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7. Abstract

This document establishes the technical basis in support of Emergency Planning activities for the PUREX Facility on the Hanford Site. The document represents an acceptable interpretation of the implementing guidance document for DOE ORDER 5500.3A. Through this document, the technical basis for the development of facility specific Emergency Action Levels and the Emergency Planning Zone is demonstrated.

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PLUTONIUM URANIUM EXTRACTION PLANT

HAZARDS ASSESSMENT

L. N. Sutton

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1.0 INTRODUCTION

This report documents the hazards assessment for the Plutonium Uranium Extraction Plant (PUREX) located on the U.S. Department of Energy (DOE) Hanford Site. Operation of PUREX is the responsibility of Westinghouse Hanford Company (WHC). This hazards assessment was conducted to provide the emergency planning technical basis for PUREX. DOE Order 5500.3A requires an emergency planning hazards assessment for each facility that has the potential to reach or exceed the lowest level emergency classification.

2.0 BUILDING DESCRIPTION

Detailed descriptions of the 200 East Area of the Hanford Site and the PUREX facility complex are found in sections 3 and 5, respectively, of the PUREX Facility Safety Analysis Report (FSAR), SD-HS-SAR-001 Rev 1 through 5, and Engineering Change Notices (ECN) 105276, 105403, 105401, 134976L and 135976L. Additional information was obtained from the "PUREX Standby Preliminary Hazards Analysis", WHC-SD-CP-PHA-001, dated June 1991 and the "PUREX/UO3 Deactivation Project Management Plan," WHC-SP-1011D (Draft). The following brief summary is derived from these descriptions.

2.1 Facility Mission

In October of 1990, WHC was directed to place PUREX in standby. In December of 1992 the DOE Assistant Secretary for Environmental Restoration and Waste Management authorized the termination of PUREX and directed DOE-RL to proceed with shutdown planning and terminal clean out activities. Prior to this action, its mission was to reprocess irradiated fuels for the recovery of uranium and plutonium. The program to design and construct the PUREX Plant (202-A building) and the associated support facilities was initiated in 1952 by the U.S. Atomic Energy Commission (now DOE). The PUREX process, developed at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, was used as an improvement over the REDOX process. The PUREX Plant was one of the mainstays in the United States' nuclear fuel separations program, processing irradiated production reactor fuels for the recovery of uranium and weapons- or fuels-grade plutonium. From the first operation in 1956 to shutdown in September 1972 and from its restart in 1983 to being placed in standby in 1990, refinements were made in the Plant to upgrade Safety and Process equipment, achieve process versatility, and adapt to changing feed material.

A complete description of the PUREX process, flow diagrams, chemical reactions and internal arrangement of the building is contained in the PUREX Technical Manual, WHC-SP-0479.

The present mission is to establish a passively safe and environmentally secure configuration at the PUREX facility and to preserve that condition for 10 years. The ten year time frame represents the typical duration expended to define, authorize and initiate follow-on decommissioning and decontamination activities.

2.2 Location

The DOE Hanford Site lies at 117.5° west longitude and 47.5° north latitude within the Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 2-1). The Hanford Site occupies an area of 1,476 km^2 north of the confluence of the Snake and Yakima Rivers with the Columbia River (Figure 2-2). The PUREX facility is a fenced .81 km^2 area located in the southeast quadrant of the 200 East Area near the center of the DOE'S Hanford site. The 200 East Area is a controlled area of approximately 8.4 km^2 located on a plateau at an elevation ranging from approximately 190 to 245 meters above mean sea level near the middle of the Hanford Site. The nearest site boundary to PUREX is 16.9 km east however, the size of the Hanford Site will be reduced in 1994. The new boundary will likely be the Columbia River on the north and highway 240 on the south. The Columbia River is 11.2 km to the north and highway 240 is 8 km to the southwest. Figure 2-3 shows the layout of the 200 East Area, the designations of the various facilities, and the location of PUREX. Land uses within the 200 East Area consist of fuel reprocessing and waste processing and disposal activities.

In addition to PUREX, 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 300 Area which contains a shutdown fuel fabrication facility and laboratory facilities supporting all of DOE's Hanford Programs; two areas for waste processing and waste storage designated 200 East and 200 West Areas; a commercial nuclear waste burial operation on land leased to the State of Washington; the Fast Flux Test Facility (FFTF); and an operating Washington Public Power Supply System nuclear power plant.

Major metropolitan areas within the broad vicinity of the site (see Figure 2-1) include Spokane, Washington, about 193 air kilometers to the northeast; Seattle, Washington, about 209 air kilometers to the northwest; and Portland, Oregon, about 241 air kilometers to the southwest. Two other areas of significant population density include Moses Lake, Washington, about 48.3 kilometers north of the K-area and the Yakima Valley, in Washington, extending from Yakima, about 72.4 kilometers west of the plant, to the Tri-Cities, in Washington, about 56.3 kilometers southeast of the plant.

2.2.1 Local Meteorology

Continuous observation and recording of meteorological data has been carried out at the Hanford Meteorological Station (HMS), located near the 200 West Area, since 1945. Climatological conditions on the 200 Area plateau are significantly different from those on the south end of the 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, the hottest month of the year, is 33.2 °C; the average minimum is 16.1 °C. During January, the coldest month, the average maximum is 2.6 °C, and the average minimum is -5.6 °C. The daily temperature range is about 8.2 °C in January and 17.1 °C in July.

The average annual precipitation for the Hanford Site is about 16 cm. Most of the precipitation occurs during the winter season with nearly half of the annual amount occurring in the months of November through February. Snowfall accounts for about 38% of all precipitation during the months of 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 lowest during the winter months, averaging 10 to 11 km/h, and highest during the summer, averaging 14 to 16 km/h.

2.2.2 Floods

Based on a study of Probable Maximum Floods (PMF) by the U.S. Army Corps of Engineers, it was determined that the 200 East Area was well above dangerous flood levels. The PMF river flow for locations on the Columbia River within the Hanford Site is 4.1×10^4 m^3/s. This would produce a water surface elevation of about 119 meters above mean sea level. Since 200 East Area elevation is 192 meters to 244 meters above mean sea level, it is safely above PMF levels.

2.2.3 Seismology

The Hanford Site is in a region of low to moderate seismicity. The historic 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 probably incomplete because the region was sparsely populated. Seismograph networks did not start providing earthquake locations and magnitudes of earthquakes in the Pacific Northwest until about 1960.

