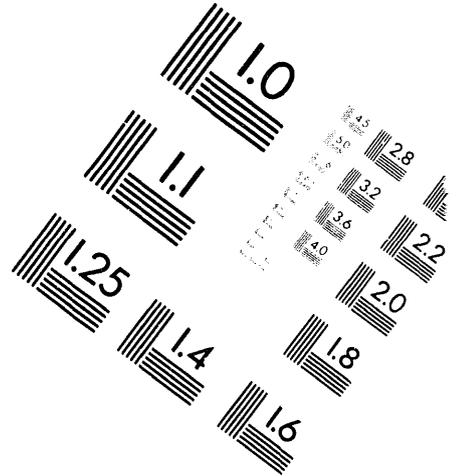
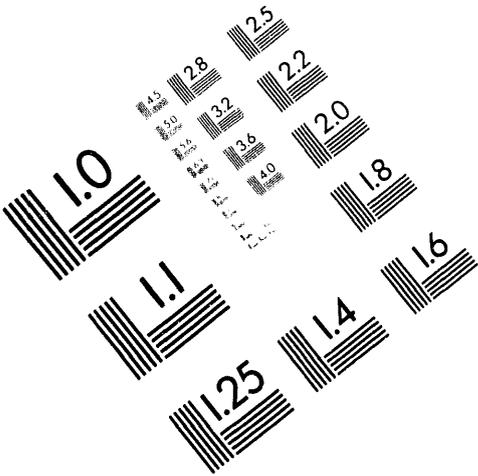




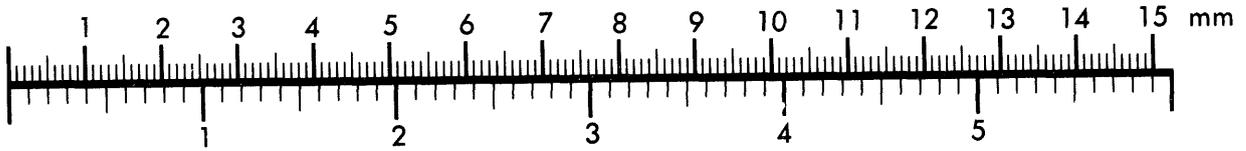
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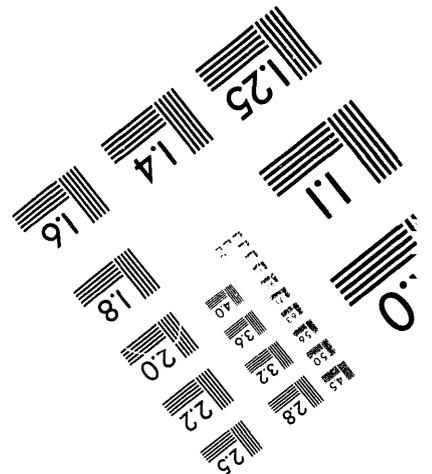
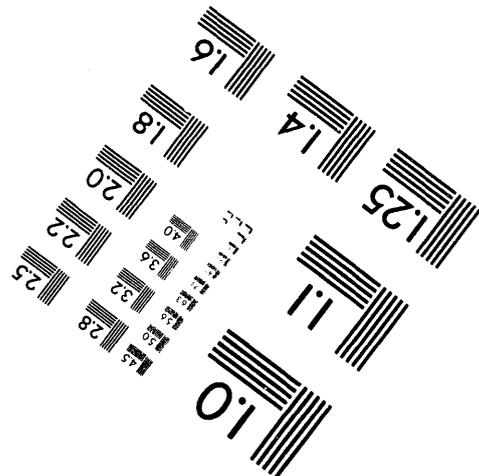
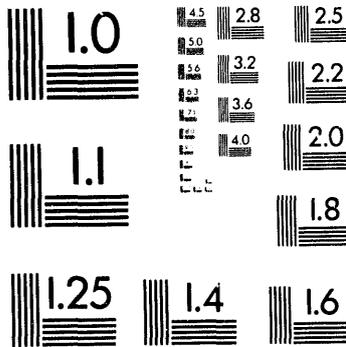
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# Radionuclide Air Emissions Report for the Hanford Site Calendar Year 1993

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**RADIONUCLIDE AIR EMISSIONS REPORT FOR THE  
HANFORD SITE, CALENDAR YEAR 1993**

**ABSTRACT**

*This report documents radionuclide air emissions from the Hanford Site in 1993 and the resulting effective dose equivalent to any member of the public. The report has been prepared and will be submitted in accordance with reporting requirements in the Code of Federal Regulations, Title 40, Protection of the Environment, Part 61, "National Emissions Standards for Hazardous Air Pollutants," Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities."*

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## LIST OF TERMS

AMU	aqueous make-up
CAM	continuous air monitor
CFR	Code of Federal Regulations
CWC	Central Waste Complex
D&D	decontamination and decommissioning
DCRT	double-contained receiver tanks
DOE	U.S. Department of Energy
DST	double-shell tank
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
GTF	Grout Treatment Facility
HEPA	high-efficiency particulate air (filter)
HT	elemental tritium
HTO	tritiated water vapor
HVAC	heating, ventilation, and air conditioning
MASF	Maintenance and Storage Facility
MEI	maximally exposed individual (hypothetical)
MW	Mixed Waste
NESHAP	National Emission Standards for Hazardous Air Pollutants
PEDF	Protective Equipment Decontamination Facility
PFP	Plutonium Finishing Plant
PNL	Pacific Northwest Laboratory
PRF	Plutonium Reclamation Facility
PUREX	Plutonium-Uranium Extraction (Plant)
RCRA	Resource Conservation and Recovery Act
REDOX	Reduction-Oxidation (Plant)
RL	U.S. Department of Energy, Richland Operations Office
RSB	Reactor Service Building
RSP	retention process sewer
SNM	special nuclear materials
SST	single-shell tank
Supply System	Washington Public Power Supply System
TRIGA	Test Reactor and Isotope Production by General Atomics
TRU	transuranic
TRUSAF	Transuranic Waste Storage and Assay Facility
UO <sub>3</sub> Plant	Uranium-Oxide Plant
WAC	Waste Acceptance Criteria
WESF	Waste Encapsulation Storage Facility
Westinghouse Hanford	Westinghouse Hanford Company
WDOH	Washington State Department of Health
WIPP	Waste Isolation Pilot Plant

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## 1.0 FACILITY INFORMATION

### 1.1 SITE DESCRIPTION

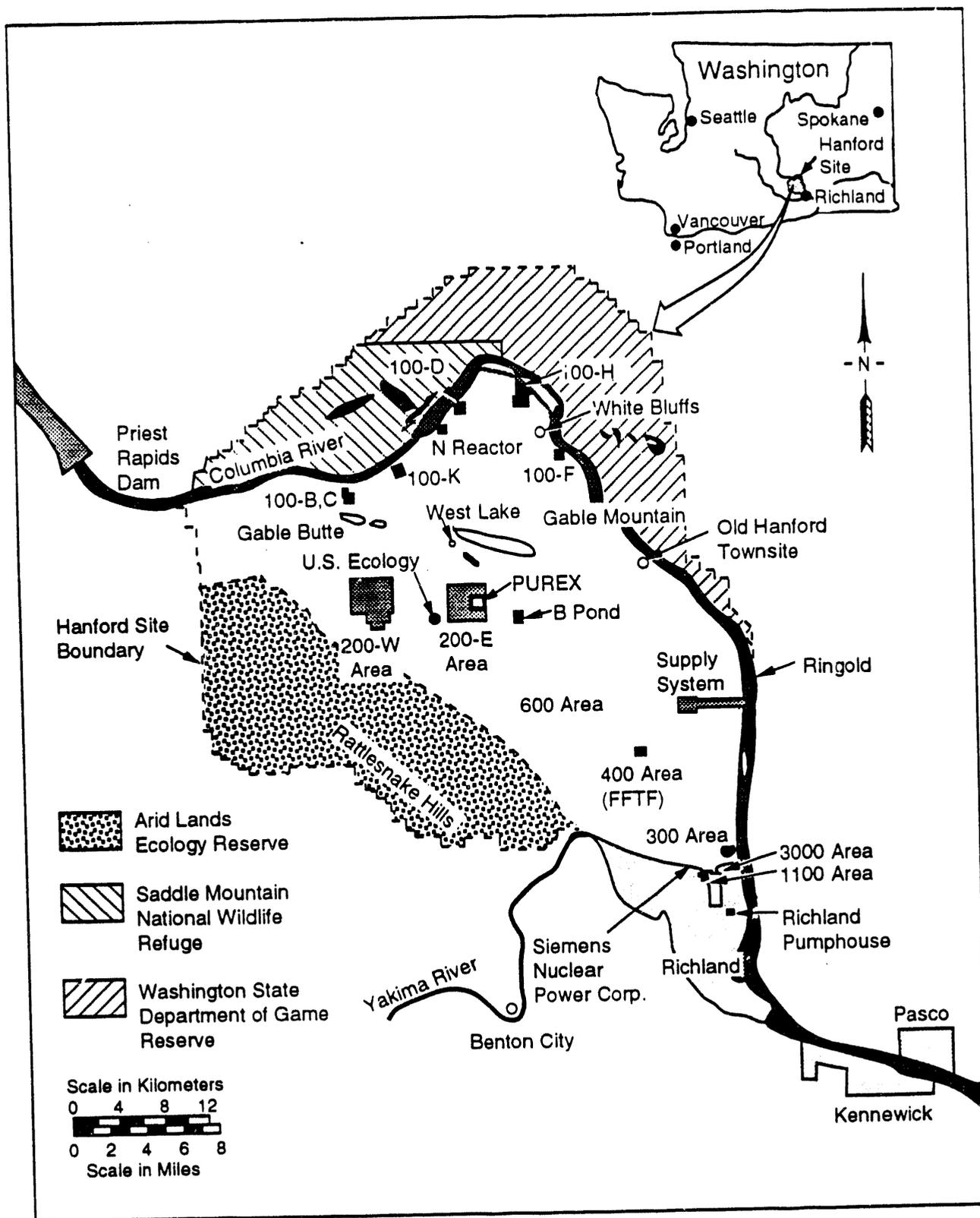
#### 1.1.1 Mission

The federal government acquired the Hanford Site in 1943 to construct and operate facilities to produce plutonium for the atomic weapons program during World War II. For more than 30 years, Hanford Site facilities were dedicated primarily to producing plutonium for national defense and managing the wastes generated by chemical processing operations. In more recent years, defense programs have declined considerably while new programs have emerged involving research and development of waste disposal technologies, renewable energy technologies, and, in particular, cleanup of contamination from past operational practices.

The current Hanford Site mission includes the following activities:

- **Environmental Restoration:** Restoring approximately 1,500 inactive waste sites and either decontaminating or demolishing about 100 surplus facilities
- **Tank Waste Remediation:** Managing the following waste types: high-level and low-level, hazardous, mixed, transuranic (TRU), TRU mixed, and sanitary.
- **Research and Development:** Research and development in basic sciences, health and environmental sciences, and magnetic fusion
- **Defense Production:** Activities related to defense production have decreased significantly. N Reactor is now in transition to deactivation and decommissioning. The Plutonium-Uranium Extraction (PUREX) Plant is in transition to a deactivation mode. The Plutonium Finishing Plant (PFP), now set up to process plutonium scrap, did not operate in 1993. The 300 Area fuel fabrication facilities, where the uranium fuel elements for N Reactor were made, are shut down.
- **Waste Management:** Current waste management activities include the management of high- and low-activity defense wastes in the 200 East and 200 West Areas and the storage of irradiated defense fuel in the 100-K Area. Key facilities include the waste storage tanks, Central Waste Complex, Low-level Burial Ground, 100-K Fuel Storage Basins, PUREX, PFP, B Plant, T Plant, 616 Storage Facility, and 242-A Evaporator.

Figure 1-1. Hanford Site Map.



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### 1.1.2 Major Activities

Four major U.S. Department of Energy (DOE) operating areas exist at the Hanford Site: the 100, 200, 300, and 400 Areas (Figure 1-1). The 100 Areas include the N Reactor and eight deactivated production reactors, with their support facilities, all located near the Columbia River. The 200 Areas, a plateau about 7.0 mi (11.3 km) from the river, include the PUREX Plant, PFP, Uranium-Oxide (UO<sub>3</sub>) Plant, and waste management facilities. The 300 Area, just north of the city of Richland, contains research and development laboratories and the shut-down N Reactor fuel fabrication facilities. The 400 Area is the location of the Fast Flux Test Facility (FFTF), approximately 5.5 mi (8.8 km) northwest of the 300 Area.

The major facilities' 1993 operating histories are summarized below.

- PFP performed a training run in 1993. The Plutonium Reclamation Facility was operated without feed material in order to train operators.
- The PUREX Plant did not operate in 1993, because it was in a deactivation mode.
- The Grout Treatment Facility (GTF) remained in standby mode through most of the year. In late 1993, DOE placed the GTF in cold standby.
- B Plant continued its revised primary mission of safely managing the radioactive inventories stored in its facilities.
- The N Reactor has not operated since January 1987 and is now in transition to deactivation and decommissioning. All nuclear fuel was removed from the reactor core and the major piping systems were drained.
- FFTF did not operate in 1993. In December 1993, DOE placed FFTF in transition to a radiologically and industrially safe shutdown condition.

The DOE contractors and their management responsibilities for facilities at the Hanford Site that have radionuclide air emissions are identified below.

- **Westinghouse Hanford Company (Westinghouse Hanford).** Manage the 200 Areas tank farms containing high-level waste; oversee environmental restoration activities; conduct liquid effluent and air emissions monitoring and near-facility environmental surveillance at DOE facilities Westinghouse Hanford manages; manage the FFTF test reactor, the transition of N Reactor to permanent shutdown, and N Reactor irradiated fuel stored in the two 100-K Area water-filled storage basins; laboratory management; solid and liquid waste management; decommission old facilities; and provide Site support services, such as fire protection, central stores, and the generation and distribution of electrical power.

- **Battelle Memorial Institute.** Manage the Pacific Northwest Laboratory (PNL) for DOE, including research and development in the physical, chemical, life, and environmental sciences; produce advanced methods of nuclear waste management; and conduct environmental monitoring on and off the Hanford Site and liquid effluent and air emission monitoring at the DOE facilities Battelle manages.

Privately and publicly owned facilities located at the Hanford Site include: (1) the Washington Public Power Supply System (Supply System) Hanford Generating Project, adjacent to N Reactor; (2) a low-level radioactive-waste burial site operated by U.S. Ecology, Richland, Washington, on the 200 Area plateau; and (3) the Supply System power reactor (WNP-2) and office buildings, located near the Columbia River, several kilometers north of the 300 Area and east of the 400 Area. The Siemens Nuclear Power Corporation fuel fabrication facility is immediately adjacent to the southern boundary of the Hanford Site. Emissions from these privately owned facilities are not included in this report.

### 1.1.3 Site Characteristics

The Hanford Site (Figure 1-1) is located in a rural region of southeastern Washington State and occupies an area of about 560 mi<sup>2</sup> (1,450 km<sup>2</sup>). It lies about 200 mi (320 km) northeast of Portland, Oregon; 170 mi (270 km) southeast of Seattle, Washington; and 124 mi (200 km) southwest of Spokane, Washington.

**1.1.3.1 Natural Characteristics.** The semiarid land of the Hanford Site has a sparse covering of desert shrubs and drought-resistant grasses. Sagebrush, cheatgrass, and bluegrass are the most broadly distributed types of vegetation. The Great Basin pocket mouse is the most abundant mammal. The most populous big-game animal is the mule deer and among small-game animals, the cottontail rabbit. Coyotes also are quite plentiful. In the winter, bald eagles regularly visit areas along the Columbia River.

The Columbia River, originating in the mountains of eastern British Columbia, Canada, flows through the northern reach of the Hanford Site. Farther downstream the river also forms part of the eastern boundary of the Hanford Site. The river drains a total area of approximately 27,300 mi<sup>2</sup> (70,800 km<sup>2</sup>) en route to the Pacific Ocean. The Columbia River flow is regulated by 11 dams within the United States, 7 upstream and 4 downstream of the Hanford Site. Other surface water on the Hanford Site consists of West Lake (a small natural pond), Rattlesnake Springs, Dry Creek, and a number of ditches and artificial ponds created for routine disposal of waste water.

The climate is dry and mild, and the area receives approximately 16 cm (6.3 in.) of precipitation annually. About 40% of the total precipitation occurs during November, December, and January; only 10% falls in July, August, and September. Approximately 45% of all precipitation from December through February is snow. The average minimum and maximum temperatures in July are 61 °F (16 °C) and 90 °F (32 °C), respectively. For

January the average minimum and maximum temperatures are 21 °F (-6 °C) and 37 °F (3 °C), respectively.

Monthly average 50-ft (15-m) wind speeds range from about 9.3 mph (15 km/h) in summer to 6.1 mph (10 km/h) in winter. The prevailing winds are from the northwest, with occasional strong gusts. During the evening, the surface winds are influenced by cold-air drainage into the valleys. The region is a typical desert basin, in which frequent strong temperature inversions occur at night. These inversions generally deteriorate during the morning, leading to unstable atmospheric conditions in mid-morning and afternoon.

Land surrounding the Hanford Site is used primarily for agriculture and livestock grazing. Agricultural lands are north and east of the Columbia River and south of the Yakima River. These areas contain orchards, vineyards, and fields of alfalfa, wheat, and vegetables. The area of the Hanford Site north of the Columbia River contains a state wildlife management area and a federal wildlife refuge. The northeast slope of the Rattlesnake Hills along the southwestern boundary of the Hanford Site is designated as the Arid Lands Ecology reserve, and is used by DOE for ecological research. The Hanford Site also is designated as a National Environmental Research Park.

More detail on Hanford Site characteristics and activities is available in the *Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes* (DOE 1987).

**1.1.3.2 Demography.** The most recent data on the population surrounding the Hanford Site are from the 1990 census by the Washington State Office of Financial Management. The population in the area surrounding the Hanford Site is rural, with the exception of the cities of Kennewick, Pasco, and Richland, Washington, which are near the southeast boundary of the Hanford Site. The 200 Areas meteorological tower, located approximately in the center of the Hanford Site, is a reference point often used. The total population out to a distance of 50 mi (80 km) from the meteorological tower in 1990 was approximately 376,000.

## **1.2 POINT-SOURCE DESCRIPTIONS**

### **1.2.1 Radionuclide Air Emissions from Point Sources**

Radionuclide air emissions from point sources generally are discharged from stacks and vents (further reference to stacks implies vents as well unless used as the proper name or description of an emission point). Stack sizes, shapes, and discharge paths vary because of facility requirements at the time of construction. Stack discharge heights range from a few feet to 200 ft (61 m), and flow rates range from less than 100 ft<sup>3</sup>/min (2,832 L/min) to more than 200,000 ft<sup>3</sup>/min (5.7 million L/min). Stacks vary in design from horizontal to vertical, rectangular to cylindrical, and permanent to portable. Stack height and flow characteristics have the greatest influence on emission dispersion.

This report lists 129 stacks on the Hanford Site that in 1993: (1) normally had radionuclide emissions, (2) potentially had radionuclide emissions, or (3) could be categorized as either (1) or (2) but did not operate or were deactivated. Stack data are reported in this document when the following criteria were met during 1993: (1) the stack was registered with the Washington State Department of Health (WDOH); or (2) radionuclide emissions from the stack were measured or had the potential of being measured. For 1993, 116 of the reported 129 stacks were registered with WDOH.

**1.2.1.1 Filtration.** The following methods are used singly or in combination to remove radionuclides from most stack emissions: (1) high-efficiency particulate air (HEPA) filters; (2) sand filters; (3) deep-bed fiberglass filters; (4) fiberglass prefilters; (5) charcoal absorbers; and (6) water scrubbers. Generally, between one and three stages of HEPA filtration are used as the final particle removal method before an emission is released to the atmosphere.

