BHI- 01358
Rev. 1

# Plutonium-Uranium Extraction Plant (PUREX) Hazards Assessment

***Prepared for the U.S. Department of Energy, Richland Operations Office***
***Office of Environmental Restoration***

***Submitted by: Bechtel Hanford, Inc.***

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# Plutonium-Uranium Extraction Plant (PUREX) Hazards Assessment

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Bechtel Hanford, Inc.

**Date Published**

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# ACRONYMS

| | |
|---|---|
| ASD | ammonia scrubber distillate |
| BHI | Bechtel Hanford, Inc. |
| BP | years before present |
| CFR | *Code of Federal Regulations* |
| CSL | chemical sewer line |
| CWL | cooling water line |
| DOE | U.S. Department of Energy |
| EAL | emergency action level |
| ECMP | east crane maintenance platform |
| EPA | U.S. Environmental Protection Agency |
| EPHA | emergency planning hazards assessment |
| EPZ | emergency planning zone |
| ERPG | emergency response planning guide |
| HEPA | high-efficiency particulate air |
| HMS | Hanford Meteorological Station |
| HUDU | Hanford Unified Dose Utility |
| HVAC | heating, ventilation, and air conditioning |
| I&C | instrumentation and control |
| MMI | modified Mercalli intensity |
| PAG | protective action guide |
| PMF | probable maximum flood |
| PR | product removal |
| PUREX | Plutonium-Uranium Extraction (Plant) |
| RQ | reportable quantity |
| S/M&T | surveillance/maintenance and transition |
| SAMCONS | surveillance and maintenance control system |
| SCD | steam condensate discharge |
| TEDE | total effective dose equivalent |
| TEDF | Treated Effluent Disposal Facility |
| TPQ | threshold planning quantity |
| TQ | threshold quantity |

# METRIC CONVERSION CHART

## Into Metric Units

| *If You Know* | *Multiply By* | *To Get* |
|---|---|---|
| **Length** | | |
| inches | 25.4 | millimeters |
| inches | 2.54 | centimeters |
| feet | 0.305 | meters |
| yards | 0.914 | meters |
| miles | 1.609 | kilometers |
| **Area** | | |
| sq. inches | 6.452 | sq. centimeters |
| sq. feet | 0.093 | sq. meters |
| sq. yards | 0.0836 | sq. meters |
| sq. miles | 2.6 | sq. kilometers |
| acres | 0.405 | hectares |
| **Mass (weight)** | | |
| ounces | 28.35 | grams |
| pounds | 0.454 | kilograms |
| ton | 0.907 | metric ton |
| **Volume** | | |
| teaspoons | 5 | milliliters |
| tablespoons | 15 | milliliters |
| fluid ounces | 30 | milliliters |
| cups | 0.24 | liters |
| pints | 0.47 | liters |
| quarts | 0.95 | liters |
| gallons | 3.8 | liters |
| cubic feet | 0.028 | cubic meters |
| cubic yards | 0.765 | cubic meters |
| **Temperature** | | |
| Fahrenheit | subtract 32, then multiply by 5/9 | Celsius |
| **Radioactivity** | | |
| picocuries | 37 | millibecquerel |

## Out of Metric Units

| *If You Know* | *Multiply By* | *To Get* |
|---|---|---|
| **Length** | | |
| millimeters | 0.039 | inches |
| centimeters | 0.394 | inches |
| meters | 3.281 | feet |
| meters | 1.094 | yards |
| kilometers | 0.621 | miles |
| **Area** | | |
| sq. centimeters | 0.155 | sq. inches |
| sq. meters | 10.76 | sq. feet |
| sq. meters | 1.196 | sq. yards |
| sq. kilometers | 0.4 | sq. miles |
| hectares | 2.47 | acres |
| **Mass (weight)** | | |
| grams | 0.035 | ounces |
| kilograms | 2.205 | pounds |
| metric ton | 1.102 | ton |
| **Volume** | | |
| milliliters | 0.033 | fluid ounces |
| liters | 2.1 | pints |
| liters | 1.057 | quarts |
| liters | 0.264 | gallons |
| cubic meters | 35.315 | cubic feet |
| cubic meters | 1.308 | cubic yards |
| **Temperature** | | |
| Celsius | multiply by 9/5, then add 32 | Fahrenheit |
| **Radioactivity** | | |
| millibecquerel | 0.027 | picocuries |

# 1.0 INTRODUCTION

This report documents the emergency preparedness hazards assessment (EPHA) for the Plutonium-Uranium Extraction (PUREX) Plant, located in the 200 East Area of the U.S. Department of Energy's (DOE's) Hanford Site. The PUREX Plant is the responsibility of Bechtel Hanford, Inc. (BHI). In accordance with DOE O 151.1, Chapter IV, a facility/activity that uses or stores hazardous materials in amounts that exceed the lower of the threshold quantities (TQs) listed in 29 *Code of Federal Regulations* (CFR) 1910.110 or 40 CFR 68.130, threshold planning quantities (TPQs) listed in 40 CFR 355, reportable quantities (RQs) listed in 40 CFR 302.4 for chemicals without TQs and TPQs, or quantities listed in 10 CFR 30.72 for radionuclides requires the preparation of an EPHA.

# 2.0 SITE AND FACILITY DESCRIPTION

Detailed descriptions of the Hanford Site's 200 East Area and the PUREX Plant are found in Sections 3.0 and 5.0, respectively, of the *PUREX Final Safety Analysis Report* (WHC 1990). Additional information was obtained from the *PUREX Standby Preliminary Hazards Analysis* (WHC 1991b); the *PUREX/$UO_3$ Deactivation Project Management Plan* (WHC 1993); the *PUREX Deactivated End State Hazard Analysis* (B&W 1999b); the *Plutonium-Uranium Extraction (PUREX) Facility Heating, Ventilation, and Air Conditioning (HVAC) Hazard Analysis* (B&W 1999c); and the *Plutonium-Uranium Extraction (PUREX) End State Basis of Interim Operation (BIO) for Surveillance and Maintenance* (B&W 1999a). The following summary is derived from these descriptions.

## 2.1 FACILITY MISSION

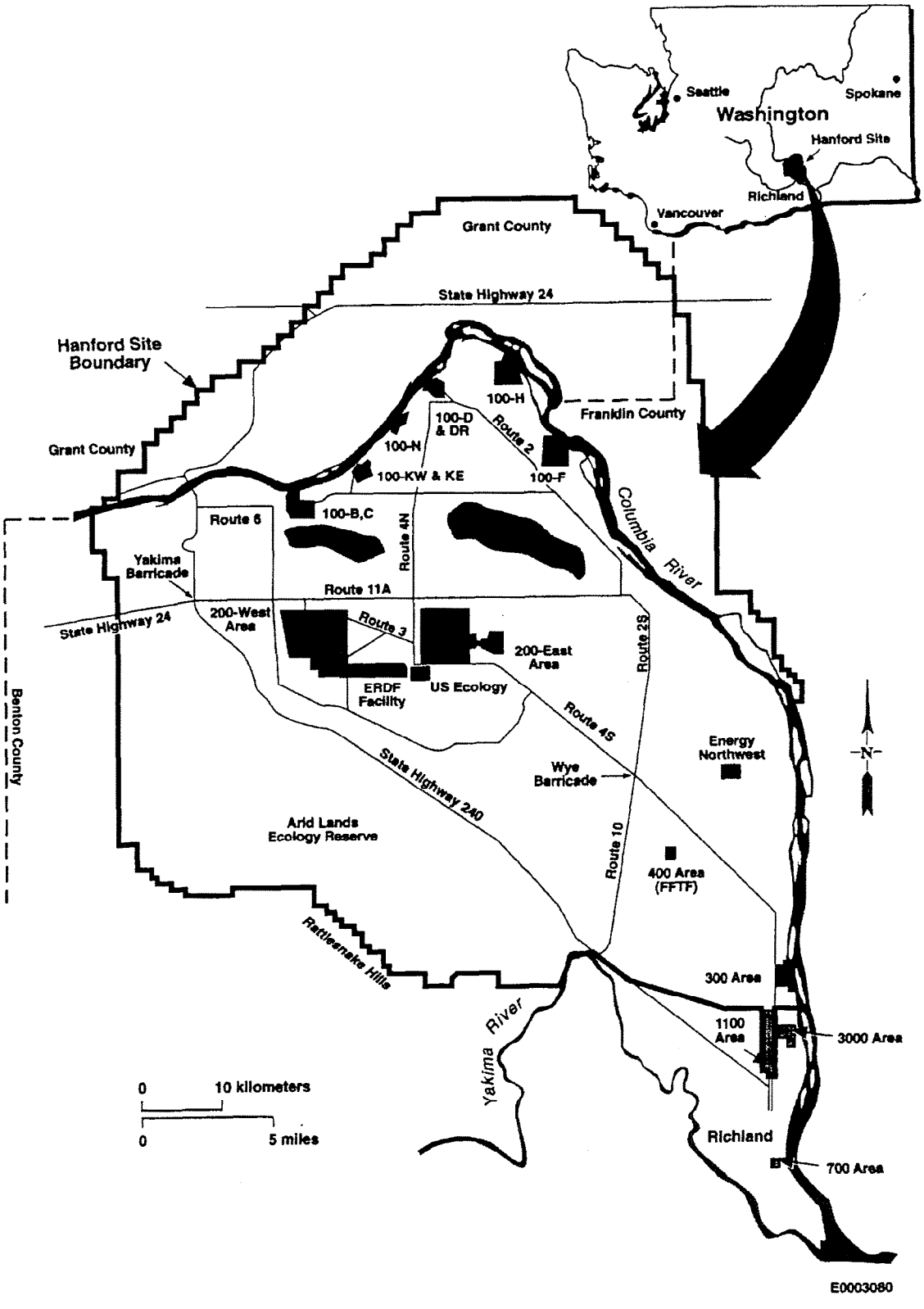
The PUREX Plant was designed and operated to reprocess irradiated fuels from the Hanford Site's N Reactor and single-pass reactors for the recovery of uranium, plutonium, and neptunium. Plutonium was recovered as an acidic solution of plutonium nitrate or was converted to plutonium oxide in N cell, as appropriate, and transferred to the Plutonium Finishing Plant. Uranium was recovered as uranyl nitrate hexahydrate, which was transferred for further processing at the $UO_3$ Plant. Neptunium was recovered and transferred to other Hanford Site facilities.

The present mission is to establish a passively safe and environmentally secure configuration at PUREX Plant and to preserve this configuration until the initiation of decontamination and decommissioning activities.

## 2.2 LOCATION

The PUREX Plant is located in the southeast part of the 200 East Area of DOE's Hanford Site (Figure 2-1). The 200 East Area is located on a plateau at an elevation ranging from approximately 190 to 245 m (620 to 800 ft) above mean sea level, near the middle of the Hanford Site. The PUREX Plant is 16.9 km (10.5 mi) (southwest) to the closest point of the Site boundary, 11 km (7 mi) from the closest point of the near-side of the Columbia River, and 8 km (5 mi) to SR Highway 240.

**Figure 2-1. Location of the 200 East Area on the Hanford Site.**



## 2.3 HANFORD SITE PHYSICAL DESCRIPTION

### 2.3.1 Location

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 2-1). The Hanford Site occupies an area of approximately 1,524 $km^2$ (approximately 586 $mi^2$) north of the confluence of the Snake and Yakima Rivers with the Columbia River (Figure 2-1). The Hanford Site is approximately 50 km (30 mi) north to south and 40 km (24 mi) east to west.

With restricted public access, this land provides a buffer for the smaller areas currently used for research, waste storage, and waste disposal. Only about 6% of the land area has been disturbed and is actively used. The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the Site's eastern boundary. The Yakima River runs along part of the southern boundary and joins the Columbia River south of the city of Richland, which bounds the Hanford Site on the southeast. Rattlesnake Mountain, the Yakima Ridge, and the Umtanum Ridge form the Site's southwestern and western boundaries, and the Saddle Mountains form the northern boundary of the Site.

The major metropolitan areas within the vicinity of the Hanford Site include Spokane, Washington, about 190 km (120 mi) to the northeast; Seattle, Washington, about 210 km (130 mi) to the northwest; and Portland, Oregon, about 240 km (150 mi) to the southwest. Two other nearby areas of significant population density in Washington State include Moses Lake, about 48 km (30 mi) north of the 100-K Area; and the Yakima Valley, extending from Yakima about 72 km (45 mi) west of the Hanford Site, to the Tri-Cities (Richland, Pasco, and Kennewick). The nearest of the Tri-Cities, Richland, is located immediately south of the Site.

The Hanford Site contains the following major facilities or activities: six reactor areas designated 100-B/C, 100-N, 100-KE/KW, 100-D/DR, 100-H, and 100-F, which contain eight shutdown production reactors and one shutdown dual-purpose reactor (N Reactor); the KE and KW fuel storage facilities within the 100-KE/KW Area; two areas for waste processing and waste storage designated as the 200 East and 200 West Areas (these sites also contain inactive processing facilities, some of which are undergoing various stages of decommissioning and/or long-term surveillance/maintenance and transition [S/M&T]); the 300 Area, which contains a shutdown fuel fabrication facility and laboratory facilities supporting all of DOE's Hanford programs; the 400 Area, which contains the shut down Fast Flux Test Facility; the 600 Area, which contains the Environmental Restoration Disposal Facility; a commercial nuclear waste burial operation on land leased to Washington State; and the Energy Northwest nuclear power plant, which is currently in operation.