Figure 2-1 Location of the Hanford Site in the State of Washington

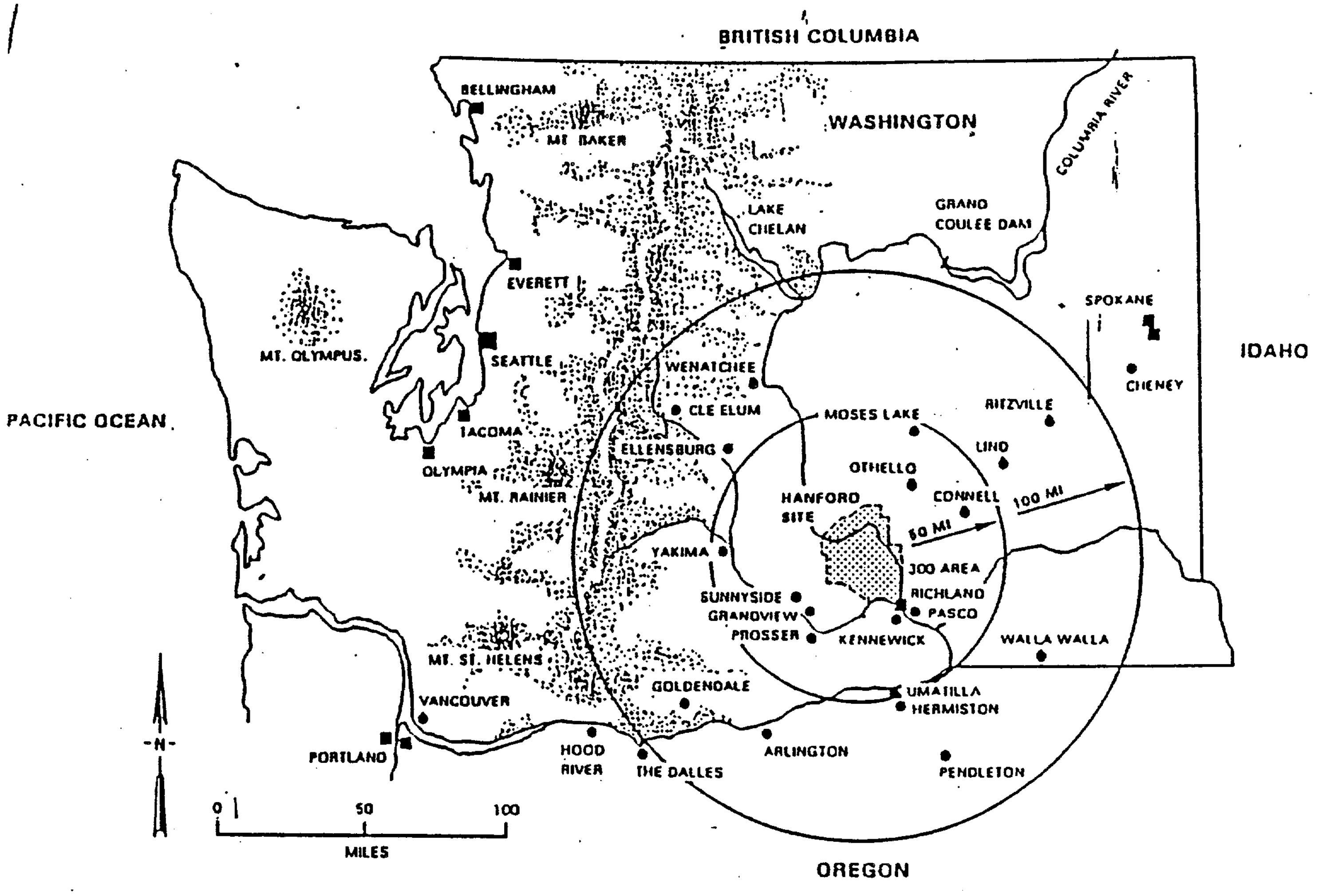


Figure 2-2 Hanford Site

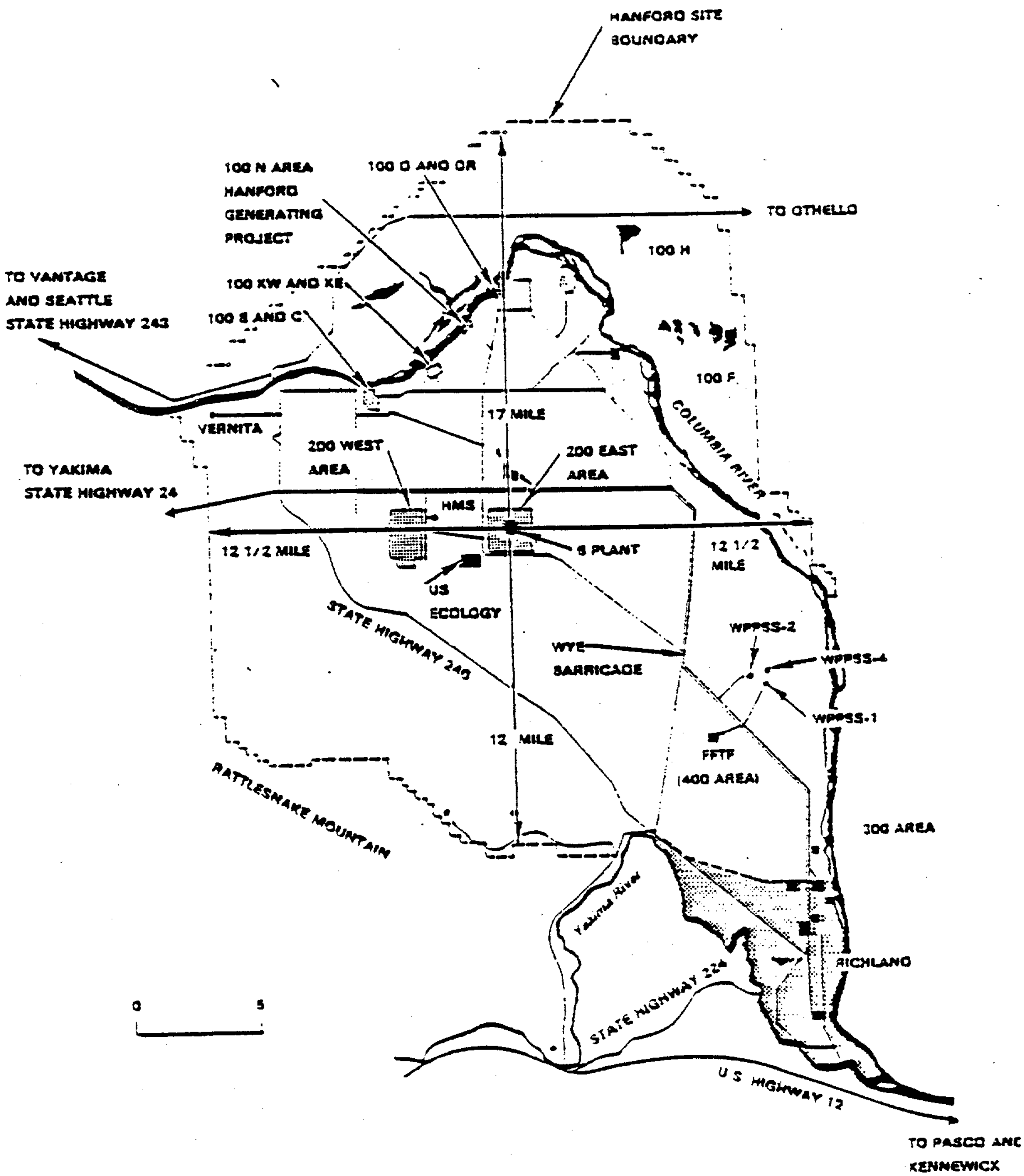
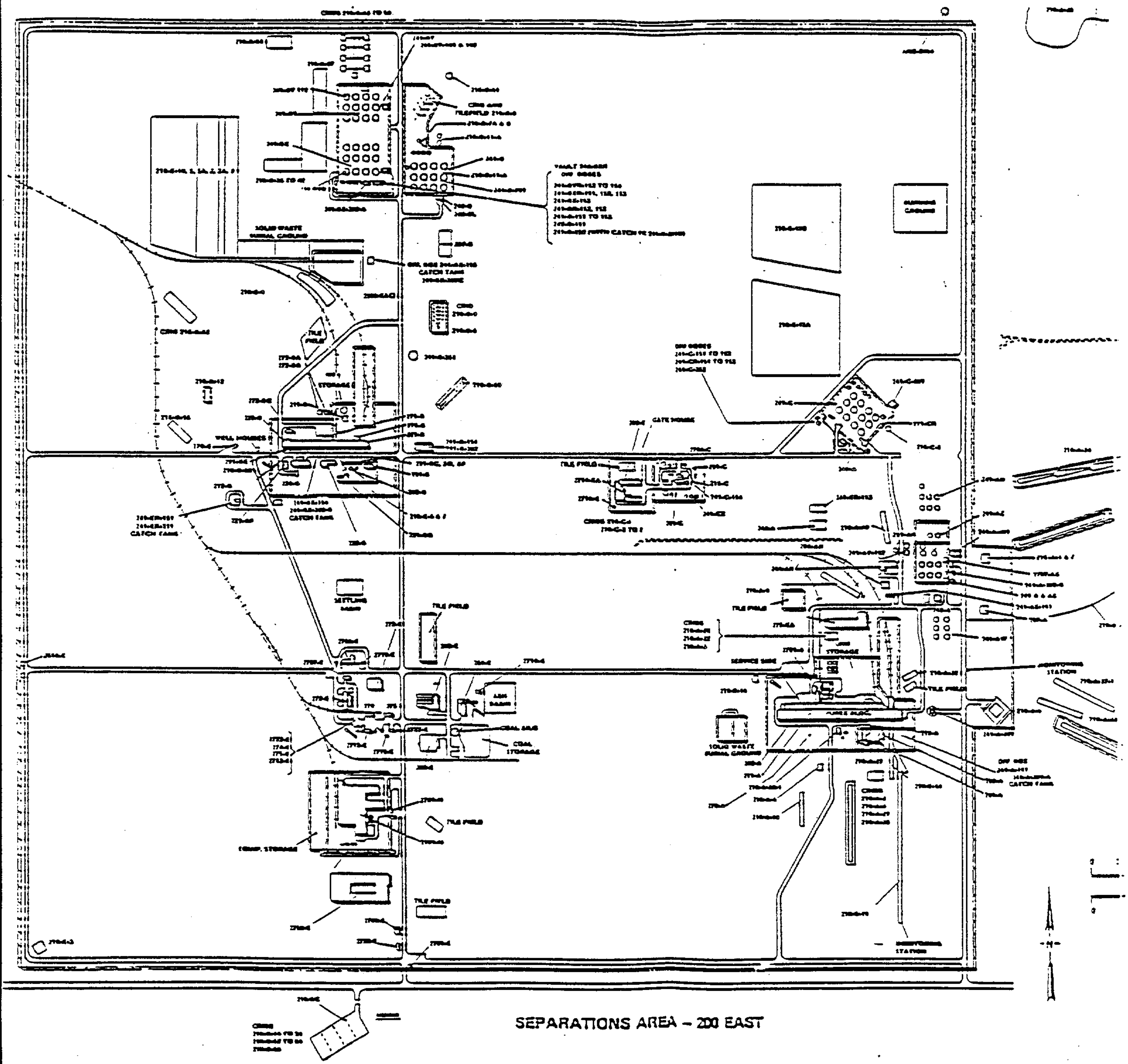


Figure 2-3 Hanford Site 200 East Area



Large earthquakes (magnitude greater than Richter 7) in the Pacific Northwest have occurred in the vicinity of 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 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 per area and the historical magnitude of these events, is relatively low when compared to other regions of the Pacific northwest, the Puget Sound area, and western Montana/eastern Idaho.

