thereby limiting the depth of penetration to 0.64 cm (0.25 in.).</p>	F-Cell contains the highest concentrations of residual mixed fission products based on past estimates (BWHC 1997), and was chosen to represent the worst case conditions in the canyon for mixed fission products contamination.
<i>Building Areas (Chemical Contamination)</i>		

Table 7-2. Key Features of the Sampling Design. (5 Pages)

Sample Collection Methodology	Key Features of Design	Basis for Sampling Design
<p>Existing analytical data from the sampling of the E Cell skip waste will be utilized in lieu of sampling.</p>	<p>No sampling is proposed for building process areas in the PUREX Canyon for chemical COPCs.</p>	<p>No sampling is required because chemical contamination in the PUREX Canyon is well documented.</p> <p>Transition phase activities included a comprehensive evaluation of hazardous materials that would remain within the PUREX Canyon post-deactivation. Most of these hazardous materials are inherent to the building structure (e.g., lead shielding, mercury vapor lamps). The results of this evaluation are presented in Appendix A of this DQO summary report.</p> <p>Chemical contaminants other than those documented during transition phase activities include spills of process solutions. Over the course of years of operations, leakage of process solutions occurred in the process cells, mainly due to connector (jumper) head gasket deterioration or misalignment. Process solutions were spilled on equipment structural surfaces, equipment tank surfaces, and on the floor and walls. Cell floor sumps were routinely emptied during operations.</p> <p>E-Cell is unique in that a process solution leak, over time, created a situation that required the removal of equipment from E-Cell, scabbling of the concrete floor, and addition of a new concrete floor prior to moving the equipment back into the cell. The scabbled concrete was collected in a metal container (skip), sampled, and placed in F-Cell for storage. Because the process solution that leaked in E-Cell was of a greater volume than incidental spills associated with routine operations, the E-Cell skip waste is considered the worst case scenario for spills of chemical process solutions. Therefore, no additional sampling is proposed to quantify chemical COPC contamination in the process areas of the PUREX Canyon. Since the E-Cell skip waste likely does not contain all of the chemical COPCs, the cell sumps will be visually inspected for accumulations of material. Any material found will be collected for laboratory analysis.</p>
<p>Building Areas (Radiological and Chemical Contamination)</p>		
<p>Visual inspection; grab samples of</p>	<p>Perform a visual inspection of service room and gallery areas (e.g., sumps,</p>	<p>Based on process knowledge, the majority of the service rooms and galleries are not</p>

Table 7-2. Key Features of the Sampling Design. (5 Pages)

Sample Collection Methodology	Key Features of Design	Basis for Sampling Design
solids or liquids for service rooms and galleries	<p>floor drains) that could contain an accumulation of contaminants.</p> <p>Based on the visual inspection, grab samples will be collected from areas in the service rooms and galleries that may have accumulated radiological or chemical contaminants, such as sumps and floor drains. All sample material collected will be composited into a single analytical sample, by service area location (e.g., P&O gallery, electrical gallery, sampling gallery), that will be analyzed for all COPCs.</p>	<p>expected to contain significant inventories of radiological or chemical contaminants. However, those areas that have the potential to have accumulated contaminants will be visually inspected and sampled if material is present.</p>
Building Areas (HLW Contamination)		
Visual inspection; grab samples of solids or liquids	<p>Based on process knowledge, identify areas within the PUREX Canyon that housed processes that could contain HLW as outlined in DOE Order 435.1.</p> <p>Perform a visual inspection of building areas (e.g., cell sumps) within the identified process areas that could contain a sufficient accumulation of residual material that could potentially classify as HLW if disposed.</p> <p>Collect a grab sample of any material remaining in the identified building areas (e.g., cell sumps) for laboratory analysis of radiological COPCs.</p>	<p>DOE Order 435.1 provides the criteria required to determine if HLW is present in the PUREX Canyon. Process knowledge is sufficient to determine if areas in the PUREX Canyon meet the criteria for potentially containing HLW if disposed. If waste is found in these areas in sufficient quantity, it will be sampled for evaluation of analytical data against process knowledge to determine whether the waste should be classified as HLW.</p>
Building Process Equipment (Radiological and Chemical Contamination)		
No sampling is proposed	No sampling is proposed for process tank systems in the PUREX Canyon.	<p>Transition phase activities included flushing of RCRA tanks systems in the PUREX Canyon. The following tasks were performed for PUREX Canyon tank systems:</p> <ul style="list-style-type: none"> • Removed residual process solutions • Flushed tank system until heels did not exhibit dangerous waste characteristics • Conducted protocol sampling and analysis of final flushes of tank systems • Emptied tanks of remaining nondangerous heels to the maximum extent practicable using existing pumps and/or jets • Isolated (blanked) all liquid feed

Table 7-2. Key Features of the Sampling Design. (5 Pages)