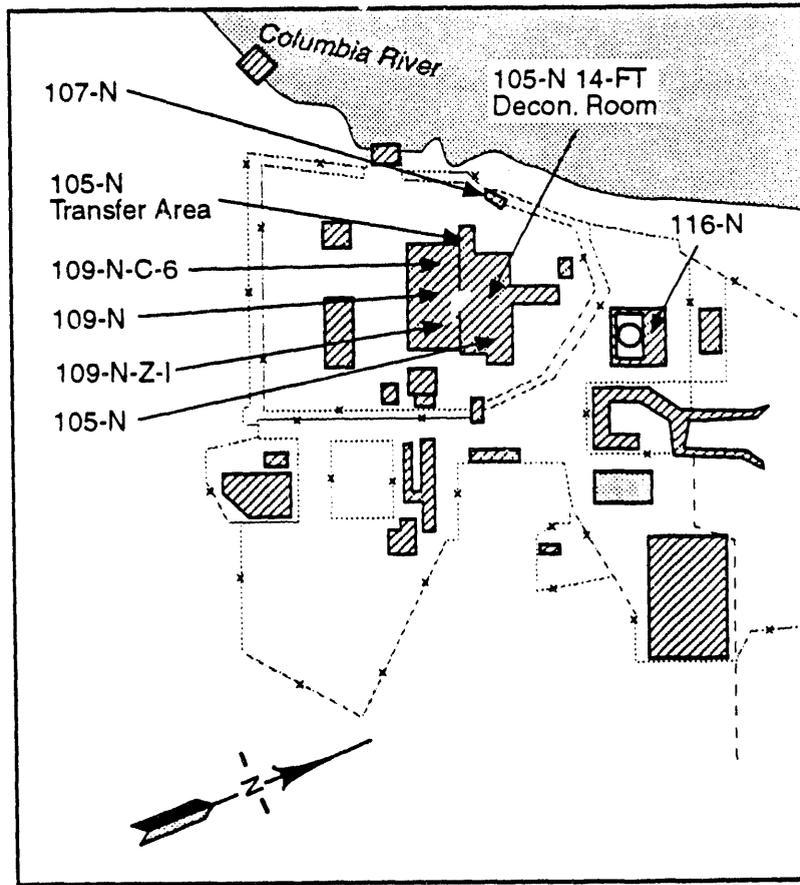
## **1.2.2 100 Areas Facilities**

The 100 Areas contain eight inactive production reactors, the N Reactor (now in transition to deactivation and decommissioning), and associated support facilities. Radionuclide air emission points at facilities in the 100-N Area and 100-K Area are described briefly below and shown respectively in Figures 1-2 and 1-3.

**1.2.2.1 N Reactor.** This dual-purpose reactor operated until 1987, producing electrical power for the regional energy system and plutonium for weapons production. Because further operation of the N Reactor is not anticipated, the reactor and associated facilities are now in transition to deactivation and decommissioning.

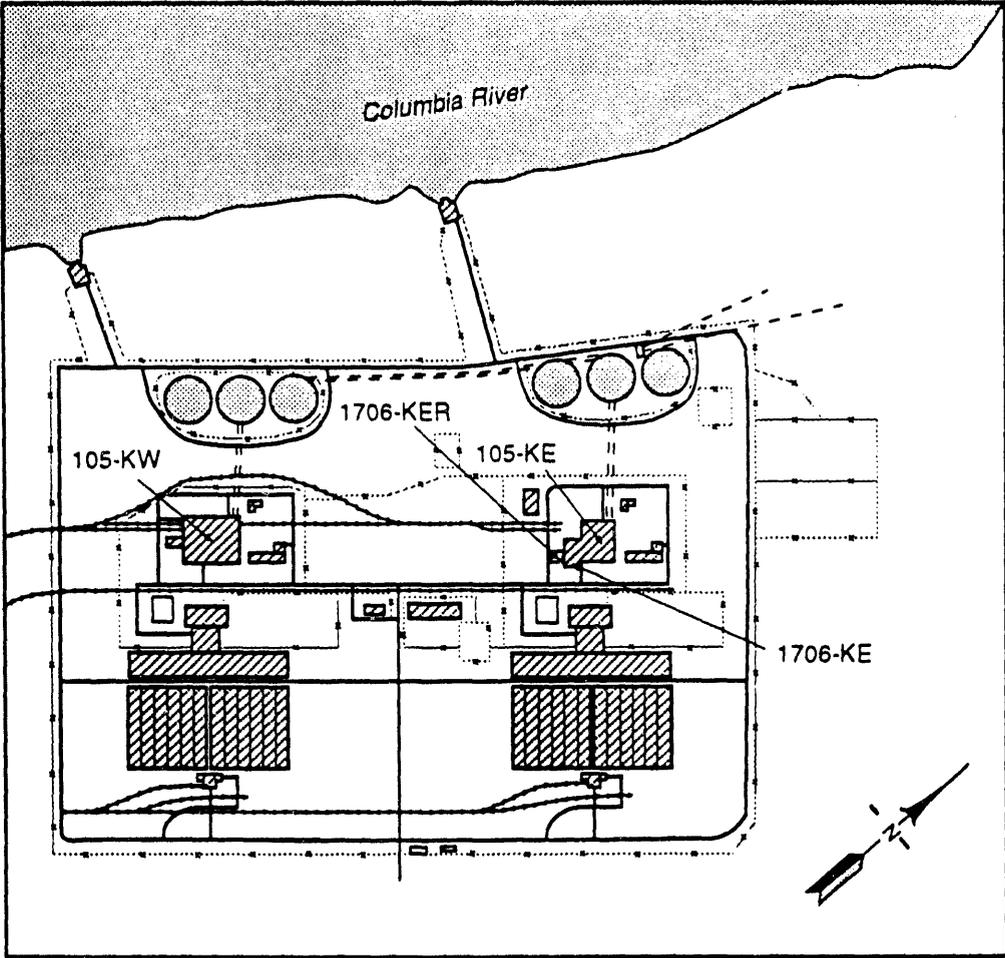
- **116-N.** This stack exhausts filtered air from the 105-N Reactor Building. Emission monitoring consists of a record sampler.
- **109-N-Z-I.** This vent did not operate in 1993. When the vent was operational, unfiltered air was released through it from 109-N Steam Generator Cells 1 through 5. Emission monitoring consisted of a record sampler and a gross-gamma-energy monitor.
- **109-N-C-6.** This vent did not operate in 1993. When it did, unfiltered air was released through it from Steam Generator Cell 6 in the 109-N Building. Emission monitoring consisted of a record sampler and a gross-gamma-energy monitor.
- **107-N.** This vent exhausts filtered air from the 107-N Basin Recirculation Building. Emission monitoring consists of a record sampler. This emission point is not registered with WDOH.

Figure 1-2. 100-N Area Emission Points.



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Figure 1-3. 100-K Area Emission Points.



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- **105-N Basin Transfer Area.** This vent exhausts unfiltered air from the N Basin and the transfer area for rail-transported well cars. Emissions are continuously monitored by a record sampler. This emission point is not registered with WDOH.
- **105-N 14-Ft. Decontamination Room.** This stack exhausts filtered air from a small room in which radioactively contaminated tools are decontaminated. Emissions are continuously monitored by a record sampler. This emission point is not registered with WDOH.

**1.2.2.2 100-K East and West Areas.** These areas contain two retired reactors awaiting decommissioning, two water-filled storage basins holding irradiated nuclear fuel, and radiological analysis laboratories.

- **105-KE.** This vent exhausts unfiltered air from the fuel storage basin in the 105-KE Building. Emission monitoring consists of a record sampler.
- **105-KW.** This vent exhausts unfiltered air from the fuel storage basin in the 105-KW Building. Emission monitoring consists of a record sampler.
- **1706-KE.** This stack exhausts filtered air from the 1706-KE Laboratory. Emission monitoring consists of a record sampler.
- **1706-KER.** This vent exhausts filtered air from the basement area (approximately 27 feet [8.2 m] below grade) of the 1706-KE Laboratory. Emission monitoring consists of a record sampler.

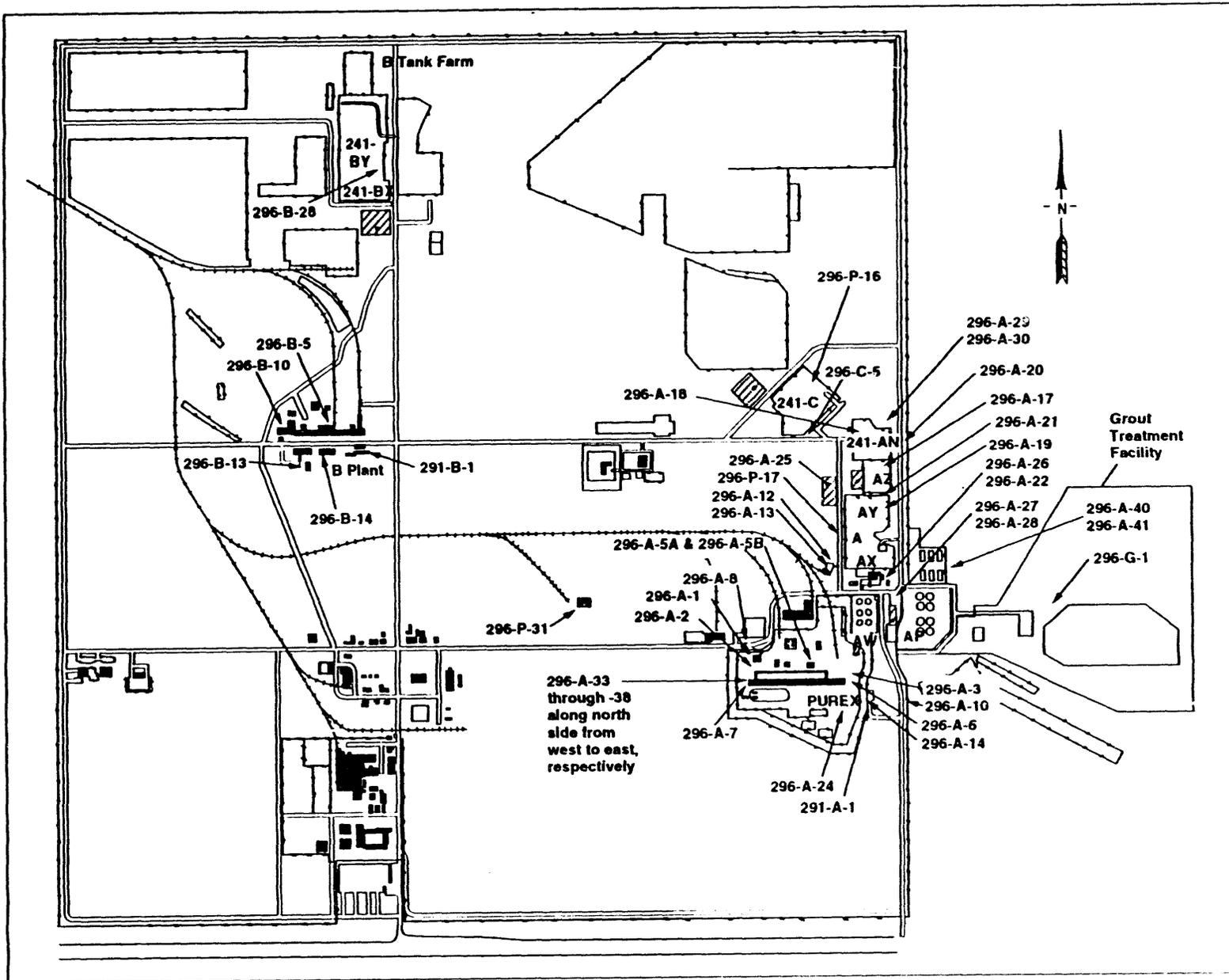
### 1.2.3 200 Areas Facilities

The 200 Areas contain facilities for chemical separations, processing, and waste handling and disposal. The radionuclide air emission discharge points in the 200 East Area are shown in Figure 1-4 and those in the 200 West Area, in Figure 1-5. The PUREX Plant and related tank farm and evaporator facilities discharge volatile forms of radionuclides, specifically  $^3\text{H}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$ , and  $^{129}\text{I}$ . When operating, the PUREX Plant discharged  $^{85}\text{Kr}$ , but it has not operated fully since December 1989. No activities conducted in 1993 resulted in a discharge of  $^{85}\text{Kr}$ .

**1.2.3.1 PUREX Plant.** The PUREX Plant is a nuclear-fuel processing plant constructed in 1956 and operated until 1972, when it was placed on standby status. Later, needed modifications were made and the PUREX Plant resumed operations in November 1983, processing a backlog of irradiated fuel from N Reactor. The plant was placed in standby following a stabilization run that ended in March 1990.

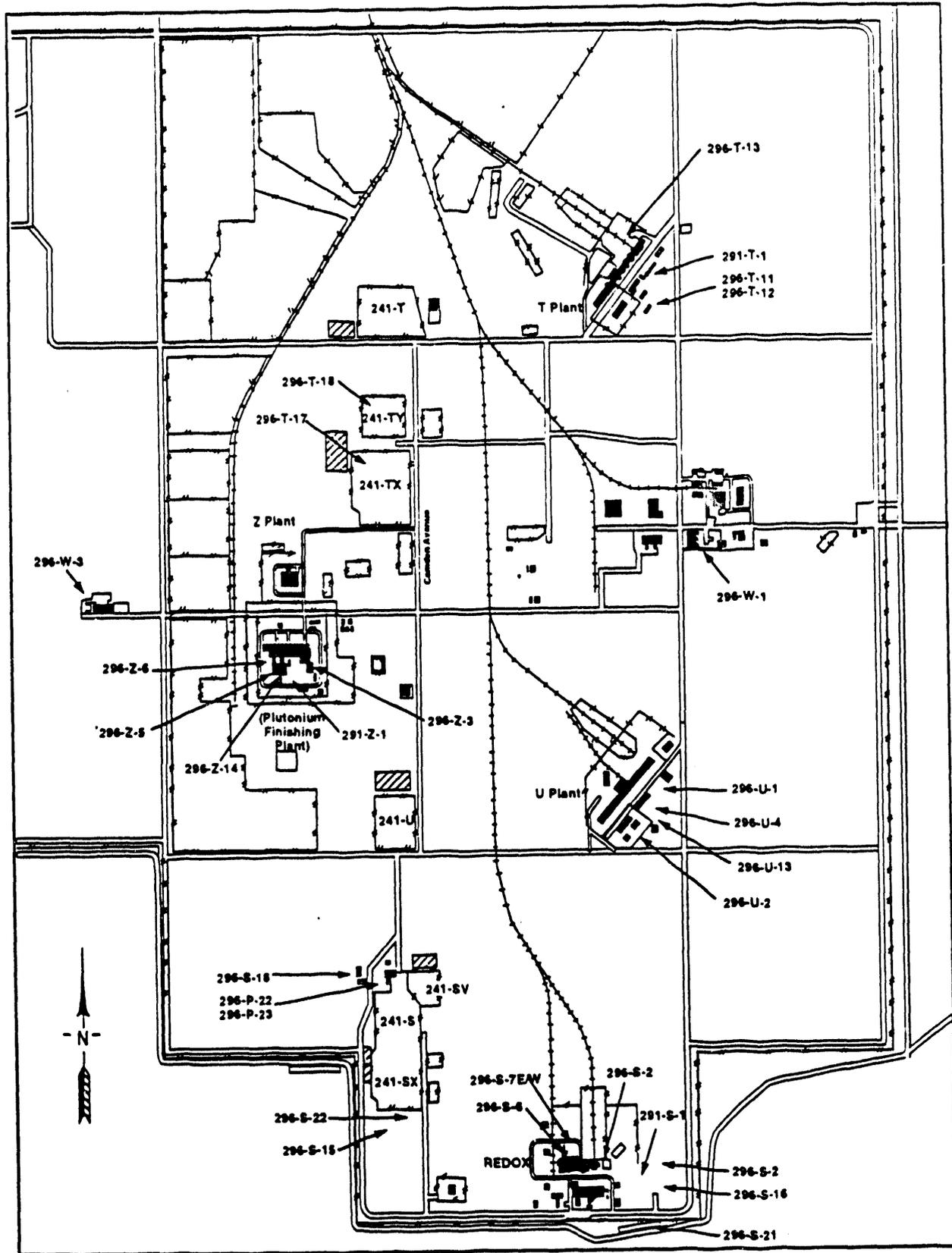
- **291-A-1.** This stack exhausts filtered air from canyon ventilation (Cells A to M), vessel and condenser vents, and the dissolver offgas system. Emission monitoring consists of a record sampler, a silver zeolite cartridge, an alpha continuous air monitor (CAM), and a beta-gamma CAM.
- **296-A-1.** This stack exhausts filtered air from N and Q Cells, Product Removal rooms, and gloveboxes in these rooms. Emission monitoring consists of a record sampler and an alpha CAM.
- **296-A-2.** This stack exhausts filtered air from the west sample gallery hoods. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.
- **296-A-3.** This stack exhausts filtered air from hoods in the east sample gallery. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-A-5A and 296-A-5B.** These stacks exhaust filtered air from laboratory hoods. Emission monitoring for each stack consists of a record sampler, an alpha CAM, and a beta-gamma CAM.
- **296-A-6.** This stack exhausts filtered room air from the east sample gallery and U Cell. Emission monitoring consists of a record sampler.
- **296-A-7.** This stack exhausts filtered room air from the PUREX west sample gallery and R Cell. Emission monitoring consists of a record sampler.
- **296-A-8.** This stack exhausts filtered air from the PUREX Plant Pipe and Operating gallery and the White Room. Emission monitoring consists of a record sampler.
- **296-A-10.** This stack exhausts filtered air from storage tunnel No. 2. Emission monitoring consists of a record sampler.
- **296-A-14.** This stack exhausts filtered air from the 293-A Offgas Treatment and Recovery Building (for nitric acid recovery). Emission monitoring consists of a record sampler.
- **296-A-24.** This stack, known as the ammonia-scrubber waste-concentrator stack, did not operate in 1993. Its monitoring systems have been deactivated and its emission points sealed. When the stack did operate, filtered air was released through it from the E and F Cell vessels to reduce ammonium-nitrate loading on the 291-A-1 filters. Emission monitoring consisted of a record sampler, two silver-zeolite cartridge samplers for volatile radionuclides, an alpha CAM, a beta-gamma CAM, and an ammonia monitor.

Figure 1-4. 200 East Area Emission Points.



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Figure 1-5. 200 West Area Emission Points.



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- **296-A-33, -34, -35, -36, -37, and -38.** All of these exhausters are now deactivated and will be deregistered with WDOH. Exhausters 296-A-33, -35, and -37 were deactivated before 1991, and exhausters 296-A-34 and -36 by the end of 1991. Exhauster 296-A-38 did not operate in 1993. The exhauster emissions were continuously monitored by record samplers and beta-gamma CAMs.

**1.2.3.2 B Plant and Waste Encapsulation Storage Facility.** This facility contains two major operating system areas, B Plant and the Waste Encapsulation Storage Facility (WESF). B Plant was designed and used to remove  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  from high-level liquid waste. At WESF, the  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  were converted to solid strontium fluoride and cesium chloride, doubly encapsulated, and placed in water-filled storage basins. WESF now is used to store radioactive inventories, and contains many radioactive strontium and cesium capsules. The 221-B Building contains radioactive contamination remaining from previous production campaigns that must be properly managed.

- **291-B-1.** This is the B Plant main stack, which exhausts filtered air from the B Plant canyon, the process vessel ventilation system number 1, and the 212-B and 224-B Buildings. Emission monitoring consists of a record sampler, a backup record sampler, and a beta-gamma CAM.
- **296-B-5.** This stack exhausts filtered air from the 221-BB Building, which houses the B Plant process condensate and B Plant steam condensate receiver tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-B-10.** This stack exhausts filtered air from the 225-B Building, which is also known as WESF. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-B-13.** This stack exhausts filtered air from the 221-BF Condensate Effluent Discharge Facility, which houses process condensate retention ventilation. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-B-14.** This stack exhausts filtered air from the 221-B Building and the vessel ventilation system No. 2. Emission monitoring consists of a record sampler and a process sampler. This stack did not operate in 1993.

**1.2.3.3 AR and CR Vaults.** The AR and CR Vaults are retention and treatment facilities for high-level radioactive liquid wastes.

- **296-A-12.** This stack exhausts filtered air from the 244-AR Vault vessel ventilation system. Emission monitoring consists of a record sampler and a beta-gamma CAM. This stack did not operate in 1993.

- **296-A-13.** This stack exhausts filtered air from the 244-AR Vault canyon and cells. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-C-5.** This stack exhausts filtered air from the 244-CR Vault Cell and vessel ventilation. Emission monitoring consists of a record sampler and a beta-gamma CAM.