### 2.3.2 Meteorology

The Hanford Site is located in a semi-arid region of southeastern Washington State. The Cascade Mountains (beyond Yakima, to the west) greatly influence the climate of the Hanford Site by their

rain-shadow effect. The Cascade Mountains also serve as a source of cold air drainage, which has a considerable effect on the wind regime at the Hanford Site.

Continuous observation and recording of meteorological data have been carried out since 1945 at the Hanford Meteorological Station (HMS), located near the 200 West Area. Climatological conditions on the 200 Area Plateau are significantly different from those at the southern portion of the Hanford Site, especially during the winter months when the incidence of low clouds and fog is much greater at the HMS.

The average daily maximum temperature in July, which is the hottest month of the year, is 33°C (91.4°F); the average minimum temperature is 16°C (60.9°F). During January, the coldest month, the average maximum temperature is 3.5°C (38.4°F), and the average minimum temperature is -4.4°C (24°F). The daily average temperature is approximately 8.2°C (46.8°F) in January and 17.1°C (62.8°F) in July.

The average annual precipitation for the Hanford Site is approximately 16 cm (6.26 in.). Most of the precipitation occurs during the winter, with nearly half of the annual rainfall occurring from November through February. Snowfall accounts for approximately 38% of all precipitation from December through February.

The predominant wind direction over most of the region is southwesterly. However, because of local topographic influences, the predominant wind direction at the HMS and over much of the Hanford Site, including the 200 Area Plateau, is northwesterly. Monthly average wind speeds are the lowest during the winter months, averaging 10 to 11 km/hr (6.2 to 6.8 mph) and are the highest during the summer, averaging 14 to 16 km/hr (8.7 to 9.9 mph).

### 2.3.3 Flooding

Significant Columbia River floods have occurred in the past (DOE 1986). The likelihood of large-scale flooding has been reduced by the construction of several flood control and water storage dams upstream of the Hanford Site.

There are no Federal Emergency Management Agency flood plain maps for the Hanford Reach of the Columbia River. The Federal Emergency Management Agency only maps developing areas, and the Hanford Reach is specifically excluded.

Evaluation of flood potential is conducted in part through the concept of the probable maximum flood (PMF), which is determined from the upper limit of precipitation falling on drainage areas and by other hydrologic factors (e.g., antecedent moisture conditions, snow melt, and tributary conditions) that could result in maximum run-off. The PMF for the Columbia River downstream of the Priest Rapids Dam has been calculated to be 40,000 $cm^3$/sec (1.4 million $ft^3$/sec) and is greater than the 500-year flood. The PMF is not expected to inundate the buildings in 300 Area but would flood the 100-F and 100-H Areas and part of the 100-B/C Area. The main export water river pumps that supply water to the 100-K fuel storage basins and 200 Areas would also

be submerged and would likely be damaged. The PMF may also flood access roads and temporarily cut off electrical power to the 100 and 300 Areas (Cushing 1992).

Potential dam failures on the Columbia River have also been evaluated. Upstream dam failures could arise from a number of causes, with the magnitude of the flooding depending on the degree of breaching at the dam. The U.S. Army Corps of Engineers evaluated a number of scenarios on the effects of failures of Grand Coulee Dam, assuming flow conditions on the order of 11,000 $cm^3$/sec (400,000 $ft^3$/sec). For purposes of emergency planning, it was hypothesized that 25% to 50% breaches (the "instantaneous" disappearance of 25% or 50% of the center section of the dam) would result from the detonation of nuclear explosives as an act of sabotage or war. The discharge or flood wave resulting from such an instantaneous 50% breach at the outfall of the Grand Coulee Dam was determined to be 600,000 $m^3$/sec (21 million $ft^3$/sec). In addition to the areas inundated by the PMF (see Figure 4.2-10 in Cushing 1992), the remainder of the 100 Areas, the 300 Area, and nearly all of Richland, Washington, would be flooded (DOE 1986, ERDA 1976). Flooding of this magnitude would be a regional emergency along the entire downstream area of the Columbia River. The planning and assessment for flooding of this magnitude is beyond the scope of this document.

Fewer than 20 major floods have occurred on the Yakima River since 1862 (DOE 1986). The most severe floods occurred in November 1906, December 1933, May 1948, and March 1996. Flooded areas could extend into the southern areas of the Hanford Site. The upstream Yakima River is physically separated from the Hanford Site by Rattlesnake Mountain, which would prevent major flooding of the Site. The irrigation reservoir development within the Yakima River Basin has considerably reduced the flood potential of the Yakima River.

Cold Creek and its tributary, Dry Creek, are part of the Yakima River watershed and originate in the synclinal valleys west of the Hanford Site. The *Hanford Waste Vitrification Plant Preliminary Safety Analysis Report* (WHC 1991a) references a study of the Cold Creek estimated 100-year flood. The study provided a figure indicating the extent of land affected by the flood. Areas west and southwest of the 200 West Area would be affected, but areas north of the 200 West Area would not be affected.

### 2.3.4 Wind and Tornados

The Hanford Site is subject to frequent strong westerly winds. The highest peak wind gust recorded at the HMS tower in the 200 West Area at the 15-m (49-ft) level was a gust of 36 m/sec (81 mph), recorded January 11, 1972. The 36 m/sec (80 mph) gust is expected to occur once every 30 years. A peak gust of 38 m/sec (85 mph) would be expected to occur once every 100 years (Cushing 1992).

The Hanford Site is well outside of established tornado alleys. The probability of a tornado in any year at any point within a 160-km (100-mi) radius of the HMS is 6.8 E-6/yr (Stone et al. 1983).

### 2.3.5 Seismology

The Hanford Site is in a region of low-to-moderate seismicity. The record of earthquakes in the Pacific Northwest dates from about 1840. The early part of this record is based on newspaper reports of structural damage and human perception of the shaking (as classified by the modified Mercalli intensity [MMI] scale) and is likely incomplete because the region was sparsely populated. Seismographic networks did not start providing earthquake locations and magnitudes in the Pacific Northwest until about 1960.

Large earthquakes (i.e., a magnitude greater than 7 on the Richter scale) in the Pacific Northwest have occurred near Puget Sound, Washington, and near the Rocky Mountains in eastern Idaho and western Montana. A large earthquake of uncertain location occurred in north central Washington in 1872. This event had an estimated maximum MMI ranging from VII to IX and an estimated Richter scale magnitude of approximately 7. The distribution of intensities suggests a location within a broad region between Lake Chelan, Washington, and the British Columbia border. Seismicity of the Columbia Plateau, as determined by the rate of earthquakes and the historical magnitude of these events, is low when compared to other regions of the Pacific Northwest. In the central portion of the Columbia Plateau, the largest two earthquakes near the Hanford Site occurred in 1918 and 1973. These events had Richter scale magnitudes of 4.4 and MMIs of V and were located north of the Hanford Site. For more information concerning the seismology and geology of this area, see Section 4.2.3 of Cushing (1992).

### 2.3.6 Ashfall

The Hanford Site is in a region subject to ashfall from volcanic eruptions. The three major volcanic peaks closest to the project are Mt. Adams, approximately 160 km (100 mi) away; Mt. Rainier, approximately 180 km (110 mi) away; and Mt. Saint Helens, approximately 210 km (130 mi) away.

Important historical ashfalls affecting this location resulted from eruptions of Glacier Peak about 12,000 years before present (BP); Mt. Mazama (Crater Lake) about 6,000 BP; and Mt. Saint Helens approximately 3,600 BP. The most recent ashfall resulted from the May 18, 1980, eruption of Mt. Saint Helens. Table 2-1 indicates the estimated depth of ash deposited at the Hanford Site from past volcanic eruptions in the region.

**Table 2-1. Estimated Ash Depth at the Hanford Site From Major Eruptions. (2 Pages)**

| Volcano | Time | Depth of Ash | Equivalent Roof Loading | |
|---|---|---|---|---|
| | | | Dry (psf) | Wet (psf) |
| Glacier Peak | 12,000 BP | 1 in. | 6 | 8.4 |
| Mt. Mazama | 6,000 BP | 6 in. | 36 | 50 |

**Table 2-1. Estimated Ash Depth at the Hanford Site From Major Eruptions. (2 Pages)**

| Volcano | Time | Depth of Ash | Equivalent Roof Loading | |
|---|---|---|---|---|
| | | | Dry (psf) | Wet (psf) |
| Mt. Saint Helens | 3,600 BP | 1 in. | 6 | 8.4 |
| Mt. Saint Helens | 1980 | 0.5 in. | 3 | 4.2 |

## 2.4 FACILITY DESCRIPTION

### 2.4.1 Background

The program to design and construct the PUREX Plant and associated support facilities was initiated in 1952. The plant was an important part of the U.S. nuclear fuel separations program, processing irradiated production reactor fuels for the recovery of uranium and weapons-grade plutonium. From the start of operation in 1956 to shutdown in September 1972, refinements were made in the plant to upgrade equipment, achieve process versatility, and adapt to changing feed material.

The plant was maintained in a "wet-standby" condition from 1972 to 1978. Major plant equipment, such as extraction columns and associated tankage, was periodically flushed with dilute nitric acid solution. Pumps, column pulsers, jets, and other mechanical equipment were operated on a regular basis. The plant was restarted in 1983 to recover plutonium from irradiated uranium fuel. The plant was shut down again in 1988, and the facility was then transitioned from cold-standby mode to deactivation mode.

### 2.4.2 Facility and Process Description

Figure 2-2 shows the layout of the 200 East Area, the designations of the various facilities, and the location of the PUREX Plant. Land uses within the 200 East Area consisted of fuel reprocessing, waste processing, and disposal activities.

The PUREX Plant is composed of the main canyon building and a number of auxiliary structures and facilities, including waste disposal sites and contaminated equipment burial tunnels (see Figure 2-3 for a layout of the PUREX Plant). In addition, other facilities (e.g., tank farms, cribs, and retention basins) were used to support the PUREX Plant during processing operations. Process operations ceased in 1990 and deactivation of the facilities associated with the PUREX Plant was completed on May 9, 1997.