Sample Collection Methodology	Key Features of Design	Basis for Sampling Design
		<p>and/or drain lines to tank systems.</p> <p>Based on the transition phase activities listed above, residual liquids in RCRA tank systems are not anticipated to designate as dangerous wastes; no additional sampling is proposed for the PUREX Canyon tank systems.</p> <p>Analytical results for tank system sampling are presented in Appendix A of this DQO summary report.</p>
<i>Building Process Equipment (HLW Contamination)</i>		
No sampling is proposed	No sampling is proposed for process tank systems in the PUREX Canyon.	Based on the transition phase activities described above associated with PUREX Canyon tank systems, process solutions in sufficient quantities to classify as HLW are not likely to remain.
<i>Soils Underlying the Building (Radiological and Chemical Contamination)</i>		
Visual inspection	Perform a visual inspection for notable cracks and staining in the lower elevations of the PUREX Canyon that would indicate the presence of contaminants that could have provided a preferential pathway to the soils underlying the building.	This activity is designed to focus further characterization activities on those areas that have the potential to have introduced contamination to the soils underlying the building.

Table 7-2. Key Features of the Sampling Design. (5 Pages)

Sample Collection Methodology	Key Features of Design	Basis for Sampling Design
Concrete sampling	<p>If cracks with significant penetration and staining are noted in the visual inspection, sample the concrete at that specific location. Collect a concrete surface sample by drilling several co-located holes to a depth of 0.64 cm (0.25 in.) and collect the cuttings.</p> <p>If contamination appears to go deeper than 0.64 cm (0.25 in.), drilling will continue to the maximum depth of concrete contamination.</p> <p>Collect the three to four concrete samples. Each concrete sample will be labeled and provided to the laboratory for analysis of all COPCs.</p> <p>Concrete sampling will be performed by drilling several co-located holes to collect enough concrete debris for analysis. A rod will be fixed to the side of the drill motor to act as a physical stop, thereby limiting the depth of penetration to 0.64 cm (0.25 in.). This sampling method will be repeated at the location of other cracks.</p>	<p>If cracks with staining are noted during the visual inspection, sampling at crack locations will verify the depth of penetration of contaminants into the concrete and the possibility of contamination in the soils underlying the crack.</p>
Soil sampling	<p>If contamination extends through the entire thickness of the concrete, based on the concrete sampling detailed above, soil sampling will be performed.</p> <p>Following concrete sample collection, penetrate the concrete to the soil below. Upon removal of the concrete, inspect the underlying gravel (if present) and/or soil. Remove gravel (if present) and collect a soil sample for laboratory analysis of all COPCs.</p> <p>If contamination is detected, borehole sampling will be considered to determine the vertical extent of contamination.</p>	<p>If concrete sampling indicates the potential for contaminants to have migrated through the basemat, soil samples will be collected to determine COPC concentrations beneath the building structure in the underlying soils.</p> <p>Soil physical properties (e.g., moisture content, grain-size distribution, and bulk density) will be used to support contaminant transport modeling, if needed and if adequate sample material is available.</p>

COPC = contaminant of potential concern.

DOE = U.S. Department of Energy.

DQO = data quality objectives.

HLW = high level waste.

PUREX = plutonium-uranium extraction.

SAP = sampling and analysis plan.

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A. APPENDIX A
SUMMARY OF EXISTING HISTORICAL DATA FOR PUREX CANYON
CHARACTERIZATION

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APPENDIX A

SUMMARY OF EXISTING HISTORICAL DATA FOR PUREX CANYON CHARACTERIZATION

This appendix summarizes the historical radiological and chemical data collected during transition phase activities. The main source of information, as it pertains to this investigation, was the PUREX Deactivation End Point document (WHC 1997). This document provided information pertaining to deactivation end points that were established, and the associated tasks completed, during transition phase activities in the mid-1990's. This document also lists references to supporting documents (i.e., laboratory analytical data, radiological survey reports, work plans) that provide the details regarding the activity performed and the end state of each building location or system. The contents of these supporting documents that aided in preparation of this DQO summary report are summarized in the following tables.

The following paragraphs provide a summary level introduction for each of the tables in this appendix.

- Table A-1 provides a summary of the radiological surveys performed when the PUREX Canyon underwent deactivation. Many of the radiological surveys listed were performed in support of the PUREX Deactivation End Point document which provided information pertaining to deactivation end points that were established, and the associated tasks completed, during transition phase activities. This table provides the range of contamination and the dose (mR/hr) associated with each of the end point task areas.
- Table A-2 provides a summary of the hazardous substances that remain in the PUREX Canyon after deactivation occurred. This table lists a general description of the remaining hazardous substances for end point task areas. In addition, this table identifies information on both measured and estimated quantities of hazardous substances for end point task areas where hazardous substances remain.
- Table A-3 lists residual nuclides remaining in the PUREX Canyon after deactivation occurred. The table contains both measured and estimated quantities of plutonium expected to remain in the canyon, as well as an estimate of fission products remaining.
- Table A-4 provides a summary of the analytical data for the tank systems that were flushed and sampled in the PUREX Canyon during deactivation. Total organic carbon (TOC), pH, and RCRA metals were analyzed from samples collected from both RCRA permitted and non-permitted tanks in the canyon.
- Table A-5 provides a summary of analytical data generated from sampling activities for the tank systems that were flushed in the PUREX Canyon during deactivation. Both RCRA permitted and non-permitted tank systems were flushed and sampled for the volatile organic compounds listed in this table.