**1.2.3.4 200 East Area Tank Farms (excluding the Evaporator).** Radioactive waste stored in tank farms consists of sludge and salt cake in single-shell tanks (SSTs) and slurry in double-shell tanks (DSTs).

- **296-A-17.** This stack exhausts filtered, noncondensable vapors from waste storage tanks in the 241-AY and -AZ Tank Farms. Emission monitoring consists of a record sampler, two silver-zeolite cartridge samplers for volatile radionuclides, and a beta-gamma CAM.
- **296-A-18.** This stack exhausts filtered air from the 241-AY-101 tank annulus. Emission monitoring consists of a record sampler. This stack has been inactive since September 1991.
- **296-A-19.** When this stack was operational, filtered air was released through it from the 241-AY-102 tank annulus. Emission monitoring consisted of a record sampler. This stack did not operate in 1993.
- **296-A-20.** 241-AZ Tank Annuli Exhaust. This stack exhausts filtered air from the 241-AZ-101 and -102 tank annuli. Emission monitoring consists of a record sampler.
- **296-A-25.** This stack exhausts filtered air from the catch tank at the 244-A lift station. Emission monitoring consists of a record sampler and a beta-gamma CAM. This stack did not operate in 1993.
- **296-A-26.** This stack exhausts filtered air from the waste unloading room and sump tank at the 204-AR tank. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-A-27.** This stack exhausts filtered air from all 241-AW tanks. Emission monitoring consists of a record sampler, two silver-zeolite cartridge samplers for volatile radionuclides, and a beta-gamma CAM.
- **296-A-28.** This stack exhausts filtered air from all tank annuli in the 241-AW tank farm. Emission monitoring consists of a record sampler and a beta-gamma CAM.

- **296-A-29.** This stack exhausts filtered air from all 241-AN tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-A-30.** This stack exhausts filtered air from all tank annuli in the 241-AN tank farm. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-A-40.** This stack exhausts filtered air from all 241-AP tanks. Emission monitoring consists of a record sampler, two silver-zeolite cartridge samplers for volatile radionuclides, and a beta-gamma CAM.
- **296-A-41.** This stack exhausts filtered air from all tank annuli in the 241-AP tank farm. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-B-28.** This stack exhausts filtered air from the 244-BX salt well receiver tanks and annulus. Emission monitoring consists of a record sampler, a beta-gamma CAM for the tank exhaust, and a beta-gamma CAM for the annulus exhaust.
- **296-P-16.** A portable exhauster emits filtered air via this stack from the 241-C-104, -105, and -106 tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-P-17.** This portable exhauster emits filtered air from the 241-A-104, -105, and -106 tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM. This stack did not operate in 1993.

**1.2.3.5 200 East Area Evaporator.** The evaporator did not process waste in 1993. The evaporator is used to remove most of the water from high-level radioactive liquid waste, leaving a slurry that is pumped back to tank farms.

- **296-A-21.** This stack exhausts filtered air from the 242-A Evaporator-Crystallizer Building. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.
- **296-A-22.** This stack exhausts filtered air from the 242-A Evaporator-Crystallizer vessel-ventilation system. Emission monitoring consists of a record sampler, two silver-zeolite cartridge samplers for volatile radionuclides, an alpha CAM, and a beta-gamma CAM.

**1.2.3.6 Grout Treatment Facility.** This facility solidified low-level liquid waste for disposal in underground vaults. The facility was placed in cold standby in 1993.

- **296-G-1.** This stack did not operate in 1993. When it operated, this stack exhausted filtered air from the GTF Air Filtration Module. Emission monitoring consisted of a record sampler and a beta-gamma CAM.

**1.2.3.7 209-E Critical Mass Laboratory.** The building is no longer in operation. Formerly it was used for testing critical mass configurations.

- **296-P-31 (formerly 209-E).** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.3.8 S Plant.** S Plant is another name for the Reduction-Oxidation Plant (REDOX), which is the 202-S building. The REDOX Plant was operated as a fuel-reprocessing facility until 1967 when it was shut down.

- **291-S-1.** The REDOX main stack exhausts filtered air from the REDOX canyon, vessel ventilation, and treated dissolver offgas system. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-S-2.** This stack exhausts filtered air from REDOX north and south sample galleries, hoods, and product removal cage. Emission monitoring consists of a record sampler.
- **296-S-4.** This stack exhausts filtered air from the REDOX decontamination room and regulated shop and unfiltered air from the regulated tool room, low-level decontamination sink, and special work permit lobby. Emission monitoring consists of a record sampler.
- **296-S-6.** This stack exhausts air from the REDOX Plant, the silo gallery, an organic feed tank, and a sample elevator. Emission monitoring consists of a record sampler.
- **296-S-7W.** This stack exhausts filtered air from the 233-S REDOX Product building, the REDOX plutonium-processing greenhouse, and process vessel ventilation and loadout area. Emission monitoring consists of a record sampler and an alpha CAM. A duplicate exhaust fan and record sampler is designated as 296-S-7E.

**1.2.3.9 T Plant.** T Plant is one of the original fuel reprocessing facilities. The last fuel reprocessed there was in 1956. Now the 221-T Building is used for decontaminating and repairing equipment and the 224-T Building for storing and assaying waste suspected of containing transuranic elements (TRU).

- **291-T-1.** This stack exhausts filtered air from 221-T canyon and process ventilation. Emission monitoring consists of a record sampler, a beta-gamma CAM, and an alpha CAM.

- **296-T-13.** This stack exhausts filtered air from the 221-T Building and canyon ventilation. Emission monitoring consists of a record sampler and a beta-gamma CAM.

**1.2.3.10 TRUSAF.** The 224-T Building was originally used to purify plutonium nitrate by the lanthanum fluoride process. After phase-out of the bismuth phosphate plants, the lanthanum fluoride process was no longer needed and the facility remained inactive until the early 1970's. At that time, the 224-T Building was modified for storage of plutonium scrap in liquid and solid forms. In 1984 the facility was selected to house the transuranic waste storage and assay (TRUSAF) operation. The TRUSAF operation consists of analysis of transuranic waste to verify compliance with the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria. Those containers meeting WIPP acceptance criteria are stored at 224-T pending shipment to the WIPP.

- **296-T-11.** This stack exhausts filtered air from the 224-T Building ventilation through the east part of the plenum. Emission monitoring consists of a record sampler.
- **296-T-12.** This stack exhausts filtered air from the 224-T Building ventilation through the west part of the plenum. Emission monitoring consists of a record sampler.

**1.2.3.11 U Plant.** U Plant was constructed as a fuel reprocessing plant but was never used for that purpose. Instead, it was used to recover uranium from bismuth-phosphate waste and high-level radioactive wastes from tank farms. Now, however, it is a shut-down, retired facility with a few offices and shops still in use. Located adjacent to U Plant is the Uranium-Oxide (UO<sub>3</sub>) Plant, which formerly produced uranium trioxide from PUREX Plant solutions. In 1972 the UO<sub>3</sub> Plant was shut down. Later, it was refurbished to process uranyl nitrate hexahydrate from the PUREX Plant, and was restarted in March 1984. The final UO<sub>3</sub> clean-out campaign was conducted in 1993.

- **291-U-1.** This stack exhausts filtered air from U Plant and 221-U canyon ventilation. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-U-2.** This stack exhausts filtered air from the powder-handling system in the 224-UA Building of the UO<sub>3</sub> Plant. Emission monitoring consists of a record sampler.
- **296-U-4.** This UO<sub>3</sub> Plant stack exhausts unfiltered air from the process offgas system (vessel vent, concentrator, and calciner) on the 224-U Building. Emission monitoring consists of a record sampler.

- **296-U-13.** This stack exhausts filtered air from the powder loadout hood. Emission monitoring consists of a record sampler and beta-gamma CAM.

**1.2.3.12 Plutonium Finishing Plant.** PFP conducted a personnel training run without feed material in 1993. Historically, PFP, located in the 200 West Area, recovered plutonium in the form of plutonium nitrate from plutonium scrap. Plutonium metal was also produced from recovered nitrate and plutonium nitrate received from the PUREX Plant. This facility now is used to stabilize and store plutonium. The reduction process stabilizes the plutonium into the state best suited for long-term storage. PFP's current mission is to stabilize the existing inventory of plutonium waste.

- **291-Z-1.** This stack exhausts filtered air from the 234-5Z, 236-Z, and 242-Z Buildings. Emission monitoring consists of a record sampler and an alpha CAM.
- **296-Z-3.** This stack exhausts filtered air from 241-Z vault sump and vessel ventilation. Emission monitoring consists of a record sampler and an alpha CAM.
- **296-Z-5.** This stack exhausts filtered air from 2736-ZB, the shipping and receiving building. Emission monitoring consists of a record sampler and an alpha CAM.
- **296-Z-6.** This stack exhausts filtered air from the 2736-ZA Building and its plutonium storage vault ventilation system. Emission monitoring consists of a record sampler and two alpha CAMs. One alpha CAM is located on each of the two ducts feeding into this stack.
- **296-Z-14.** This stack exhausts filtered air from the 232-Z Incinerator Building. Emission monitoring consists of a record sampler and two alpha CAMs.

**1.2.3.13 200 West Area Tank Farms (Excluding Evaporators).** Radioactive waste stored in tank farms consists of sludge and salt cake in SSTs and liquid and slurry in DSTs.

- **296-P-22.** This stack exhausts filtered air from annuli in the 241-SY-101, -102, and -103 tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-P-23.** This stack exhausts filtered air from the 241-SY-101, -102, and -103 tanks. Emission monitoring consists of a record sampler and a beta-gamma CAM.

- **296-S-15.** This stack exhausts filtered air from tanks 241-SX-107 through -112 and 241-SX-114. Emission monitoring consists of a record sampler and a beta-gamma CAM.
- **296-S-22.** This stack exhausts filtered air from the 244-S salt well receiver tank and annulus. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.
- **296-T-18.** This stack exhausts filtered air from the 244-TX salt well receiver tank and annulus. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.

**1.2.3.14 200 West Area Evaporators.** The 242-T Evaporator-Crystallizer is shut down, and therefore did not operate in 1993. The 242-S Evaporator-Crystallizer also did not operate in 1993, and is on standby. The evaporators are designed to remove most of the water from radioactive liquid waste; the resulting slurry is then routed to tank farms for storage.

- **296-S-18.** This stack exhausts filtered air from the 242-S Evaporator-Crystallizer Building. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.
- **296-T-17.** This stack exhausts filtered air from the 242-T Evaporator-Crystallizer and cold-cell ventilation. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.

**1.2.3.15 2724-W Laundry.** This is the Protective Equipment and Decontamination Facility, also known as the 2724-W Laundry, located in the 200 West Area. Radioactively contaminated protective clothing and equipment used by Hanford Site contractors was laundered at this facility. This facility was shut down in 1993.

- **296-W-1.** This stack exhausts air from clothes dryers and a washroom. The air is scrubbed with a water wash before exhausting through the stack. Emission monitoring consists of a record sampler.

**1.2.3.16 222-S Analytical Laboratories.** The 222-S Analytical Laboratories provide chemical and radiochemical analytical support for Westinghouse Hanford, including environmental and effluent sample analysis, research and development, and tank farm waste characterization.

- **296-S-16.** This stack exhausts filtered air from the 219-S Building vault and waste tanks. Emission monitoring consists of a record sampler.

- **296-S-21.** This stack exhausts filtered air from 222-S Laboratory hoods, gloveboxes, hot-cells, and room ventilation system. Emission monitoring consists of a record sampler, an alpha CAM, and a beta-gamma CAM.

**1.2.3.17 Waste Compactor.** The facility compacts the volume of radioactive solid waste.

- **296-W-3.** This exhaust discharges filtered air from the 213-W compactor. Emission monitoring consists of a record sampler and a beta-gamma CAM.

#### 1.2.4 300 Area Facilities

The 300 Area consists primarily of laboratories, research facilities, and a steam plant. Emission points in the 300 Area are shown in Figure 1-6.

**1.2.4.1 306-E Metal Fabrication Development Building.** This building is in use for materials testing and fabrication. In the past, this building housed three separate operations: (1) a large, high-bay used for nonfueled test article fabrication for FFTF, (2) nondestructive, radiography examination in a series of shielded cells, and (3) a small depleted-uranium-powder laboratory used to fabricate insulator pellets for the FFTF fuel pins.

- **306-E-ULAB.** This stack exhausts filtered air from the Uranium Oxide Laboratories in rooms 158 and 159. The laboratories are currently shut down. Emission monitoring consists of a record sampler.

**1.2.4.2 308 Fuels Development Laboratory.** The 308 Laboratory was used for fabricating mixed-oxide fuel pins used by FFTF. The facility houses a shutdown swimming-pool-type Test Reactor and Isotope Production reactor by General Atomics (TRIGA) that was used in neutron radiography of the completed pins. The 308 Building is in transition to shutdown.

- **308-GL-EX.** This exhaust discharges filtered air from gloveboxes and hoods in the 308 Building. Emission monitoring consists of a record sampler and an alpha CAM.
- **308-ET-EX.** This exhaust discharges filtered air from those portions of the 308 Laboratory previously associated with etching and cleaning operations, discontinued several years ago. Emission monitoring consists of a record sampler and an alpha CAM.
- **308-TRIGA.** This stack discharges filtered air from the reactor hall housing the TRIGA reactor. The reactor, however, is permanently shutdown and partially defueled. Emission monitoring consists of a record sampler, an alpha CAM, and a record sampler for <sup>131</sup>I.

**1.2.4.3 340 Complex.** The 340 Complex houses the radioactive liquid waste and solid waste handling operations for the 300 Area. The 340-A Building contains six aboveground storage tanks for radioactive liquid waste. The east side of the building has a railcar loadout facility for shipping liquid waste to the 200 Areas. The west side is a storage area for radioactive waste.

- **340-NT-EX.** 340 Tank and Vault Exhaust. This stack exhausts filtered air from the 340-A Building vault and waste tanks. Emission monitoring consists of a record sampler, an alpha CAM, a beta-gamma CAM, a radioiodine CAM, and a record sampler for  $^{131}\text{I}$ .

**1.2.4.4 303-C Materials Evaluation Laboratory.** The building is used primarily for storage of special nuclear materials in sealed containers.

- **Emission Point (EP)-303C-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.5 306-W Materials Development Laboratory.** The building contains shops and laboratory facilities for metal-working and ceramic studies.

- **EP-306W-01-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-306W-02-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-306W-03-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-306W-04-S.** This stack exhausts filtered building ventilation air from the northwest portion of the building. It is sampled for particulate alpha and beta radioactivity.



**1.2.4.6 314 Engineering Development Laboratory.** The building contains high-bay facilities and laboratories for engineering studies.

- **EP-314-01-S.** This stack exhausts filtered building ventilation air from chemistry laboratories on the north side of the building. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.7 318 Radiological Sciences Laboratory.** The building contains facilities for calibrating radiation survey instruments and processing personnel dosimeters.

- **EP-318-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.8 320 Physical Sciences Laboratory.** The building contains environmental radiochemistry laboratories.

- **EP-320-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-320-02-S.** This stack exhausts filtered chemistry hoods. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-320-03-S.** This stack exhausts filtered chemistry hoods. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-320-04-S.** This stack exhausts filtered chemistry hoods. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.9 323 Mechanical Properties Laboratory.** The building contains facilities for investigating structural properties of irradiated materials.

- **EP-323-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.10 324 Waste Technology Engineering Laboratory.** The building contains laboratories for performing chemical and process development activities.

- **EP-324-01-S.** This stack exhausts filtered building air. The exhaust is sampled for particulate radioactivity (alpha, beta,  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ , and gamma emitting radionuclides), and tritium (HTO, HT).

**1.2.4.11 325 Applied Chemistry Laboratory.** The building contains radiochemistry laboratories.

- **EP-325-01-S.** This stack exhausts filtered building air. The exhaust is sampled for particulate radioactivity (alpha, beta,  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ , and gamma emitting radionuclides), and tritium (HTO, HT).

**1.2.4.12 326 Materials Sciences Laboratory.** The building contains laboratories and equipment for studies of metallurgical, chemical, and physical behavior of reactor components and fuel materials.

- **EP-326-01-S.** This stack exhausts filtered building air. The exhaust is sampled for particulate radioactivity (alpha, beta).

**1.2.4.13 327 Post Irradiation Testing Laboratory.** The building contains hot-cells for examining and testing irradiated materials.

- **EP-327-01-S.** This stack exhausts filtered building air. The exhaust is sampled for particulate radioactivity (alpha, beta,  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ , and gamma emitting radionuclides), and radon ( $^{220}\text{Rn}$  and  $^{222}\text{Rn}$ ).
- **EP-327-02-V.** This roof vent exhausts filtered air from the decontamination cell. The exhaust is sampled for particulate radioactivity (alpha, beta,  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ , and gamma emitting radionuclides).

**1.2.4.14 329 Chemical Sciences Laboratory.** The building contains chemistry laboratories for radioanalytical studies, environmental radionuclide studies, and radiation detection instrumentation development.

- **EP-329-01-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-329-02-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-329-03-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.15 329 Neutron Multiplier Facility.** The building contains a neutron multiplier source for activation analysis and on-line spectrometry of fission products.

- **EP-329-04-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.16 331 Life Sciences Laboratory.** The building contains facilities for biological and ecological research studies.

- **EP-331-01-V.** This vent exhausts filtered building ventilation air. The exhaust had been sampled at two separate points (referred to as D1 and D2) for particulate alpha and beta radioactivity. Now only D1 is used. Sampling point D2 is registered unnecessarily with WDOH; in 1993 deregistration with WDOH was requested. Proper registration of the stack will be requested as well. WDOH has already been provided a full explanation on this stack and the two associated sampling points.
- **EP-331A-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-331A-02-V.** This vent exhausts filtered building ventilation air from the liquid waste transfer room. The room contains facilities for transferring and storing radioactive liquid waste used in biological research studies. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.17 331-H Aerosol Wind Tunnel Research Facility.** The building contains a wind tunnel for atmospheric pollutant deposition studies. There are no unsealed radionuclides in use in the facility at this time.

- **EP-331H-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.18 377 Geotechnical Engineering Laboratory.** The facility was formerly used for studying a steam generator that had been removed from a nuclear power plant. The steam generator was removed before 1990 and the facility was decontaminated. In 1991 and 1992, the facility was modified for use as a physical properties testing laboratory for radioactively contaminated soils and began laboratory operation in 1993.

This facility was formerly known as the 377 Steam Generator Facility. In 1993 the facility was renamed the 377 Geotechnical Engineering Laboratory to reflect the change in operations. The stack name was also changed from 377-SGEF to 377-GEL.

- **377-GEL.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.19 3708 Radiation Measurements Laboratory.** The building contains facilities for measuring small amounts of radionuclides, performing calibration studies, and performing leach studies with vitrified radioactive waste.

- **EP-3708-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.20 3720 Chemical and Metal Sciences Laboratory.** The building contains low-level radiochemistry laboratories and a counting room.

- **EP-3720-01-S.** This stack exhausts filtered building air. The exhaust is sampled for particulate radioactivity (alpha, beta,  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ , and gamma emitting radionuclides).
- **EP-3720-02-S.** This stack exhausts filtered building air from the north-annex low-level radiochemistry laboratories. The exhaust is sampled for particulate alpha and beta radioactivity.
- **EP-3720-03-S.** This stack exhausts filtered building air from the south-end laboratories. This region of the building contains a counting room and low-level radiochemistry laboratories. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.21 3730 Gamma Irradiation Facility.** The building contains a hot-cell for metallurgical studies of specimens of irradiated metals.

- **EP-3730-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.22 3745 Radiological Calibrations and Standards Facility.** The building contains a counting room for measuring facility ventilation and exhaust samples.

- **EP-3745-01-S.** This stack exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

**1.2.4.23 3746-A Radiological Physics Laboratory.** The building contains facilities for low-level radiological physics studies.

- **EP-3746A-01-V.** This vent exhausts filtered building ventilation air. The exhaust is sampled for particulate alpha and beta radioactivity.

## 1.2.5 400 Area Facilities

The 400 Area consists of the FFTF, the Maintenance and Storage Facility (MASF), and the Fuels Materials Examination Facility. Emission points in the 400 Area are shown in Figure 1-7.

**1.2.5.1 Fast Flux Test Facility.** FFTF, located in the 400 Area, is a 400-megawatt thermal, sodium-cooled, low-pressure, high-temperature reactor plant. It was used for irradiation testing of breeder reactor fuels and materials.