**Figure 2-2. Location of the PUREX Plant in the 200 East Area.**

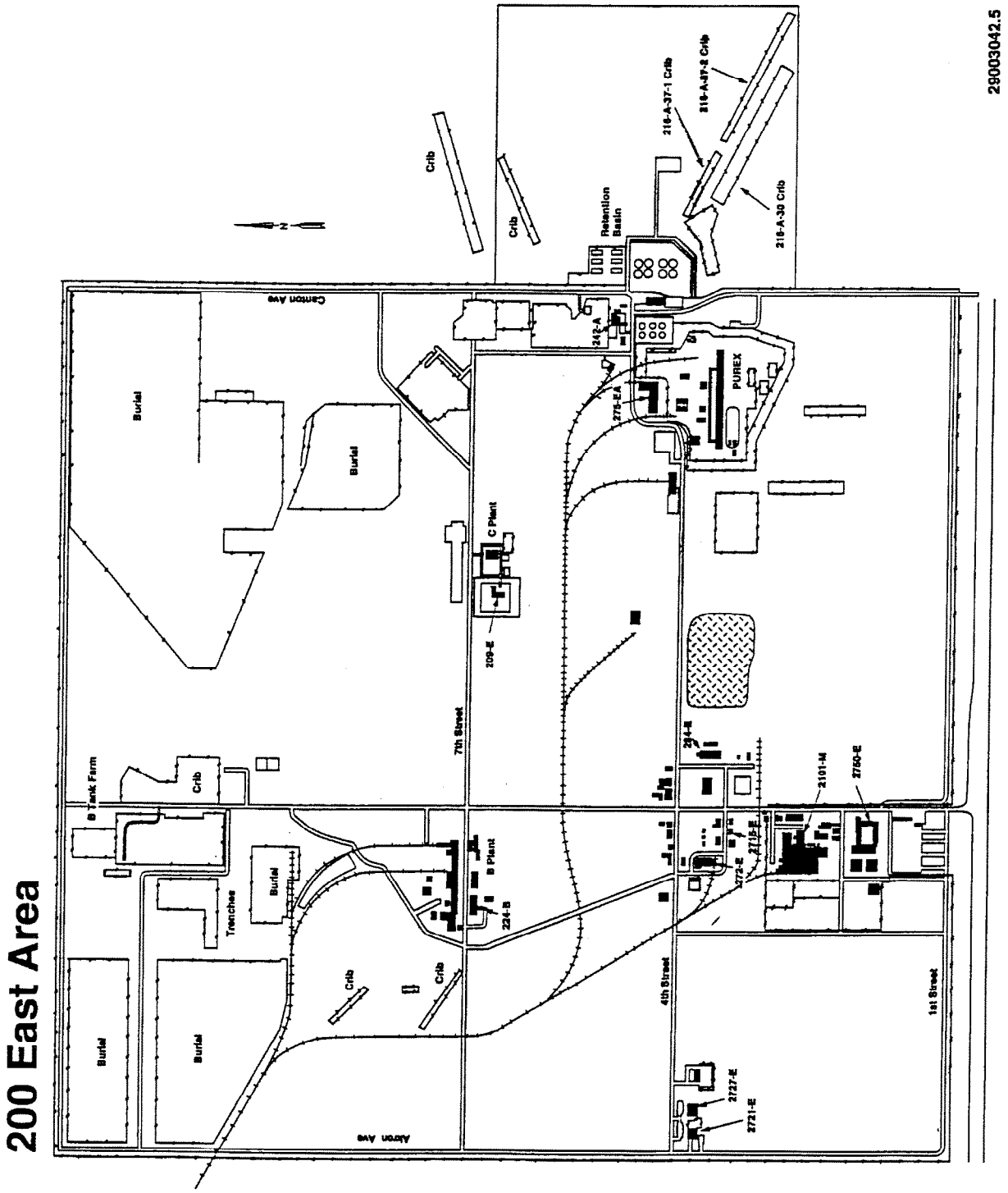
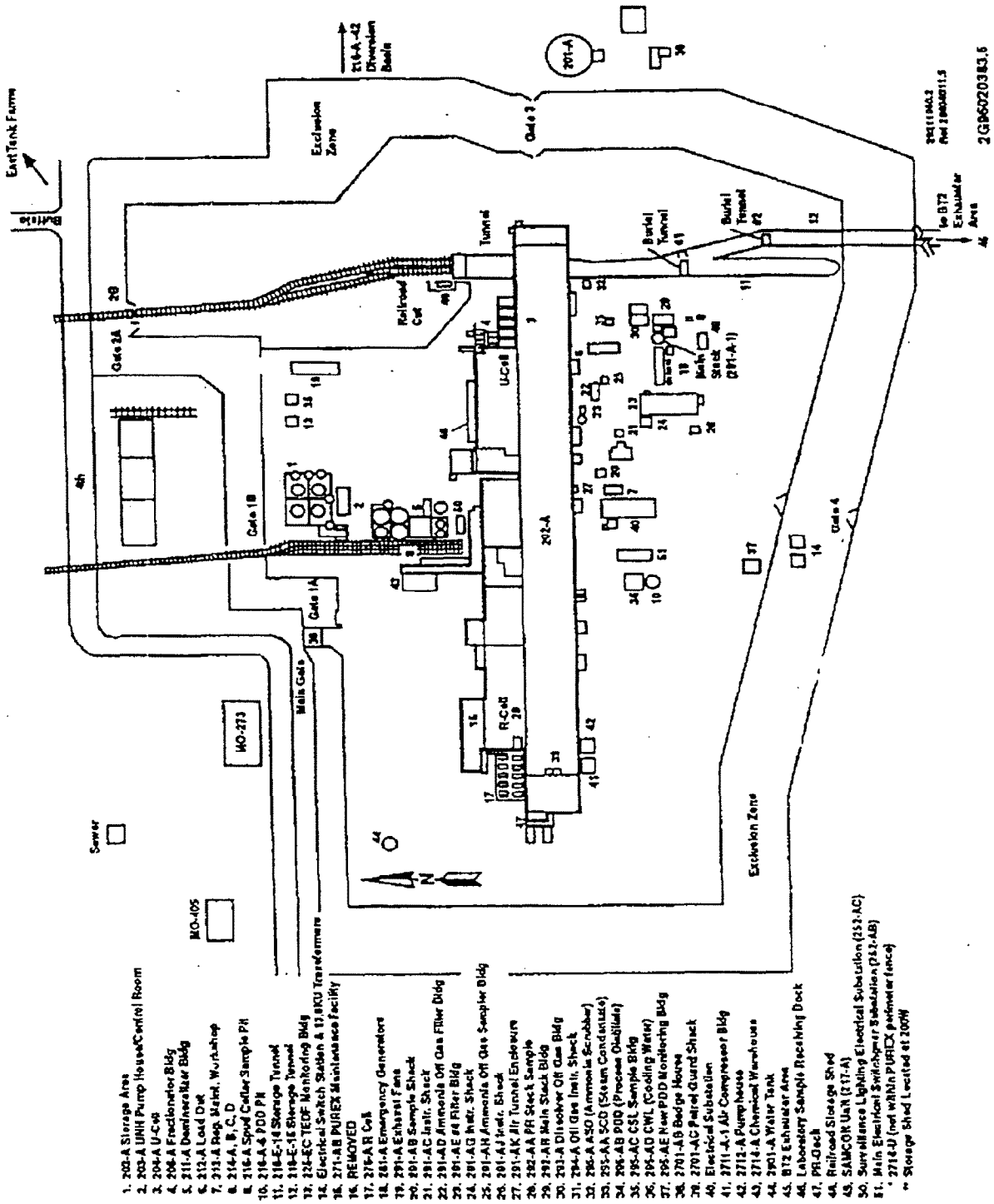


Figure 2-3. PUREX Plant Layout.



The PUREX Plant consists of the 202-A Building and a number of support buildings, including two annex buildings located on the north side of the canyon: the office annex and the laboratory annex. The major portions of the building and support facilities are described in the following subsections. A complete list of PUREX Plant buildings managed under the BHI S/M&T Project, and therefore addressed by this EPHA, is provided in Table 2-2. Two earth-covered tunnels (e.g., the 218-E-14 and 218-E-15 burial tunnels) extend southward from the east end of the 202-A Building. These burial tunnels contain equipment contaminated with large quantities of alpha- and beta/gamma-emitting radionuclides. Because the burial tunnels are managed by the Project Hanford Management Contractor, the tunnels are addressed in a separate EPHA. Waste sites associated with the PUREX Plant were screened in BHI (1999) and were identified as not requiring a hazards assessment; therefore, the waste sites will not be addressed in this EPHA.

**Table 2-2. List of PUREX Plant Buildings Under S/M&T. (3 Pages)**

| Facility Designation | Facility Function |
|---|---|
| 200-E-142 | 1986 diesel spill |
| 202-A | PUREX Plant (Canyon Building) |
| 203-A | Acid pump acid/acid storage and handling facility |
| 204-A | U cell |
| 205-A | Silica gel facility |
| 206-A | Fractionator building |
| 210-A | Drum storage |
| 211-A | Bulk cold chemical storage farm |
| 212-A | Fission product load-out |
| 213-A | PUREX |
| 214-A/B/C/D | PUREX Plant warehouse |
| 215-A | Sodium hydroxide instrument pad (concrete pad remains) |
| 216-A | Spud cellar sample pit |
| 216-A-26 | French drain |
| 216-A-26A | French drain |
| 216-A-26B | French drain |
| 216-A-28 | French drain |
| 216-A-33 | French drain |
| 217-A | SAMCONS I&C unit |
| 221-A | Pipefitter shop |
| 225-EC | TEDF monitoring building |
| 252-AB | Main electrical switchgear substation |

**Table 2-2. List of PUREX Plant Buildings Under S/M&T. (3 Pages)**

| Facility Designation | Facility Function |
|---|---|
| 252-AC | Surveillance lighting electrical substation |
| 271-AB | PUREX maintenance facility |
| 276-A | R cell |
| 281-A | Emergency generator facility |
| 291-AB | Exhaust air sample shack |
| 291-AC | Exhaust air instrument house |
| 291-AD | Ammonia off-gas filter building |
| 291-AE | #4 deep-bed filter building |
| 291-AG | Sample station #2 |
| 291-AH | Ammonia off-gas sample station |
| 291-AJ | Sample station #3 |
| 291-AK | Air tunnel enclosure |
| 291-A-1 | 202-A main stack |
| 292-AA | PR stack sample house |
| 292-AB | Gaseous effluent monitoring building (main stack building) |
| 293-A | Dissolver off-gas station |
| 293-AA | Former hydrogen peroxide storage pad (concrete pad reused under 252-AB) |
| 294-A | Off-gas instrument shack |
| 295-A | ASD sample station (ammonia scrubber) |
| 295-AA | SCD sample/pump station (steam condensate) |
| 295-AB | PDD sample station (process distillate) |
| 295-AC | CSL sample station |
| 295-AD | CWL sample station (cooling water) |
| 295-AE | PDD monitoring station |
| 296-A-1 | Stack |
| 296-A-2 | Stack |
| 296-A-3 | Stack |
| 296-A-5A | Stack |
| 296-A-5B | Stack |
| 296-A-6 | Stack |
| 296-A-7 | Stack |
| 296-A-8 | Stack |

**Table 2-2. List of PUREX Plant Buildings Under S/M&T. (3 Pages)**

| Facility Designation | Facility Function |
|---|---|
| 296-A-14 | Stack |
| 296-A-24 | Stack |
| 2701-AB | Badge house |
| 2701-AC | Patrol guard shack |
| 2711-A-1 | Air compressor building |
| 2712-A | Pump house |
| 2714-A | Chemical warehouse |
| 2901-A | Water tower |
| UPR-200-E-54 | Leak of contaminated water from deep-bed filter #1 |

I&C = instrumentation and control
PR = product removal
SAMCONS = surveillance and maintenance control system
TEDF = Treated Effluent Disposal Facility

**2.4.2.1 202-A Canyon Building.** The 202-A Canyon Building consists of three main structural components: a thick-walled, heavily shielded concrete portion called the canyon, which contains processing equipment; a section composed of three gallery levels parallel to and isolated from the canyon; and a steel and transite annex to the north of the gallery section, which houses offices, the laboratory, and a number of building service areas. Crane maintenance platforms provided personnel access to the east and west ends of the canyon. Figure 2-4 provides a cross-section of the 202-A Building. Figure 2-5 provides plan views of the 202-A Building.

The canyon building is a narrow structure 306 m (1,004 ft) in length, 9.14 m (30 ft) in width, and 31.7 m (104 ft) high, with about 12.2 m (40 ft) of this height located below grade. The canyon is divided into a single row of 12 process cells, paralleled on the south side by a radioactive pipe trench, with an air tunnel connected to the cells and running underneath the pipe trench. East of the canyon, a railroad spur enters the plant below grade through an area that was formerly used for the entrance and exit of rail cars carrying fuel and failed canyon equipment. The rail entrance may be accessed by a roll-up door, which is currently sealed to maintain ventilation balance and access control.

Three gallery levels parallel to the canyon on the north side of the structure contain service piping and process instrumentation, equipment for obtaining process samples, and storage space. All gallery areas have been deactivated, the piping has been drained and/or flushed, chemicals and hazardous materials have been removed, and equipment has been deactivated.

**Figure 2-4. Cross-Section of the PUREX Plant.**

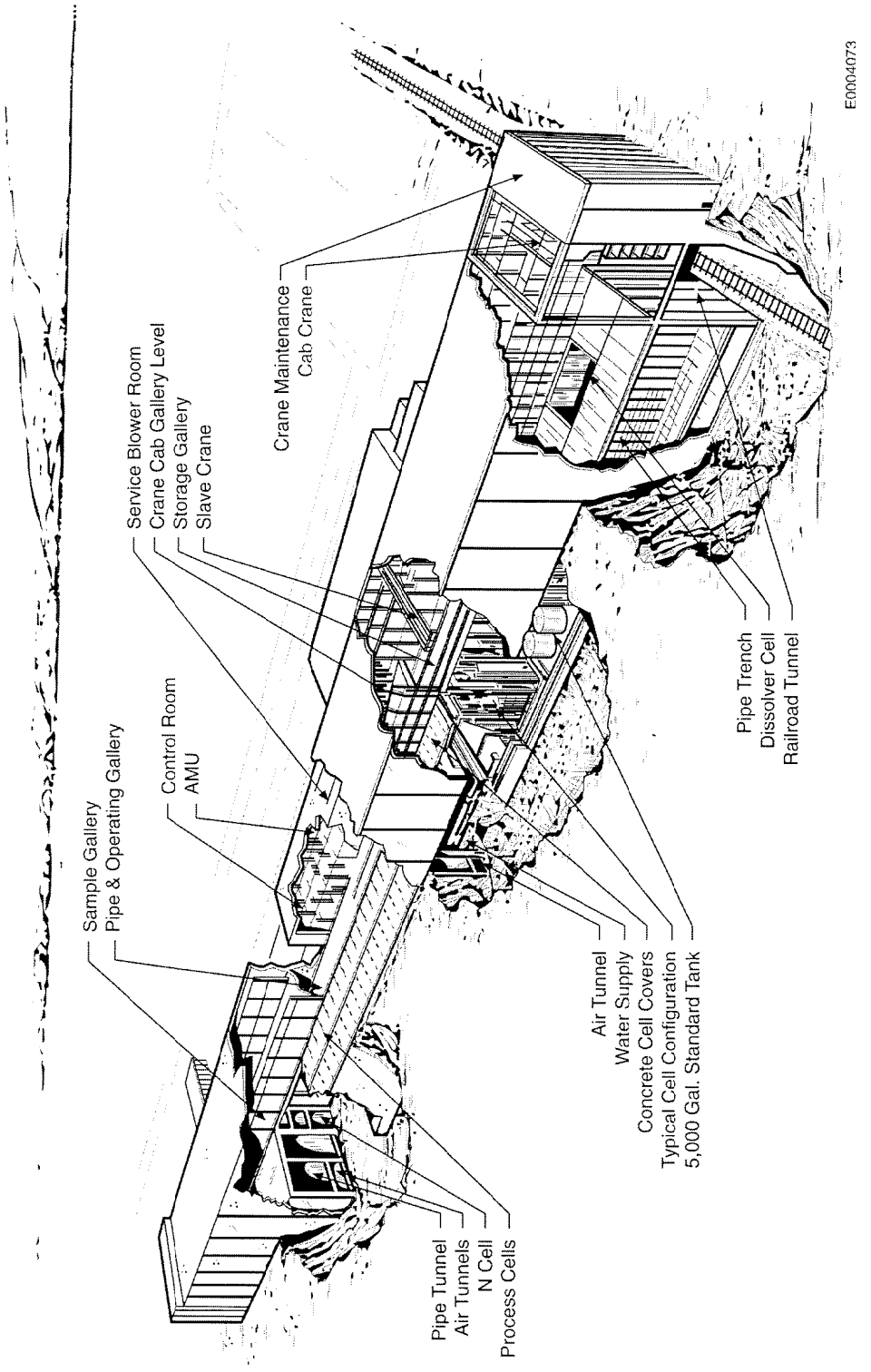


Figure 2-5. Plan View – PUREX 202-A Building. (2 Pages)