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Table A-1. Summary of Radiological Survey Data for the PUREX Canyon. (3 Pages)

End Point Task Area	Alpha (dpm)	Beta/Gamma (10 ³ dpm)	Dose (mR/hr)
202-A Facility Exterior	< 20 - < 200	< 1	< 0.5
	< 20 - < 200	< 1	< 0.5
	< 200	< 1	< 0.5 - 25
	< 200	< 1	< 0.5
	< 20 - < 500	< 1 - < 5	< 0.5
202-A Pump/Trap Pits	< 200 - < 500	< 1 - < 5	< 0.5
	< 200	< 1	0.5
	< 200	< 1	< 0.5 - 5
AMU	a	a	a
Canyon	a	a	a
Canyon Craneway	< D - 3,500	10 - 300	0.2 - 10
East Crane	< D - 14,000	5 - 400	< 0.5 - 5.5
West Crane	140 - 42,000	5 - 350	< 0.5 - 142
Canyon C-Cell Deck Access Airlock	< 200	< 1	< 0.5
	< 200 - 700	< 1 - 35	< 0.5 - 100
	200 - 700	1 - 35	0.5 - 100
Canyon F-Cell Deck Viewing Window	< 200 - 500	< 1 - < 5	N/A
	< 200	< 1	N/A
Canyon Lobby	a	a	a
Head End, Central, Power Control Rooms and Offices	a	a	a
East Mezzanine Canyon Support Rooms	a	a	a
Hot Shop	a	a	a
Lab	< D - 1,500	< 1 - 80	< 0.5 - 4
	< D - < 200	< D - 400	< 0.5
	< D	< D	< 0.5
	< 200 - 42,000	< 1 - 80	< 0.5
	< D	< D - 20	< 0.5 - 10
	< 20 - < 200	< 1 - 6	< 0.5
	< 200	< 1	< 0.5
M-Cell	< 200 - 105,000	< 5 - 400	0.4 - 150
M-Cell Pipe Chase	a	a	a
M-Cell Pipe Chase Tanks	a	a	a
N-Cell	N/A	N/A	0.5 - 7.0
	< 200 - 35,000	< 1 - < 5	< 0.5 - 35
N-Cell Room Exhaust	< 200	< 1	N/A

Table A-1. Summary of Radiological Survey Data for the PUREX Canyon. (3 Pages)

End Point Task Area	Alpha (dpm)	Beta/Gamma (10 ³ dpm)	Dose (mR/hr)
	< 200 - 350	N/A	N/A
P&O Gallery	< 20 - < 500	< 1 - < 5	< 0.5
	< D	< D	N/A
PIV Room	^a	^a	^a
PR-Room	N/A	N/A	0.7 - 4.5
	< 200 - 10,500	N/A	1 - 15
	^a	^a	^a
Q-Cell Control Room	700	N/A	0.5
	< D - 49,000	< D - 500	< 0.5 - 1
	< 200	< 1	< 0.5
	N/A	N/A	< 0.5
	< 200	< 1	< 0.5
R-Cell	< 0 - 4200	< D	5 - 35
	< D	< D	< 0.5
	< 20 - 14,000	< 1 - 400	2 - 55
R-Cell Equipment	^a	^a	^a
R-Cell Exterior	< 200 - 560,000	< 1 - 330	N/A
Sample Gallery	< D	1 - 60	< 0.5 - 3
	280 - 1,050	1 - 450	< 0.5 - 90
	< D	< D	< 0.5 - 1.5
	< D	< D	< 0.5
	N/A	N/A	< 0.5
	< D	< D	N/A
	< 200 - 5,400	< 1 - 350	< 0.5
Sample Gallery Hood HVAC	< 200	< 1 - 30	< 0.5
Sample Gallery Hood HVAC Station	1250	30	< 0.5
Sample Gallery Iodine Monitors	< D	< D	< 0.5 - 86
Sample Gallery Room Exhaust	350	8 - 30	N/A
	< D - 100	< D - 17	N/A
	< D	2 - 100	N/A
	< 20	< 1	N/A
Sample Gallery Waste Compactor	^a	^a	^a
Storage Gallery	< 20	< 1	< 0.5 - 3.5
	< 200	< 1	< 0.5 - < 5
	< D	< D - 70	< 0.5 - 1,650