- **FFTF-RE-SB.** Lower Reactor Service Building (RSB). This exhaust discharges unfiltered air from the lower level of the RSB. Emission

monitoring consists of a record sampler, a beta CAM, and a noble gas monitor.

- **FFTF-CB-EX.** Combined exhaust. This stack exhausts normally unfiltered air from the reactor containment and gases from the argon processing system. Standby particulate filters are automatically dampered into the system if airborne radioactive particulate levels rise above certain concentrations. Emission monitoring consists of a record sampler, a continuous tritium monitor, a beta CAM, a noble gas monitor, and a record sampler for <sup>131</sup>I. The tritium record sampler was eliminated on December 12, 1993.
- **FFTF-HT-TR.** Heat Transport System South. This exhaust discharges normally unfiltered air from portions of FFTF that are exterior to the containment. Standby particulate filters are automatically dampered into the system if airborne radioactive particulate levels rise above certain concentrations. Emission monitoring consists of a record sampler, a beta CAM, and a noble gas monitor.

**1.2.5.2 437 MASF.** The Maintenance and Storage Facility (MASF) is a multipurpose service center supporting the specialized maintenance and storage requirements of FFTF. The MASF provides the capability for sodium film removal, decontamination, repair, and storage of nonfueled components and hardware for FFTF.

- **437-MN&ST.** This exhaust discharges filtered air from the MASF. Emission monitoring consists of a record sampler and a beta CAM.

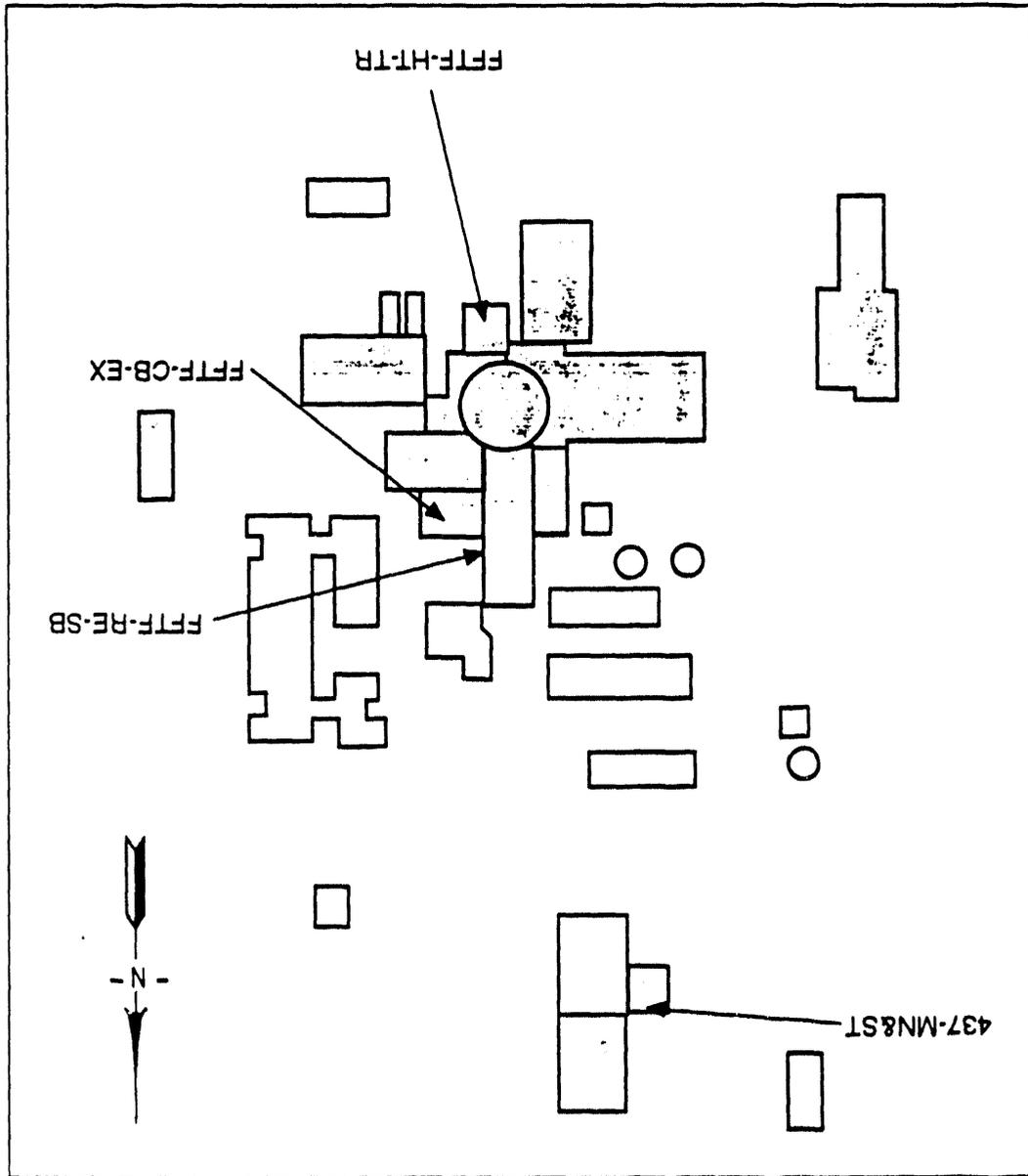


Figure 1-7. 400 Area Emission Points.

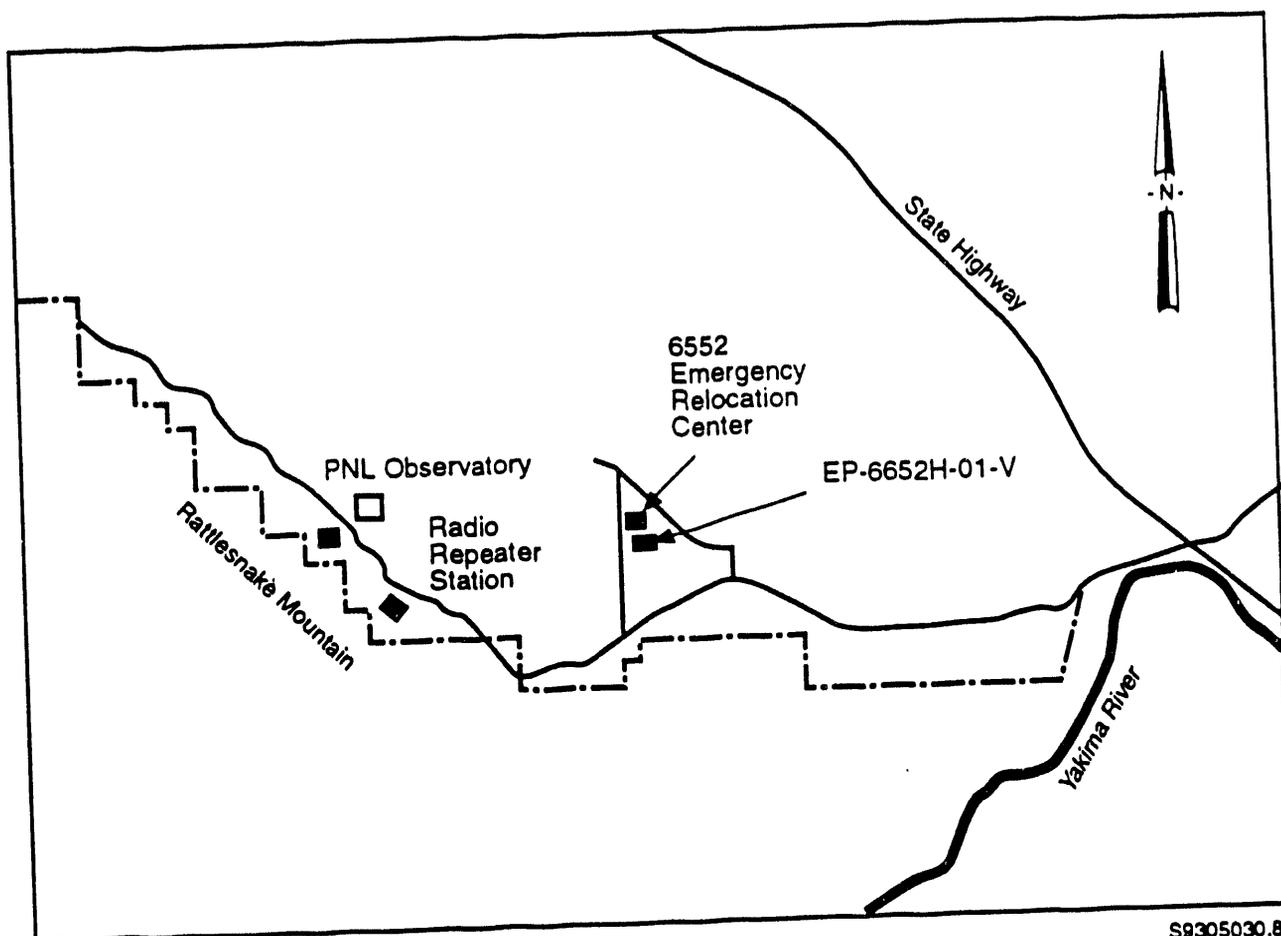
### 1.2.6 600 Area Facilities

Emission points in the 600 Area are shown in Figure 1-8.

**1.2.6.1 6652-H Ecology Laboratory.** This laboratory is located on the Arid Land Ecology Reserve. The building contains facilities for ecology studies.

- **EP-6652H-01-V.** This vent exhausts filtered building ventilation air. The two contributing streams to this emission point are sampled separately. In previous years, each of the two contributing streams were treated as separate emission points (EP-6652H-01-V and EP-6652H-02-V). In 1993, the results for the two sampled streams are added together and reported as a single emission point (EP-6652H-01-V).

Figure 1-8. 600 Area Emission Points.



## 2.0 RADIONUCLIDE AIR EMISSIONS DATA ON POINT SOURCES

Data on radionuclide emissions released during 1993 from the point sources (i.e., stacks) described in Section 1.2 are shown in Table 2-1. The table first displays source data on the 19 major Hanford Site stacks. A stack is classified as major if its emissions, with all treatment controls removed, have the potential to exceed 0.1 mrem/yr effective dose equivalent (EDE) at the nearest residence. A nearest residence is a known habitable location not on the Hanford Site (dwelling, business, school, or office) that is nearest to an emission point representative of a collective operating area such as the 100 Areas. The maximally exposed individual (MEI) differs from a person at a nearest residence in that the MEI is a hypothetical member of the public residing near the Hanford Site who, by virtue of location and living habits, could receive the highest possible radiation dose from all radionuclide emissions from the Hanford Site. Historically, the MEI has been an individual living in the Ringold, Washington area. In 1993 the MEI was calculated to be a resident of a farm east of the 300 Area.

The remainder of the table, beginning on page 2-5 and grouped according to the stack operating areas, gives data on an additional 110 minor stacks. A stack is considered minor when its potential maximum emissions with all treatment controls hypothetically removed cannot cause a dose at the nearest residence to exceed 0.1 mrem/yr EDE. All major and minor stack emissions in 1993 combined resulted in doses below 0.1 mrem/yr EDE.

Each emission point listed has information on discharge height, distance to the nearest offsite residence, type and efficiency of any emission control, and the 1993 releases, in curies, by radionuclide or type of radioactivity.

Distances to the nearest offsite residence from reference points for stacks on the Hanford Site are listed in Table 2-2. The stacks are grouped by operating area, resulting in a single distance applicable to all the stacks in that area. Reporting these distances is a requirement of 40 CFR 61 (EPA 1993).

The distances to the respective nearest residences, and not the MEI, were used in determining whether a stack was major or minor (WHC 1991). These distances, however, were not used in calculating the EDEs reported in this document. Instead, the distances from each operating area to the MEI location at the farm east of the 300 Area were used in the EDE calculations. The MEI location represents the receptor point for maximizing the dose from the total combined emissions of all Hanford Site stacks, not just those in individual operating areas.

An example of the difference between the two sets of distances is represented by the 200 West Area. The distance from 200 West Area stacks to the nearest residence is 15 mi (24 km) east. But the distance from 200 West Area stacks to the Hanford Site MEI location at the 300 Area farm is 22 mi (35 km) southeast.

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 1 of 11)

Major Stack (has potential of >0.1 mrem/yr EDE to nearest offsite residence) <sup>a</sup>							
ID <sup>b</sup> (location)	Discharge Height (m)	Nearest Residence <sup>c</sup>	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>	EDE <sup>f</sup> (mrem/yr) <sup>j</sup>
291-A-1 (PUREX Plant, 200 East Area)	61.0	16 km east	HEPA, charcoal	1.5 E+09	<sup>90</sup> Sr	4.9 E-05	1.5 E-06
					<sup>129</sup> I	4.8 E-03	9.5 E-04
					<sup>137</sup> Cs	1.4 E-04	9.1 E-06
					<sup>147</sup> Pm	1.1 E-04	2.8 E-08
					<sup>212</sup> Pb	9.7 E-04	7.2 E-07
					<sup>220</sup> Rn <sup>j</sup>	1.2 E+01	
					<sup>238</sup> Pu	3.2 E-06	5.9 E-06
					<sup>239,240</sup> Pu	4.9 E-06	9.8 E-06
					<sup>241</sup> Pu	3.3 E-05	1.0 E-06
					<sup>241</sup> Am	2.7 E-05	8.2 E-05
291-B-1 (B Plant, 200 East Area)	61.0	16 km east	HEPA	7.3 E+08	<sup>90</sup> Sr	6.5 E-05	2.0 E-06
					<sup>137</sup> Cs	1.3 E-03	8.4 E-05
					<sup>239,240</sup> Pu	4.0 E-06	8.0 E-06
296-A-22 (200-E Evaporator, 200 East Area)	18.6	16 km east	HEPA	2.4 E+06	<sup>90</sup> Sr	ND <sup>g</sup>	--
					<sup>239,240</sup> Pu	ND	--
					<sup>241</sup> Am	ND	--
296-A-40 (241-AP Tank Farm, 200 East Area)	4.1	16 km east	HEPA	1.3 E+07	<sup>90</sup> Sr total alpha	6.6 E-08 ND	2.0 E-09
296-A-1 (PUREX Plant, 200 East Area)	20.7	16 km east	HEPA	7.5 E+07	<sup>239,240</sup> Pu	2.1 E-06	4.2 E-06
					<sup>241</sup> Am	8.4 E-07	2.6 E-06
					total beta	3.4 E-07	1.0 E-08
296-A-17 (Tank Farms, 200 East Area)	15.2	16 km east	HEPA	6.8 E+07	<sup>90</sup> Sr	8.2 E-06	2.5 E-07
					<sup>129</sup> I	4.6 E-05	9.1 E-06
					<sup>137</sup> Cs	5.3 E-05	3.4 E-06
					total alpha	5.7 E-09	1.1 E-08
296-A-27 (Tank Farms, 200 East Area)	3.7	16 km east	HEPA	1.6 E+07	<sup>90</sup> Sr	2.8 E-08	8.3 E-10
					<sup>137</sup> Cs	1.6 E-07	1.0 E-08
					total alpha	1.5 E-08	3.0 E-08
296-A-29 (Tank Farms, 200 East Area)	3.7	16 km east	HEPA	1.1 E+07	<sup>90</sup> Sr total alpha	1.2 E-07 ND	3.7 E-09
296-P-16 (Tank Farms, 200 East Area)	4.6	16 km east	HEPA	5.7 E+07	total alpha	1.8 E-08	3.6 E-08
					total beta	1.4 E-05	4.3 E-07
291-Z-1 (PFP, 200 West Area)	61.0	24 km east	HEPA	3.7 E+09	<sup>239,240</sup> Pu	5.1 E-04	7.9 E-04
					<sup>241</sup> Pu	3.4 E-03	8.3 E-05
					<sup>241</sup> Am	9.3 E-05	2.2 E-04
					total beta	4.4 E-05	1.1 E-06

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 2 of 11)

Major Stack (has potential of >0.1 mrem/yr EDE to nearest offsite residence) <sup>a</sup>							
ID <sup>b</sup> (location)	Discharge Height (m)	Nearest Residence <sup>c</sup>	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>	EDE <sup>f</sup> (mrem/yr) <sup>i</sup>
296-Z-3 (PFP, 200 West Area)	7.3	24 km east	HEPA	2.7 E+07	<sup>239,240</sup> Pu	4.4 E-07	6.8 E-07
					<sup>241</sup> Am	1.9 E-07	4.4 E-07
					total beta	4.5 E-08	1.1 E-09
296-P-23 (Tank Farms, 200 West Area)	4.0	24 km east	HEPA	1.5 E+07	total alpha	8.1 E-09	1.3 E-08
					total beta	7.0 E-07	1.7 E-08
296-S-15 (Tank Farms, 200 West Area)	4.6	24 km east	HEPA	4.8 E+07	total alpha total beta	ND 9.1 E-08	2.2 E-09
340-NT-EX (340 Waste Handling, 300 Area)	5.5	1.4 km northeast	HEPA, charcoal	2.5 E+07	total alpha total beta	1.3 E-08 5.5 E-08	1.4 E-06 4.8 E-07
EP-324-01-S (324 Bldg., 300 Area)	48.4	1.9 km south	HEPA	1.1 E+09	<sup>3</sup> H (asHTO) <sup>h</sup>	2.1 E+00	5.7 E-04
					<sup>3</sup> H (as HT) <sup>h</sup>	1.6 E+00	4.4 E-06
					<sup>134</sup> Cs	3.3 E-07	3.7 E-07
					<sup>239,240</sup> Pu	9.3 E-10	1.0 E-07
EP-325-01-S (325 Bldg., 300 Area)	17.9	1.9 km south	HEPA	1.9 E+09	<sup>3</sup> H (as HTO)	8.5 E+00	2.3 E-03
					<sup>3</sup> H (as HT)	8.5 E+00	2.3 E-05
					<sup>241</sup> Am	5.2 E-08	8.8 E-06
					<sup>125</sup> Sb	1.5 E-06	5.1 E-07
					<sup>137</sup> Cs	1.6 E-07	4.8 E-07
					<sup>154</sup> Eu	1.4 E-06	3.5 E-06
					<sup>238</sup> Pu	6.7 E-08	6.8 E-06
					<sup>239,240</sup> Pu	9.8 E-07	1.1 E-04
					<sup>90</sup> Sr	8.7 E-07	1.2 E-06
					EP-327-01-S (327 Bldg., 300 Area)	13.7	1.9 km south
<sup>137</sup> Cs	7.7 E-07	2.3 E-06					
<sup>238</sup> Pu	1.5 E-09	1.5 E-07					
<sup>239,240</sup> Pu	7.1 E-09	7.8 E-07					
<sup>220</sup> Rn <sup>j</sup>	8.5 E+01						
<sup>222</sup> Rn <sup>j</sup>	1.5 E+00						
<sup>90</sup> Sr	1.2 E-07	1.7 E-07					
EP-327-02-V (327 Decon. Cell, 300 Area)	9.1	1.9 km south	HEPA	1.0 E+07	<sup>241</sup> Am	2.9 E-11	4.9 E-09
					<sup>137</sup> Cs	3.8 E-09	1.1 E-08
					<sup>238</sup> Pu	3.3 E-11	3.3 E-09
					<sup>239,240</sup> Pu	1.9 E-10	2.1 E-08
					<sup>90</sup> Sr	6.3 E-10	9.0 E-10

**Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993.** (sheet 3 of 11)

<b>Major Stack (has potential of &gt;0.1 mrem/yr EDE to nearest offsite residence)<sup>a</sup></b>							
<b>ID<sup>b</sup> (location)</b>	<b>Discharge Height (m)</b>	<b>Nearest Residence<sup>c</sup></b>	<b>Emission Control<sup>d</sup></b>	<b>Total Flow (m<sup>3</sup>)</b>	<b>Radionuclide</b>	<b>Curies<sup>e</sup></b>	<b>EDE<sup>f</sup> (mrem/yr)<sup>i</sup></b>
EP-3720-01-S (3720 Bldg., 300 Area)	9.1	1.9 km south	HEPA	3.7 E+08	<sup>125</sup> Sb	1.4 E-08	4.8 E-09
					<sup>60</sup> Co	1.4 E-08	4.4 E-08
					<sup>154</sup> Eu	9.0 E-08	2.3 E-07
					<sup>155</sup> Eu	2.6 E-08	2.7 E-09
					<sup>239,240</sup> Pu	1.9 E-10	2.1 E-08