In the central portion of the Columbia Plateau, the largest earthquakes near the Hanford Site are two earthquakes that occurred in 1918 and 1973. These two events had magnitudes of 4.4 and intensity V and were located north of the Hanford Site.

2.2.4 Wind and Tornado

The Site is subject to frequent strong westerly winds. The all-time peak wind recorded at the Hanford Meteorology Station tower in the 200 East area at the 15-m level was a gust of 36.2 m/sec recorded January 11, 1972. The 35.8 m/sec gust is expected to occur once every 30 years. A peak of 38 m/sec would be expected to occur once every 100 years.

The average occurrence of thunderstorms is 10/year. They are most frequent during the summer but thunderstorms have occurred in each month of the year. Only 1.9% of all thunderstorms observed at the HMS have been classified as "severe" based upon the National Weather Service criteria of wind gusts of 93 km/h or greater.

The entire State of Washington averages less than one tornado per year. Those that do occur are less severe than those affecting the Great Plains and Gulf State areas. The estimated probability of a tornado striking a point at Hanford is 9.6×10^{-6}/year. The HMS climatological summary and the National Severe Storms Forecast Center list 22 tornado occurrences within 161 kilometers (100 miles) of the Hanford Site from 1916 through August 1982; none of the tornadoes have resulted in major damage to property or loss of life. Within an 80-kilometers (50 miles) radius of the Hanford Site, only five small tornados have been recorded between 1950 and 1970.

2.2.5 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 about 161 kilometers away, Mt. Rainier at about 177 kilometers away, and Mt. St. Helens approximately 209 kilometers away.

Important historical ashfalls affecting this location were from eruptions of Glacier Peak about 10,000 BC, Mt. Mazama about 4000 BC, and Mt. St. Helens about 6000 BC. The most recent ashfall resulted from the May 18, 1980 eruption of Mt. St. Helens.

2.3 Facility Description

The PUREX complex is comprised of the main canyon building and a number of auxiliary structures and facilities, including waste disposal sites and contaminated equipment burial tunnels. In addition, other facilities such as tank farms, cribs, retention basins, etc are in place to support the PUREX facility. The complex consists of the 202-A building and a number of support buildings and these are described in detail in section 1 of the PUREX FSAR. The major portions of the building and support facilities are described below.

2.3.1 202-A Canyon Building

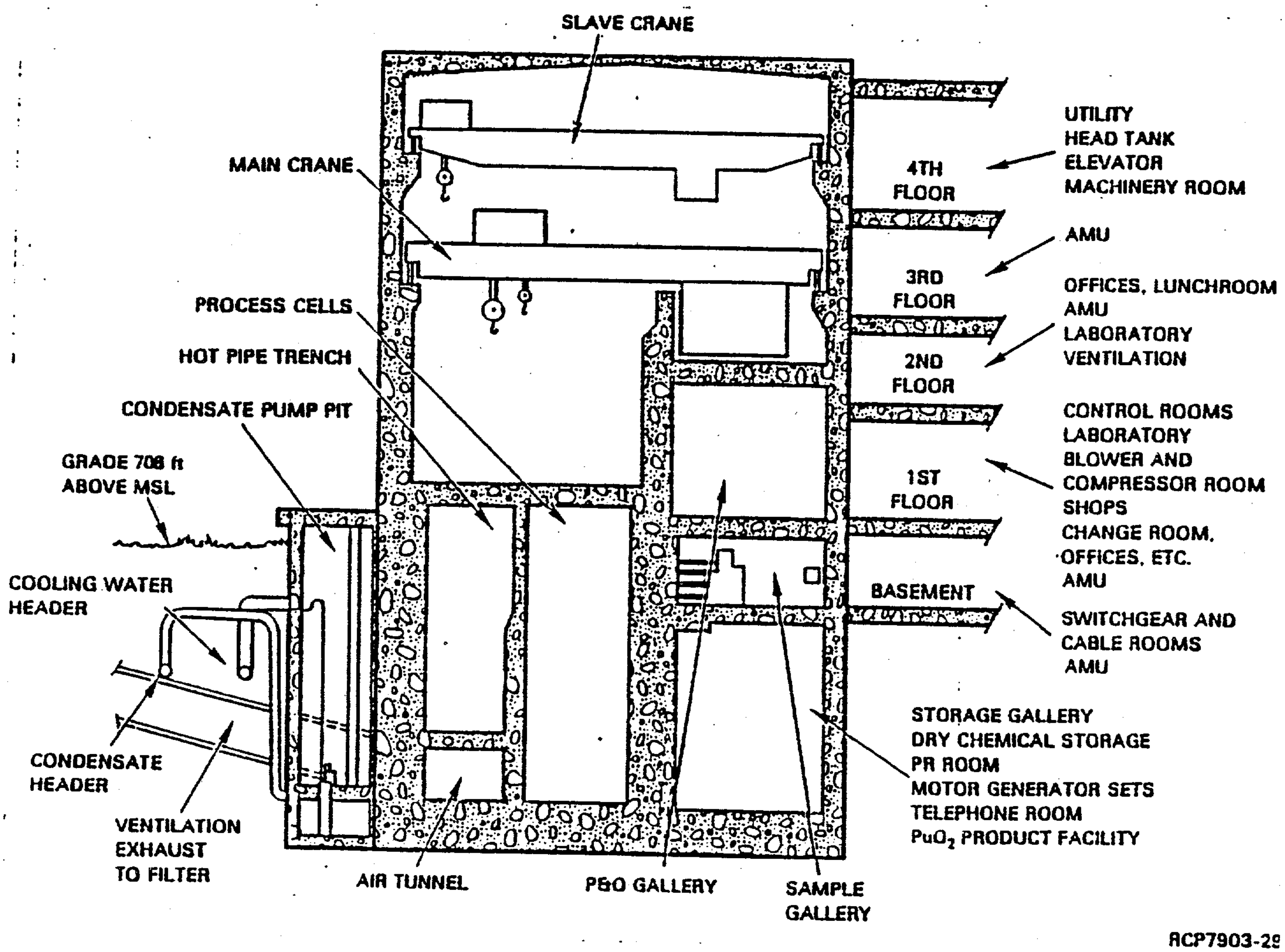
The 202-A canyon building consists of three main structural components: (1) a thick-walled, heavily shielded concrete portion called the canyon which contains processing equipment; (2) a section comprised of three gallery levels parallel to and isolated from the canyon; and (3) a steel and transite annex to the north of the gallery section which houses offices, the laboratory, and a number of building service areas. Crane maintenance platforms provide personnel access to the east and west ends of the canyon. The canyon building is a narrow structure 306 meters in length, 9.14 meters in width, and 31.7 meters high, with about 12.2 meters of this height 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, (see Figure 2-2). A tunnel is provided on the north side of the building for the entrance and exit of rail cars for the delivery of fuel and removal of failed canyon equipment. This rail entrance is accessed by a roll up door which is used 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 for equipment and dry chemicals, (see Figure 2-4 for gallery locations).

The Pipe and Operating (P&O) gallery contains instrument transmitter racks, electrical motor control, steam and cooling water supply lines and the piping and associated valves for transferring nonradioactive solutions for in-cell use.

The sample gallery contains the remote samplers for obtaining 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.

Figure 2-4 Cross Section of PUREX Facility



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 removal (PR) room, and the plutonium oxide production facility (in N cell) and a low-level contaminated equipment maintenance shop (Hot Shop).

2.3.2 203-A Tank Farm

A pump house and concrete pad inclosed and sectioned with concrete dikes containing four 379,000 liter tanks originally used for the receipt, storage, and tank trailer loading of UNH. The UNH has been processed and now two of the tanks contain recovered nitric acid.

2.3.3 205-A Facility

A transite building housing the (deactivate) silica gel beds (formerly used for uranium product treatment) and a concrete tank pad enclosed by a concrete dike wherein storage tanks receive and store recovered nitric acid shipped from the UO_3 Plant in the 200 West Area.

2.3.4 206-A Facility

A concrete structure adjacent to U cell containing a vacuum fractionator and associated equipment for concentrating PUREX and UO_3 Plant recovered nitric acid.

2.3.5 211-A Facility

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. The only chemicals remaining in 211-A is the organic that was transferred from G and R cells to TK-40.

2.3.6 2714-A Building

A steel warehouse for receipt, storage, and transfer of process chemicals received in less than bulk quantities.

2.3.7 212-A Building

A steel building located on the south side of PUREX used for load-in and load-out of liquid wastes (inactive).

2.3.8 218-E-14 and -15 Tunnels

Two earth-covered tunnels extending southward from the east end of building 202-A for storage of large, grossly contaminated equipment on rail cars.