Table A-1. Summary of Radiological Survey Data for the PUREX Canyon. (3 Pages)

End Point Task Area	Alpha (dpm)	Beta/Gamma (10 ³ dpm)	Dose (mR/hr)
	N/A	N/A	1.5 - 85
U-Cell	6000 - 210,000	70 - 900	5 - 42
	< 200 - < 500	< 1 - 20	N/A
White Room	< 200 - 2800	< 1	8 - 25
	< D - 5,500	< 1.5 - 150	< 0.5
PR Elevator	< 200	< 1	N/A
	< 20	< 1	N/A
	< 20 - < 200	< 1 - < 5	< 0.5
	< D	< D	N/A
	< 20 - < 200	< 1	N/A

*Radiological data was gathered during PUREX deactivation activities and is referenced in the end point document. However, this information cannot be located.

AMU = aqueous makeup unit.

<D = less than detectable using standard survey equipment.

dpm = disintegrations per minute.

mR/hr = millirem per hour.

N/A = no reading taken.

PR = product removal.

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
General	<p>Lead as a solid component, such as paint, light bulb contacts, washers affixing transite, sanitary water line joints packed with lead mesh; steam, air, and water safety relief valve seals; components of control panels – all abandoned in place and stable during surveillance and maintenance (S&M).</p> <p>Zinc used in galvanized piping; zinc, silver, and lead contacts are used in the electrical system. Lead and zinc were used as soldering in the electrical and plumbing systems. All stable during S&M.</p> <p>Mercury in thermostats and in electronic switches (i.e., electronic switches) throughout the building. Mercury vapor lights were also used for exterior lighting.</p> <p>Asbestos abandoned throughout the facility as a solid component such as in transite siding, utility line insulation, and gasket material. Refer to Asbestos Assessment for additional descriptions of asbestos remaining at PUREX.</p> <p>Unknown organic in liquid films, greases, and solid residues in bearings and gearboxes throughout the canyon. Stable during S&M period.</p> <p>Undetermined quantities of polychlorinated biphenyls (PCB) exist in transformers, ballasts, and lubricants/gear oil once used throughout the canyon.</p>	
202-A Facility Exterior	See "General" Section on this list for description of remaining material.	
202-A Facility Exterior	See "General" Section on this list for description of remaining material.	
202-A Pump/Trap Pits	See "General" Section on this list for description of remaining material.	
Aqueous Makeup Rooms (AMU) And Annex Exterior	Lead washers affixing transite	Throughout building exterior
AMU	See "General" Section on this list for description of remaining material.	
AMU Elevator	See "General" Section on this list for description of remaining material.	
AMU 4 th Floor	See "General" Section on this list for description of remaining material.	
Canyon East Crane	See "General" Section on this list for description of remaining material.	
Canyon Slave Crane	See "General" Section on this list for description of remaining material.	
Canyon West Crane	See "General" Section on this list for description of remaining material.	
Canyon Pool Cell & Slug Storage Basin	Lead counterweights, wrapped in a bundle, are on the south end of a lifting yolk located on a rack in	401 kg (~885 lb)/Solid

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
	the slug storage basin.	Approximately 30 lead counterweights (2"x3"x12")
Canyon C-Cell Deck Access Airlock	See "General" Section on this list for description of remaining material.	
Canyon F-Cell Deck Viewing Window	Lead in viewing window.	Unknown quantity
Canyon/A-Cell	Ag in Silver Reactor	Unknown quantity: full charge is 250 lb AgNO ₃ (670 g-mol Ag)
	Dissolver moderator lining: cadmium	~43 kg (~94.6 lb)
	Dissolver thermowells: mercury	~38 kg (~83.6 lb)/Liquid
	Lead counterweights	89 kg (195.9 lb)/Solid
Canyon/B-Cell	Ag in Silver Reactor	Unknown quantity: full charge is 250 lb AgNO ₃ (670 g-mol Ag)
	Dissolver moderator lining: cadmium	~43 kg (~94.6 lb)
	Dissolver thermowells: mercury	~38 kg (~83.6 lb)/Liquid
	Lead counterweights	167 kg (367.3 lb)/Solid
Canyon/C-Cell	Ag in Silver Reactor	Unknown quantity: full charge is 250 lb AgNO ₃
	Dissolver moderator lining: cadmium	~43 kg (~94.6 lb)
	Dissolver thermowells: mercury	~38 kg (~83.6 lb)/Liquid
	Lead counterweights	111.9 kg (246.2 lb)/Solid
Canyon/D-Cell	Lead counterweights	24.1 kg (53 lb)/Solid
Canyon/E-Cell	Lead: counterweights	254.3 kg (559.5 lb)/Solid
	jumpers	410.1 kg (902.2 lb)/Solid
Canyon/F-Cell	Lead: counterweights	1133.6 kg (2494 lb)/Solid
	shielding	536.4 kg (1180 lb)/Solid
	Chromium in floor debris: concrete solids contaminated with solutions from E Cell process.	Trace amounts through E Cell floor