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 4 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>100 Areas Stacks</b>					
116-N (100-N Area)	61.3	HEPA, charcoal	1.0 E+09	<sup>60</sup> Co <sup>90</sup> Sr <sup>125</sup> Sb <sup>155</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu <sup>241</sup> Am	2.7 E-06 2.4 E-06 3.2 E-06 1.3 E-06 2.7 E-08 4.5 E-07 1.6 E-07
109-N-Z-1 (100-N Area)	13.7	none	(did not operate)		
109-N-C-6 (100-N Area)	13.7	none	(did not operate)		
105-N 14-ft Decontamination Room (100-N Area); not registered with WDOH	8.5	HEPA	9.5 E+07	<sup>60</sup> Co <sup>90</sup> Sr <sup>137</sup> Cs <sup>154</sup> Eu <sup>239,240</sup> Pu <sup>241</sup> Am	5.3 E-08 6.9 E-08 6.9 E-08 4.3 E-07 5.1 E-10 2.1 E-09
105-N Transfer Area (100-N Area); not registered with WDOH	18	none		<sup>60</sup> Co <sup>90</sup> Sr <sup>106</sup> Ru <sup>125</sup> Sb <sup>155</sup> Eu <sup>239,240</sup> Pu <sup>241</sup> Am	2.3 E-07 1.0 E-07 1.8 E-06 5.4 E-07 3.3 E-07 1.4 E-09 2.3 E-09
107-N Basin Recirculation Facility (100-N Area); not registered with WDOH	12	HEPA	1.1 E+08	<sup>60</sup> Co <sup>90</sup> Sr <sup>106</sup> Ru <sup>134</sup> Cs <sup>137</sup> Cs <sup>155</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu	3.7 E-08 1.0 E-08 7.6 E-07 6.0 E-09 2.4 E-08 1.6 E-08 6.6 E-10 7.3 E-10
105-KE (KE Basin, 100-KE Area)	12.8	none	7.4 E+08	<sup>60</sup> Co <sup>90</sup> Sr <sup>106</sup> Ru <sup>125</sup> Sb <sup>137</sup> Cs <sup>154</sup> Eu <sup>155</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu <sup>241</sup> Am	2.2 E-06 5.0 E-05 7.6 E-06 7.6 E-07 1.4 E-04 3.9 E-06 1.1 E-06 9.9 E-07 7.7 E-06 5.2 E-06

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 5 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>100 Areas Stacks (continued)</b>					
105-KW (KW Basin, 100-KW Area)	12.8	none	7.4 E+08	<sup>90</sup> Sr <sup>106</sup> Ru <sup>125</sup> Sb <sup>137</sup> Cs <sup>154</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu <sup>241</sup> Am	1.7 E-06 1.6 E-06 1.2 E-06 2.1 E-05 1.9 E-06 7.5 E-09 5.3 E-08 4.0 E-08
1706-KER (-27-ft Laboratory Basement, 100-KE Area);	0.9	HEPA	1.8 E+08	<sup>90</sup> Sr <sup>125</sup> Sb <sup>134</sup> Cs <sup>137</sup> Cs <sup>154</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu <sup>241</sup> Am	3.3 E-08 5.0 E-08 4.9 E-09 3.4 E-08 4.7 E-08 3.0 E-10 1.1 E-09 6.6 E-10
1706-KE (Laboratory, 100-KE Area)	7.6	HEPA	3.7 E+07	<sup>90</sup> Sr <sup>106</sup> Ru <sup>125</sup> Sb <sup>134</sup> Cs <sup>155</sup> Eu <sup>238</sup> Pu <sup>239,240</sup> Pu	2.4 E-08 1.3 E-06 2.6 E-07 7.8 E-08 9.1 E-08 6.1 E-10 7.4 E-09
<b>200 East Area Stacks</b>					
296-A-2 (PUREX Plant)	20.7	HEPA	7.0 E+07	ND	
296-A-3 (PUREX Plant)	24.1	HEPA	4.2 E+07	total alpha total beta	4.4 E-08 4.8 E-07
296-A-5A (PUREX Plant)	17.1	HEPA	3.1 E+08	<sup>239,240</sup> Pu total beta	ND ND
296-A-5B (PUREX Plant)	17.1	HEPA	3.2 E+08	<sup>239,240</sup> Pu total beta	ND ND
296-A-6 (PUREX Plant)	20.7	HEPA	1.9 E+08	<sup>239,240</sup> Pu total beta	ND 1.0 E-07
296-A-7 (PUREX Plant)	20.7	HEPA	2.7 E+08	total beta	2.2 E-06
296-A-8 (PUREX Plant)	20.7	HEPA	1.3 E+08	total beta	2.6 E-07
296-A-10 (PUREX Plant)	4.6	HEPA	8.2 E+07	ND	
296-A-14 (PUREX Plant)	9.1	HEPA	7.3 E+07	ND	

**Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993.** (sheet 6 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>200 East Area Stacks (continued)</b>					
296-A-24 (PUREX Plant)	20.7	HEPA	(did not operate)		
296-A-33 (PUREX Plant)	6.1	none	(did not operate)		
296-A-34 (PUREX Plant)	6.1	none	(did not operate)		
296-A-35 (PUREX Plant)	6.1	none	(did not operate)		
296-A-36 (PUREX Plant)	6.1	none	(did not operate)		
296-A-37 (PUREX Plant)	6.1	none	(did not operate)		
296-A-38 (PUREX Plant)	6.1	none	(did not operate)		
296-B-5 (B Plant)	3.7	HEPA	1.8 E+07	total beta	2.1 E-08
296-B-10 (B Plant)	22.9	HEPA	2.4 E+08	<sup>90</sup> Sr <sup>137</sup> Cs	2.6 E-06 3.9 E-06
296-B-13 (B Plant)	3.5	HEPA	1.0 E+07	total beta	3.2 E-08
296-B-14 (B Plant)	0.0	HEPA	(did not operate)		
296-A-12 (AR Vault)	45.7	HEPA	(did not operate)		
296-A-13 (AR Vault)	38.1	HEPA	4.0 E+07	total alpha total beta	2.3 E-08 1.1 E-07
296-A-18 (Tank Farms)	4.6	HEPA	(did not operate)		
296-A-19 (Tank Farms)	4.6	HEPA	(did not operate)		
296-A-20 (Tank Farms)	7.3	HEPA	1.0 E+07	total beta	3.0 E-08
296-A-21 (Evaporator)	6.7	HEPA	2.8 E+08	ND	
296-A-26 (Tank Farms)	9.4	HEPA	2.5 E+07	ND	
296-A-28 (Tank Farms)	3.7	HEPA	5.7 E+07	total alpha total beta	1.1 E-08 3.6 E-07
296-A-30 (Tank Farms)	3.7	HEPA	3.7 E+07	total alpha total beta	ND 4.9 E-09
296-A-41 (Tank Farms)	8.9	HEPA	1.4 E+08	total alpha total beta	3.5 E-08 ND
296-P-17 (Tank Farms)	4.6	HEPA	(did not operate)		
296-G-1 (Grout)	7.6	HEPA	(did not operate)		
296-P-31 (209-E Bldg.)	10.0	HEPA	3.0 E+07	total alpha	8.2 E-09

**Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993.** (sheet 7 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>200 East Area Stacks (continued)</b>					
296-C-5 (CR Vault)	14.6	HEPA	5.0 E+07	total alpha total beta	2.0 E-08 1.2 E-06
296-A-25 (Tank Farms)	3.0	HEPA	(did not operate)		
296-B-28 (Tank Farms)	3.4	HEPA	8.2 E+05	total alpha total beta	5.2 E-10 1.3 E-08
<b>200 West Area Stacks</b>					
291-S-1 (S Plant)	61.0	sand filter	2.8 E+08	<sup>239,240</sup> Pu total beta	2.8 E-07 1.2 E-06
296-S-2 (S Plant)	20.7	HEPA	1.0 E+07	total alpha total beta	6.6 E-09 2.4 E-08
296-S-4 (S Plant)	20.7	HEPA	5.3 E+07	total alpha total beta	1.1 E-07 8.6 E-07
296-S-6 (S Plant)	20.7	none	1.4 E+08	total alpha total beta	2.8 E-07 4.6 E-06
296-S-7W (S Plant)	7.6	HEPA	1.3 E+08	<sup>239,240</sup> Pu <sup>241</sup> Am total beta	7.6 E-07 7.0 E-07 ND
291-T-1 (T Plant, 200 West Area)	61.0	HEPA	4.4 E+08	<sup>90</sup> Sr <sup>137</sup> Cs <sup>239,240</sup> Pu <sup>241</sup> Am	3.4 E-05 2.5 E-05 2.3 E-05 4.8 E-06
296-T-11 (T Plant)	7.6	HEPA	2.4 E+08	<sup>239,240</sup> Pu total beta	ND 1.0 E-06
296-T-12 (T Plant)	7.6	HEPA	7.9 E+07	ND	
296-T-13 (T Plant)	20.7	HEPA	5.5 E+07	<sup>239,240</sup> Pu total beta	1.1 E-05 5.8 E-06
291-U-1 (U Plant)	61.0	sand filter	3.6 E+08	<sup>90</sup> Sr <sup>137</sup> Cs <sup>239,240</sup> Pu	2.9 E-05 2.0 E-04 1.9 E-06
296-U-2 (U Plant)	24.4	HEPA	6.3 E+06	U, total total alpha total beta	3.3 E-07 2.6 E-07 4.1 E-07

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 8 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>200 West Area Stacks (continued)</b>					
296-U-4 (UO <sub>2</sub> )	42.7	none	3.3 E+07	<sup>90</sup> Sr <sup>106</sup> Ru <sup>137</sup> Cs U, total <sup>239,240</sup> Pu	2.6 E-07 4.0 E-06 2.3 E-07 1.5 E-05 4.3 E-08
296-U-13 (U Plant)	8.2	HEPA	6.3 E+06	U, total	1.9 E-06
296-Z-5 (PFP)	4.6	HEPA	1.5 E+08	<sup>241</sup> Am	7.9 E-07
296-Z-6 (PFP)	0.9	HEPA	1.4 E+08	total alpha	3.3 E-08
296-Z-10 (PFP)	10	HEPA	3.7 E+07	(not record sampled)	
296-Z-11 (PFP)	4	HEPA	5.6 E+07	(not record sampled)	
296-Z-14 (PFP)	6.1	HEPA	2.5 E+07	total alpha total beta	3.7 E-09 ND
296-P-22 (Tank Farms)	4.6	HEPA	9.3 E+06	ND	
296-S-22 (Tank Farms)	3.7	HEPA	(did not operate)		
296-T-18 (Tank Farms)	3.7	HEPA	1.6 E+06	total alpha total beta	1.8 E-09 5.4 E-08
296-S-18 (Evaporator)	6.7	HEPA	2.5 E+08	<sup>239,240</sup> Pu total beta	ND 2.7 E-07
296-T-17 (Evaporator)	10.1	HEPA	1.5 E+07	total alpha total beta	1.3 E-09 ND
296-W-1 (Laundry)	6.7	none	2.1 E+08	<sup>239,240</sup> Pu total beta	4.4 E-07 5.3 E-06
296-S-16 (222-S Lab)	3.0	HEPA	2.0 E+06	total alpha total beta	4.5 E-09 6.0 E-08
296-S-21 (222-S Lab)	11.6	HEPA	9.8 E+08	ND	
296-W-3 (Waste Compactor)	7.6	HEPA	3.4 E+07	total alpha total beta	ND 1.1 E-08
<b>300 Area Stacks</b>					
EP-3745-01-S (3745 Bldg.)	2	HEPA	9.4 E+06	total alpha total beta	1.2 E-08 4.3 E-08
EP-3746A-01-V (3746-A Bldg.)	4	HEPA	5.1 E+07	total alpha total beta	4.4 E-08 2.2 E-07
377-GEL (377 Bldg.)	10	HEPA	4.5 E+07	total alpha total beta	7.7 E-08 3.3 E-07

**Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993.** (sheet 9 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>300 Area Stacks (continued)</b>					
EP-303C-01-S (303-C Bldg.)	4	HEPA	1.0 E+07	total alpha total beta	1.9 E-08 1.3 E-07
306E-ULAB (306-E Bldg.)	20.1	HEPA	3.9 E+07	total alpha total beta	3.6 E-08 1.1 E-07
EP-306W-01-V (306-W Bldg.)	8	HEPA	2.2 E+08	total alpha total beta	1.3 E-07 9.0 E-07
EP-306W-02-V (306-W Bldg.)	8	HEPA	2.7 E+08	total alpha total beta	1.6 E-07 1.1 E-06
EP-306W-03-V (306-W Bldg.)	8	HEPA	3.7 E+08	total alpha total beta	2.1 E-07 4.1 E-07
EP-306W-04-S (306-W Bldg.)	10	HEPA	3.7 E+08	total alpha total beta	1.4 E-07 2.2 E-07
308-GL-EX (308 Bldg.)	9.1	HEPA	5.0 E+07	total alpha total beta	2.7 E-08 1.8 E-07
308-ET-EX (308 Bldg.)	9.1	HEPA	5.2 E+07	total alpha total beta	4.4 E-08 1.5 E-07
308-TRIGA (308 Bldg.)	11.3	HEPA, charcoal	3.4 E+07	total alpha total beta	4.0 E-08 1.1 E-07
EP-314-01-S (314 Bldg.)	6	HEPA	4.8 E+07	total alpha total beta	3.9 E-08 7.1 E-07
EP-318-01-S (318 Bldg.)	9	HEPA	1.0 E+08	total alpha total beta	7.5 E-08 3.0 E-07
EP-320-01-S (320 Bldg.)	13	HEPA	6.4 E+08	total alpha total beta	6.4 E-07 4.8 E-06
EP-320-02-S (320 Bldg.)	8	HEPA	7.7 E+06	total alpha total beta	1.6 E-08 6.3 E-08
EP-320-03-S (320 Bldg.)	6	HEPA	1.4 E+07	total alpha total beta	2.4 E-08 1.3 E-07
EP-320-04-S (320 Bldg.)	6	HEPA	9.5 E+06	total alpha total beta	9.6 E-09 1.9 E-07
EP-323-01-S (323 Bldg.)	5	HEPA	7.8 E+07	total alpha total beta	1.1 E-07 3.5 E-07
EP-326-01-S (326 Bldg.)	14	HEPA	8.3 E+08	total alpha total beta	2.4 E-06 2.1 E-05

Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993. (sheet 10 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>d</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>300 Area Stacks (continued)</b>					
EP-329-01-V (329 Bldg.)	11	HEPA	1.1 E+08	total alpha total beta	1.5 E-07 1.0 E-06
EP-329-02-V (329 Bldg.)	10	HEPA	2.4 E+08	total alpha total beta	3.2 E-07 1.5 E-06
EP-329-03-V (329 Bldg.)	10	HEPA	8.1 E+07	total alpha total beta	3.5 E-07 2.5 E-06
EP-329-04-V (329 Bldg.)	5	HEPA	3.3 E+07	total alpha total beta	4.5 E-08 2.4 E-07
EP-331-01-V (formerly associated with "D1") (331 Bldg.)	15	HEPA	9.8 E+08	total alpha total beta	2.0 E-07 2.1 E-06
EP-331A-01-S (331-A Bldg.)	5	HEPA	1.0 E+08	total alpha total beta	2.6 E-08 4.5 E-07
EP-331A-02-V (331 Bldg.)	6	HEPA	8.5 E+06	total alpha total beta	2.3 E-09 1.4 E-08
EP-331H-01-S (331-H Bldg.)	6	HEPA	9.8 E+07	total alpha total beta	3.4 E-08 2.9 E-07
EP-3708-01-S (3708 Bldg.)	7	HEPA	9.4 E+07	total alpha total beta	6.3 E-08 4.9 E-07
EP-3720-02-S (3720 Bldg.)	5	HEPA	4.5 E+07	total alpha total beta	6.0 E-08 2.7 E-07
EP-3720-03-S (3720 Bldg.)	9	HEPA	8.4 E+07	total alpha total beta	4.7 E-08 1.3 E-07
EP-3730-01-S (3730 Bldg.)	5	HEPA	6.1 E+06	total alpha total beta	3.1 E-09 4.9 E-08
<b>400 Area Stacks</b>					
FFTF-CB-EX (FFTF)	14.3	none	3.6 E+08	<sup>41</sup> Ar <sup>3</sup> H total alpha total beta	ND 2.1 E+00 5.9 E-07 2.3 E-06
FFTF-RE-SB (FFTF)	6.1	none	1.9 E+08	total alpha total beta	1.4 E-06 4.5 E-06
FFTF-HT-TR (FFTF)	8.8	none	6.2 E+07	total alpha total beta	2.3 E-07 8.2 E-07
437-MN&ST (MASF)	9.1	HEPA	2.4 E+08	total alpha total beta	1.6 E-07 6.0 E-07

**Table 2-1. Hanford Site Radionuclide Air Emissions Data for 1993.** (sheet 11 of 11)

Minor Stack (has maximum dose potential of <0.1 mrem/yr EDE to nearest offsite residence <sup>a</sup> )					
ID <sup>b</sup> (location)	Discharge Height (m)	Emission Control <sup>d</sup>	Total Flow (m <sup>3</sup> )	Radionuclide	Curies <sup>e</sup>
<b>600 Area Stacks</b>					
EP-6652H-01-V (6652-H Bldg.)	3.6	HEPA	5.0 E+07	total alpha total beta	4.0 E-08 1.8 E-07

<sup>a</sup>Determining the state of National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart H compliance for each emission point involved using nearest offsite residences, which differed from the MEI.

<sup>b</sup>ID = Identification, i.e., the alpha-numeric designator for the respective stack or vent.

<sup>c</sup>Nearest residence = A residence closest to the specific area considered, as opposed to the entire Site, which is represented by the MEI location (farm east of the 300 Area).

<sup>d</sup>Efficiencies are: 99.95% for HEPA; 95% for charcoal; 99.8% for sand filter; 0% for no emission control.

<sup>e</sup>1 Curie = 3.7 E+10 Becquerel

<sup>f</sup>EDE = Effective dose equivalent for the MEI (farm east of the 300 Area), not the nearest residence.

<sup>g</sup>ND = none detected, i.e., the average of all the measurements for that given radionuclide or type of radioactivity made during the year was below background levels.

<sup>h</sup>HTO is tritium as condensable water vapor; HT is tritium as noncondensable gas.

<sup>i</sup>1 mrem = 1 E-02 mSv

<sup>j</sup>A description of the offsite dose effects of radon emissions is provided in Section 5.3.

**Table 2-2. Distances to the Nearest Offsite Residences from Hanford Site Areas.**

Area	Nearest Offsite Residence
100 Areas	6.1 mi (9.9 km) west
200 East Area	9.9 mi (16 km) east
200 West Area	15 mi (24 km) east
300 Area	0.87 mi (1.4 km) northeast*; 0.62 mi (1.0 km) south**
400 Area	5.0 mi (8.1 km) south
600 Area	1.5 mi (2.4 km) south-southeast

\*Westinghouse Hanford stacks

\*\*PNL stacks

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### 3.0 POINT-SOURCE EMISSION DOSE ASSESSMENTS

#### 3.1 DESCRIPTION OF POINT-SOURCE EMISSION DOSE MODEL

The CAP88-PC computer code (Parks 1992) was used to demonstrate compliance with the 10 mrem/yr EDE standard in 40 CFR Part 61.92. Because the Hanford Site has numerous release points that are widely separated from each other, it was necessary to determine the point at which the maximum dose would be received from combined air emissions at all locations. Emission points used for modeling purposes were centered on each of the major Hanford Site operating areas that released radionuclides to the atmosphere during 1993. In the case of the 200 Areas, the reference points were the major sources in the 200 East and 200 West areas, the PUREX facility and the Plutonium Finishing Plant, respectively. The location selected for the compliance analysis was a farm on Sagamore Road, directly across the Columbia River from the site boundary to the east of the 300 Area. The actual stack releases from each operating area are listed in Table 3-1. The major operating areas and their location with respect to the maximally exposed individual at the Sagamore Road farm are listed in Table 3-2. Table 3-2 also lists the dose to this receptor of a 1-Ci release of specific radionuclides at each location. The distribution of dose to this individual by radionuclide from each release point is presented in Table 3-3.