2.3.9 291-A Facilities

The canyon exhaust air filtration and discharge facilities. These facilities include two below-grade concrete filter cells, an unused, third filter cell, four parallel exhaust fans, and a 61 meter high concrete stack.

2.3.10 292-AE Building

A steel structure adjacent to the east side of the 61 m stack, housing stack monitoring, sampling, and flush equipment.

2.3.11 293-A Building

A concrete structure of two levels containing absorption towers used to remove oxides of nitrogen and residual radioiodine from dissolver offgas.

2.3.12 294-A Facility

A small steel building above grade and three filter cells below grade. It is located north of building 293-A and provides secondary filtration of dissolver off-gas.

3.0 IDENTIFICATION AND SCREENING OF HAZARDS

The hazardous radioactive material in the PUREX facility consists of residual contamination in all process cells, ventilation systems, and process piping, single pass reactor fuel, plutonium metal solutions in storage tanks and N-Reactor fuel elements in the dissolver cells. The inventory of radioactive material remaining in the PUREX facility greatly exceeds the screening values specified in 10 CFR 30.72 Schedule C (1.11 E8 MBq of ^{137}Cs, 3.33 E6 MBq of ^{90}Sr). Additionally, greater than one third of a critical mass of Plutonium exists within the facility requiring implementation of criticality prevention measures. These hazards will be characterized in section 4.

Large amounts of chemicals were used when PUREX was in operation. The chemicals were brought in by tank truck or rail car and stored primarily in the 211-A Tank farm. The facility is in the process of disposing of unneeded chemicals and many of them are already gone. Table 3-1 is a listing of chemicals remaining in the PUREX inventory. Most of the chemicals are stored in 2714A. The list does not include the nitric acid stored in the U and P tanks (approximately 1,040,000 liters). None of the chemical quantities on the list exceed threshold planning quantities found in 40 CFR 355 Appendix A, so only nitric acid will be evaluated further in section 4.

Table 3-1 Chemicals Remaining in PUREX Inventory

Product	Quantity
	Kg
Ferric Nitrate	636
Cadmium Nitrate	2,386
Ethylene Glycol	1,560
Potassium Permanganate	150
Rare Earth Nitrate	796
Soda Ash	362
Sodium Nitrate	453
Tartartic Acid	227
Water Softner	726
Calcium Hydride	45
Sulfuric Acid	419

4.0 HAZARD CHARACTERIZATION

The screening process in section 3.0 identified an extensive radionuclide inventory that exceed screening thresholds. In addition, there is a large inventory of nitric acid that greatly exceeds the threshold planning quantity.

4.1 Spent Reactor Fuel

Four buckets (779 fuel elements) of aluminum-clad single pass reactor fuel are currently stored in PUREX in the slug storage basin. The storage basin is located east of the railroad tunnel at the canyon level. The basin is 6.1 m wide, 9.14 m long and 8.23 m deep, open to the canyon and contains 3.66 m of water. The fuel contains 2.8 metric tons of depleted uranium, and 8.7 kilograms of plutonium. The fuel is contained within 379,000 liters of radioactively contaminated water. Sample results indicate that the water has 1.48 MBq/l of beta emitters and 1.52 kBq/l of alpha emitters. Current plans call for the return of the fuel to the 100KE storage basin.

Approximately 36 N Reactor fuel elements remain in dissolver cells A, B and C. They were inadvertently spilled during dissolver charging operations. Records indicate that they contain a total of 240 kg of .95% enriched uranium and 17.3 kg of depleted uranium. Remote video inspection showed that the condition of the fuel ranges from very little damage to obvious cladding failure. Plans are to use the canyon crane to remove dissolver equipment, remove the fuel elements with a specially designed tool and place them in a cask car for shipment to 100K.

4.2 PUREX Burial Tunnels

The PUREX Burial Tunnels known as 218-E-14 and 218-E-15 are used for the storage of failed process equipment from the PUREX facility. The equipment stored there is contaminated with large quantities of alpha and beta/gamma emitting radionuclides. The equipment has been stored for a number of years to allow the radioactive material to decay to a level that the equipment could be cleaned and repaired for reuse. The primary reason for storage was that the equipment was a very costly, major piece of process equipment. The contamination levels on and in this equipment were higher than allowable for transport to other portions of the PUREX building for decontamination or to the T-Plant decontamination facility for decontamination and repair. Little qualitative data exists to determine or estimate the radionuclide quantity of the failed equipment stored in the tunnels.

4.3 PUREX Cells and Process Vessels

The three dissolvers currently contain pieces of zirconium hulls from past decladding operations. They are immersed in water and probably oxidized, however, a strong caustic soak was used to further passivate these heels to prevent pyrophoric ignition.

Tanks D5 and E6 contain about 22,700 L of rework quality metal solution. The solution contains about 5.3 metric tons of uranium and 9 kg of plutonium in a 1 molar nitric acid matrix. PUREX is in the process of diluting the material with flush solutions in tank F18 and sending it to the tank farms as waste.

The canyon walls, floors and vessels are contaminated with residual radioactive materials. Prior to flushing the external surfaces, existing water solutions in the canyon vessels will be transferred to the tank farms and the residual heels will be sampled to determine additional flushing requirements. Final heels in the vessels will be at the lowest level possible, generally between 76 and 379 L. All solutions will be transferred to the tank farms using existing routes.

Large amounts of residual contamination remain in the Product Removal (PR) room, N-Cell and Q-Cell. Initial clean up has already been performed. Estimates for plutonium remaining in N-Cell range up to 10 kg with a "most likely" value of 3 kg. Some areas in Q-Cell are grossly contaminated with neptunium and lesser amounts of protactinium (neptunium decay product). Cell deactivation will proceed in two phases. First, small items will be bagged out and removed as TRU waste. Larger items will then be removed and reduced in size if possible and removed as TRU waste. In some instances, the large items may be decontaminated as much as practical, a fixative will be applied and the item will remain in the plant.

4.4 Gaseous Effluent Streams

The PUREX facility is served by a number of gaseous effluent exhaust stacks. Some are of concrete construction, some are of steel construction and some are simple wall mounted exhausters for the purposes of air exchange for heating and cooling. Table 4-1 describes the source of the effluent exhausted, the number identified for the stack in question, the average flow through the particular stack, and the type of filtration associated with that stack. Deactivating the PUREX facility reduces the potential for release of radioactive and non-radioactive particulate material. Eventually, the exhaust streams will be reconfigured such that all gaseous effluent will be routed through the main stack. Gaseous discharges are still necessary from the PUREX facility to maintain contamination control of many process areas within the facility.

4.5 Recovered Nitric Acid

Tanks U1 and U2 are located in the PUREX U-Cell. Tanks U1 and U2 are 3.2 m X 4.9 m X 4.3 m, and each has a volume of approximately 56,800 liters. The tanks were used during processing operations to store recovered acid. The storage tanks contain 50% nitric acid recovered from PUREX and UO_3 processing. The acid is slightly contaminated with radionuclides and is scheduled to be shipped to BNFL in Great Britain.

Tanks P2, P3, P4, P13 and P14, located in 203-A, also contain recovered nitric acid. Tanks P2 and P3 contain 280,000 liters and 312,000 liters respectively. The acid is scheduled to be shipped to Great Britain. The acid in tanks P13 and P14, about 40,900 liters total, is tentatively scheduled to go to Great Britain depending on favorable sample results. The 314,000 liters of acid in P4 will be neutralized and sent to the Tank Farms.

Properties

Nitric acid is a transparent, colorless or yellowish, fuming, suffocating caustic, and corrosive liquid. Nitric acid is classified by the Department of Transportation as a Corrosive Material, and labeled as a Corrosive Oxidizer. Nitric Acid is corrosive to the eyes, skin, mucous membranes and teeth. It causes upper respiratory irritation which may seem to clear up only to return in a few hours and more severely. Depending on the environmental factors the vapor will consist of a mixture of the various oxides of nitrogen and nitric acid. Nitric is flammable by chemical reaction with reducing agents. It is also a powerful oxidizing agent. Nitric ignites on contact with acetone; alcohols + disulfuric acids; alcohols + potassium permanganate; ammonia and potassium permanganate, as well as numerous other chemicals. Nitric forms explosive mixtures with acetic acid and other chemicals. It will react with water or steam to produce heat and toxic and corrosive fumes. To fight a nitric fire, use water. When heated to decomposition it emits highly toxic fumes of NO_x and hydrogen nitrate.