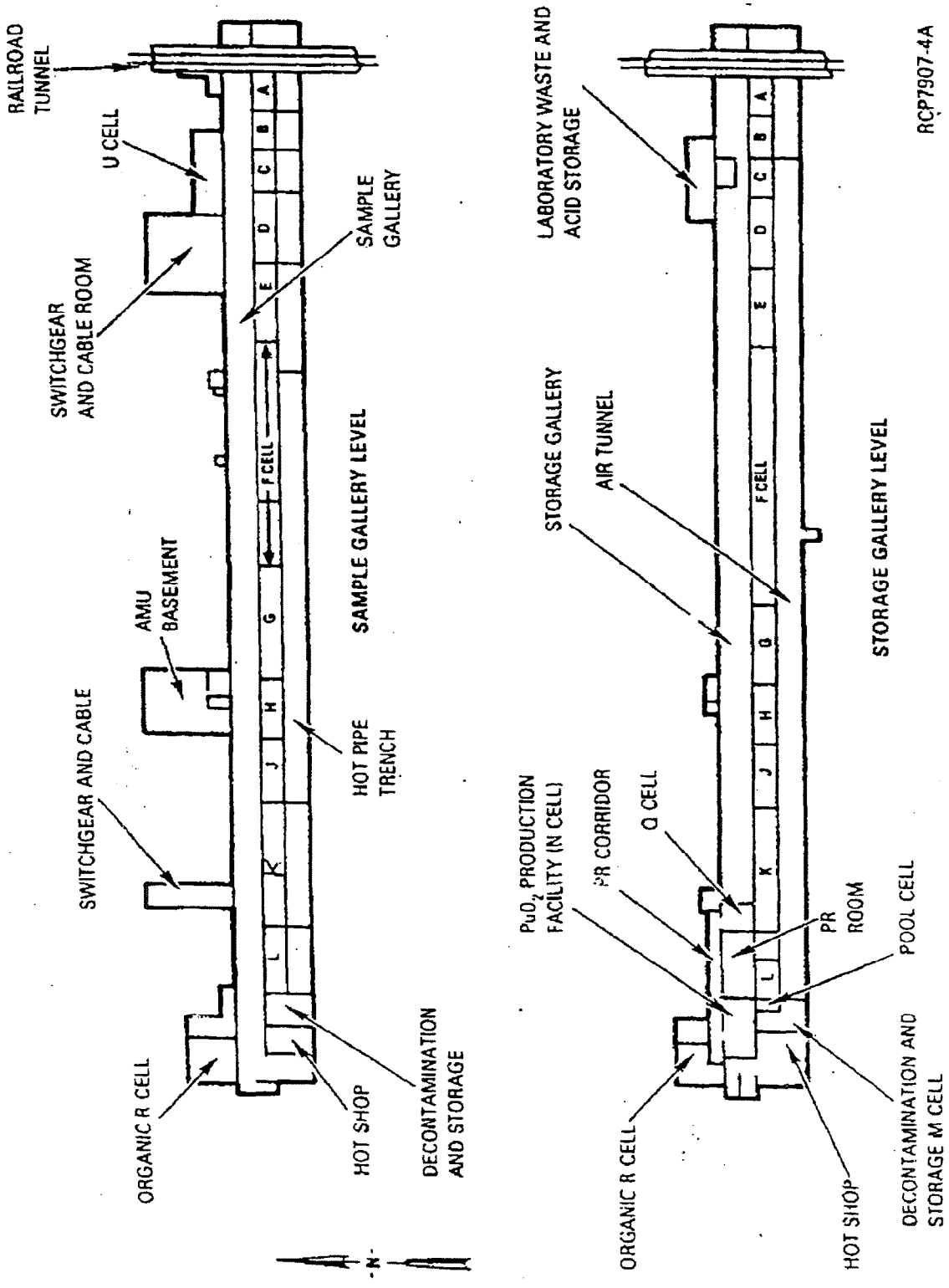
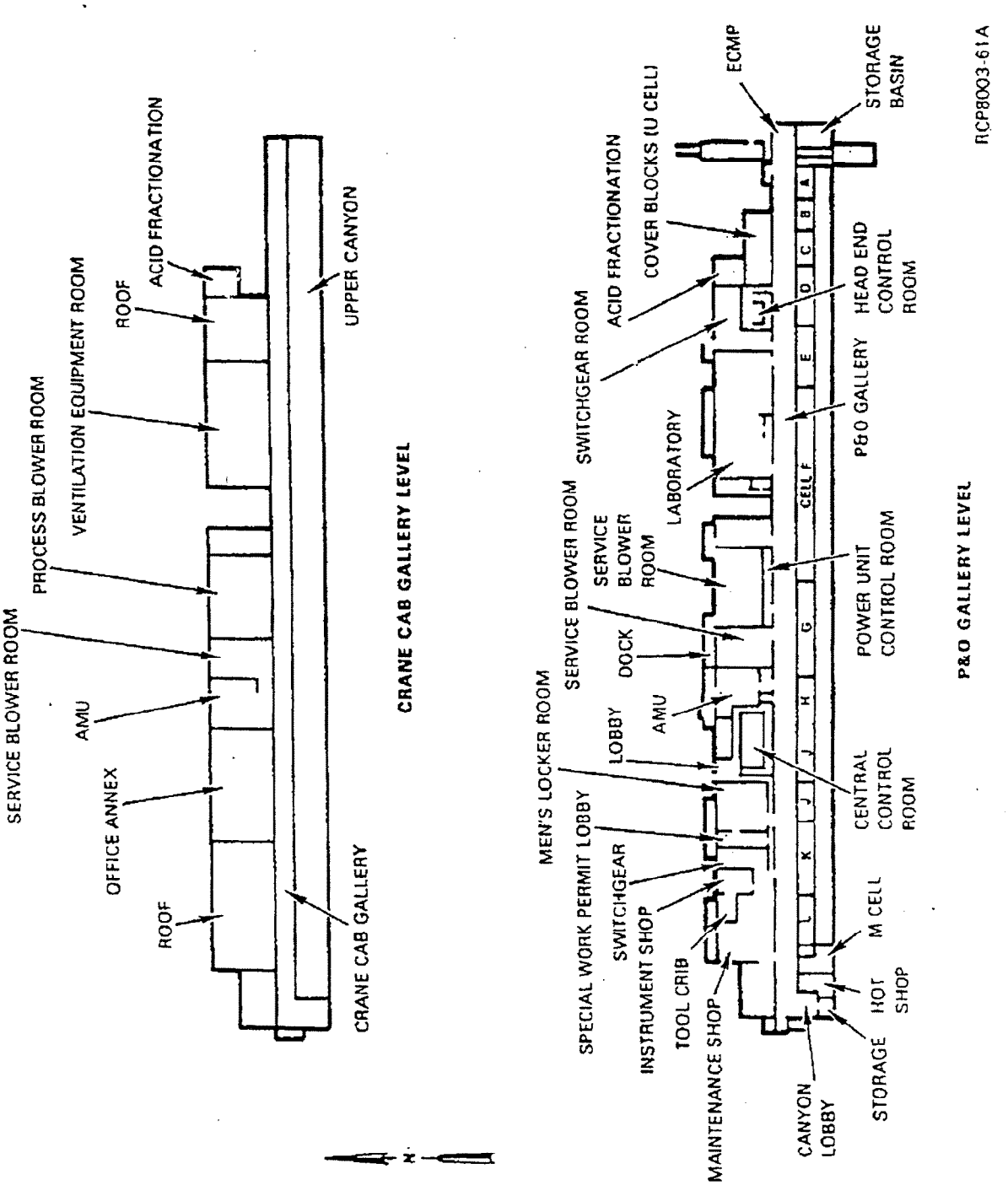


**Figure 2-5. Plan View – PUREX 202-A Building. (2 Pages)**



The pipe and operating gallery contains instrument transmitter racks, electrical motor control, steam and cooling water supply lines, and the piping and associated valves that were formerly used to transfer nonradioactive solutions for in-cell use.

The sample gallery contains the remote samplers that were previously used to obtain process solution samples from the cell equipment. A shielded pipe chase behind the remote sampler boxes contains header piping for recovered nitric acid, organic solvent, sampler drains, and sampler lines to and from the cell equipment. The piping has been drained and/or flushed, and the drains have been sealed as part of deactivation efforts.

The west end of the storage gallery is a separate area containing the deactivated neptunium purification and loadout facility (Q cell), the plutonium product handling and product removal (PR) room, the plutonium oxide production facility (in N cell), and a low-level contaminated equipment maintenance shop (hot shop). These areas have been deactivated by sealing the gloveboxes, removing small process equipment, and removing or stabilizing residual radioactive materials.

The service annex is adjacent to the galleries and consists of two separate areas. The larger, main area consists of the 271-AB office/maintenance annex. The 271-AB Annex is a 9.75-m (32-ft) by 32-m (105-ft) by 8.53-m (28-ft)-high, two-story building located on the north side and at the west end of the 202-A Building. This annex contained operations offices and maintenance facilities. The laboratory annex (the smaller area of the service annex) is a 54.8-m (180-ft) by 12.29-m (60-ft) two-story building. The first floor was occupied by numerous laboratories, and the second floor housed heating, ventilation, and air conditioning (HVAC) equipment for the annex, as well as concrete high-efficiency particulate air (HEPA) filter enclosures for the hoods located in the laboratories below. The service annex also contains several steel-on-steel frame, transite-on-steel frame, and partially and fully enclosed flammable gas manifolds, compressed gas cylinder storage, and regulated/nonregulated drum storage.

External to the 202-A Building are the U and R cells, which are located on the north side of the structure. The U cell is located east of what was previously the laboratory area and contained recovered nitric acid storage tanks and laboratory waste tanks. The R cell is located west of the main area and contained process equipment for cleanup of process solvent.

**2.4.2.2 203-A Storage Area.** The pump house and concrete pad at the 203-A tank farm were enclosed and sectioned with concrete dikes containing four 379,000-L (100,000-gal) tanks that were used for the receipt, storage, and tank trailer loading of uranyl nitrate hexahydrate. All tanks and piping have been drained and/or flushed.

**2.4.2.3 204-A Building (U Cell).** The 204-A Building U cell is a concrete structure (vault) that was built below grade. It has removable concrete cover blocks extending above grade, forming the building roof. U cell contains four large tanks, two of which were used for recovered nitric acid and laboratory waste collection.

**2.4.2.4 205-A Silica Gel Facility.** The 205-A Facility is a transite building that houses the (deactivated) silica gel beds (formerly used for uranium product treatment) and a concrete tank pad enclosed by a concrete dike where storage tanks received and stored recovered nitric acid shipped from the $UO_3$ Plant in the 200 West Area.

**2.4.2.5 206-A Fractionator.** The 206-A Building is a reinforced-concrete structure with a split-level roof adjacent to U cell that contained a vacuum fractionator and associated equipment for concentrating PUREX Plant and $UO_3$ Plant recovered nitric acid. The piping has been drained and/or flushed.

**2.4.2.6 210-A Drum Storage.** This building is a three-sided steel lean-to and is located east of the 203-A Building. The building was used primarily for the storage of clean drums.

**2.4.2.7 211-A Bulk Cold Chemical Storage Farm.** The 211-A Facility contains a steel and transite pump house and associated tank farm for receipt, storage, and transfer of bulk process chemicals. The process water demineralizer units are also located in the pump house. No chemicals remain in the 211-A Facility, and the piping has been drained and/or flushed.

**2.4.2.8 2714-A Chemical Warehouse Building.** The 2714 Building contains a steel warehouse that was used for receipt, storage, and transfer of process chemicals received in less-than-bulk quantities. All chemicals have been removed.

**2.4.2.9 212-A Fission Product Load-Out.** The 212-A Building is a steel building located on the south side of the PUREX Plant and was used prior to the 1970s for load-in and load-out of liquid wastes into shipping casks. The building is now inactive.

**2.4.2.10 213-A Fission Product Load-In/Maintenance Shop.** The 213-A Building was used prior to the 1970s to load and unload high-level fission solutions into transfer containers. The building was emptied and decontaminated.

**2.4.2.11 214-A/B/C/D PUREX Facility Warehouse.** The 214-A Building is a warehouse that was divided into four separate areas (A, B, C, and D) by one-hour rated fire walls. Section 214-A served as dangerous waste storage and the remaining areas served as consumable material storage. The warehouse is now empty.

**2.4.2.12 215-A Sodium Hydroxide Instrument Pad.** The original building was removed and excessed in 1998. Only the concrete pad (which was cleaned) remains.

**2.4.2.13 216-A Spud Cellar Sample Pit.** The sample pit is a below-grade concrete structure used for sampling low-level stack condensate.

**2.4.2.14 217-A SAMCONS I&C Unit.** The 217-A Building contains the surveillance and maintenance control system (SAMCONS) unit instrumentation and control (I&C) system. The building is a prefabricated unit that was constructed to house the main console and computer for

the SAMCONS, the controllers for the dampers on the PUREX exhaust fans, and other instrument and termination cabinets and racks. The building also contains a battery-backed uninterruptible power supply system and associated charger for the SAMCONS unit.

**2.4.2.15 Safety Support Systems.** The PUREX building has fire alarm pull boxes, smoke detectors, and manual fire extinguishers. The pull boxes and smoke detectors are connected to a central fire alarm panel in the filter building.