#### 3.2 SUMMARY OF INPUT PARAMETERS

Dose calculations were performed using established standard parameters for the Hanford Site and its environment (Schreckhise et al 1993). Releases from stacks were modeled using an effective stack height as shown in Table 3-1. The dose from elemental tritium (HT) was estimated by assuming that it contributes approximately 1% of the dose from a comparable release of tritiated water vapor (HTO) as a result of oxidation in the environment (Brown 1989). This was necessary because CAP-88 uses a specific-activity model based on tritium as water vapor, which overestimates the dose from elemental tritium by several orders of magnitude. Releases of  $^{220}\text{Rn}$  were modeled by assuming that this short-lived gas had decayed to the next long-lived member of its decay chain,  $^{212}\text{Pb}$ , before transport offsite. Releases reported as total alpha or total beta were evaluated as  $^{239,240}\text{Pu}$  or  $^{90}\text{Sr}$ , respectively, to conservatively estimate their expected impact. The 400 Area total beta measurements were modelled as  $^{137}\text{Cs}$ .

A combination of actual radionuclide data and default values from the CAP-88 data libraries for radionuclide-specific parameters were used in the dose calculations. Parameters used for the ingestion pathway assumed that the receptor's entire diet was produced at the MEI residence and that maximum individual exposure and consumption parameters were those determined previously for the Hanford Site. Ingestion of food was not considered for radon releases from the 300 Area because the releases occurred from October to December when crop production is minimal.

Table 3-1. Release Estimates of Hanford Site  
Radionuclide Air Emissions in 1993.

Release Location ▶	100 Areas	200 East Area	200 West Area	300 Area	400 Area	Total
Release Height ▶	89 m	89 m	89 m	10 m	10 m	
Radionuclide ▼	(Ci) <sup>a</sup>					
<sup>3</sup> H				1.1 E+01 <sup>b</sup>	2.1 E+00	1.3 E+01
<sup>60</sup> Co	5.2 E-06			1.4 E-08		5.2 E-06
<sup>90</sup> Sr	5.4 E-05	1.4 E-04 <sup>c</sup>	1.3 E-04 <sup>c</sup>	4.3 E-05 <sup>c</sup>		3.7 E-04
<sup>106</sup> Ru	1.3 E-05		4.0 E-06			1.7 E-05
<sup>125</sup> Sb	6.0 E-06			1.5 E-06		7.5 E-06
<sup>129</sup> I		4.8 E-03				4.8 E-03
<sup>134</sup> Cs	8.9 E-08			3.3 E-07		4.2 E-07
<sup>137</sup> Cs	1.6 E-04	1.5 E-03	2.3 E-04	9.3 E-07	8.2 E-06	1.9 E-03
<sup>147</sup> Pm		1.1 E-04				1.1 E-04
<sup>154</sup> Eu	6.3 E-06			1.5 E-06		7.8 E-06
<sup>155</sup> Eu	2.8 E-06			2.6 E-08		2.8 E-06
<sup>212</sup> Pb		9.7 E-04				9.7 E-04
<sup>220</sup> Rn		12		8.5 E+01		9.7 E+01
<sup>222</sup> Rn				1.5 E+00		1.5 E+00
<sup>234</sup> U			9.5 E-06	5.9 E-09		9.5 E-06
<sup>235</sup> U			3.4 E-07	6.2 E-10		3.4 E-07
<sup>236</sup> U			6.8 E-07			6.8 E-07
<sup>238</sup> U			6.5 E-06	5.9 E-09		6.5 E-06
<sup>238</sup> Pu	1.0 E-06	3.2 E-06		6.9 E-08		4.3 E-06
<sup>239,240</sup> Pu	8.2 E-06	1.1 E-05 <sup>d</sup>	5.5 E-04 <sup>d</sup>	7.0 E-06 <sup>d</sup>	2.4 E-06	5.8 E-04
<sup>241</sup> Pu		3.3 E-05	3.4 E-03			3.4 E-03
<sup>241</sup> Am	5.4 E-06	2.8 E-05	9.9 E-05	5.5 E-08		1.3 E-04

<sup>a</sup>1 Ci = 3.7 E+10 Becquerel

<sup>b</sup>The tritium includes contributions from both HTO and HT. The HT release was converted to equivalent curies of HTO for reporting purposes. Since 1 Ci of HT is equivalent, in terms of dose effect, to 0.1 Ci of HTO, the 10 Ci HT release is converted to 0.1 Ci of equivalent HTO and added to the 11 Ci HTO release yields the 11 Ci reported.

<sup>c</sup>This value represents both <sup>90</sup>Sr and total beta release data. For dose calculations, total beta data are construed conservatively as <sup>90</sup>Sr for those stacks whose emissions are not analyzed for this radionuclide.

<sup>d</sup>This value represents both <sup>239,240</sup>Pu and total alpha releases. For dose calculations, total alpha data are construed conservatively as <sup>239,240</sup>Pu for stacks whose emissions are not analyzed for this radionuclide.

**Table 3-2. CAP-88 Unit Dose Factors for the Offsite Hypothetical Maximally Exposed Individual Affected by Radionuclide Air Emissions from the Hanford Site in 1993.**

Release Location ▶	100 Areas	200 East Area	200 West Area	300 Area	400 Area
Release Height ▶	89 m	89 m	89 m	10m	10m
MEI <sup>a</sup> Location ▶	25 mi (41 km)SE	17 mi (28 km) SE	22 mi (35 km)SE	0.9 mi (1.5 km)E	6.8 mi (11 km) SE
Radionuclide ▼	Effective Dose Equivalent (mrem/Ci-yr) <sup>b</sup>				
<sup>3</sup> H				2.7 E-04	2.5 E-05
<sup>60</sup> Co	2.1 E-02			3.1 E+00	
<sup>90</sup> Sr	9.4 E-03	3.1 E-02	2.4 E-02	1.4 E+00	
<sup>106</sup> Ru	1.2 E-03		3.0 E-03		
<sup>125</sup> Sb	2.3 E-03			3.4 E-01	
<sup>129</sup> I		2.0 E-01			
<sup>134</sup> Cs	7.4 E-03			1.1 E+00	
<sup>137</sup> Cs	2.0 E-02	6.5 E-02	5.2 E-02	3.0 E+00	2.4 E-01
<sup>147</sup> Pm		2.6 E-04			
<sup>154</sup> Eu	1.8 E-02			2.5 E+00	
<sup>155</sup> Eu	6.8 E-04			1.0 E-01	
<sup>212</sup> Pb		7.4 E-04			
<sup>234</sup> U			5.8 E-01	4.1 E+01	
<sup>235</sup> U			5.6 E-01	3.9 E+01	
<sup>236</sup> U			5.4 E-01		
<sup>238</sup> U			5.1 E-01	3.7 E+01	
<sup>238</sup> Pu	5.3 E-01	1.8 E+00		1.0 E+02	
<sup>239,240</sup> Pu	5.7 E-01	2.0 E+00	1.6 E+00	1.1 E+02	8.3 E+00
<sup>241</sup> Pu		3.0 E-02	2.4 E-02		
<sup>241</sup> Am	8.7 E-01	3.0 E+00	2.3 E+00	1.7 E+02	

<sup>a</sup>MEI = Maximally exposed individual.

<sup>b</sup>1mrem = 1.0 E-02 mSv; 1 Ci = 3.7 E+10 Becquerel

**Table 3-3.** CAP-88 Dose Estimates for the Offsite Hypothetical Maximally Exposed Individual Affected by Radionuclide Air Emissions from the Hanford Site in 1993.

Release Location	100 Areas		200 East Area		200 West Area		300 Area		400 Area		Site Total	
Nuclide	Dose (mrem) <sup>a</sup>	% Area Total	Dose (mrem)	%								
<sup>3</sup> H							3.0 E-03	77.8	5.2 E-05	70.3	3.1 E-03	48.6
<sup>60</sup> Co	1.1 E-07	0.8					4.4 E-08	0.0			1.5 E-07	0.0
<sup>90</sup> Sr <sup>b</sup>	5.1 E-07	3.6	4.3 E-06	0.4	3.1 E-06	0.3	6.1 E-05	1.6			6.9 E-05	1.1
<sup>106</sup> Ru	1.5 E-08	0.1			1.2 E-08	0.0					2.7 E-08	0.0
<sup>125</sup> Sb	1.4 E-08	0.1					5.1 E-07	0.0			5.2 E-07	0.0
<sup>129</sup> I			9.5 E-04	81.5							9.5 E-04	15.1
<sup>134</sup> Cs	6.6 E-10	0.0					3.7 E-07	0.0			3.7 E-07	0.0
<sup>137m</sup> Cs/Ba	3.2 E-06	23.0	9.7 E-05	8.3	1.2 E-05	1.0	2.8 E-06	0.1	1.9 E-06	2.6	1.2 E-04	1.9
<sup>147</sup> Pm			2.8 E-08	0.0							2.8 E-08	0.0
<sup>154</sup> Eu	1.1 E-07	0.8					3.8 E-06	0.1			3.9 E-06	0.1
<sup>155</sup> Eu	1.9 E-09	0.0					2.7 E-09	0.0			4.6 E-09	0.0
<sup>212</sup> Pb			7.2 E-07	0.1							7.2 E-07	0.0
<sup>234</sup> U					5.5 E-06	0.5	2.4 E-07	0.0			5.7 E-06	0.1
<sup>235</sup> U					1.9 E-07	0.0	2.4 E-08	0.0			2.1 E-07	0.0
<sup>236</sup> U					3.7 E-07	0.0					3.7 E-07	0.0
<sup>238</sup> U					3.3 E-06	0.3	2.2 E-07	0.0			3.6 E-06	0.1
<sup>238</sup> Pu	5.3 E-07	3.8	5.9 E-06	0.5			7.0 E-06	0.2			1.3 E-05	0.2
<sup>239,240</sup> Pu <sup>c</sup>	4.7 E-06	33.6	2.2 E-05	1.9	8.5 E-04	71.6	7.7 E-04	20.0	2.0 E-05	27.0	1.7 E-03	26.4
<sup>241</sup> Pu			1.0 E-06	0.1	8.3 E-05	7.0					8.4 E-05	1.3
<sup>241</sup> Am	4.7 E-06	33.6	8.5 E-05	7.3	2.3 E-04	19.4	9.3 E-06	0.2			3.3 E-04	5.3
<b>Area Total</b>	<b>1.4 E-05</b>		<b>1.2 E-03</b>		<b>1.2 E-03</b>		<b>3.9 E-03</b>		<b>7.4 E-05</b>		<b>6.3 E-03</b>	
<b>% Site Total</b>	<b>0.2</b>		<b>18.5</b>		<b>18.9</b>		<b>61.2</b>		<b>1.2</b>		<b>100</b>	
<sup>220</sup> Rn <sup>d</sup>			1.3 E-05				8.4 E-03				8.4 E-03	
<sup>222</sup> Rn							1.7 E-03				1.7 E-03	
<b>Total (inc. Rn)</b>	<b>1.4 E-05</b>		<b>1.2 E-03</b>		<b>1.2 E-03</b>		<b>1.4 E-02</b>		<b>7.4 E-05</b>		<b>1.6 E-02</b>	

<sup>a</sup>1 mrem = 1.0 E-02 mSv

<sup>b</sup>Values represent both total beta and <sup>90</sup>Sr release data. For dose calculations, the total beta data are construed conservatively as <sup>90</sup>Sr for those stacks whose emissions are not analyzed for this radionuclide.

<sup>c</sup>Values represent both total alpha and <sup>239,240</sup>Pu release data. For dose calculations, the total alpha data are construed conservatively as <sup>239,240</sup>Pu for those stacks whose emissions are not analyzed for this radionuclide.

<sup>d</sup>For dose modelling purposes, the <sup>220</sup>Rn is assumed to have decayed to <sup>212</sup>Pb prior to transport offsite.

Radionuclide air concentrations at the MEI location were determined using meteorological data specific to each release point. Joint frequency distributions and CAP-88 wind files were prepared from data collected at the network of weather stations positioned throughout the Hanford Site operating areas. These distributions represent the average of hourly data taken during 1993. This information was used to determine annual average dispersion coefficients for each collective emission point representing all the other emission points in the respective operating area. Atmospheric dispersion estimates for radon emissions from the 300 Area are based on data collected during the last quarter of the year to correspond with the period the radon releases were occurring.

### 3.3 COMPLIANCE ASSESSMENT

The combined dose to a receptor at the Sagemore Road farm from air emissions at all Hanford Site operating areas during 1993 was 0.0063 mrem EDE, which is less than 0.1% of the 10 mrem/y standard. As shown in Table 3-3, this dose resulted mainly from emissions related to activities at facilities in the 300 Area. Operations at the 300 Area accounted for approximately 60% of the offsite dose, and the contribution from 200 Area facilities made up the remainder. Radionuclides contributing more than 10% of the total dose included tritium,  $^{129}\text{I}$ , and  $^{239,240}\text{Pu}$  (or total alpha releases construed as  $^{239,240}\text{Pu}$ ).

The MEI for the Hanford Site compliance calculations is located approximately 1.5 km E of the 300 Area facilities, based on a hypothetical release point at the 324 Building. This location was chosen to represent the source of all 300 Area emissions because it is the closest major emissions source in the 300 Area. This location represented the point of maximum dose to an offsite individual during 1993 because of increased activities in the 300 Area and decreased emissions from the inactive 200 Area facilities, which have historically been the major source of emissions from the Hanford Site. The dose to an individual at Ringold, which has historically been the MEI from Hanford Site air emissions, was somewhat lower than the receptor at the Sagemore Road farm in 1993.

The percentage that each radionuclide contributed to the area and Hanford Site totals is shown in Table 3-3. Dose estimates and portions of the Hanford Site total dose attributable to each major stack and all the minor stacks and vents are shown in Table 3-4.

Again, for emphasis:

**HANFORD SITE EDE FOR 1993: 0.0063 mrem**

This dose is higher than the 1992 annual dose. The 1991 and 1992 doses were modelled using the mainframe version of CAP88 and an MEI location at Ringold. The 1993 dose was modelled using CAP88-PC, which relies on default parameters more than the mainframe version. Much of the increase in the 1993 dose can be attributed to the use of the CAP88-PC program and the greater contribution of 300 Area releases to the Sagemore Road farm MEI compared to the Ringold MEI. Below are the offsite MEI doses attributable to Hanford Site emissions for the previous three years.

- 0.0093 mrem EDE, for 1990 (DOE-RL 1991)
- 0.0068 mrem EDE, for 1991 (DOE-RL 1992)
- 0.0037 mrem EDE, for 1992 (DOE-RL 1993).

**Table 3-4.** Total Doses from Hanford Site Radionuclide Air Emissions in 1993.

Hanford Site Major Stacks	Dose (mrem <sup>a</sup> EDE <sup>b</sup> )	% of Hanford Site-Related Offsite Dose
291-A-1	1.06 E-03	16.8
291-Z-1	1.09 E-03	17.3
291-B-1	9.41 E-05	1.5
296-A-22	0.00 E+00	0.0
296-A-40	2.03 E-09	0.0
296-P-23	2.92 E-08	0.0
296-S-15	2.17 E-09	0.0
296-Z-3	1.12 E-06	0.0
296-A-1	6.76 E-06	0.1
296-A-17	1.28 E-05	0.2
296-P-16	4.66 E-07	0.0
296-A-27	4.12 E-08	0.0
296-A-29	3.68 E-09	0.0
340-NT-EX	3.67 E-06	0.1
EP-324-01-S	5.78 E-04	9.2
EP-325-01-S	2.47 E-03	39.1
EP-327-01-S	3.79 E-06	0.1
EP-327-02-V	3.81 E-08	0.0
EP-3720-01-S	3.00 E-07	0.0
<b>Major Stack Totals</b>	<b>5.32 E-03</b>	<b>84.4</b>
<b>Minor Stack Totals</b>	<b>9.82 E-04</b>	<b>15.6</b>
<b>ALL STACK TOTALS</b>	<b>6.3 E-03</b>	<b>100.0</b>

<sup>a</sup>1mrem = 1.0 E-02mSv<sup>b</sup>EDE = Effective dose equivalent.

### **3.4 METEOROLOGICAL DATA**

Radionuclide air emissions disperse once they enter the atmosphere. Atmospheric dispersion models predict the degree of dilution and the magnitude of resulting air concentrations. Site-specific measurements of the occurrence frequencies for wind speed, wind direction, and atmospheric stability are used in the models. The dispersion models yield annual average dispersion factors (in units of s/m<sup>3</sup>). Combining these factors with annual average release rates predicts average radionuclide air concentrations for the year. Annual average dispersion factors around the 100, 200, 300, and 400 Areas for 1993 are in Tables 3-5 through 3-8.

### **3.5 UNPLANNED RELEASES OF RADIONUCLIDES TO THE ATMOSPHERE**

During 1993, no unplanned releases of radionuclides to the atmosphere occurred from facilities at the Hanford Site. Releases from point sources on the Hanford Site were monitored. The resulting quantities of radionuclides released and the corresponding effective dose equivalents are reported in Sections 2.0 and 3.0 of this document.

### **3.6 ADDITIONAL INFORMATION**

#### **3.6.1 Projects Requiring Approval or Waiver Under 40 CFR 61**

No waivers of the approval process under 40 CFR 61.96 were exercised in 1993. In late 1992, the Environmental Protection Agency (EPA) determined that the Hanford Site was not in compliance with 40 CFR 61, Subpart H. Consequently, EPA approval was requested for all construction or modification projects with the potential to increase radionuclide air emissions.

EPA approval was obtained for the following projects that were completed in 1993 (EPA 1992).

Tank Farms received approval to erect vinyl greenhouses for specific routine maintenance activities. Approval to use a portable exhauster with the greenhouses was also received. The air emissions were projected to be below 0.1 mrem.

The 222-S Laboratory received approval to construct and operate a vinyl greenhouse at the 222-S Laboratory. The projected offsite dose was below 0.1 mrem per year.

Approval was received for the final processing of waste using concretion at the 304 Building. The projected offsite dose was below 0.1 mrem per year.

The 222-S Laboratory received approval for a small project involving  $^{85}\text{Kr}$  cylinder venting. The projected offsite dose was below 0.1 mrem per year.

B Plant received approval for two projects in 1993. The first project was for the K-3 filter changeout and addition of a washdown system. The projected offsite dose was below 0.1 mrem per year.

B Plant also received approval for a  $\text{CO}_2$  decontamination demonstration project. The projected offsite dose was below 0.1 mrem per year.

**Table 3-5. Annual Average Dispersion Around the 100-N Area in 1993  
for an 89-Meter Release Height.<sup>a</sup>**

Distance to MEI ▶	0.8 km	2.4 km	4.0 km	5.6 km	7.2 km	12 km	24 km	40 km	56 km	72 km
Direction ▼	$\bar{X}/Q'$									
N	9.59 E-08	6.53 E-08	5.40 E-08	4.33 E-08	3.54 E-08	2.21 E-08	1.07 E-08	6.08 E-09	4.14 E-09	3.09 E-09
NNE	4.69 E-08	4.00 E-08	3.34 E-08	2.67 E-08	2.18 E-08	1.35 E-08	6.56 E-09	3.75 E-09	2.57 E-09	1.94 E-09
NE	8.05 E-08	4.47 E-08	3.46 E-08	2.75 E-08	2.26 E-08	1.45 E-08	7.37 E-09	4.33 E-09	3.02 E-09	2.29 E-09
ENE	8.37 E-08	5.53 E-08	4.58 E-08	3.72 E-08	3.09 E-08	1.99 E-08	1.02 E-08	6.00 E-09	4.20 E-09	3.20 E-09
E	1.32 E-07	1.11 E-07	9.34 E-08	7.65 E-08	6.39 E-08	4.20 E-08	2.22 E-08	1.35 E-08	9.67 E-09	7.47 E-09
ESE	8.71 E-08	6.67 E-08	5.58 E-08	4.59 E-08	3.86 E-08	2.55 E-08	1.34 E-08	8.04 E-09	5.68 E-09	4.35 E-09
SE	9.48 E-08	6.39 E-08	5.02 E-08	3.95 E-08	3.21 E-08	2.01 E-08	1.01 E-08	5.97 E-09	4.20 E-09	3.22 E-09
SSE	8.60 E-08	5.46 E-08	4.15 E-08	3.25 E-08	2.65 E-08	1.68 E-08	8.60 E-09	5.13 E-09	3.62 E-09	2.77 E-09
S	1.02 E-07	6.19 E-08	4.89 E-08	3.87 E-08	3.16 E-08	1.99 E-08	9.94 E-09	5.82 E-09	4.07 E-09	3.10 E-09
SSW	9.67 E-08	4.50 E-08	3.40 E-08	2.66 E-08	2.17 E-08	1.37 E-08	6.89 E-09	4.06 E-09	2.85 E-09	2.17 E-09
SW	6.76 E-08	4.14 E-08	3.39 E-08	2.76 E-08	2.29 E-08	1.49 E-08	7.73 E-09	4.61 E-09	3.25 E-09	2.48 E-09
WSW	4.70 E-08	3.89 E-08	3.52 E-08	2.97 E-08	2.52 E-08	1.69 E-08	8.98 E-09	5.45 E-09	3.88 E-09	2.99 E-09
W	9.40 E-08	8.01 E-08	7.05 E-08	5.89 E-08	4.98 E-08	3.33 E-08	1.76 E-08	1.07 E-08	7.56 E-09	5.81 E-09
WNW	7.87 E-08	7.96 E-08	6.79 E-08	5.47 E-08	4.48 E-08	2.80 E-08	1.37 E-08	7.86 E-09	5.41 E-09	4.08 E-09
NW	7.97 E-08	7.95 E-08	6.75 E-08	5.44 E-08	4.45 E-08	2.78 E-08	1.34 E-08	7.60 E-09	5.18 E-09	3.88 E-09
NNW	4.36 E-08	4.79 E-08	4.13 E-08	3.34 E-08	2.75 E-08	1.72 E-08	8.39 E-09	4.77 E-09	3.26 E-09	2.44 E-09

<sup>a</sup>Calculated from meteorological data collected at the 100-N Area and the Hanford Meteorology Tower.