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
Canyon/G-Cell	Lead: counterweights	531.8 kg (1170 lb)/Solid
	shielding	90.9 kg (200 lb)/Solid
	Potential PCBs in pulsar lubricant	Unknown quantity: once used for lubrication
Canyon/H-Cell	Lead: counterweights	303.2 kg (664.9 lb)/Solid
	Potential PCBs in pulsar lubricant	Unknown quantity: once used for lubrication
Canyon/J-Cell	Lead: counterweights	779 kg (1713.7 lb)/Solid
	jumpers	259.3 kg (570.5 lb)/Solid
	Cadmium: 4 Neutron monitor pigs (1 from J4, 3 from J6)	23.6 kg (52 lb) total/Solid
Canyon/K-Cell	Potential PCBs in pulsar lubricant	Unknown quantity: once used for lubrication
	Lead: counterweights	254.3 kg (559.5 lb)/Solid
	shielding	32.1 kg (70.6 lb)/Solid
Canyon/L-Cell	jumpers	45.5 kg (100 lb)/Solid
	Lead counterweights	310.1 kg (682.3 lb)/Solid
Canyon Deck	Lead sheets on deck (2) 2'x4'x1/16"	13.7 kg (30 lb)/Solid
Canyon Lobby	See "General" Section on this list for description of remaining material.	
Compressor Room	See "General" Section on this list for description of remaining material.	
Compressor Room ▪ Process and Instrument Air	See "General" Section on this list for description of remaining material.	
Head End, Central, Power Control Rooms and Offices	See "General" Section on this list for description of remaining material.	
Maintenance Shops	See "General" Section on this list for description of remaining material.	
SWP Lobby	See "General" Section on this list for description of remaining material.	

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
East Mezzanine and Canyon Support Rooms	Residual hydraulic oil in pneumatic system lines.	Quantity unknown
East Switch Gear Room	See "General" Section on this list for description of remaining material.	
Hot Shop	See "General" Section on this list for description of remaining material.	
Lab Center Corridor and Change/Lunch Rooms	See "General" Section on this list for description of remaining material.	
Lab HVAC Room	Lead Shielding: 6 lead sheets (6"x18"x1/8")	2.5 kg (5.5 lb)/Solid
Lab HVAC Equipment	See "General" Section on this list for description of remaining material.	
Laboratory	<u>Decon Room (under Hood 31):</u> 7 lead bricks (25 lb each) 2 lead sheets (12"x12"x1/4") <u>Outside Lab 5 in Corridor in Door 4:</u> 2 lead sheets (12"x12"x1/8") 2 lead sheets (6"x14"x1/8") <u>Outside Lab 5 in Corridor in Door 6:</u> 4 lead sheets (12"x12"x1/8") <u>Outside Lab 5 in Corridor in Door 10:</u> 1 lead sheet (1"x8"x30")	79.5 kg (175 lb)/Solid 13.4 kg (29.4 lb)/Solid 7.4 kg (14.7 lb)/Solid 3.9 kg (8.6 lb)/Solid 13.4 kg (29.4 lb)/Solid 44.6 kg (98.2 lb)/Solid
Lab Counting Room Equipment	See "General" Section on this list for description of remaining material.	
Lab Hoods	See "General" Section on this list for description of remaining material.	

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
Lab Dock	See "General" Section on this list for description of remaining material.	
M-Cell	See "General" Section on this list for description of remaining material.	
N-Cell	<p><u>Lead Shielding:</u></p> <p>8 Leaded glass panels for Upper and Lower Control Room.</p> <p>2 Lead-filled vault doors to Lower Control Room.</p>	<p>3869.1 kg (8512 lb)/Solid</p> <p>(3) Upper and (3) Lower at 568.2 kg (1250 lb) each</p> <p>(2) Upper at 230 kg (506 lb) each</p> <p>~1818.2 kg (~4000 lb)/ total Solid</p>
N-Cell Gloveboxes	<p>Bagging Box, Conveyor Housing, and Secondary Canning Glovebox with stainless steel and lead sides.</p> <p>Lead glass and packing on Secondary Canning Glovebox</p> <p>Lead Acryl window on Vessel Glovebox</p> <p>Powder Load Out and Maintenance Glovebox with stainless steel and lead sides.</p> <p>Lead Acryl, both attached and detached on Calciner Glovebox.</p> <p>Lead packing as needed to fill window installation cavities.</p>	<p>340.9 kg (750 lb) total/Solid</p> <p>113.6 kg (250 lb) each</p> <p>77.3 kg (170 lb)/Solid</p> <p>8.2 kg (18 lb)/Solid</p> <p>527.3 kg (1160 lb)/Solid</p> <p>Quantity Unknown</p> <p>Quantity Unknown</p>
N-Cell Room Exhaust	See "General" Section on this list for description of remaining material.	
Pipe and Operating	See "General" Section on this list for description of remaining material.	