Table 4-1 PUREX Gaseous Effluent Release Points

SYSTEM/SOURCE	STACK	Average Flow Rate (m_3/sec)	FILTRATION TYPE
Canyon Exhaust	291-A-1	56.6	#1 and #2 deep bed fiberglass prefilters and 2 stages of HEPA filters downstream
NH_3 Offgas System	296-A-24	0.47	2 Stages HEPA (shut down)
Burial Tunnel # 2	296-A-10	2.36	1 Stage HEPA
PR Room Exhaust	296-A-1	2.36	2 Stage HEPA
East Sample Gallery Hood	296-A-3	1.46	1 Stage HEPA
West Sample Gallery Hood	296-A-2	1.75	1 Stage HEPA
East Sample Gallery	296-A-6	5.9	1 Stage HEPA
West Sample Gallery	296-A-7	8.26	1 Stage HEPA
White Room Exhaust	296-A-8	5.66	1 Stage HEPA
East Laboratory Exhaust	296-A-5A	6.61	1 Stage HEPA
West Laboratory Exhaust	296-A-5B	7.08	1 Stage HEPA
293-A Building	296-A-14	2.36	1 Stage HEPA

Table 4-2 Physical Properties of concentrated (100%) Nitric Acid

Molecular Weight	=	63.02
Specific Gravity	=	1.50 @ $25_{o}C/4^{\circ}C$
Melting Point	=	$-42^{\circ}C$
Boiling Point	=	$86^{\circ}C$
Vapor Pressure	=	48 mm Hg
1 ppm = 2.62 mg/m^3		

Table 4-3 Exposure Limits for Nitric Acid

OSHA PEL:TWA	2 ppm
STEL	4 ppm
ACGIH TLV:TWA	2 ppm
NIOSH REL:TWA	2 ppm
IDLH	100 ppm
ERPG-1	2 ppm
ERPG-2	15 ppm
ERPG-3	30 ppm

5.0 SCENARIO DEVELOPMENT

5.1 Facility Emergency Events

5.1.1 Spent Fuel Accidents

5.1.1.1 Failure of Primary Barrier and Range of Possible Releases

The primary barriers for the fuel during storage are the facility and the facility's ventilation system. The primary barrier during transportation is the cask car. The accident postulated for the spent fuel involves a transportation accident. Any accidents occurring within the PUREX facility would be mitigated by the building filtration system. The accident assumes a failure of the transfer cask with the resulting exposure of the fuel to the environment.

5.1.1.2 Effects of Other Barriers

Administrative controls placed on the transportation activity will minimize any potential for an accident.

5.1.2 PUREX Storage Tunnel Seismic Event

5.1.2.1 Failure of Primary Barrier and Range of Possible Releases

An earthquake is postulated which collapses the tunnels and resuspends the "loose" contamination on the failed stored equipment.

5.1.2.2 Effects of Other Barriers

There are no additional barriers to the release.

5.1.3 PUREX Cells and Vessels

5.1.3.1 Failure of Primary Barrier and Range of Possible Releases

All activities related to clean out take place within the confines of the PUREX facility. The piping and process vessels represent the primary barrier to releases. In the event of their failure, radioactive solutions would be released into the 202A building.

5.1.3.2 Effects of Other Barriers

Any postulated releases from accidents would be mitigated by the filtration system.

5.1.4 PUREX Ventilation System Main Stack Release

5.1.4.1 Failure of Primary Barrier and Range of Possible Releases

Listed below are potential release scenarios for the filters.

- Pressure differential across the filter compartment breaches the HEPA filter media
- Seismic event fails the outlet seals while leaving the ventilation flow intact
- Seismic event fails the filter housing structure
- Ventilation upset, fire, tornado, explosion, or gross failure of a number of filters results in increased turbulence within filters.

A filter release consequence evaluation is included in section 6 below to characterize the hazard from this potential source.

5.1.4.2 Effects of Other Barriers

The PUREX main ventilation system consists of ten parallel filter banks that can be isolated as necessary. In the event that a bank fails, it can be isolated thus stopping the release.

5.1.5 Nitric Acid Releases

5.1.5.1 Failure of Primary Barrier and Range of Possible Releases

The primary barrier for the acid is the storage tanks. Listed below are potential release scenarios for the acid.

- Seismic event fails the tanks and the acid is confined within the bermed area
- Seismic event fails the tanks and the berm with the acid flowing into the depression near 275-EA
- Spray leak during ISO container filling assuming 170 L/hr for 30 minutes
- ISO container failure.

5.1.5.2 Effects of Other Barriers

The storage tanks are surrounded by a berm. This berm will minimize the surface area of a spill. In addition, procedural controls for ISO container loadout will minimize the potential for the spray leak.

5.1.6 Facility Fire or Explosion

This scenario postulates a fire or explosion external to the facility that has the potential to involve hazardous materials.

5.1.7 Loss of Service Systems

This scenario postulates the loss of service systems (utilities) due to some upset condition.

5.1.8 Loss of Confinement

The worst case loss of confinement accidents are addressed in the nitric acid release and ventilation system failure scenarios above.

5.2 Natural Emergencies

Seismic events, high winds/tornados, floods, ash/snow roof loading and range fires are natural phenomena with potential emergency consequences. Guidance for classifying these events is provided in Section 6 below based on the results of the scenarios described above and the general Hanford policy on events of this type.

5.2.1 Earthquake

The Hanford Site is located in the Columbia Basin, an area of low seismicity in which moderate-level earthquakes have occurred. The July 15 1936, Milton-Freewater Modified Mercalli (MM) VII event occurred within the Columbia Basin and cannot be definitely associated with a causative fault; therefore, a similar event is conservatively assumed to have potential to recur anywhere in the Columbia Basin. This assumption is made even though historical data indicate that no events larger than MM V or VI have occurred in the center of the basin in the vicinity of the PUREX Plant. In the absence of definitive evidence, the Rattlesnake-Wallula Lineament is assumed to be an active fault. To allow for additional conservatism, the current practice of the U. S. Nuclear Regulatory Commission (NRC) is used. That is, this lineament is assumed to have the potential to generate an earthquake of MM VIII, which is one intensity unit higher than may have occurred or could conceivably occur. An MM VII intensity corresponds to a zero-period, free-field horizontal ground acceleration of 0.25 g, which has been designated the safe shutdown earthquake (SSE) and is used as a design criterion for new, nonreactor nuclear facilities. The Hanford Region Historical Earthquake (HRHE) is postulated as the largest historical earthquake known to have occurred within the Columbia Basin Plateau on the Rattlesnake-Wallula Fault at its nearest point to the Hanford Site.

5.2.2 High Winds/Tornado

The Hanford Site is subject to frequent strong westerly winds. The all-time peak gust of 35.8 m/sec was recorded January 11, 1972. The 35.8 m/sec gust is expected to occur once every 30 years. A peak gust of 42.9 m/sec would be expected to occur once every 500 years.

The Site is well outside of established tornado alleys. The probability of a tornado in any year at any point within the 161 km radius of the Hanford Meteorology Station is 6.8 E-6/yr. The Hanford design base tornado is defined as having a 67.1 m/sec rotational velocity and a 11.2 m/sec translational speed.

5.2.3 Flood

The Probable Maximum Flood (PMF), calculated by the Corps of Engineers, is based on the concurrence of the worst of several natural phenomena, including a record snowfall in the Columbia River watershed, no melting of this snow until late spring, then warm, heavy rain. This hypothetical flood would have a flow of 40,800 cubic meters per second and is estimated to be well below the level of the PUREX.

5.2.4 Range Fire

The Hanford Site is in a semiarid region with sagebrush and grasses growing between areas. Range fires periodically occur and can sweep over large regions before they are controlled. The summer months are historically the most likely time for a large fire to occur because of the combustible condition of the natural grasses. This event postulates that a range fire has entered the 200 East area and threatens the PUREX facility. Barriers to the event include the availability of the Hanford Fire Department as well as requirements to keep the area around PUREX free from plants and grasses.

5.2.5 Snow and Ashfall

The Hanford Site is in a region subject to snowfall as well as ashfall from volcanic eruptions. The SAR does not hypothesize this event. The three major volcanic peaks closest to the project are: Mt. Adams about 161 km away, Mt. Rainier, and Mt. St. Helens approximately 209 km away. The maximum depth of snow accumulated was 31 cm in 1964. The roof of the PUREX Plant and auxiliary structures has been designed to withstand up to 97.7 kg/m^2, (which is comparable to 40.6 cm of snow of typical density) as required by the 1952 Uniform Building Code (which was in place at the time of construction). There has been no snow load or other roof live load damage to the PUREX structures to date.

Important historical ash falls affecting this location were from eruptions of Glacier Peak about 12,000 years ago, Mt. Mazama about 6,000 years ago, and Mt. St. Helens about 3,600 years ago. The most recent ashfall resulted from the May 18, 1980 eruption of Mt. St. Helens. The table below indicates the estimated ash depth deposited at the Hanford site from past volcanic eruptions in the region. The ash weight from the Mt Mazama event would probably have exceeded the design roof loading of most older Hanford buildings and roof failure is probable. However, the ash loading from the other eruptions would have been well below the roof loading limit. There would probably be ample warning of an approaching large ash fall and the facility could be placed in a stable condition. Therefore, a large release is not expected even if roof damage occurred.