E = East.  
N = North.  
S = South.  
W = West.

**Table 3-6. Annual Average Dispersion Around the 200 Areas in 1993  
for an 89-Meter Release Height.<sup>a</sup>**

Distance to MEI ▶	0.8 km	2.4 km	4.0 km	5.6 km	7.2 km	12 km	24 km	40 km	56 km	72 km
Direction ▼	$\bar{X}/Q'$									
N	3.78 E-08	3.77 E-08	3.36 E-08	2.82 E-08	2.40 E-08	1.61 E-08	8.65 E-09	5.25 E-09	3.74 E-09	2.88 E-09
NNE	4.57 E-08	3.14 E-08	2.57 E-08	2.10 E-08	1.75 E-08	1.15 E-08	6.01 E-09	3.60 E-09	2.54 E-09	1.95 E-09
NE	5.54 E-08	3.45 E-08	2.91 E-08	2.41 E-08	2.04 E-08	1.36 E-08	7.16 E-09	4.29 E-09	3.02 E-09	2.31 E-09
ENE	5.27 E-08	3.46 E-08	3.04 E-08	2.56 E-08	2.18 E-08	1.48 E-08	8.08 E-09	5.00 E-09	3.60 E-09	2.80 E-09
E	5.99 E-08	6.75 E-08	6.07 E-08	5.09 E-08	4.30 E-08	2.84 E-08	1.49 E-08	8.90 E-09	6.28 E-09	4.80 E-09
ESE	3.96 E-08	5.52 E-08	5.07 E-08	4.27 E-08	3.60 E-08	2.36 E-08	1.21 E-08	7.09 E-09	4.94 E-09	3.75 E-09
SE	1.10 E-07	1.10 E-07	9.36 E-08	7.61 E-08	6.30 E-08	4.02 E-08	2.01 E-08	1.17 E-08	8.07 E-09	6.10 E-09
SSE	1.29 E-07	9.67 E-08	7.43 E-08	5.75 E-08	4.63 E-08	2.83 E-08	1.37 E-08	7.82 E-09	5.38 E-09	4.05 E-09
S	1.81 E-07	1.09 E-07	7.85 E-08	5.87 E-08	4.62 E-08	2.72 E-08	1.27 E-08	7.09 E-09	4.82 E-09	3.60 E-09
SSW	1.22 E-07	6.16 E-08	4.42 E-08	3.27 E-08	2.54 E-08	1.46 E-08	6.57 E-09	3.63 E-09	2.46 E-09	1.83 E-09
SW	1.07 E-07	5.40 E-08	4.00 E-08	3.02 E-08	2.38 E-08	1.40 E-08	6.49 E-09	3.62 E-09	2.46 E-09	1.84 E-09
WSW	8.75 E-08	5.32 E-08	3.96 E-08	2.97 E-08	2.33 E-08	1.35 E-08	6.13 E-09	3.37 E-09	2.27 E-09	1.69 E-09
W	9.77 E-08	7.38 E-08	5.70 E-08	4.36 E-08	3.45 E-08	2.03 E-08	9.36 E-09	5.24 E-09	3.58 E-09	2.69 E-09
WNW	6.90 E-08	3.94 E-08	3.13 E-08	2.47 E-08	2.00 E-08	1.23 E-08	5.86 E-09	3.30 E-09	2.25 E-09	1.68 E-09
NW	5.93 E-08	3.87 E-08	3.15 E-08	2.51 E-08	2.05 E-08	1.28 E-08	6.21 E-09	3.54 E-09	2.43 E-09	1.83 E-09
NNW	4.23 E-08	4.09 E-08	3.60 E-08	2.95 E-08	2.44 E-08	1.55 E-08	7.74 E-09	4.52 E-09	3.15 E-09	2.40 E-09

<sup>a</sup>Calculated from meteorological data collected at the Hanford Meteorology Tower.

E = East.  
N = North.  
S = South.  
W = West.

**Table 3-7. Annual Average Dispersion Around the 300 Area in 1993  
for a 10-Meter Release Height.<sup>a</sup>**

Distance to MEI ▶	0.8 km	2.4 km	4.0 km	5.6 km	7.2 km	12 km	24 km	40 km	56 km	72 km
Direction ▼	$\bar{X}/Q'$									
N	7.79 E-06	1.23 E-06	5.66 E-07	3.45 E-07	2.40 E-07	1.16 E-07	4.48 E-08	2.25 E-08	1.44 E-08	1.03 E-08
NNE	4.06 E-06	6.39 E-07	2.92 E-07	1.77 E-07	1.23 E-07	5.92 E-08	2.27 E-08	1.13 E-08	7.24 E-09	5.19 E-09
NE	3.53 E-06	5.54 E-07	2.53 E-07	1.53 E-07	1.06 E-07	5.13 E-08	1.97 E-08	9.86 E-09	6.31 E-09	4.52 E-09
ENE	2.65 E-06	4.17 E-07	1.91 E-07	1.16 E-07	8.03 E-08	3.88 E-08	1.49 E-08	7.45 E-09	4.76 E-09	3.41 E-09
E	4.09 E-06	6.47 E-07	2.96 E-07	1.80 E-07	1.25 E-07	6.06 E-08	2.33 E-08	1.17 E-08	7.44 E-09	5.33 E-09
ESE	3.42 E-06	5.44 E-07	2.50 E-07	1.53 E-07	1.06 E-07	5.17 E-08	2.00 E-08	1.00 E-08	6.44 E-09	4.62 E-09
SE	4.62 E-06	7.33 E-07	3.36 E-07	2.04 E-07	1.42 E-07	6.86 E-08	2.63 E-08	1.32 E-08	8.43 E-09	6.04 E-09
SSE	7.15 E-06	1.13 E-06	5.18 E-07	3.15 E-07	2.19 E-07	1.06 E-07	4.08 E-08	2.05 E-08	1.31 E-08	9.38 E-09
S	7.62 E-06	1.21 E-06	5.53 E-07	3.36 E-07	2.34 E-07	1.13 E-07	4.36 E-08	2.19 E-08	1.40 E-08	1.00 E-08
SSW	1.83 E-06	2.86 E-07	1.30 E-07	7.90 E-08	5.48 E-08	2.65 E-08	1.02 E-08	5.16 E-09	3.32 E-09	2.39 E-09
SW	1.20 E-06	1.86 E-07	8.44 E-08	5.10 E-08	3.52 E-08	1.69 E-08	6.49 E-09	3.26 E-09	2.09 E-09	1.50 E-09
WSW	8.78 E-07	1.35 E-07	6.13 E-08	3.70 E-08	2.56 E-08	1.23 E-08	4.76 E-09	2.41 E-09	1.55 E-09	1.12 E-09
W	2.12 E-06	3.32 E-07	1.52 E-07	9.19 E-08	6.38 E-08	3.08 E-08	1.18 E-08	5.93 E-09	3.79 E-09	2.72 E-09
WNW	4.81 E-06	7.58 E-07	3.47 E-07	2.11 E-07	1.46 E-07	7.08 E-08	2.72 E-08	1.36 E-08	8.72 E-09	6.26 E-09
NW	7.25 E-06	1.15 E-06	5.26 E-07	3.21 E-07	2.23 E-07	1.09 E-07	4.20 E-08	2.12 E-08	1.36 E-08	9.79 E-09
NNW	5.53 E-06	8.75 E-07	4.01 E-07	2.44 E-07	1.70 E-07	8.24 E-08	3.17 E-08	1.59 E-08	1.02 E-08	7.32 E-09

<sup>a</sup>Calculated from meteorological data collected at the Hanford Meteorology Tower.

E = East.  
N = North.  
S = South.  
W = West.

**Table 3-8. Annual Average Dispersion Around the 300 Area From October - December in 1993  
for a 10-Meter Release Height.<sup>a</sup>**

Distance to MEI ▶	0.8 km	2.4 km	4.0 km	5.6 km	7.2 km	12 km	24 km	40 km	56 km	72 km
Direction ▼	$\bar{X}/Q'$									
N	7.72 E-06	1.63 E-06	7.77 E-07	4.81 E-07	3.37 E-07	1.66 E-07	6.43 E-08	3.24 E-08	2.07 E-08	1.49 E-08
NNE	5.10 E-06	1.08 E-06	5.15 E-07	3.18 E-07	2.23 E-07	1.09 E-07	4.22 E-08	2.12 E-08	1.35 E-08	9.68 E-09
NE	3.92 E-06	8.22 E-07	3.92 E-07	2.42 E-07	1.70 E-07	8.33 E-08	3.23 E-08	1.62 E-08	1.04 E-08	7.46 E-09
ENE	3.00 E-06	6.29 E-07	3.00 E-07	1.86 E-07	1.31 E-07	6.44 E-08	2.51 E-08	1.27 E-08	8.17 E-09	5.88 E-09
E	5.02 E-06	1.06 E-06	5.07 E-07	3.14 E-07	2.20 E-07	1.08 E-07	4.21 E-08	2.12 E-08	1.36 E-08	9.76 E-09
ESE	4.46 E-06	9.41 E-07	4.50 E-07	2.78 E-07	1.95 E-07	9.62 E-08	3.74 E-08	1.89 E-08	1.21 E-08	8.69 E-09
SE	5.13 E-06	1.11 E-06	5.33 E-07	3.30 E-07	2.32 E-07	1.14 E-07	4.46 E-08	2.25 E-08	1.44 E-08	1.04 E-08
SSE	6.83 E-06	1.44 E-06	6.88 E-07	4.26 E-07	2.99 E-07	1.47 E-07	5.72 E-08	2.88 E-08	1.85 E-08	1.33 E-08
S	6.36 E-06	1.29 E-06	6.10 E-07	3.75 E-07	2.62 E-07	1.28 E-07	4.91 E-08	2.46 E-08	1.57 E-08	1.12 E-08
SSW	1.43 E-06	2.76 E-07	1.29 E-07	7.90 E-08	5.49 E-08	2.65 E-08	1.01 E-08	5.02 E-09	3.19 E-09	2.28 E-09
SW	1.02 E-06	1.87 E-07	8.65 E-08	5.24 E-08	3.62 E-08	1.73 E-08	6.51 E-09	3.22 E-09	2.04 E-09	1.45 E-09
WSW	1.01 E-06	1.79 E-07	8.23 E-08	4.99 E-08	3.45 E-08	1.65 E-08	6.22 E-09	3.07 E-09	1.95 E-09	1.39 E-09
W	1.88 E-06	3.71 E-07	1.75 E-07	1.08 E-07	7.50 E-08	3.64 E-08	1.40 E-08	7.00 E-09	4.47 E-09	3.20 E-09
WNW	4.13 E-06	8.17 E-07	3.85 E-07	2.36 E-07	1.65 E-07	8.02 E-08	3.08 E-08	1.54 E-08	9.79 E-09	7.01 E-09
NW	6.74 E-06	1.40 E-06	6.74 E-07	4.19 E-07	2.94 E-07	1.45 E-07	5.67 E-08	2.87 E-08	1.85 E-08	1.33 E-08
NNW	5.37 E-06	1.14 E-06	5.42 E-07	3.35 E-07	2.35 E-07	1.15 E-07	4.46 E-08	2.24 E-08	1.44 E-08	1.03 E-08

<sup>a</sup>Calculated from meteorological data collected at the Hanford Meteorology Tower.

E = East.  
N = North.  
S = South.  
W = West.

**Table 3-9. Annual Average Dispersion Around the 400 Area During 1993  
for a 10-Meter Release Height.<sup>a</sup>**

Distance to MEI ▶	0.8 km	2.4 km	4.0 km	5.6 km	7.2 km	12 km	24 km	40 km	56 km	72 km
Direction ▼	$\bar{X}/Q'$									
N	7.8 E-06	1.23 E-06	5.66 E-07	3.44 E-07	2.39 E-07	1.16 E-07	4.47 E-08	2.25 E-08	1.44 E-08	1.03 E-08
NNE	5.08 E-06	8.01 E-07	3.66 E-07	2.22 E-07	1.54 E-07	7.48 E-08	2.87 E-08	1.44 E-08	9.21 E-09	6.61 E-09
NE	3.53 E-06	5.58 E-07	2.56 E-07	1.55 E-07	1.08 E-07	5.23 E-08	2.01 E-08	1.00 E-08	6.42 E-09	4.60 E-09
ENE	2.17 E-06	3.40 E-07	1.56 E-07	9.46 E-08	6.57 E-08	3.19 E-08	1.23 E-08	6.19 E-09	3.97 E-09	2.85 E-09
E	3.78 E-06	5.98 E-07	2.74 E-07	1.66 E-07	1.16 E-07	5.59 E-08	2.14 E-08	1.07 E-08	6.85 E-09	4.91 E-09
ESE	3.86 E-06	6.11 E-07	2.81 E-07	1.71 E-07	1.19 E-07	5.77 E-08	2.22 E-08	1.12 E-08	7.15 E-09	5.13 E-09
SE	5.32 E-06	8.41 E-07	3.84 E-07	2.33 E-07	1.62 E-07	7.83 E-08	3.00 E-08	1.50 E-08	9.58 E-09	6.69 E-09
SSE	5.33 E-06	8.38 E-07	3.82 E-07	2.31 E-07	1.60 E-07	7.70 E-08	2.93 E-08	1.47 E-08	9.34 E-09	6.69 E-09
S	6.27 E-06	9.89 E-07	4.53 E-07	2.76 E-07	1.92 E-07	9.30 E-08	3.59 E-08	1.80 E-08	1.15 E-08	8.29 E-09
SSW	3.35 E-06	5.26 E-07	2.40 E-07	1.46 E-07	1.01 E-07	4.88 E-08	1.87 E-08	9.41 E-09	6.02 E-09	4.32 E-09
SW	2.35 E-06	3.67 E-07	1.67 E-07	1.01 E-07	6.99 E-08	3.37 E-08	1.29 E-08	6.47 E-09	4.14 E-09	2.97 E-09
WSW	1.72 E-06	2.68 E-07	1.22 E-07	7.37 E-08	5.10 E-08	2.45 E-08	9.34 E-09	4.66 E-09	2.97 E-09	2.13 E-09
W	2.10 E-06	3.29 E-07	1.49 E-07	9.04 E-08	6.26 E-08	3.02 E-08	1.15 E-08	5.76 E-09	3.68 E-09	2.64 E-09
WNW	1.70 E-06	2.64 E-07	1.20 E-07	7.23 E-08	5.00 E-08	2.40 E-08	9.16 E-09	4.58 E-09	2.93 E-09	2.10 E-09
NW	2.59 E-06	4.06 E-07	1.84 E-07	1.11 E-07	7.70 E-08	3.70 E-08	1.41 E-08	7.00 E-09	4.46 E-09	3.19 E-09
NNW	4.66 E-06	7.35 E-07	3.37 E-07	2.05 E-07	1.43 E-07	6.94 E-08	2.68 E-08	1.35 E-08	8.67 E-09	6.24 E-09

<sup>a</sup>Calculated from meteorological data collected at the Hanford Meteorology Tower.

E = East.  
N = North.  
S = South.  
W = West.

### 3.7 CERTIFICATION

This certification applies to Sections 1.0, 2.0, and 3.0 only.

"I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. See 18 U.S.C. 1001."

John L. Wagoner  
U.S. Department of Energy,  
Richland Operations Office

6/30/94  
Date

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#### 4.0 DIFFUSE-SOURCE EMISSIONS

DOE Headquarters has requested that estimated doses to the public, related to radioactive emissions from both point and diffuse sources, be included in this report. Previously, calculating public doses had been confined to emissions from point sources such as stacks. Data on diffuse emissions were contained in environmental monitoring results, which generally were too low to use for meaningful dose estimates. Instead, environmental monitoring data were reported simply as the activity of radionuclides detected rather than converting the activity to doses. This can be demonstrated by comparing environmental monitoring data with data on stack emissions in Hanford Site annual reports covering the last 35 years.

In the past, when the Hanford Site was operating at or near full capacity, point-source emissions were easily detected. Now, however, emissions from point sources have diminished in most instances to background levels. Methodologies for calculating doses from point sources are well established, based primarily on analyzing samples and measuring flow of stack emissions. Similar methodologies have not been developed for diffuse sources because of complicating factors such as: (1) difficulty in accurately quantifying air flow from the source, (2) more complex influences from meteorological conditions, and (3) exceedingly low detection levels. Currently, all nuclear material production facilities at the Hanford Site are shutdown or in standby mode. Therefore, the environmental contribution from diffuse source emissions has become a significant portion of the much lower total radioactivity attributable to activities at the Hanford Site.

For this report, doses have been calculated for emissions from both point and diffuse sources, even though the methods used for calculating diffuse emissions are still being refined. Dose calculations for each type of emission are provided separately.

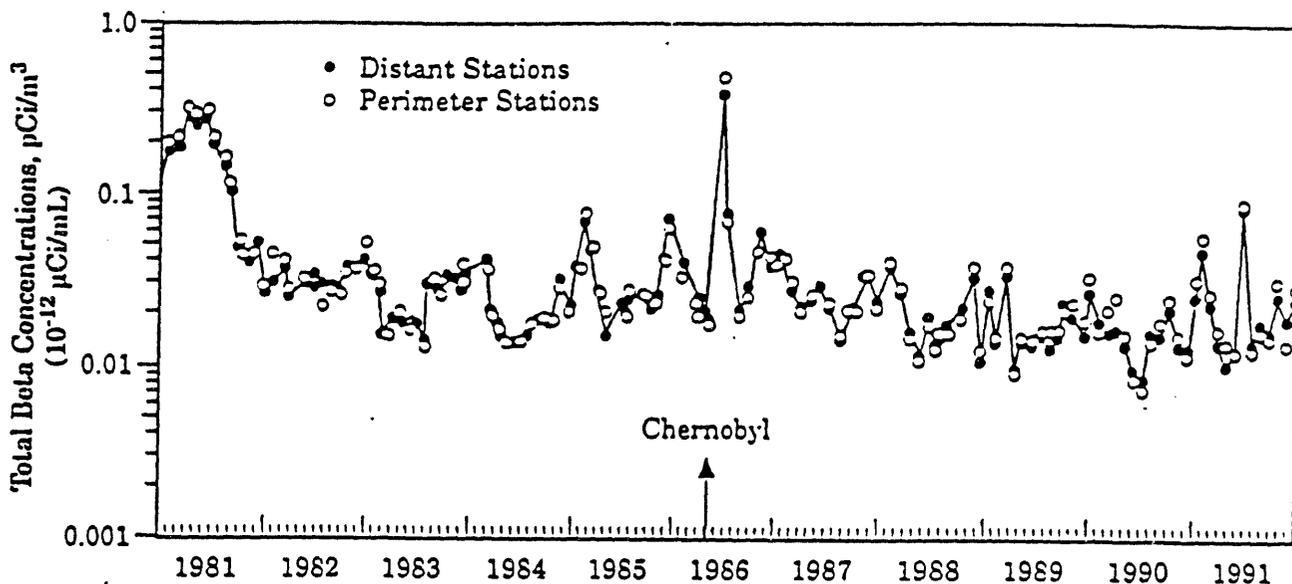
As methods for estimating the dose from diffuse emissions are better refined, more precise amounts representing radionuclides occurring naturally and from nuclear-testing fallout (see Figure 4-1) may be subtracted from ambient air concentrations. Undoubtedly this would lower dose estimates.