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
(P&O) Gallery		
P&O Gallery Systems	See "General" Section on this list for description of remaining material.	
PIV Room	See "General" Section on this list for description of remaining material.	
PR Room	Lead Shielding: Q-Cell piping (Q686 and Q619)	Quantity unknown (piping runs along PR Room)
PR Room Exhaust	See "General" Section on this list for description of remaining material.	
PR Room Gloveboxes	Lead Shielding: L14 Loadout Glovebox	294.5 kg (648 lb)/Solid
Q-Cell	Lead-filled door to Process Cell used as shielding. <u>Q-Cell Outer Lobby</u> (18) 86.75" x 35.5" x 2" doors with lead plexiglass viewing windows stored at the bottom of the Q-Cell stairwell near Column 9.	1818.2 kg (4000 lb)/Solid 18 leaded plexiglass viewing windows. (percentage of lead unknown)
Q-Cell Control Room	See "General" Section on this list for description of remaining material.	
Q-Cell Loadout Room	See "General" Section on this list for description of remaining material.	
Q-Cell Gloveboxes	Leaded glass in 31 portholes on hood face used as shielding.	140.9 kg (310 lb) total weight (percentage lead content unknown)/Solid
Q-Cell AMU	See "General" Section on this list for description of remaining material.	
Q-Cell Maintenance Hood Room	See "General" Section on this list for description of remaining material.	
Q-Cell Vault Room	See "General" Section on this list for description of remaining material.	
R-Cell	Potential PCBs in pulsar lubricant	Unknown quantity: once used for lubricant
R-Cell Equipment	See "General" Section on this list for description of remaining material.	
R-Cell Exterior	See "General" Section on this list for description of remaining material.	

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
Sample Gallery	<p><u>Six In Line Monitors</u></p> <p>(approx. 100 lb of lead clad in stainless steel in each monitor)</p> <ul style="list-style-type: none"> ▪ 1 on G5 w/no lead counterweights. ▪ 2 on H3 w/(8) lead 25-lb counterweights ▪ 1 on J4 w/(4) lead 25-lb counterweights ▪ 1 on K4 w/(4) lead 25-lb counterweights ▪ 1 on L2 w/(4) lead 25-lb counterweights. <p>Lead Shielding on E3 and F15 Jet Air Valves.</p> <p>Lead Shielding on F26 Pipe Chase.</p> <p>Lead Shielding on Drip Tray left of J1 sampler.</p> <p><u>Manipulator Room</u></p> <ul style="list-style-type: none"> ▪ 2 manipulators w/(4) 10 lb counterweights each. ▪ 1 portable lead shielding board approx. (4'x4'x1/2") <p><u>Portable Lead Shielding Board</u></p> <ul style="list-style-type: none"> ▪ 1 in front of Sampler U3 ▪ 1 against column 13 <p>Lead construction on ventilation containment located across of L4 sampler.</p>	<p>273 kg (600 lb)/Solid plus</p> <ul style="list-style-type: none"> ▪ 0 kg ▪ 91 kg (200 lb)/Solid ▪ 45 kg (100 lb)/Solid ▪ 45 kg (100 lb)/Solid ▪ 45 kg (100 lb)/Solid <p>2.3 kg (5 lb)/Solid</p> <p>Unknown Quantity/Solid</p> <p>Approximately 25/lb/Solid</p> <ul style="list-style-type: none"> ▪ 36 kg (80 lb)/Solid ▪ 213 kg (469 lb)/Solid <ul style="list-style-type: none"> ▪ 213 kg (469 lb)/Solid ▪ 213 kg (469 lb)/Solid <p>Unknown Quantity/Solid</p>
Sample Gallery Chemical Headers	See "General" Section on this list for description of remaining material.	
Sample Gallery Decon Hood	See "General" Section on this list for description of remaining material.	

Table A-2. Summary of Hazardous Substances Remaining in the PUREX Canyon. (10 Pages)