Table 5-1 Estimated Ash Depth at 200 Area from Major Eruptions

Volcano	Time	Depth of Ash	Equivalent Roof Loading Dry (kg/m^2)*	Equivalent Roof Loading Wet (kg/m^2)
Glacier Peak	12,000 B.P.	2.54 cm	9.3	41.1
Mt Mazama	6,000 B.P.	15.2 cm	176	244
Mt. St. Helens	3,600 B.P.	2.54 cm	29.3	41.1
Mt. St. Helens	1980	1.27 cm	14.7	20.5

B.P. = Before present

As a result of the 1980 Mt. St. Helens eruption, the site design criteria was modified to include ashfall.

5.2.6 Aircraft Crash

This event is not discussed in existing safety documentation but it is postulated that an aircraft crash could occur at the PUREX facility. Release of hazardous or radioactive material is dependent upon what the nature of the crash i.e., size of aircraft, location of crash etc.

5.3 Security Emergencies

DOE Order 5500.3A specifies that the facility hazards assessment shall consider the broad range of emergency events that could affect the facility. These events may result from hostile attack, terrorism, sabotage, or malevolent acts as well as the more traditional accidents and natural phenomena. Closely related DOE order 5630.3 requires a graded assessment of radiological and toxicological sabotage vulnerability. Events of this type are not within the scope of a SAR. Specific scenarios for the various security contingencies have not been developed. Paragraphs in Section 6 reflect the general Hanford emergency preparedness policy toward events of this type based on the potential consequences.

6.0 CONSEQUENCE ASSESSMENT AND CLASSIFICATION OF EVENT SCENARIOS

6.1 Calculation Models

Consequences of the events and conditions identified in Section 4.0 were estimated using two computational models. The Emergency Prediction Information (EPI) code was used to calculate the source term and dispersion for chemical releases while the Hanford Unified Dose Utility (HUDU) program was used for radiological dose calculations and the dispersion calculation for radiological releases.

The EPI program was developed by Homan Associates, Inc. for use in hazardous material emergency planning and response. The program has five source models:

Continuous Release
Term Release
Area Continuous
Area Term
Liquid Spill

The liquid spill option calculates the source term from a pool of spilled liquid. The area continuous and area term options are also spills but the user must supply the source term. The EPI program uses both the plume and puff Gaussian dispersion models depending on the duration of the release. The program users manual documents the features of the program.

The HUDU program was developed for use in the Hanford emergency centers to provide a rapid initial assessment of radiological emergency situations. The code employs a straight-line Gaussian atmospheric dispersion model to estimate the transport of radionuclides released from an accident site. It calculates internal doses due to inhalation and external doses due to exposure to the plume. The HUDU program was used to calculate radiological consequences discussed in this hazards assessment.

6.2 Receptor Locations

Classification of an emergency depends not only on the amount released but also the distances to the facility and site boundaries and the radiation and toxic criteria for each class of emergency. The facility boundary receptor location for PUREX was selected to be 100 meters from the point of release.

The closest distance to the site boundary is 16.9 km (southwest) and was used for Hanford Site boundary calculations. The size of the Hanford Site will be reduced in 1994. The new boundaries have not been established but will probably be the Columbia River on the north and highway 240 on the south. Calculations were also performed for highway 240 as it is only 8 km distant.

6.3 Facility Emergency Events

This section describes the evaluation assumptions and consequences of the scenarios that were identified in section 4. The projected consequences from these events are used to establish the size of the emergency planning zone and to provide guidance for establishing EALs.

6.3.1 Spent Fuel Transportation

The spent fuel is solid so the radioactive material is not in a readily dispersable form. The fuel will be rinsed prior to placing it in the shipping cask so this event would not result in a significant release of respirable radioactive materials to the environment; however, due to the loss of confinement and the potential complexity of the recovery, an Alert level emergency should be declared.

6.3.2 PUREX Burial Tunnels

The scenario postulates that an earthquake occurs which collapses the two solid waste burial tunnels located on the south side of PUREX and causes the release of respirable beta and alpha particulate material to the environs. The release was calculated as an acute ground level release. An analysis, based on air sample results, (Siemer 1991) estimated that a total of 550 kBq of alpha emitters (assumed to be ^{239}Pu) and 30.3 MBq of beta emitters (assumed to be ^{90}Sr) is released from each tunnel during a seismic event. These amounts were doubled to account for the collapse of both tunnels and modelled using HUDU with a wind speed of 1 m/sec and a stability class of F.

Radiation Dose

Onsite dose @ 100 Meters (EDE)	=	970 μSv
Highway 240 dose @ 8 Km (EDE)	=	<1 μSv
Columbia River dose @ 11.2 Km	=	<1 μSv
Offsite dose @ 16.9 Km (EDE)	=	<1 μSv

The consequences of this scenario are borderline for the Alert emergency declaration. Based on the consequences coupled with the facility condition, a total collapse of the burial tunnels with exposed contaminated equipment should be classified as an Alert level emergency.

6.3.3 PUREX Cells and Vessels

Any releases from piping and vessels in the facility would be filtered by the ventilation system. There would be no on site or off site consequences resulting from releases internal to the facility.

6.3.4 Main Stack Release

The following assumptions apply to the stack release:

- the stack is 61 meters tall
- the stack radius is 1 meter
- the stack flowrate is 56 m^3/sec
- stability class is A for on site consequence calculations and F for off site consequence calculations
- wind speed is 5 m/sec for on site consequence calculations and 1 m/sec for off site consequence calculations

The PUREX main stack is known to contain thoron (^{220}Rn) and its daughter products (^{212}Pb, ^{212}Bi, ^{212}Po, ^{208}Tl). Air samples can be expected to contain between 1.85 Bq/ml and 37 Bq/ml of total alpha activity due to thoron daughters alone.

PUREX procedures require personnel to take actions to terminate releases associated with effluent exhaust stacks at levels well below an Alert emergency classification. An Alert level release would result in an off scale reading on the stack monitoring instrumentation. Therefore, the fact that an alarm has occurred is not sufficient information to declare an emergency. There must be a process/building upset condition e.g., suspected filter failure, associated with the stack alarm to consider declaration of an emergency event. A preliminary investigation should be conducted to determine the validity of the alarm. If possible, (calculations show that it may not be possible to retrieve a filter paper after an alert level quantity of mixed fission products has exited the stack) the sample filter should be surveyed using portable instruments. A valid alarm coupled with indications of a possible filter failure should be declared an Alert emergency. Escalation to higher emergency levels should be based on interpretation of down wind survey data by the Hanford Site Emergency Response Organization.

6.3.5 Nitric Acid Spill (Recovered Acid)

The following assumptions apply to the nitric acid releases:

- the acid is a 50% solution
- acid temperature is 25°C
- partial pressure of acid is 0.39 mmHg (Perry's Handbook)
- stability class is F
- wind speed is 1 m/sec
- standard terrain

Case 1 assumes that a seismic event causes the storage tanks to rupture with the berm remaining intact. The berm area is approximately 158 m^2 which is modelled as a disk with a radius of 7.1 m.

EPI results are 2.1 ppm at 100 meters, .0012 ppm at the site boundary and .003 ppm at highway 240. This accident warrants an Alert level emergency declaration.

Case 2 makes the same assumptions as Case 1 except the berm fails and the acid flows down into the depression around 275EA. The spill area is approximately 7430 m^2 modelled as a disk with a radius of 48.6 m.

EPI results are 15 ppm at 100 meters, .055 ppm at the site boundary and .13 ppm at highway 240. This accident warrants a Site Area emergency declaration.

Case 3 is a spray leak during acid loading operations assumed to last for 30 minutes. A leak rate of 170 l/min is assumed. Specific gravity of the 50% solution is 1.3 g/ml (.65 g/ml HNO_3). A respirable particle release fraction 0.15% is also assumed. Taking these together results in a release rate of .046 g/sec HNO_3 for a total release of 82.8 grams of HNO_3.

EPI results are .39 ppm at 100 meters, 1.8E-4 ppm at the site boundary and 4.6E-4 ppm at highway 240. This accident does not warrant emergency declaration.

Case 4 is a release of 18,900 liters from an ISO container. Spill depth is assumed to be 1 cm.

EPI results are 8.3 ppm at 100 meters, .014 ppm at the site boundary and .034 ppm at highway 240. This accident warrants an Alert level emergency declaration.

Additional calculations were performed to determine the minimum spill size and approximate volumes for Alert and Site Area level emergency spills assuming a spill depth of 1 cm.

EPI calculations indicate that a spill of about 1,500 liters covering 150 m^2 should be declared and Alert and a spill of about 75,000 liters covering 7400 m^2 a Site Area Emergency. Please note that spill area is the overriding factor e.g. if 2,000 liters is spilled on a porous surface and wets an area of only 100 m^2 then Alert criteria would not be met.

6.3.6 Facility Fire or Explosion

Releases associated with fires or explosions internal to the facility i.e., in the 202A canyon building would in most cases be mitigated by the ventilation system filters. Fires or explosions external to the canyon may result in the release of radioactive or hazardous materials to the environment depending on their locations. Due to the potential degradation in safety, uncontrolled fires or an explosion in the PUREX compound which threaten areas or structures where hazardous or radioactive materials are stored should be classified as an Alert.