**2.4.2.16 Pipefitter Shop.** The pipefitter shop is a metal building once used for maintenance activities.

**2.4.2.17 225-EC Treated Effluent Disposal Facility (TEDF) Monitoring Building.** The 225-EC Building (also known as the Chemical Sewer Line [CSL] Building) is a metal instrumentation shed. The 225-EC building contained equipment to sample and monitor liquid effluent on its way to the TEDF. All sample lines have been emptied and the monitoring equipment has been removed.

**2.4.2.18 252-AB Main Electrical Switchgear Substation.** The 252-AB Building is a prefabricated structure that houses the new electrical switchgear that was installed as part of PUREX deactivation. The building houses the switchgear and distribution system, transformers, and motor control centers. The majority of the non-lighting loads at PUREX are fed from the 252-AB Building. The building also houses the batteries for operating the switchgear and the associated battery charging system.

**2.4.2.19 252-AC Surveillance Lighting Electrical Substation.** The 252-AC Building is a prefabricated structure that houses the new surveillance lighting electrical substation.

**2.4.2.20 291-A Facilities.** The 291-A Facilities housed the canyon exhaust air filtration and discharge facilities. These facilities include two below-grade concrete filter cells (only one of which is still active [filter #2]), an unused third filter cell, three parallel exhaust fans, air tunnels, and a 61-m (200-ft)-high concrete stack.

**2.4.2.21 292-AB Gaseous Effluent Monitoring Building (Main Stack Building).** The 292-AB Building is a steel structure located adjacent to the east side of the 61-m (200-ft) stack. The building houses stack monitoring and sampling equipment.

**2.4.2.22 293-A Dissolver Off-Gas Station.** The 293-A Building is a two-level concrete structure containing absorption towers that were used to remove oxides of nitrogen and residual radioiodine from dissolver off-gas. This facility is inactive and all systems have been drained and/or flushed.

**2.4.2.23 294-A Off-Gas Instrument Shack.** The 294-A Facility is a small steel building located above grade with three filter cells that are located below grade. The facility is located north of the

293-A Building and previously provided secondary filtration of dissolver off-gas. This facility and the filters are currently inactive.

**2.4.2.24 276-A R Cell.** The 276-A Building is a concrete vault, built below grade with removable concrete cover blocks, extending above grade forming the building roof. R cell provided organic solvent decontamination and storage.

**2.4.2.25 281-A Emergency Generators Facility.** The 281-A Facility's emergency generators previously provided backup power to PUREX; however, the facility is now inactive. The three diesel-engine-driven electrical generators and associated fuel oil storage tank have been removed, and only the building, instruments and controls, and pad remain.

**2.4.2.26 292-AA Product Removal Stack Sample House (PR Exhaust Sampling and Monitoring).** The 292-AA Building is a metal instrumentation shed that contained equipment to sample and monitor exhaust prior to discharge from the stacks.

**2.4.2.27 293-A Dissolver Off-Gas Station.** The 293-A Building is a reinforced-concrete structure. The building is separated into four main areas at two elevations. The lower elevation extends approximately 1.8 m (6 ft) below ground and contains a basement and sub-basement area that is accessed by a steel door on the northeast side of the building. The above-ground level of the building was isolated by a concrete shielding wall between the instrumentation and process area. These areas are accessed by steel doors on the west end of the building. A tank vault is located in an isolated area on the east end of the building. The top of the vault is covered with concrete cover blocks that provided the only access to this area. All walls and floors of the 293-A Building are constructed of reinforced concrete. The building contains the equipment and instrumentation used to scrub the PUREX building dissolvers off-gas to remove nitrous oxides and convert the gas into nitric acid. During deactivation, all of the equipment and process lines were flushed and emptied.

**2.4.2.28 293-AA Former Hydrogen Peroxide Storage (Concrete Pad Reused Under 252-AB).** The 293-AA concrete retention basin has a 49,400-L (13,000-gal) capacity and previously contained three 38,000-L (10,000-gal) aluminum tanks that were used to store 50 wt% hydrogen peroxide. The tanks and pumps have been removed, leaving a clean concrete pad that was reused under the 252-AB substation.

**2.4.2.29 294-A Off-Gas Instrument Shack.** The 294-A Building is a metal building with a concrete basement area. The basement area contains three dissolver off-gas filters (one for each dissolver) constructed of a steel shell with fiberglass filter media. The building contains the filters and associated instrumentation used for the 202-A Building dissolvers off-gas secondary filtration prior to exhausting to the 293-A Building (south of 294-A) and/or the 291-A main stack.

**2.4.2.30 295-A Ammonia Scrubber Distillate (ASD) Sample Station.** The 295-A Building contained instrumentation and equipment that was used to monitor and sample the waste stream. The equipment was drained and removed during deactivation.

**2.4.2.31 295-AA Steam Condensate Discharge (SCD) Sample/Pump Station.** The 295-AA Building contained the SCD process waste stream monitoring equipment. The equipment was drained and removed during deactivation.

**2.4.2.32 295-AB Process Distillate Discharge (PDD) Sample Station.** The 295-AB Building contained the PDD process waste stream monitoring equipment. The equipment was drained and removed during deactivation.

**2.4.2.33 295-AC Chemical Sewer Line (CSL) Sample Station.** The 295-AC Building contained the CSL process waste stream monitoring equipment. The equipment was drained and removed during deactivation.

**2.4.2.34 295-AD Cooling Water Line (CWL) Sample Station.** The 295-AD Building's walls and roof are constructed of insulated metal panels and the floor is concrete. The building contained the CWL process waste stream monitoring equipment. The equipment was drained and removed during deactivation.

**2.4.2.35 295-AE Process Distillate Discharge (PDD) Monitoring Station.** The 295-AE Building is a 5.5-m (18-ft) by 4.6-m (15-ft) by 3.0-m (10-ft)-high metal structure. The walls and roof are constructed of insulated metal panels and the floor is concrete. Although the building was designed to enclose instrumentation and monitoring equipment, it was never used.

**2.4.2.36 2701-AB Badge House.** The 2701-AB Building is a 16.2-m (53-ft) by 8.2-m (27-ft) by 4.9-m (16-ft)-high concrete structure. The building has a basement area that was used as the Hanford Site's security command center. The walls are concrete block and the floors are concrete and steel (around security area). The building roof is reinforced concrete with a built-up tar and gravel covering. All security equipment has been previously removed from the building, and the remaining building equipment was later removed during deactivation.

**2.4.2.37 2701-AC Patrol Guard Shack.** The 2701-AC Building is a small metal structure located on top of the 202-A Building that was used as a guard shack. The building is empty and contains no hazardous materials or energies.

**2.4.2.38 2711-A-1 Air Compressor Building.** The 2711-A Building is a 6.1-m (20-ft) by 6.1-m (20-ft) by 3.7-m (12-ft)-high metal shack. The walls and roof are constructed of insulated metal panels and the floor is concrete. The building houses two dry air compressors, associated instruments, and controls to provide dry air to gloveboxes in PUREX. The compressors were drained and isolated during facility deactivation.

**2.4.2.39 2712-A Pump House.** The 2712-A Building enclosed two vacuum pumps, associated instruments, and controls that were emptied and isolated during facility deactivation.

**2.4.2.40 2714-A Chemical Warehouse.** The 2714-A Building was used for receipt, storage, and transfer of process chemicals received in less-than-bulk quantities. All materials were removed from the building during facility deactivation.

**2.4.2.41 2901-A Water Tower.** The 189,000-L (50,000-gal) capacity elevated water storage tank connected to and filled from the sanitary water system. The tank was emptied during deactivation of the fire suppression system.

**2.4.2.42 291-AB Exhaust Air Sample Shack.** The 291-AB Building encloses instrumentation and monitoring equipment.

**2.4.2.43 291-AC Exhaust Air Instrument House.** The 291-AC Building is a wooden structure that encloses instrumentation and monitoring equipment.

**2.4.2.44 291-AD Ammonia Off-Gas Filter Building.** The 291-AD Building contains equipment used to filter the off-gas from the ammonia scrubber (i.e., a stainless-steel knock-out pot, an electric heater, and an empty filter box [filter removed during deactivation]) and instrumentation monitoring equipment.

**2.4.2.45 291-AG Sample Station #2.** The 291-AG Building encloses instrumentation and monitoring equipment.

**2.4.2.46 291-AH Ammonia Off-Gas Sample Building.** The 291-AH Building encloses instrumentation and monitoring equipment.

**2.4.2.47 291-AJ Sample Station #3.** The 291-AJ Building encloses instrumentation and monitoring equipment.

**2.4.2.48 291-AK Air Tunnel Enclosure.** The 291-AK air tunnel enclosure is a metal annex located directly south of 202-A Building which housed the fire suppression system for the canyon air tunnel. This system has been deactivated.

**2.4.2.49 296-Deactivated Stacks.** Several stacks that previously exhausted to the atmosphere from the PUREX Plant have been capped and isolated.

**2.4.2.50 Other Buildings/Structures.** The remaining buildings identified in Table 2-2 and not previously discussed are generally classified as offices, instrument and equipment enclosures, or storage areas. The buildings are either not contaminated or have only low-level fixed contamination. No significant hazards were identified in the *Plutonium Uranium Extraction (PUREX) End State Basis for Interim Operation (BIO) for Surveillance and Maintenance* (B&W 1999a).

### 2.4.3 Facility Confinement Systems

**2.4.3.1 Ventilation System.** The 202-A Building ventilation consist of three pressure zones with air generally flowing from lower contamination areas to higher contamination areas, with the most negative pressure in the highest contamination areas. The pressure zones are as follows:

- Piping and operating gallery
- Sample gallery
- Lowest level (storage gallery; cells Q, M, and N; PR room, and hot shop).

The PUREX HVAC system consists of a canyon exhaust fan inducing airflow through the main building and the canyon. The operating exhaust fan maintains a relatively constant negative pressure on the canyon air space based on control feedback from two differential pressure cells reading the canyon-to-atmospheric pressure. Two 200-hp backup canyon exhaust fans are provided in case of failure of the single canyon exhaust fan. The single operating fan is powered by an electrical substation. Mechanical or power failure of the operating canyon exhaust fan is detected by the monitoring system (see description below) and will activate operation of the backup fan. Ventilation air is drawn into the 202-A Building canyon and process cells from the top (the U cell and R cell are also ventilated through this system). From the cells, air is drawn through small ports into the air tunnel, then through the 291-A filter, and is then exhausted through the stack. The lack of operational supply fans eliminates the potential for over-pressurization.

The buildings associated with the active portion of the PUREX ventilation systems are the #2 deep-bed filter, the 291-AE (fourth filter building), the 291-A (exhaust plenum and fan pad), the 291-A-1 (main stack), air tunnels, and the 292-AB Main Stack Monitoring Building.

A 2.4-m (8-ft)-wide by 2.4-m (8-ft)-high reinforced-concrete exhaust air duct connects the 202-A Building to the #2 deep-bed filter that is located in the south yard area and is composed of below-grade concrete exhaust air treatment and discharge facilities. The overall dimensions of the filter area are 25 m (82 ft) by 15.8 m (52 ft) by 4 m (13 ft) deep.

The #2 deep-bed filter was designed to remove 99.9% of the particulates from the air stream. The filter area has two fiberglass bed sections: the pre-filter and the cleanup filter. The pre-filter bed consists of five separate layers, each packed with a different density of fiberglass. The cleanup filter beds consist of 132 deep-bed filter units.

The 291-AE (fourth filter) Building is a 37.5-m (123-ft) by 12.5-m (41-ft) by 5.2-m (17-ft)-high reinforced-concrete building that houses 10 modular filter units, each with upstream and downstream isolation dampers. A typical modular filter unit consists of a stainless-steel housing containing an inlet damper, an in-place filter testing assembly, a 4-by-3 array of HEPA filters, an in-place filter testing assembly, and an outlet damper. Five filters are currently operational, and the remaining filters are kept in reserve. Two reinforced-concrete air ducts are located below 291-AE, parallel to each other, running in the north-south direction. The west duct is an inlet air

duct connected to the underground air duct for the #2 filter. The east duct is the discharge air duct from the HEPA filter units and connects with the aboveground reinforced-concrete exhaust air plenum. Attached to the south side of the building is a 7.3-m (24-ft) by 3.7-m (12-ft) by 2.7-m (9-ft)-high metal building that houses the mechanical and electrical equipment and serves as the entrance vestibule for the 291-AE Building.

The 291-A exhaust plenum and fan area consists of an underground air duct connected to the 291-AE discharge air duct and an aboveground segment that houses three electric motor-driven ventilation fan units. The walls and floor are constructed of reinforced concrete. The motor-driven fans are located on the south side of the aboveground plenum segment.

The 291-A-1 main stack is reinforced concrete and rises 61 m (200 ft) above grade. The stack has a free-standing, 2.1-m (7-ft) inner-diameter, stainless-steel liner. The top of the stack is capped to cover the annulus between the stack and the liner. Aircraft warning lights are provided on the stack.

The 292-AB Building is a 10.7-m (35-ft) by 6-m (20-ft)-high two-story metal building. The second floor is constructed on metal grate with a metal plate over approximately 80% of the floor area. The building serves as an enclosure for instrumentation and monitoring equipment.

Buildings and structures associated with the deactivated ventilation systems include #1 and #2 deep-bed filter housings, 291-AB, 291-AD, 291-AG, 291-AH, 291-AJ, 291-AK, and multiple 296-A stacks.

**2.4.3.2 Surveillance and Maintenance and Control System.** The SAMCONS unit (located the 217-A Building) monitors and controls the following items:

- Airflow through the major flow paths and three differential pressures (canyon pressure is sampled by dual transmitters to ensure that valid signals are transmitted to the acquisition system)
- Temperature measurements for the canyon exhaust fans bearings, air tunnel, and the fourth filter building
- Liquid levels from radioactive liquid catch tanks receiving stack condensate
- Humidity and dew point of the air in the air tunnel to detect liquid accumulation on the HEPA filters
- The main stack alpha and beta particulate measurements
- Condition and status of the main switchgear and motor control centers.