Location (*)	Material Description	Quantity/State
Sample Gallery Hood HVAC	See "General" Section on this list for description of remaining material.	
Sample Gallery Hood HVAC Station	See "General" Section on this list for description of remaining material.	
Sample Gallery Iodine Monitors	<p><u>DOG Iodine Monitor</u></p> <ul style="list-style-type: none"> ▪ Lead cap ▪ Lead siding and lead board underneath monitor. <p><u>F1 Iodine Monitor</u></p> <ul style="list-style-type: none"> ▪ Lead glass 	<ul style="list-style-type: none"> ▪ Unknown Quantity/Solid ▪ Unknown Quantity/Solid ▪ Unknown Quantity/Solid
Sample Gallery Load-in Hoods	See "General" Section on this list for description of remaining material.	
Sample Gallery N-Cell Halon Fire System	See "General" Section on this list for description of remaining material.	
Sample Gallery N-Cell Vacuum Pump	See "General" Section on this list for description of remaining material.	
Sample Gallery PDD Neutralization	See "General" Section on this list for description of remaining material.	
Sample Gallery Room Exhaust	See "General" Section on this list for description of remaining material.	
Sample Gallery Samplers	<p><u>Samplers</u></p> <ul style="list-style-type: none"> ▪ Lead glass on sampler faces ▪ Lead doors part of original A-Type samplers' construction. <p>(A3, B3, C3, D3, D4, D5 HOOD, E1, E6, F8, F10, F13, F15, F16, F18, F26, G2, G8, H1, H2, H3, J1, J-23-1, J-23-2, J21, and J22)</p> <ul style="list-style-type: none"> ▪ Lead shielding (3'x6"x1/2") on E6 sampler counter. <p><u>D1 Cave</u></p> <ul style="list-style-type: none"> ▪ Covered and painted lead bricks: walls of D1 	<ul style="list-style-type: none"> ▪ Unknown Quantity/Solid ▪ 20 kg (44 lb)/Solid ▪ Unknown Quantity/Solid

Table A-3. PUREX Canyon Residual Nuclides Summary.

Location	Measurable Pu (grams)	Estimated Pu (grams)	Estimated Fission Products (curies)
Canyon (including L Cell)	4,296	930 - 4,800	200 - 500
White Room	N/A	50 - 500	0
N Cell	1,643	N/A	0
PR Room	1,199	N/A	0

PR = product removal.
 Pu = plutonium.

Table A-4. Summary of PUREX Tank Systems Analytical Data (RCRA Metals, pH, and TOC). (3 Pages)

Tanks	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 Tanks (Complete) (T-J7,E-J8,TK-K1,T-K2, T-K3,E-K4,TK-K5,TK-K6)	0.06	0.336	< 0.6	0.342	< 0.06	< 0.005	< 0.005	< 0.005	2.73	203
L-Cell Tanks (Complete) (T-J6,T-J4,TK-J5,T-L1,T- L2,TK-L3,T-L4,T-L5,TK- F10)	0.165	0.784	0.027	0.358	0.004	0.001	0.001	0.015	1.47 2.39 ^a	256
Headend Feed Tanks,H1,H2, and F-Cell Tanks (Complete) (TK-E1,TK-D4,TK- D3,TK-H1,T-H2,TK-F7,E- F6,TK-F26,TK-F8)	< 0.1	1.4	< 1.1	< 5.0	< 1.0	< 0.125	< 0.25	< 0.005	2.57	91.8
G and R Cell Tanks (Part I) (Complete) (TK-R1,TK-G1,T-G2,TK- G2)	0.678	1.06	< 0.6	< 0.3	< 0.06	< 0.005	0.0065	< 0.005	7.62	444
G and R Cell Tanks (Part II) (Complete) (T-R2,TK-R2,TK-R8, TK-R5,D-R6,TK-R7,TK- G5, D-G6)	< 0.11	0.618	< 1.1	< 0.55	< 0.11	< 0.25	< 0.25	< 0.25	10.67	2100
Backcycle Waste and Neptunium Package Tanks (Complete) (E-H4,TK-J1,TK-J21,T- J22, T-J23,TK-J3)	< 0.01	0.867	< 0.1	0.291	< 0.01	< 0.25	< 0.25	< 0.005	2.89	171
U-Cell Tanks (Complete) (TK-U8,T-F5,TK-F3,TK- U1, TK-U2,TK-U5,T-U6,TK- U4)	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)

Table A-4. Summary of PUREX Tank Systems Analytical Data (RCRA Metals, pH, and TOC). (3 Pages)

Tanks ^a	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
Cladding Waste Tanks (Complete)										
(TK-D1, TK-D2, TK-E3, G-E2, G-E4, TK-E5)	< 0.6	0.396	< 0.6	< 0.3	< 0.06	< 0.25	< 0.25	< 0.005	9.44	29.7
TK-D5, TK-E6, TK-F13, TK-F15 and TK-F16 Tanks (Complete)	0.074	0.215	0.041	0.121	0.002	0.001	0.001	0.009	2.33	144
F11 System Tanks (Complete)	0.0038	0.0421	0.0413	0.021	0.002	0.001	0.001	0.0019	5.86	160
(TK-F12, E-F11)										
TK-F18	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	0.24 (U)	0.41 (U)	4.0 (U)	0.34 (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)	0.289	0.737	0.370	0.329	0.038	0.012	0.010	.001	11.39	1.07
AMU Tank 156 (Complete)	0.0038	8.69 0.019 ^b	0.037	0.0338	0.0038	0.0012	0.0016	0.001	2.66	2.9
Tank M2 (Complete)	0.0023	0.0037	0.038	0.038	0.006	0.0009	0.0008	0.0009	6.75	3.02
Tank F4 (Complete)	0.027	0.615	0.038	0.059	0.214	0.002	0.0008	0.005	2.52	3.67
Tank P4 (Complete)	0.0023	0.58	0.0565	0.0118 (B)	0.006 (U)	0.002 (B)	0.0008 (U)	0.00038	11.73	9.04

Table A-4. Summary of PUREX Tank Systems Analytical Data (RCRA Metals, pH, and TOC). (3 Pages)

Tanks*	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

*Underlining indicates permitted tanks (DOE/RL-88-21).