6.3.7 Loss of Service Systems

A complete loss of service systems in and of itself will not result in any releases that could result in unacceptable consequences for the onsite or offsite individuals. This event cannot require the facility to declare an emergency.

6.4 Natural Emergencies

6.4.1 Earthquake

The level of peak horizontal ground acceleration produced by the Hanford Region Historical Earthquake (HRHE) at the PUREX site has been calculated to be 0.1 g (PUREX FSAR, Rev 3). Table 6-1 summarizes the PUREX facility seismic analysis.

Table 6-1 PUREX Seismic Analyses Summary

Facility	HRHE	SSE*
202-A Building	Survives[a]	Fails[b]
East Crane Maintenance Platform	Fails	Fails
R-Cell	Survives	Survives
202-A Annex (Lab, Office Bldg, etc.)	Survives	Fails
291-A Filter Cells, Tunnels, and Plenums	Survives	Survives
291-A fans and motors	Survives	Survives
291-A Belt drives and metal ducting	Survives	Fails
291-A Stack	Survives	Fails
Utilities[c]	Fails	Fails

* Safe Shutdown Earthquake calculated to be 0.25g horizontal ground acceleration
a Structure survives event in "as-is" condition
b Structure may require upgrades to withstand event.
c Includes steam, water and electrical services. May imply loss of power to ventilation exhaust fans.

None of the postulated events have a calculated dose consequence equal to the General Emergency criteria at PUREX. The results of structural analysis as shown in Table 6-1 indicate that for the HRHE earthquake the major facility structures would remain intact. If the SSE earthquake were to occur at PUREX then those same major facilities which contain the majority of the contaminated material would fail to provide containment. This analysis indicates that an HRHE level earthquake at PUREX should be classified as an Alert Emergency and an SSE magnitude earthquake should be classified as a Site Area Emergency due to loss of facility integrity.

6.4.2 High Winds/Tornado

Some damage is expected if high winds or a tornado strike the PUREX facility but the offsite impact is not expected to be significant. The survivability varies with building. For example, a tornado may topple the 291-A stack but cause little damage to other facility stacks. The buildings have experienced two wind storms in recent years with gust to 35.8 m/sec (1972) and 32.6 m/sec (1990) with no damage.

A graded precautionary approach is recommended for high winds at the PUREX facility. An Alert emergency should be declared if sustained winds exceed 40 m/sec and damage from high winds is observed. The 40 m/sec wind speed is suggested for consistency with the EAL at other Hanford facilities.

A Site Area Emergency should be declared if a tornado strikes a portion of the PUREX facility which houses radioactive or non-radioactive hazardous materials, and causes extensive damage. Significant off site consequences are not expected with the current plant condition and hazardous material inventory.

6.4.3 Range Fire

The PUREX facility would probably not be affected by a range fire since the ground near the buildings is devoid of vegetation. Furthermore, many of the buildings are concrete and therefore not particularly susceptible to a fire initiated from outside the building. As a precaution, it is suggested that an Alert be declared if a range fire or intra 200 East area fire threatens the PUREX facility or buildings which store significant quantities of radioactive or hazardous material. The Alert emergency is based on the potential degradation of safety at the facility.

6.4.4 Aircraft Crash

The range of possible releases from an aircraft crash is quite large. A light aircraft crash near the facility may not release any material whereas a direct hit from a commercial jet liner could cause extensive damage to the facility and a large release. The suggested approach is to classify any aircraft crash near or at the facility as an Alert Emergency. Any upgrade of the emergency class would be based on hazardous material release quantities.

6.5 Security Contingencies

6.5.1 Explosive Device

The presence of an explosive device in an area of the PUREX facility which contains hazardous materials is classified as an Alert emergency. Activation of the emergency response organization will assist in building evacuation and access control. Furthermore, activation of the emergency response organization when the device is found will speed the response if the device detonates. A confirmed detonation of an explosive device within the PUREX facility may warrant an upgrade to a Site Area Emergency if a substantial inventory of hazardous material is threatened.

6.5.2 Sabotage

Confirmed physical damage from sabotage which threatens facility integrity is classified as an Alert Emergency since the level of safety has been degraded and there could be additional damage that has not yet been discovered. Any release that occurs due to sabotage is classified based on the known or potential severity of the release.

6.5.3 Hostage Situation/Armed Intruder

A confirmed hostage situation, armed intruder, credible security threat or ongoing security compromise involving physical attack on the building is classified as an Alert emergency based on the guidance for emergency classification. The resources of the emergency response organization will be useful in controlling access to the area and identifying and assessing potential damage scenarios. Any release that occurs from the action of intruders should be classified based on the known or potential severity of the release.

7.0 THE EMERGENCY PLANNING ZONE

The Emergency Planning Zone (EPZ) is an area within which special planning and preparedness efforts are warranted since the consequences of a severe accident could result in Early Severe Health Effect (ESHE). DOE order 5500.3A endorses the EPZ concept and requires that the choice of an EPZ for each facility be based on an objective analyses of the hazards associated with the facility. The Emergency Management Guide on Hazards Assessment provides several pages of guidance on establishing the size of the EPZ. The suggested approach is to determine the emergency classification of the events analyzed in the Hazards Assessment and then base the EPZ size on the larger of a default size for each emergency class or the maximum distance that an ESHE Threshold is exceeded. A final step is to make adjustments to the area, if necessary, based on reasonableness tests in the guidance document. For example, the selected EPZ should conform to natural and jurisdictional boundaries where reasonable. The selection of the EPZ for the PUREX facility based on the consequence assessment of the identified scenarios is described below.

7.1 The Minimum EPZ Radius

The highest emergency classification for the scenarios described above is a Site Area Emergency. The EPZ size is the larger of 2 km (the default size for a Site Area Emergency) or the maximum radius for ESHE. The Emergency Management Guide Hazards Assessment document provides the following criteria for ESHEs.

Radiological

External or uniformly distributed internal emitters	1 Sv
Thyroid	30 Sv
Skin	12 Sv
Ovary	1.7 Sv
Bone Marrow	1.65 Sv
Testes	4.4 Sv
Other Organs	5.5 Sv

Non-Radiological

A peak concentration of the substance in air that equals or exceeds the ERPG-3 value, or equivalent.

Conclusion

EPI calculations show that releasing the entire inventory of acid on a flat surface would result in exceeding the ESHE criteria a distance of about 120 meters. Therefore, the EPZ is the default circle with a radius of 2 kilometers for the PUREX facility. The Tank Farm facility however has a defined EPZ of 16.1 kilometers which is larger than the EPZ defined for PUREX. The PUREX EPZ would be within that of the Tank Farm EPZ so the bounding EPZ for PUREX and the 200 Areas is that which has been defined for the Tank Farms.

7.2 Tests of Reasonableness

The radial distance selected above defines the minimum EPZ size that should be considered. Other factors should also be considered and the size and shape adjusted accordingly so that:

(1) Are the maximum distances to PAG/ERPG-level impacts for most of the analyzed accident scenarios (i.e., all but the most severe consequence scenario for each hazardous material) equal to or less than the EPZ radius selected?

The EPZ bounds all analyzed accident scenarios, and includes the most severe events postulated.

(2) Is the selected EPZ radius large enough to provide for extending response activities outside the EPZ if conditions warrant?

The EPZ radius is large enough to include response activities on and immediately off of the Hanford Site.

(3) Is the EPZ radius large enough to support an effective response at and near the scene of the emergency?

Yes, the EPZ radius extends enough to support this effort.

(4) Does the proposed EPZ conform to natural and jurisdictional boundaries where reasonable, and are other expectations and needs of the offsite agencies likely to be met by the selected EPZ?

The EPZ does not conform to natural and jurisdictional boundaries at this point in time. The geopolitical boundaries associated with all Hanford EPZs will be defined during FY 94 in conjunction with the State of Washington and the local county emergency management organizations.

(5) What enhancement of the facility and site preparedness stature would be achieved by increasing the selected EPZ radius?

The PUREX EPZ is smaller than that defined for the Tank Farms. The primary reason for extending the Tank Farm EPZ beyond the range of the ESHE distances was to enhance the site preparedness stature. The interim EPZ for the Waste Tank facilities was identified as 10 miles in FY 92, and it has enhanced facility and site preparedness stature through additional planning and coordination. There is no reason to extend the PUREX EPZ to any greater distance than the 2 kilometers identified.

8.0 EMERGENCY CLASSES, PROTECTIVE ACTIONS, AND EMERGENCY ACTION LEVELS

8.1 Classification Criteria

A goal of the DOE emergency preparedness system is to quickly classify the severity of an accident. 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 preanalyzed accident scenarios. The emergency classification criteria are shown below.