**2.4.3.3 Drains.** No active drain systems are found in the PUREX Facility.

**2.4.3.4 Safety Support Systems.** No active safety support systems are found in the PUREX Facility.

### 2.4.4 Facility Utility Distribution Systems

**2.4.4.1 Electrical Power, Lighting, and Communications.** All of the original plant power systems have been de-energized. Two electrical substations provide newly installed power systems to the PUREX Plant during S/M&T. One station (i.e., the 252-AB Building) supplies power to the 292-AB Stack Monitoring Building, the 291-AE No. Filter Building, the 291-A-1 monitoring system, the operating canyon exhaust fan, and the SAMCONS I&C skid for S/M&T. The other station (i.e., 252-AC Building) supplies power to dedicated surveillance lighting throughout the facility, provides electric heat to the 291-AE and 292-AB Buildings, and cooling to the 292-AB Building during warm weather.

**2.4.4.2 Water Supply Systems.** No active water supply systems are found in the PUREX Facility.

### 2.4.5 Facility Condition

**2.4.5.1 Process Upsets and Impacts.** Three significant events have occurred during the PUREX operating history that have resulted in significant contamination areas in the facility.

The first process-upset event occurred when an instrument line leading to the L-6 stripper/concentrator released approximately 75.7 L (20 gal) of plutonium-bearing solution into the west end of the pipe and operating gallery. Liquid contamination was spread through the chemical sewer drain, the canyon lobby, the pipe and operating gallery, and into R cell. Many coats of white sealant paint were applied to the immediate area of the spill in the west end of the pipe and operating gallery so the area became known as the "white room." In 1957, a shielding wall and separate ventilation system were installed to isolate the white room. The area remains a contamination zone as of this revision to the EPHA.

The second process-upset event occurred in 1958 when the bottom portion of the silver reactor filters in cell A exploded, spreading contamination within the heavily shielded area. Although spread of contamination to other portions of the PUREX Plant was minimal and no contamination reached the environment, cleanup and repair were difficult because of the inaccessible location of the filters.

While not an off-normal event, a significant accumulation of material has built up over the years on the L cell floor. This material accumulated as the result of process leaks and normal operational losses. The estimated inventory for the L cell is 3,896 g of plutonium.

### 2.4.6 Surveillance and Maintenance Activities

The overall function of S/M&T is to maintain the facility structure and equipment until decontamination and decommissioning and to minimize worker hazards and prevent unauthorized releases of hazardous substances to the environment.

Surveillance will consist of walkthroughs of selected portions of the 202-A Building, ancillary buildings, and the adjacent outdoor area. The purpose of surveillance is to check for structural deterioration, posting deficiencies, contamination migration, identifying hazardous conditions, preventive maintenance, hazardous materials management, routine housekeeping, and equipment calibration, testing, maintenance, and repair.

# 3.0 IDENTIFICATION AND SCREENING OF HAZARDS

## 3.1 TOXICOLOGICAL HAZARDS

The PUREX Plant deactivation project removed, reduced, or stabilized the hazardous chemicals and waste within the PUREX Plant. All bulk chemicals were removed, and only isolated residual quantities are present. The residuals are in the heels that remain in chemical and process tanks and in the isolated dead-end legs of piping and dry residual material resulting from spills and leaks. Tanks and vessels were flushed until sampling indicated that residuals met *Resource Conservation and Recovery Act of 1976* standards.

Hazardous residual from spills or leaks is primarily found as dried salts or captured in cell debris or sludge and is normally assumed, based on post-operating experience, to be nonreactive and not readily mobile.

The following quantities of hazardous chemicals were identified in the facility:

- 170.3 kg of silver nitrate. This exceeds the 40 CFR 302.4, Table 302 final RQs of 0.5 kg. Therefore, a quantitative analysis is required (see Section 6.0).

- Less than 129 kg of cadium. This exceeds the 40 CFR 302.4, Table 302 final RQ of 4.54 kg. Therefore, a quantitative analysis is required (see Section 6.0).

- Less than 114 kg of mercury. This exceeds the 40 CFR 302.4, Table 302 final RQ of 0.5 kg. Therefore, a quantitative analysis is required (see Section 6.0).

- Trace amounts of chromium in debris on the E cell floor. Although there is no quantifiable number provided in the safety analyses, it is assumed that the "trace quantities" are less than the RQ given for chromium in 40 CFR 302.4, Table 302. Therefore, no quantitative analysis is required for chromium.

Significant quantities of lead and asbestos (friable or otherwise) are also contained within the facility. Therefore, a quantitative analysis is required (see Section 6.0).

## 3.2 RADIOLOGICAL HAZARDS

The hazardous radioactive material in the PUREX Plant consists of residual contamination in all process cells, ventilation systems, and process piping.

The PUREX Plant is estimated to contain a total of 7,138 g of plutonium and approximately 1,300 g of fission products. This inventory exceeds the screening TQs for radionuclides and, therefore, requires the performance of a hazards analysis.

# 4.0 HAZARD CHARACTERIZATION

The screening process in Section 3.0 identified an extensive radionuclide inventory, mainly in the burial tunnels, that exceeds screening thresholds.

## 4.1 TOXICOLOGICAL CHARACTERIZATION

Silver nitrate is found in the PUREX Plant in the form of a coating over approximately 10.4 $m^3$ (371 $ft^3$) of berl saddle packing in three silver reactors located in A, B, and C cells.

The cadmium identified in Section 3.1 is contained within the dissolver moderator linings of the process equipment in the A, B, and C cells. Mercury is contained within dissolver thermowells in the A, B, and C cells.

The asbestos and lead identified in Section 3.1 are in the form of insulation material, shielding, buckets, glass, lining, doors, etc. The asbestos is considered friable (B&W 1999a).

## 4.2 RADIOLOGICAL CHARACTERIZATION

The PUREX Plant deactivation project removed, reduced, or stabilized the major radioactive sources and waste within the PUREX Plant. Radiological contamination in PUREX consists of uranium, transuranics, and mixed fission products. The radioactive material inventory remaining at the end of deactivation is primarily in the form of contaminated equipment and surfaces, dust, debris, and sludge, with some remaining plutonium oxide dust stabilized in gloveboxes.

Five areas of PUREX are identified as containing significant quantities of plutonium: L cell, deep-bed filters #1 and #2, N cell, PR room, and the white room (B&W 1999a). Table 4-1 provides the PUREX radiological inventory estimates.

**Table 4-1. PUREX Radiological Inventory Estimate. (2 Pages)**

| Location | Measurable Plutonium (g) | Estimated Plutonium (g) | Estimated Fission Products (g) |
|---|---|---|---|
| Canyon (includes L cell) | 4,296 | 930 to 4,800 | 200 to 500 |
| White room | N/A | 50 to 500 | 0 |
| N cell | 1,643 | N/A | 0 |
| PR room | 1,199 | N/A | 0 |

**Table 4-1. PUREX Radiological Inventory Estimate. (2 Pages)**

| Location | Measurable Plutonium (g) | Estimated Plutonium (g) | Estimated Fission Products (g) |
|---|---|---|---|
| Deep bed filters | N/A | 200 to 400 | 80 to 800 |
| Total | 7,138 | 1,180 to 5,700 | 280 to 1,300 |

Source: The information in this table was obtained from B&W (1998, 1999b).
N/A = not applicable

### 4.2.1 PUREX Plant Cells and Process Vessels

The PUREX Plant's canyon walls, floors, and vessels are contaminated with residual radioactive materials. The water solutions in the canyon vessels have been transferred to the tank farms. The remaining heels in each of the vessels will be at the lowest level possible (generally between 76 and 379 L [20 and 100 gal]). All solutions have been transferred to the tank farms using existing transport routes.

# 5.0 CONSEQUENCE MODELS AND CLASSIFICATION CRITERIA

## 5.1 EMERGENCY CLASSIFICATION CRITERIA

A goal of the DOE emergency preparedness system is to quickly classify the severity of an accident involving quantities of hazardous substances that exceed DOE screening criteria. Preplanned actions are then implemented for each emergency class. The emergency classification is based in part on projected dose and concentration values at the facility and Hanford Site boundaries for analyzed accident scenarios. Potential consequences of hazardous material releases are estimated to determine areas potentially affected, the need for personnel protective actions, and the time available to take protective actions. The consequences are determined for both radiological releases (e.g., total effective dose equivalent [TEDE] or committed effective dose equivalent) and for chemical releases (e.g., emergency response planning guides [ERPGs]), out to at least the two following receptor locations relevant to a facility:

- The facility boundary (demarcation between the facility and the immediate vicinity) and the remainder of the Hanford Site. The facility boundary definition figures prominently in the distinction between events that have only a local impact (i.e., on the facility occupants and associated workers at or near the scene of the event) and events that impact areas of the Site outside the immediate vicinity of the affected facility.

- The site boundary receptor is the nearest location to the facility where DOE does not have full ownership and control over access to the property. An event that may produce consequences exceeding a protective action criteria (i.e., the applicable protective action guide [PAG] for ionizing radiation or the ERPG-2 value or equivalent limit for hazardous chemicals) at or beyond the site boundary is to be classified as a "general" emergency because of the need to fully involve offsite authorities in the protective response. Additional considerations in defining the site boundary receptors may be presented.

The emergency classification criteria are shown in Tables 5-1 and 5-2.

**Table 5-1. Radiological Release Criteria.**

| Emergency Category | Criteria |
|---|---|
| Alert | ≥0.001 Sv (100 mrem) TEDE at the facility boundary |
| Site Area | ≥0.01 Sv (1 rem) TEDE at the facility boundary |
| General | ≥0.01 Sv (1 rem) TEDE at the site boundary |

**Table 5-2. Toxicological Release Criteria.**

| Emergency Category | Criteria[a] |
|---|---|
| Alert | ≥ERPG-1 at facility boundary |
| Site Area | ≥ERPG-1 at facility boundary |
| General | ≥ERPG-2 at Site boundary |

[a] The criteria apply to a peak concentration of the substance in air. If ERPG values have not been established for a substance, alternative criteria specified in the emergency management guide for hazards assessments (DOE G 151.1-1) shall be used.

General criteria for emergency classification also exist, in addition to the numerical values identified in Tables 5-1 and 5-2. The threshold between reportable occurrences and the ALERT classification is difficult to establish based solely on a numerical value. The following general criteria apply, in addition to the airborne release concentration values specified in Tables 5-1 and 5-2.

**ALERT –** An ALERT shall be declared when events are in progress or have occurred that involve an actual or potential substantial degradation of the level of safety of the facility with an increased potential for a release.

In general, the ALERT classification is appropriate when the severity and/or complexity of an event may exceed the capabilities of the normal operating organization to adequately manage the event and its consequences.

**SITE AREA Emergency –** A SITE AREA Emergency shall be declared when events are in progress or have occurred that involve actual or likely major failures of facility functions needed to protect workers and the public.

**GENERAL Emergency –** A GENERAL Emergency shall be declared when events are in progress or have occurred that involve actual or imminent catastrophic failure of facility safety systems with a potential for loss of confinement or containment integrity.

Additional emergency classification guidance is provided in the emergency management guide on event classification and emergency action levels (DOE G 151.1-1, Vol. III). The hazards assessment in Section 6.0 is based primarily on a comparison of calculated consequences with the numerical criteria in Tables 5-1 and 5-2. However, some recommendations are provided based on the more general emergency classification criteria.

## 5.2 CALCULATION MODELS

Radiological consequences are estimated using the Hanford Unified Dose Utility (HUDU) computer code (Scherpelz 1991). This code is the primary emergency response tool used to evaluate radiological releases on the Hanford Site and in the Unified Dose Assessment Center.

The HUDU computer code employs a straight-line Gaussian plume model and Pasquill-Gifford stability classes. Release source terms consider only the respirable fraction. Release of radionuclides into the environment is either elevated (effective release height is greater than 2.5 times the building height) or ground level releases. By convention, release heights less than 10 m (32.8 ft) default to ground-level releases. Plume rise is not considered in these analyses, which produces conservative dose estimates.

Toxicological consequences are estimated using the Emergency Prediction Information (EPI) code software. This code is based on a straight-line Gaussian plume model. The code is used to evaluate the atmospheric release of toxic substances.

The consequences calculated in this EPHA may not be identical to the results in the facility's safety documentation. The primary reason for this is the use of different computer codes and release assumptions for emergency planning.

## 5.3 RECEPTOR LOCATIONS

Two receptor locations are evaluated for comparison with the emergency classification criteria: a maximum onsite individual at a distance of 100 m (328 ft) (which is used to define the facility boundary) and a maximum offsite individual at 15.29 km (9.5 mi) (the distance is used to define the site boundary). The dose consequence to the closest point of the near side of the Columbia River (10.98 km [6.8 mi]) will also be evaluated.

## 5.4 METEOROLOGICAL CONDITIONS

To determine the proper event classification for each scenario analyzed, consequences are calculated for a severe meteorological condition. For the purposes of this assessment, severe meteorology is assumed to be "F" stability and 1 m/sec wind speed. To be conservative, and unless otherwise noted, all releases were modeled as ground-level open air (i.e., no building wake effects). To create information that will be useful for response personnel, calculations are also performed for a wind speed of 4.5 m/sec and "D" stability class.