^bAnalytical results after refueling and resampling.

B = compound was found in the blank.

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

mg/L = milligrams per liter.

N = interference detected in matrix.

TOC = total organic carbon.

U = analyzed but not detected.

Table A-5. Summary of PUREX Tank Systems Analytical Data (volatile organic compounds). (3 Pages)

Tanks*	Benzene (mg/L)	Carbon tetrachloride (mg/L)	Chlorobenzene (mg/L)	Chloroform (mg/L)	1,2-Dichloroethylene (mg/L)	1,1-Dichloroethylene (mg/L)	2-Butanone (mg/L)	Tetrachloroethylene (mg/L)	Trichloroethylene (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
K-Cell Tanks (T-J7-E-J8,TK-K11-T-K2, T-K3-E-K4,TK-K5,TK-K6)	U	U	U	U	U	U	0.034	U	U	U
L-Cell Tanks (T-J6,T-JA,TK-J5,T-L1,I-L2,TK-L3,T-L4,T-L5,TK-F10)	U	U	U	U	U	U	0.034	U	U	U
Headend Feed Tanks H1, H2, and F-Cell Tanks (TK-E1,TK-D4,TK-D3,TK-HL,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 Tanks (Part I)	U	U	U	U	U	U	0.062	U	U	U
(TK-R1,TK-G1,T-G2,TK-G2)										
G and R Cell Tanks (Part II)	U	U	U	U	U	U	U	U	U	U
(T-R2,TK-R2,TK-R8,TK-R5,D-R6,TK-R7,TK-G3, D-G6)										

Table A-5. Summary of PUREX Tank Systems Analytical Data (volatile organic compounds). (3 Pages)

Tank*	Benzene (mg/L)	Carbon tetrachloride (mg/L)	Chlorobenzene (mg/L)	Chloroform (mg/L)	1,2-Dichloroethane (mg/L)	1,1-Dichloroethane (mg/L)	2-Butanone (mg/L)	Tetrachloroethylene (mg/L)	Trichloroethylene (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
Backcycle Waste and Neptunium Package Tanks (E-H4,TK-JL,TK-J21,T-J22, T-J23,TK-J3)	U	U	U	U	U	U	U	U	U	U
U-Cell Tanks (TK-U8,L-E5,TK-E3,TK-U1, TK-U2,TK-U5,T-U6,TK-U4)	U	U	U	U	U	U	U	U	U	U
Cladding Waste Tanks (TK-D1,TK-D2,TK-E3,G-E2, G-E4,TK-E5) TK-D5,TK-E6,TK-F13, TK-F15, and TK-F16 Tanks	U	U	U	U	U	U	0.5 (U)	U	U	U
F11 System Tanks (TK-F12,E-F11)	U	U	U	U	U	U	U	U	U	U
TK-F18	U	U	U	U	U	U	U	U	U	U
Tank U3	U	U	U	U	U	U	U	U	U	U

Table A-5. Summary of PUREX Tank Systems Analytical Data (volatile organic compounds). (3 Pages)

Tanks ^a	Benzene (mg/L)	Carbon tetrachloride (mg/L)	Chlorobenzene (mg/L)	Chloroform (mg/L)	1,2-Dichloroethylene (mg/L)	1,1-Dichloroethylene (mg/L)	2-Butanone (mg/L)	Tetrachloroethylene (mg/L)	Trichloroethylene (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
TK-G5A, (TK-G7, TK-G8)	U	U	U	U	U	U	U	U	0.012 (J)	U
AMU Tank 156	U	U	U	0.006	U	U	U	U	U	U
Tank M2	U	U	U	U	U	U	U	U	U	U
Tank F4	U	U	U	U	U	U	U	U	U	U
Tank P4	U	U	U	U	U	U	U	U	U	U

* Sample analyzed by Quanterra Laboratory.
 ** Sample analyzed by 222-S Laboratory.
 a Underlining indicates permitted tanks (DOE/RL-88-21).
 b Analytical results after refueling and resampling.
 B = compound was found in the blank.
 J = an estimated value for the target or tentatively identified compound.
 mg/L = milligrams per liter.
 N = interference detected in matrix.
 TOC = total organic carbon.
 U = analyzed but not detected.