Table 8-1 Radiological Release Criteria

Emergency Category	Criteria*
Alert	> 1 mSv committed dose equivalent at facility boundary > 5 mSv thyroid (worker) dose at facility boundary > 5 cSv skin dose at facility boundary
Site Area	≥ 1 cSv committed dose equivalent at facility boundary > 5 cSv thyroid (worker) dose at facility boundary > 50 cSv skin dose at facility boundary
General	≥ 1 cSv committed dose equivalent at site boundary > 5 cSv thyroid (infant) dose at site boundary > 50 cSv skin dose at site boundary

Table 8-2 Non-Radiological Release Criteria

Emergency Category	Criteria*
Alert	> ERPG 1 at facility boundary
Site Area	≥ ERPG 2 at facility boundary
General	≥ ERPG 2 at site boundary

*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 shall be used.

There are also general criteria for emergency classification in addition to the numerical values in the tables above. 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 the tables above.

ALERT

An ALERT LEVEL EMERGENCY shall be declared when events are in progress or have occurred which 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

A SITE AREA EMERGENCY shall be declared when events are in progress or have occurred which involve actual or likely major failures of facility functions needed for protection of workers and the public.

GENERAL

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.

There is additional emergency classification guidance in the Emergency Management Guide on Event Classification and Emergency Action Levels (EALs). The Hazards Assessment in the following sections is based primarily on a comparison of calculated consequences with the numerical criteria in the tables above. However, some recommendations are provided based on the more general emergency classification criteria.

8.2 Protective Actions

Table 8-3 contains the protective action recommendations that have been developed for classifiable emergencies in the 200 areas. Please note the PUREX cannot generate a General Emergency.

8.3 Emergency Action Levels

Appendix A contains the Emergency Action Levels developed from this assessment.

9.0 MAINTENANCE AND REVIEW OF THIS HAZARDS ASSESSMENT

The manager of Hanford Hazards Assessment is responsible for ensuring that this Hazards Assessment is regularly reviewed and maintained current. The review requirement is specified in DOE/RL-94-02, "Hanford Emergency Response Plan."

Table 8-3 Protective Action Recommendations

Alert Level Emergency	Restrict access to impacted 200 Area at the main entrances. Evacuate or shelter affected facility nonessential personnel. Shelter the remainder of personnel in the affected 200 Area, (that is, 200 East or 200 West). For security events, contact the Patrol Operations Center to determine actions. Ensure protective action recommendations consistent with affected 200 Area actions are provided to US Ecology (377-2411).
Site Area Emergency	Implement all Alert protective actions. Restrict access to Hanford Site northern areas by closing Route 4S at the Wye Barricade and Route 11A at the Yakima Barricade. Plan for affected area evacuation upon activation of the Northern Area ECC. Verify the ONC has initiated Columbia River alerting, closure of the Hanford Airspace and Highway 240. Shelter personnel in the other 200 Area.
General Emergency	Implement all site area protective actions. Shelter all personnel in unaffected areas north of the Wye Barricade and plan for evacuation of nonessential personnel north of the Wye Barricade once the Northern Area ECC is activated.
Sheltering (take cover) is an alternative action if evacuation is not immediately possible. Sheltering is to be with ventilation control. (Ventilation control means placing fans in recirculation made or turning off air conditioners or fans and closing door and windows, thus limiting inflow of outside air).	

10.0 REFERENCES

Department of Energy, June 26, 1992, Emergency Management Guide, Guidance for Hazards Assessment, U.S. Department of Energy, Washington, D.C.

Department of Energy, April 30, 1991, Planning and Preparedness for Operational Emergencies, DOE Order 5500.3A, U.S. Department of Energy, Washington, D.C.

Emergency Prediction Information Code, Homann Associates, Inc., Fremont, Ca.

Green, Don W. et al (editors), Perry's Chemical Engineers' Handbook, 6th Ed., McGraw-Hill Book Company, New York, NY.

National Institute for Occupational Safety and Health, February 1987, Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Resources, Washington, D.C.

Scherpelz, R. I., February 1991, HUDU - The Hanford Unified Dose Utility Computer Code, PNL-7636, Pacific Northwest Laboratory, Richland, Wa.

PUREX Final Safety Analysis Report, SD-HS-SAR-001, Rev. 1 thru 5

PUREX Standby Preliminary Hazards Analysis, Rev 0.

PUREX/UO3 Deactivation Project Management Plan, WHC-SP-1011D (Draft)

APPENDIX A: EMERGENCY ACTION LEVEL TABLES

FACILITY EMERGENCY EVENTS

RADIOACTIVE MATERIAL RELEASE

Initiating Condition	Emergency Action Level	Event Classification
Spent fuel cask car accident	Cask car containing spent nuclear fuel is involved in an accident that breaches confinement.	**ALERT LEVEL EMERGENCY**
Burial tunnel release	Seismic or other catastrophic event that causes the burial tunnels to collapse exposing the contaminated equipment.	
Ventilation stack release	Activation of the stack's CAM alarm **AND** DP gage indicates filter failure (breach of HEPA filter). **AND** Confirmation of CAM alarm via portable instrument survey of sample filter.	

Note: No Site Area or General Emergency classes identified for this category.

HAZARDOUS MATERIAL RELEASE

Initiating Condition	Emergency Action Level	Event Classification
Nitric acid release	Spills covering approximately 150 m^2 or more: Storage tank failure with spill contained within the 203A bermed area. ISO Container failure	**ALERT LEVEL EMERGENCY**
Nitric acid release	Spills covering approximately 7400 m^2 or more: Storage tank failure with a berm failure.	**SITE AREA EMERGENCY**

Note: No General Emergency class identified for this category.

FIRE/EXPLOSION

Initiating Condition	Emergency Action Level	Event Classification
Fire or explosion	Fire or explosion in the PUREX compound (external to 202A) which threatens areas or structures containing radioactive or hazardous materials.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified for this category.

NATURAL EMERGENCIES

SEISMIC EVENT

Initiating Condition	Emergency Action Level	Event Classification
A seismic event	A seismic event is felt by personnel, with some breakage and disturbance of tall objects at PUREX. OR The seismic event produces ground acceleration between .02g and .05g, confirmed by the Hanford Meteorological personnel.	**ALERT LEVEL EMERGENCY**
A seismic event	A seismic event felt by personnel with evidence of falling building debris at PUREX. OR The seismic event produces ground accelerations greater than .05g, confirmed by the Hanford Meteorological personnel.	**SITE AREA EMERGENCY**

Note: No General Emergency class identified for this category.

HIGH WINDS / TORNADO

Initiating Condition	Emergency Action Level	Event Classification
High winds in the 200 Areas	Sustained wind speeds greater than or equal to 90 mph in the 200 Areas, confirmed by the Hanford meteorological personnel.	**ALERT LEVEL EMERGENCY**
A tornado strikes a PUREX facility	Tornado visually seen striking a PUREX facility which contains radioactive or hazardous materials causing extensive damage.	**SITE AREA EMERGENCY**

Note: No General Emergency class identified for this category.

AIRCRAFT CRASH

Initiating Condition	Emergency Action Level	Event Classification
Aircraft crash	Aircraft crashes in the PUREX compound.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified for this category.

SECURITY CONTINGENCIES

BOMB THREAT/EXPLOSIVE DEVICE

Initiating Condition	Emergency Action Level	Event Classification
Bomb threat	A credible bomb threat (with concurrence of Hanford Patrol, see note) indicating that a device is located within the PUREX complex.	**ALERT LEVEL EMERGENCY**
Explosive device	A confirmed explosive device (with concurrence of Hanford Patrol, see note) located within the PUREX complex.	
Explosive device	A device explodes in an area which threatens large quantities of hazardous materials	**SITE AREA EMERGENCY**

Note: No General Emergency class identified for this category.

Note: Security status declarations by Safeguards and Security personnel or implementation of the 200 West Area security plan does not necessarily require declaration of an operational emergency. The shift operations manager/area emergency director must coordinate with the area patrol Shift Commander for classification of the event.

SABOTAGE

Initiating Condition	Emergency Action Level	Event Classification
Sabotage (industrial/radiological)	Confirmed deliberate act (with concurrence of Hanford Patrol, see note) against the PUREX facility resulting in significant damage	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified for this category.

Note: Security status declarations by Safeguards and Security personnel or implementation of the 200 West Area security plan does not necessarily require declaration of an operational emergency. The shift operations manager/area emergency director must coordinate with the area patrol Shift Commander for classification of the event.

HOSTAGE SITUATION/ARMED INTRUDER

Initiating Condition	Emergency Action Level	Event Classification
A hostage situation	A confirmed hostage situation (with concurrence of Hanford Patrol, see note) is occurring within the PUREX complex.	**ALERT LEVEL EMERGENCY**
Armed intruder(s)	Confirmed hostile armed individual(s) (with concurrence of Hanford Patrol, see note) located within the PUREX complex.	

Note: No Site Area or General Emergency classes identified for this category.

Note: Security status declarations by Safeguards and Security personnel or implementation of the 200 West Area security plan does not necessarily require declaration of an operational emergency. The shift operations manager/area emergency director must coordinate with the area patrol Shift Commander for classification of the event.