The following assumptions were made for the mixing layer depth for each stability class used: "D" = 200 m (656.2 ft) and "F" = 60 m (196.9 ft). The results provide information that can be rapidly scaled by responders in the initial stages of response to estimate consequences for the current meteorological conditions.

# 6.0 SCENARIOS AND CONSEQUENCES

The supporting committed calculation for this EPHA is documented in BHI (2000). Modeling assumptions for the HUDU computer code are provided in Section 5.0. Unless stated otherwise, all quantitative scenarios assume an open-air, ground-level release.

## 6.1 TOXICOLOGICAL RELEASES

As stated in Section 3.1, 170.3 kg of silver nitrate are found within the A, B, and C cells of the process canyon. However, processing activities are no longer being carried out at PUREX that would result in the buildup of potentially explosive quantities of ammonia-silver salts. The cover panels over the process cells protect the cell contents from accident scenarios that might result in a release of material (RHO [1981a, 1981b] determined that the cover blocks will resist seismic events). Therefore, there are no anticipated releases of silver nitrate from the A, B, and C cells.

As stated in Section 3.1, significant quantities of asbestos and lead are found throughout the facility. Although much of the asbestos is considered friable, no release mechanisms are associated with S/M&T activities or from external or natural phenomena events that would result in a release of toxicological chemicals greater in impact than a release of radiological material. The lead is in a form that is nonreadily dispersible (i.e., sheeting, weights, buckets, lining, and glass), and will not be at risk of release that would result in an impact greater than a release of radiological material. Therefore, quantitative analyses of releases involving lead and asbestos will not be performed, as it is assumed that radiological consequences would exceed hazardous chemical consequences.

## 6.2 RADIOLOGICAL RELEASES

### 6.2.1 Loss of Filtration During Exhaust Fan Operation

The accident scenario for loss of filtration during exhaust fan operation applies to situations where the facility ventilation system is disrupted causing the exhaust fan to run but no filtration occurs. The accident scenario assumes an unmitigated release of material. The basis for this accident scenario is the hazards analysis contained in B&W (1999b).

**6.2.1.1 Source Term.** The source term for this accident scenario is based on the following assumptions:

- The air concentrations of radionuclides being released would be the average of the air samples taken upstream of the filters, as well as the other plutonium isotopes as identified in WHC (1990).

- For evaluation of the filter failure condition, it was assumed that the fans would continue to pull 18.7 $m^3$/sec (40,000 $ft^3$/min) of air through the stack (unfiltered).

- The accident condition was assumed to last 24 hours.

Table 6-1 shows the assumed activity that is released (B&W 1999a).

**Table 6-1. Source Term for Loss of Filtration During Exhaust Fan Operation.**

| Isotope | Quantity (Ci) |
|---|---|
| Co-60 | 4.60E-07 |
| Sr-90 | 3.00E-02 |
| Y-90 | 3.00E-02 |
| Ru-106 | 4.60E-05 |
| Sb-125 | 1.60E-04 |
| Cs-134 | 8.10E-07 |
| Cs-137 | 9.40E-04 |
| Pb-212 | 4.80E-05 |
| Bi-212 | 5.30E-05 |
| Pu-238 | 6.50E-04 |
| Pu-239 | 3.30E-03 |
| Pu-240 | 1.20E-03 |
| Pu-241 | 1.10E-01 |
| Pu-242 | 4.20E-07 |
| Am-241 | 6.70E-04 |

The HUDU computer code results are shown in Table 6-2. This accident scenario was modeled as an elevated release. Stack height was set at 61 m (200.1 ft), release diameter set at 1 m (3.3 ft), and an airflow rate of 18.7 $m^3$/sec (40,000 $ft^3$/min) was used (B&W 1999a).

**Table 6-2. Effective Dose Equivalent (mrem) for Loss of Filtration During Exhaust Fan Operation.**

| Stability Class (Wind Speed) | Facility Boundary (100 m) | Site Boundary (15.29 km) | Near Side of Columbia River (10.98 km) |
|---|---|---|---|
| "D" (4.5 m/sec) | 0 | <1 | <1 |
| "F" (1.0 m/sec) | 0 | 5 | 6 |

For the conditions analyzed in Table 6-2, the approximate distance at which the U.S. Environmental Protection Agency (EPA's) PAG of 0.01 Sv (1 rem) is met are less than 0.10 km (0.06 mi) for all conditions.

The results of this analysis indicate that under severe meteorological conditions, a loss of filtration during exhaust fan operation is below the criteria for an ALERT. The worst-case dose consequence was determined to be 9 mrem at approximately 400 to 500 m (1,312.4 to 1,640.5 ft) from the facility (e.g., exhaust stack).

### 6.2.2 Loss of Power to Ventilation System

The loss of power to ventilation system accident scenario applies to situations where a loss of power occurs with the PUREX ventilation equipment, resulting in a release of airborne radionuclides due to facility "breathing" (i.e., the pressure within the building becomes positive with respect to atmospheric pressure, resulting in a reversal of airflow). The accident scenario assumes an unmitigated release of material. The basis for this accident scenario is the hazards analysis provided in B&W (1999b).

**6.2.2.1 Source Term.** The source term for this accident scenario is based on the following assumptions:

- The average of air samples taken upstream of the PUREX HEPA filters, as well as the other plutonium isotopes as identified in WHC (1990).

- The accident condition was assumed to last 24 hours.

The air samples were taken upstream of the filters during the deactivation of the PUREX Plant. The airflow during this time period was approximately 2,240 $m^3$/min (80,000 $ft^3$/min) (B&W 1999a). The estimated airflow in PUREX under static conditions is 25 $m^3$/min (1,000 $m^3$/min). This is significantly less than during deactivation activities. Assuming that radionuclide air concentrations for airflows of 25 $m^3$/min (1,000 $m^3$/min) would be the same for airflows of 2,240 $m^3$/min (80,000 $ft^3$/min) is extremely conservative, as entrainment of smearable

surface contamination increases with increasing air speed. Because airflow during static conditions is a factor of 80 less than during deactivation activities, the source term will be reduced by a factor of 10 to arrive at a more realistic source term for this scenario.

Table 6-3 shows the assumed activity that is released.

**Table 6-3. Source Term for Loss of Exhaust Fan.**

| Isotope | Quantity (Ci) |
|---|---|
| Co-60 | 4.60E-08 |
| Sr-90 | 1.10E-03 |
| Y-90 | 3.00E-03 |
| Ru-106 | 4.60E-06 |
| Sb-125 | 1.60E-05 |
| Cs-134 | 8.10E-08 |
| Cs-137 | 3.40E-05 |
| Pb-212 | 4.80E-06 |
| Bi-212 | 5.30E-06 |
| Pu-238 | 6.50E-05 |
| Pu-239 | 2.10E-04 |
| Pu-240 | 1.20E-04 |
| Pu-241 | 1.10E-02 |
| Pu-242 | 4.20E-08 |
| Am-241 | 6.45E-05 |

The HUDU computer code results are shown in Table 6-4. This accident was modeled as a ground-level release with building wake. The airflow rate was assumed to be 0.5 $m^3$/sec (1,000 $ft^3$/min). The building area was set at 1,316 $m^2$ (1,573.9 $yd^3$) (assumed to be the smallest cross-sectional area of the 202-A Building).

For the conditions analyzed in Table 6-2, the approximate distance at which the EPA's PAG of 0.01 Sv (1 rem) is met are less than 0.10 km (0.06 mi) for all conditions.

The results of this analysis indicate that under severe meteorological conditions, a loss of filtration during exhaust fan operation is below the criteria for an ALERT.

**Table 6-4. Effective Dose Equivalent (mrem) for Loss of Exhaust Fan.**

| Stability Class (Wind Speed) | Facility Boundary (100 m) | Site Boundary (15.29 km) | Near Side of the Columbia River (10.98 km) |
|---|---|---|---|
| "D" (4.5 m/s) | 29 | <0.1 | <0.1 |
| "F" (1.0 m/s) | 17 | <1 | <1 |

### 6.2.3 Earthquake Scenario

The basis for the earthquake accident scenario was the hazards analysis provided in B&W (1999a).

The major PUREX Plant structures were built in accordance with 1952 Uniform Building Code Zone 2 earthquake regulations. The ability of these structures to withstand seismic events was summarized in B&W (1999a). The seismic evaluation concluded that the process cell cover blocks and, in general, the 202-A Building, will not fail.

The key structural element that would fail due to a seismic event is the east crane maintenance platform (ECMP). The ECMP is assumed to fail, resulting in a release of contaminated dust and debris into the building ventilation air pathways. In addition, it is assumed that the PUREX ventilation system also loses power due to the seismic event and the source term would be released from the building unfiltered.

**6.2.3.1 Source Term.** The source term for this accident scenario was taken directly from Section 4.3.1 of B&W (1999a).

The total material at risk was determined to be the sum of the following:

- The high value airborne concentrations of radionuclides in the canyon, as reported for an unfiltered release due to the loss of HVAC. This value is conservative because the majority of the inventory is contained in the PUREX canyon underneath the cover blocks (which withstand the seismic event).

- The material at risk within the ECMP was estimated based on a conservative average of samples taken from the ECMP.

Table 6-5 shows the assumed activity that is released (B&W 1999a).

**Table 6-5. Source Term for Earthquake Scenario.**

| Isotope | Quantity (Ci) |
|---|---|
| Co-60 | 4.60E-07 |
| Sr-90 | 4.61E-02 |
| Y-90 | 3.00E-02 |
| Ru-106 | 4.60E-05 |
| Sb-125 | 1.60E-04 |
| Cs-134 | 8.10E-07 |
| Cs-137 | 2.43E-03 |
| Pb-212 | 4.80E-05 |
| Bi-212 | 5.30E-05 |
| Pu-238 | 6.50E-04 |
| Pu-239 | 4.79E-03 |
| Pu-240 | 1.20E-03 |
| Pu-241 | 1.10E-01 |
| Pu-242 | 4.20E-07 |
| Am-241 | 6.70E-04 |

The HUDU computer code results are shown in Table 6-6. The accident was modeled as a ground-level release with no building wake.

**Table 6-6. Effective Dose Equivalent (rem) for Earthquake Scenario.**

| Stability Class (Wind Speed) | Facility Boundary (100 m) | Site Boundary (15.29 km) | Near Side of Columbia River (10.98 km) |
|---|---|---|---|
| "D" (4.5 m/s) | 1.5 | <1.0 mrem | <1.0 mrem |
| "F" (1.0 m/s) | 29 | 0.015 | 0.021 |

For the conditions analyzed in Table 6-6, the approximate distance at which the EPA's PAG of 0.01 Sv (1 rem) is exceeded are shown in Table 6-7.

**Table 6-7. Approximate Distance at Which PAG (1 rem) Exceeded.**

| Distance | D Stability | F Stability |
|---|---|---|
| Kilometers | 0.13 | 0.80 |
| Miles | 0.08 | 0.50 |

The results of this analysis indicate that under severe meteorological conditions, collapse of the ECMP and a loss of ventilation would meet the criteria for classification as a SITE AREA Emergency, greater than 0.01 Sv (1 rem) TEDE at the facility boundary.

# 7.0 SUGGESTED EMERGENCY ACTION LEVELS AND EVENT CLASSIFICATIONS

An index of emergency conditions is provided in Table 7-1.

**Table 7-1. Emergency Conditions Index.**

| Emergency Condition Title | Page | Table No. |
|---|---|---|
| **SECTION 1 – OPERATIONS SCENARIOS** | | |
| Loss of Filtration During Exhaust Fan Operation | 7-2 | 7-2 |
| Loss of Ventilation Power | 7-2 | 7-3 |
| Facility Fire | 7-3 | 7-4 |
| **SECTION 2 – NATURAL PHENOMENA** | | |
| Earthquake | 7-4 | 7-5 |
| High Wind/Tornado | 7-5 | 7-6 |
| Range Fire | N/A | N/A |
| Ash/Snow Loading | 7-5 | 7-7 |
| **SECTION 3 – EXTERNAL EVENTS** | | |
| Loss of Utilities | N/A | N/A |
| Adjacent Facilities | N/A | N/A |
| Aircraft Crash | 7-7 | 7-8 |
| **SECTION 4 – SAFEGUARDS AND SECURITY** | | |
| Bomb Threat/Explosive Device/Explosion | 7-8 | 7-9 |
| Sabotage | 7-9 | 7-10 |
| Hostage Situation/Armed Intruder | 7-10 | 7-11 |

## 7.1 OPERATIONS SCENARIOS

### 7.1.1 Loss of Filtration During Exhaust Fan Operation

The basis for the suggested emergency action level (EAL) in Table 7-2 is the scenario analyzed in Section 6.2.1.

**Table 7-2. Operations – Loss of Filtration During Exhaust Fan Operation.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Loss of filtration during exhaust fan operation | Contaminated air exits the exhaust stack without first being filtered by the HVAC/ HEPA filters. | Below emergency classification |

NOTE: No emergency classification defined.

**Potential Event Indicators.** Indicators for this type of event include the following:

- SAMCONS I&C skid unit.

### 7.1.2 Loss of Ventilation Power

The basis for the suggested EALs in Table 7-3 is the scenario analyzed in Section 6.2.2.

**Table 7-3. Operations – Loss of Ventilation Power.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Exhaust fan(s) lose power | Contaminated air exits the facility from other than the exhaust stack without first being filtered by the HVAC/HEPA filters (e.g., over-pressurization of 202-A Building or loss of power to exhaust fans). | Below emergency classification |

NOTE: No emergency classification defined.

**Potential Event Indicators.** Indicators for this type of event include the following:

- SAMCONS I&C skid unit.

### 7.1.3 Facility Fire

In most cases, releases associated with fires internal to the facility (e.g., in the 202-A Building) would be mitigated by the ventilation system filters. Facility fires that threaten areas or structures that contain significant quantities of hazardous or radioactive materials (refer to Section 4.0) and would result in release that would not be filtered by the ventilation system should be classified as an ALERT. Table 7-4 indicates the EALs for a facility fire.

**Table 7-4. Operations – Facility Fire.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Fire in the 202-A PUREX Plant | A fire that requires the Hanford Fire Department for suppression<br>AND<br>that results in a release of inventory that is filtered by exhaust HEPA filters. | Below emergency classification |
| | A fire that requires the Hanford Fire Department for suppression<br>AND<br>that results in a release of material from any of the following areas:<br>• Any canyon process cell<br>• White room<br>• N cell<br>• PR room<br>• Deep-bed filters<br>AND<br>the release is NOT filtered by exhaust HEPA filters. | ALERT |

NOTE: No SITE AREA or GENERAL Emergency class defined.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observation
- SAMCONS I&C skid unit.

## 7.2 NATURAL PHENOMENA SCENARIOS

### 7.2.1 Earthquake

The basis for the suggested EALs in Table 7-5 is the scenario analyzed in Section 6.2.3.

**Table 7-5. Natural Phenomena – Earthquake.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Earthquake | An earthquake occurs that is detectable to personnel (e.g., sensation of shifting ground, tall structures swaying, objects rocking) but no structural damage is immediately visible to the 202-A Building. | ALERT |
| | An earthquake causes the east crane maintenance platform to collapse. | SITE AREA EMERGENCY |

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observation,
- SAMCONS I&C skid unit, AND
- Confirmed structural damage to facility confinement.

### 7.2.2 High Wind/Tornado

Some damage is expected if high winds or tornados strike the PUREX Plant that damage external structures or possibly even upset of the ventilation system. Release of hazardous materials from this type of event is expected to be minor, and the consequences are bounded by the analyses of other scenarios.

The 202-A Building and supporting building structures have experienced two wind storms in recent years with gusts up to 3.6E+1 m/sec (80 mph) (in 1972) and 3.4E+1 m/sec (75 mph) (in 1990) with no damage. The likelihood of below-grade buildings suffering damage due to high winds or a tornado is remote.

The PUREX Facility also includes a number of uncontaminated support buildings that contain extremely small quantities of hazardous materials (e.g., asbestos). As these buildings age, the possibility of wind-generated missiles exist. However, these missiles are not expected to damage facilities.

Consequences from a loss of power to the ventilation system (e.g., power lines are blown down) are addressed by Section 7.1.2.

Table 7-6 provides the suggested EALs for a high wind/tornado impacting the PUREX Plant based on the above discussion. A convention concerning high winds at the Hanford Site is to declare an ALERT condition if sustained winds exceed 40 m/sec (90 mph) and damage from the winds is observed.

**Table 7-6. Natural Phenomena – High Wind/Tornado.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| High wind/tornado | Sustained winds exceed 90 mph<br>AND<br>damage to facility buildings is observed. | ALERT |
| | A tornado touches down and damages the 202-A Building<br>AND<br>causes damage to facility confinement structures. | SITE AREA EMERGENCY |

NOTE: No GENERAL Emergency class defined. If a high wind/tornado initiates another emergency condition, see the appropriate emergency condition table.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations
- Local or site meteorological system, AND
- Confirmed structural damage to facility confinement.

### 7.2.3 Range Fire

A range fire event classification would be declared at the site level.

### 7.2.4 Ash/Snow Loading

Table 2-1 indicates the estimated ash depth deposited at the Hanford Site from past volcanic eruptions in the region. A heavy deposition of ash or snow could collapse some of the older roofs. The basis for the suggested EAL in Table 7-7 is the scenario analyzed in Section 6.2.3.

**Table 7-7. Natural Phenomena – Ash/Snow Loading.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Ash/snow loading | An accumulation of ash and/or snow causes the east crane maintenance platform to collapse. | SITE AREA EMERGENCY |

NOTE: No GENERAL Emergency class defined.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations AND
- Confirmed structural damage to facility confinement.

## 7.3 EXTERNAL EVENTS

### 7.3.1 Loss of Utilities

Two electrical substations provide newly installed power systems to the PUREX Plant during S/M&T. One station supplies power to the 292-AB Stack Monitoring Building, the 291-AE No. Filter Building, the 291-A-1 monitoring system, the operating canyon exhaust fan, and the I&C skid for S/M&T. The other station supplies power to dedicated surveillance lighting throughout the facility, provides electric heat to the 291-AE and 292-AB Buildings, and cooling to the 292-AB Building during warm weather.

The quantitative analysis for the loss of power to the ventilation system is address in Section 7.1.2. No consequences resulting in the loss of control of hazardous materials are expected based on the disruption of utility services to the PUREX Plant. Loss of ventilation in conjunction with other accident conditions are addressed in separate EALs (see Sections 7.1.3, 7.2.1, 7.2.2, and 7.2.4).

### 7.3.2 Adjacent Facilities

The nearest facilities to the PUREX Plant are tanks farms 241-C, 241-AN, 241-AZ, 241-AX, 241-A, 241-AW, and 241-AP, which contain radioactive or toxic materials. No potential accidents are identified at these facilities that could significantly physically damage PUREX Plant confinement structures. Radiological or toxic releases could affect PUREX Plant project personnel from a number of facilities at the 200 East and 200 West Areas (e.g., B Plant, Waste Encapsulation Storage Facility, U Plant, REDOX, 233-S, and Plutonium Finishing Plant) for which the Operational Emergency Hazardous Materials and Base Programs will provide protective actions in case of emergencies at these facilities.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations
- Audible alarms from other facilities
- Crash telephones.

### 7.3.3 Aircraft Crash

A range of possible releases could occur following an aircraft crash at the PUREX Plant. A light aircraft crash near the facility may not release any material, whereas a direct hit from a

commercial jet liner or military plane could cause extensive damage to the plant and a release of inventory.

Based on the consequences from the quantitative analyses in Section 6.0, and on the general classification criteria provided in Section 5.0, it is recommended that any aircraft accident at the PUREX Plant that results in structural damage to any of the areas containing significant quantities of hazardous materials (reference Section 4.0) be classified as a SITE AREA Emergency. The suggested EAL for this scenario is provided in Table 7-8.

**Table 7-8. External Events – Aircraft Crash.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Aircraft crash | An aircraft crash causes a release of inventory from any of the following areas at the PUREX Plant:<br>• Any canyon process cell<br>• White room<br>• N cell<br>• PR room<br>• Deep-bed filters<br>AND<br>The release is NOT exhausted out the exhaust stack. | SITE AREA EMERGENCY |

NOTE: No GENERAL Emergency class defined. If an aircraft crash initiates another emergency condition, see the appropriate emergency condition table.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations AND
- Confirmed structural damage to facility confinement.

## 7.4 SAFEGUARDS AND SECURITY

Malevolent acts involving explosive devices, sabotage, and hostage/armed intruder situations could result in degradation of facility safety or loss of control over hazardous materials that would warrant the declaration of an event classification.

### 7.4.1 Bomb Threat/Explosive Device/Explosion

A credible bomb threat indicating that there is an explosive device in the PUREX Plant, or a discovery of an explosive device within the facility, should be classified as an ALERT. An

explosion within the PUREX Plant would be classified as an ALERT based on the probability that confinement structures may have been damaged. A confirmed explosion in any of the areas containing hazardous materials (Section 4.0) may be upgraded to a SITE AREA Emergency due to the release of a substantial quantity of inventory.

The suggested EALs are presented in Table 7-9.

**Table 7-9. Safeguards and Security – Bomb Threat/Explosive Device/Explosion.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Bomb threat/explosive device[1] | A credible bomb threat indicating that an explosive device is located in the PUREX Plant<br>OR<br>An explosive device is confirmed to be in the PUREX Plant. | ALERT |
| Explosion within PUREX Facility | An explosion occurs within the PUREX Plant. | ALERT EMERGENCY |
| Explosion within 202-A Building or ventilation system | An explosion occurs within any of the following locations of the PUREX Plant:<br>• Any canyon process cell<br>• White room<br>• N cell<br>• PR room<br>• Deep-bed filters<br>AND<br>results in a release of inventory that is not filtered. | SITE AREA EMERGENCY |

Notes:
[1] The presence of an explosive device is an extreme hazard to the safety of personnel and the facility. Activation of the emergency response organization will assist in onsite evacuation and access control. Furthermore, activating the emergency response organization when the device is found will speed the response if the device detonates.
[2] No GENERAL Emergency class defined.
[3] If an explosion initiates another emergency condition, see the appropriate emergency condition table.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations,
- Communicated threats, AND
- Confirmed structural damage to facility confinement.

### 7.4.2 Sabotage

Acts of sabotage could result in the release of hazardous material to the environment. However, the amount of material at risk and the means to release and disperse the material is limited. The most serious consequences are bounded by the use of explosive devices, as discussed in Section 7.4.1. The suggested EAL for this type of event is provided in Table 7-10.

**Table 7-10. Safeguards and Security – Sabotage.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Sabotage | Confirmed physical damage to the confinement structures from sabotage, which causes an actual or potential unfiltered release of hazardous materials to the environment | SITE AREA EMERGENCY |

NOTE: No GENERAL Emergency class defined.

**Potential Event Indicators.** Indicators for this type of event include the following:

- Personnel observations AND

- Confirmed structural damage to facility confinement (which may be indicated by personnel observations or by the SAMCONS I&C monitoring system).

### 7.4.3 Hostage Situation/Armed Intruder

A confirmed hostage situation, armed intruder, credible security threat, or ongoing security compromise involving physical attack on the PUREX Plant that causes the actual or potential release of hazardous materials should be classified as an ALERT Emergency. Some examples of these types of events are as follows:

- An armed assault directed at an individual employee, at gaining access to valuable property, or at causing damage to facility property. The motivation for and objectives of such an assault may not be known until long after the fact.

- Kidnapping of a Hanford Site employee or family member or the taking of hostages undertaken to extort money, materials, or concessions from the DOE, contractor, or individual employee. The DOE, contractor, or employee may come under great pressure to meet the perpetrator's demands, some of which may have safety, health, or environmental implications.

The suggested EAL for this type of event is provided in Table 7-11.

**Table 7-11. Security Contingency – Hostage Situation/Armed Intruder.**

| Initiating Event | Emergency Action Level | Event Classification |
|---|---|---|
| Hostage situation/armed intruder(s) | Confirmed hostage situation or armed intruder(s) at the facility. | ALERT |

NOTE: No SITE AREA or GENERAL Emergency class defined.

**Potential Event Indicators.** Indicators for these types of events include personnel observations.

# 8.0 EMERGENCY PLANNING ZONE DETERMINATION

The emergency planning zone (EPZ) is an area within which special planning and preparedness efforts are warranted to mitigate the consequences of a severe accident. DOE orders endorse the EPZ concept and require that the choice of an EPZ for each facility be based on objective analyses of the hazards associated with the facility. Guidance provided in DOE G 151.1, Volume II (DOE 1997), recommends developing a composite EPZ for a group of facilities located in close proximity to one another.

Using the results of facility hazards assessments and the method outlined in DOE G 151.1, a composite EPZ for the 200 East and West Area facilities has previously been established and documented in the Hanford Site Emergency Plan. This EPZ is a 16-km (10-mi) radius centered at the 200 East and West Areas. The EPZ and its bases were reviewed against the results of this hazard assessment. It is concluded that the existing EPZ is still adequate and that no changes to the EPZ are warranted on the basis of this hazards assessment.

**Table 8-1. Radiological Consequences of REDOX Facility Events at Various Distances.**

| Section No. Scenario/Release | Wind Speed | Dose (rem – TEDE) at distance in miles | | | Distance to: | |
|---|---|---|---|---|---|---|
| | | Facility Boundary (0.06 mi) | Near Side of Columbia River (6.8 mi) | Site Boundary (9.5 mi) | 100 rem | 1 rem |
| 6.2.1 Loss of filtration during exhaust fan operation | "F" 1 m/sec | 0 | 6.00E-03 | 5.00E-03 | <0.06 | <0.06 |
| | "D" 4.5 m/sec | 0 | <1.00E-03 | <1.00E-03 | <0.06 | <0.06 |
| 6.2.2 Loss of exhaust fan | "F" 1 m/sec | 2.9E-02 | <1.00E-03 | <1.00E-03 | <0.06 | <0.06 |
| | "D" 4.5 m/sec | 1.7E-02 | <1.00E-04 | <1.00E-04 | <0.06 | <0.06 |
| 6.2.3 Earthquake | "F" 1 m/sec | 29 | 2.10E-02 | 1.50E-02 | <0.06 | 0.50 |
| | "D" 4.5 m/sec | 1.5 | <1.00E-03 | <1.00E-03 | <0.06 | 0.08 |

# 9.0 MAINTENANCE AND REVIEW OF THIS HAZARDS ASSESSMENT

The *Hanford Emergency Management Plan*, Section 4.0 (DOE-RL 1999), requires that hazards assessments be reviewed annually and maintained current.

# 10.0 REFERENCES

10 CFR 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," *Code of Federal Regulations* as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

40 CFR 68, "Chemical Accident Prevention Program," *Code of Federal Regulations*, as amended.

40 CFR 302, "Designation, Reportable Quantities, and Notification," *Code of Federal Regulations*, as amended.

40 CFR 355, "Emergency Planning and Notification," *Code of Federal Regulations*, as amended.

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