#### 4.1 DIFFUSE EMISSIONS FROM UNMONITORED SOURCES

Some air emissions from Hanford Site facilities with no radioactive source terms, such as office areas, are not monitored routinely. Similar types of unmonitored emission sources are support buildings, confinement zones, storage rooms, shops, and similar structures containing no radioactive materials available for release. Emissions forcibly discharged by exhaust fans are monitored if radioactive material can be potentially released.

Passive breather vents on various tanks, vaults, and other structures are potential conduits of radioactive emissions. However, because airborne radionuclides inside vented

Figure 4-1. Monthly Average Gross Beta Radioactivity in Airborne Particulate Samples, 1981 through 1991 (Woodruff et al. 1992).



structures can be released only by passively exchanging with outside ambient air, emissions of this sort have been considered diffuse in nature because they lack a measurable flow. These potential emission sources are not monitored as a point-source stack is, but by using a comprehensive network of ambient air samplers. There are numerous types of these sources in and around the facilities described in Section 4.3. Dose and release estimates from unmonitored sources of radionuclide air emissions are included in Section 4.2 with the estimates related to diffuse sources.

Record sampling systems are installed on all stacks and vents with exhaust fans that forcibly discharge potentially radioactive air. In almost all cases these stacks and vents (both large and small) are continuously sampled and the samples analyzed weekly. The weekly measurements are averaged for the entire year, and any positive result greater than zero, no matter how small, is included in the annual radionuclide air emissions report and modeling of offsite dose. For the large majority of these discharge points, periodic confirmatory sampling for gross alpha and beta would satisfy both EPA and DOE requirements.

Just as Hanford Site operations have decreased in recent years, so have radionuclide air emissions. The majority of the stacks and vents now exhaust air at or near background levels of radioactivity.

## 4.2 ESTIMATED RADIONUCLIDE AIR EMISSION RELEASES AND RESULTING DOSE TO ANY MEMBER OF THE PUBLIC FROM DIFFUSE AND UNMONITORED SOURCES

The potential dose to an offsite individual and the potential releases from diffuse and unmonitored sources were estimated using ambient air monitoring data from locations around the Hanford Site perimeter. The Hanford Site air monitoring network consists of 50 sampling stations, of which 20 are located on the site, 10 are located at the site perimeter, 7 are in nearby communities, and 2 are in distant communities (Dirkes et al 1994). The data used for this analysis were taken during 1993 at 6 of the perimeter sampling stations located in generally downwind directions (northeast to south) from the site and at the distant community stations, which are assumed to be unaffected by airborne effluents from Hanford (Bisping 1994).

### 4.2.1 Methods for Assessing Diffuse-Source Emissions

Hanford Site scientists have elected to use environmental monitoring data collected at the Site perimeter to estimate the dose from diffuse and unmonitored sources. This method was chosen in preference to other possible methods because Site perimeter data most accurately represent the actual dose to an offsite individual, and because information about the extent and levels of soil contamination on the Hanford Site is currently insufficient to use resuspension and dispersion models. The ambient air sampling results consisted of annual average air concentrations for radionuclides that may be released from Site operations and diffuse sources, including tritium, iodine ( $^{129}\text{I}$ ,  $^{131}\text{I}$ ), and particulates ( $^{90}\text{Sr}$ ,  $^{60}\text{Co}$ ,  $^{106}\text{Ru}/^{106}\text{Rh}$ ,  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}/^{137\text{m}}\text{Ba}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ , and uranium isotopes). The naturally occurring radionuclides  $^7\text{Be}$  and  $^{40}\text{K}$  were also analyzed in particulate samples. Tritium, iodine, and uranium were only sampled at selected locations, and in one case particulate samples for two perimeter stations in the same general vicinity were composited for radioanalysis in order to obtain more accurate counting statistics. Air concentrations measured for composite samples were assigned to the location that would be expected to have the lowest concentration to avoid under-predicting estimated releases from diffuse sources.

Radionuclide air concentrations resulting from 1993 stack emissions were calculated for each of the selected perimeter sample locations using the CAP88-PC code package, and the combined contributions to airborne radionuclide levels from all operating areas were subtracted from the ambient monitoring results. The reference regional background level of each radionuclide was assumed to be equal to the average air concentration measured at distant community sampling stations in Yakima and Sunnyside, Washington. The average background concentration at these stations was also subtracted from the ambient monitoring results at perimeter stations in order to estimate the potential contribution from diffuse source emissions.

#### 4.2.2 Results of Diffuse-Source Evaluation

During 1993, the annual average ambient air concentrations at downwind perimeter sampling stations were found to be numerically greater than the combined contributions from stack releases and background for several radionuclides, including  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{129}\text{I}$ ,  $^{137}\text{Cs}$ ,  $^{235}\text{U}$ ,  $^{238}\text{U}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ , and  $^{241}\text{Am}$ . However, these perimeter concentrations are generally not statistically different from those measured at the distant community stations which are unaffected by Hanford effluents (Dirkes et al, 1994). Concentrations of other radionuclides may have been greater than stack releases and background at individual monitoring stations, however the corrected average for those nuclides at all sampling stations was less than zero.

Releases from diffuse and unmonitored sources were estimated from the corrected air concentrations by performing a back-calculation using CAP88-PC. The 200 West Area was assumed to be the source of diffuse emissions for all radionuclides, which results in the highest release estimate. The diffuse source releases reported in Table 4-1 represent the mean of the release estimates for each of the selected downwind perimeter locations at which a particular radionuclide was sampled. In accordance with guidance from DOE headquarters, the average release estimates for diffuse sources were calculated using air concentrations that were both positive and negative with respect to the regional background and stack emission estimates. Where the resulting mean release estimate reported in Table 4-1 for an individual radionuclide is less than zero, it indicates that the average of the monitored air concentrations at the downwind perimeter stations was numerically smaller than the combined concentrations expected as a result of stack emissions and regional background. In such cases, it is likely that diffuse sources did not contribute significantly to the offsite measured air concentrations for those radionuclides.

The estimated diffuse source releases for the sampled radionuclides were also used to estimate the dose at the downwind perimeter sampling station with the highest air concentrations (Prosser Barricade) and at the Byers Landing station which is closest to the Sagemore Road location selected for the Hanford Site's maximally exposed individual (MEI) from stack emissions. The 1993 results in Table 4-1 indicate that the hypothetical mean doses to individuals at these locations were 0.049 mrem/y at the Prosser Barricade location and 0.028 mrem/y at the Byer's Landing location. Where the release estimate for a particular radionuclide was numerically less than zero, the dose estimate for that nuclide was set equal to zero before summing the contributions of all radionuclides to obtain the total dose at each location. Although the estimated dose from diffuse sources at Sagemore Road location is somewhat higher than the dose from point sources, the combined dose from stack emissions and diffuse and unmonitored sources during 1993 was substantially below the 10 mrem/year standard.

**Table 4-1.** Estimated 1993 Hanford Site Diffuse Emissions and Resulting Dose

Location ▶		Byers Landing (closest to MEI Location)	Prosser Barricade (highest air concentrations)
Radionuclide ▼	Diffuse-Source Estimated Release from 200 Areas (Ci <sup>d</sup> /yr) <sup>b</sup>	Estimated Dose at Location (mrem <sup>d</sup> /yr) <sup>c</sup>	Estimated Dose at Location (mrem/yr) <sup>c</sup>
<sup>3</sup> H	-9.3 E+01	0.0 E+00	0.0 E+00
<sup>60</sup> Co	-7.8 E-02	0.0 E+00	0.0 E+00
<sup>90</sup> Sr	6.2 E-03	2.6 E-04	4.4 E-04
<sup>106</sup> Ru	8.5 E-01	4.8 E-03	8.3 E-03
<sup>129</sup> I	3.3 E-02	6.6 E-04	1.4 E-03
<sup>131</sup> I	-6.2 E+01	0.0 E+00	0.0 E+00
<sup>134</sup> Cs	-1.2 E-01	0.0 E+00	0.0 E+00
<sup>137</sup> Cs/ <sup>137m</sup> Ba	9.7 E-02	8.5 E-03	1.4 E-02
<sup>234</sup> U	-1.3 E-04	0.0 E+00	0.0 E+00
<sup>235</sup> U	2.1 E-03	2.3 E-03	4.0 E-03
<sup>238</sup> U	6.9 E-03	7.0 E-03	1.2 E-02
<sup>238</sup> Pu	2.8 E-05	7.9 E-05	1.4 E-04
<sup>239,240</sup> Pu	2.3 E-04	6.9 E-04	1.2 E-03
<sup>241</sup> Am	8.3 E-04	3.9 E-03	6.7 E-03
<b>Total</b>		2.8 E-02	4.9 E-02

<sup>a</sup>Dose factor includes ingestion, inhalation, air submersion, and external exposure to radionuclides on ground

<sup>b</sup>Emissions from diffuse sources assumed to originate in the Hanford Site 200 Areas, except for uranium. The 300 Area also has potential sources for resuspension of uranium from soil, in addition to naturally occurring uranium isotopes found throughout the area. Because it was not possible to determine the source of uranium isotopes detected at offsite sample stations, the releases were modeled as if the total inventory were from the 200 Areas.

<sup>c</sup>Dose is based on air monitoring results for sample stations downwind, generally east and south, of the Hanford Site. The measured air concentrations for these locations are corrected for estimated contributions from stack releases and regional background levels of monitored radionuclides. Doses that are reported as being <0 result from air monitoring results that are below the detection limit or for which the monitoring results are lower than the contributions from stack releases and background.

<sup>d</sup>1 Ci = 3.7 E+10 Becquerel; 1 mrem = 1.0 E-02 mSv

### 4.2.3 Estimate of Uncertainty in Dose from Diffuse Sources

In order to obtain an estimate of the uncertainty in dose estimates at the Hanford Site perimeter, the reported 1993 air concentrations at the Byers Landing sampling station and at the distant community stations were used to estimate the mean and 95% confidence intervals for each location. This analysis employed the uncorrected air concentrations at the reference locations, including the contributions from stack releases, diffuse sources, and regional background. The Byers Landing station was selected for this analysis because it is closest to the location of the Hanford Site MEI at the Sagemore Road farm and also was the only perimeter station at which all radionuclides were reported. The calculation was performed using the GENII-S computer code (Leigh et al 1992) to produce a stochastic analysis of the environmental radiation doses. The mean values of the measured air concentrations were input as basic concentrations along with the maximum and minimum sample values to define a triangular distribution for each radionuclide. To obtain the dose distribution for each location, the code used a Latin hypercube sampling routine to select random values for each radionuclide concentration in 100 trials.

The estimated mean dose at the Byers Landing station was 0.14 mrem/y for artificially produced radionuclides sampled at that location, with a 95% confidence interval of 0.095 to 0.19 mrem/y. The corresponding result for the distant community monitoring stations was 0.072 mrem/y with 95% confidence limits of 0.0 to 0.17 mrem/y. Although the mean dose estimate at the site perimeter was somewhat higher than that at the distant community stations, the upper 95% confidence limits are similar. Because the measured dose at perimeter stations was almost entirely a result of background radioactive materials (naturally occurring radionuclides and fallout), the estimated diffuse-source component was a relatively small fraction of the total. The 95% confidence interval for the dose from diffuse sources would therefore be a fraction of that for the total dose at these locations.

### 4.2.4 Discussion

It should be noted that the release estimates for diffuse and unmonitored sources in Table 4-1 were obtained using the CAP88-PC code package, which incorporates a continuous release gaussian plume dispersion model. Releases from diffuse sources would be expected to occur primarily under conditions that are very different from the annual average assumptions used in the CAP88-PC model. This is particularly true for resuspension of contaminated soil, and to some extent for emissions from sources such as evaporation ponds, which are a function of the wind speed. Because release rates from such sources are greatest under conditions that favor atmospheric dispersion, use of an annual average continuous release model to back-calculate the release quantities may introduce a significant bias in these estimates. The dose estimates for sources of this type may also be affected by seasonal variation in the resuspension rates due to prevalence of strong winds during certain seasons of the year. If these episodes occur primarily during times when crop production is minimal, some of the exposure pathways incorporated into the CAP88-PC code (direct deposition on human and animal food crops, for example) would not be applicable. The release and dose estimates reported for diffuse sources in this evaluation should therefore be viewed as

approximations whose accuracy is limited by a number of factors inherent in the sampling and modeling process.

### 4.3 DIFFUSE-EMISSION SOURCES

The Hanford Site consists of 1,450 km<sup>2</sup> (560 mi<sup>2</sup>) of semiarid shrub-steppe land, of which approximately 6% has been disturbed and actively used. This 6% of land [about 83 km<sup>2</sup> (32 mi<sup>2</sup>), or 8,090 ha (20,000 acres)] is divided into large operational and support areas: the 100, 200, 300, 400, and 1100 Areas. The 600 Area designates the remaining land outside the operational and support areas. Almost all point and diffuse sources of radionuclide emissions are located in the five operational areas; two minor point sources are in the 600 Area. Point sources are measured directly or calculated from process knowledge. Diffuse sources are measured through a network of monitoring systems extending from the potential and actual sources to far offsite.

The Hanford Site was acquired in 1943 and dedicated to producing plutonium for national defense and managing the resulting production wastes. Restoring the Hanford Site environment is the new mission that has largely supplanted the previous operational objectives. The environmental restoration effort will entail activities such as decontaminating and decommissioning over 100 facilities and cleaning up and restoring about 1,500 waste sites. Until the restoration and cleanup work is completed, radioactive emissions may be released from hundreds of diffuse sources, in addition to known point-source stacks.

Besides measuring point source emissions and modeling those emissions to determine public doses, environmental surveillance is conducted. Environmental and food-chain pathways are monitored near facilities emitting radionuclides from either point sources or diffuse sources. The environmental pathways for all air emissions from the Hanford Site are monitored using a stratified sampling approach. Samples are collected and radiation is measured according to three surveillance zones. These zones extend from main onsite operating areas to offsite regions (Woodruff et al. 1992).

The first zone begins near the operating facilities and ends at the Hanford Site perimeter. Diffuse emissions generally will be most concentrated and easier to detect in this zone before diluting further as they drift offsite.

The second surveillance zone is a series of sampling stations that surround the Hanford Site near its perimeter. Because a person could live as close to the Hanford Site as some of these stations, their data represent the maximum exposures for a member of the public. Therefore, ambient air sampling data from the perimeter locations most closely reflect the actual impacts of radionuclide air emissions from point sources and diffuse sources on the Hanford Site.

The third surveillance zone encompasses nearby and distant communities within an 80-km (50-mi) radius of the center of the Hanford Site but beyond its boundaries.

Surveillance is conducted in communities to provide measurements at those locations where the most people are potentially exposed. This surveillance ensures that radionuclide levels are well below standards established to protect the public health. Finally, background concentrations are measured at distant locations and compared with onsite, perimeter, and community locations to indicate the effects of Hanford Site activities. Background locations are essentially unaffected by Hanford Site emissions but contain similar levels of radioactivity originating naturally and from nuclear-testing fallout.

The goal of environmental surveillance at the Hanford Site is to verify compliance with DOE and EPA radiological dose standards for public protection. This goal is accomplished by measuring radionuclides and consequent exposure in the onsite and offsite environment. The environmental surveillance criteria are derived from: (1) the collected environmental surveillance data on radionuclides and doses; (2) applicable regulations other than DOE Orders, (3) DOE Order 5400.1 (DOE 1988); and (4) the DOE *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991). The surveillance program (Woodruff et al. 1991) was established on these criteria and the pathway analyses that provide information on radionuclides and media contributing to human dose. Experience from Hanford Site environmental surveillance activities and studies conducted over the past 45 years has built an invaluable technical background of information for planning and data interpretation.

#### **4.3.1 Description of Diffuse-Emission Sources**

The presently identified actual or potential sources of diffuse radionuclide emissions to the environment at the Hanford Site are described in this section. Among the sources that could contribute diffuse radionuclide emissions are several kinds of waste handling and disposal facilities used at the Hanford Site such as cribs, ponds, ditches, trenches, retention basins, valve pits, French drains, reverse wells, tanks, and burial grounds. Operating facilities or facilities on standby or that are inactive also could contribute diffuse emissions. Tables 4-2 and 4-3 show the types of waste and the types of diffuse sources, respectively. Each site or facility usually has one or more unique features or characteristics that may contribute to the release of diffuse emissions. Features may include passive vents, risers, equipment and personnel access doors, and exhausters. Characteristics may include an undetected leak, unburied waste, or an absence of intrusion barriers. Rates of diffuse emissions may be influenced by a variety of environmental conditions, such as: (1) changing atmospheric pressures; (2) wind speed; (3) erosion; (4) evaporation; (5) percolation; (6) biotic intrusion; or (7) wind-caused resuspension.

The general types of sites and facilities and their potential primary sources of diffuse emissions are briefly described in sections 4.3.1.1 through 4.3.1.12 that follow.

**Table 4-2. Types of Waste and Number of Waste Sites at the Hanford Site.**

<b>Types of Waste</b>	<b>Number of Waste Sites</b>
Nonhazardous	184
Hazardous	142
Radioactive	146
Mixed	949
<b>Total</b>	<b>1,421</b>

**Table 4-3. Types of Diffuse-Emission Sources.**

<b>Types of Diffuse Sources</b>	<b>Active</b>	<b>Inactive</b>
Tanks	28	149
Cribs	16	115
Trenches, ponds, ditches, retention basins	21	120
Reverse wells	0	11
French drains	21	47
Unplanned spill sites	0	229
Burial grounds	9	68
<b>Total</b>	<b>95</b>	<b>739</b>

**4.3.1.1 Crib.** Low-level liquid waste is discharged to the ground by structures called cribs. These are generally subsurface systems, similar to sanitary drain fields, that allow the liquid component of the waste to percolate into the soil. The natural properties of the soil are used to remove radioactive material from the effluent water through filtration, ion-exchange, and precipitation reactions.

Many cribs are vented to the atmosphere through engineered structures called vents and pipe risers. These engineered structures promote downward flow of liquids disposed of in the cribs but also provide pathways to the surface and atmosphere. Secondary causes of diffuse emissions include erosion, uptake and intrusion by biota, followed by wind-caused resuspension.

**4.3.1.2 Pond.** Ponds are used to manage the large quantities of water (i.e., cooling water and chemical-sewer wastewater) associated with chemical processing operations. Normally, these liquid effluents are uncontaminated. The ponds allow percolation of the liquid effluent into the soil column. Diffuse emissions from ponds are caused primarily by wind-caused resuspension.

**4.3.1.3 Ditch.** A ditch is an open, unlined excavation used for disposing of liquid effluents or transporting liquid effluents to ponds for disposal. Diffuse emissions from ditches are primarily caused by wind-caused resuspension.

**4.3.1.4 Trench.** Early disposal practices included disposing of liquid effluents into unlined trenches and filling them with soil over time. These were mostly replaced by cribs such as the BC-cribs. Diffuse emissions from trenches are primarily caused by erosion, uptake and intrusion by biota, followed by wind-caused resuspension.

**4.3.1.5 Retention Basin.** Similar to trenches, retention basins generally were lined with concrete and used to hold liquids before routing them to ditches or ponds. Diffuse emissions from retention basins are caused primarily by wind-caused resuspension.

**4.3.1.6 Diversion Box.** A diversion box is usually an underground, concrete structure formed around a junction of transfer lines carrying liquid effluent. When diversion boxes are accessed for operations or maintenance, radioactively contaminated material may be released in the form of diffuse emissions.

**4.3.1.7 Valve Pit.** A valve pit is similar in structure to a diversion box, but contains piping valves. When valve pits are accessed for maintenance or operations, radioactively contaminated material may be released in the form of diffuse emissions.

**4.3.1.8 French Drain and Reverse Well.** A French drain is a rock-filled encasement inserted in the ground. A reverse well is an ordinary well used for mixing liquid waste with groundwater. These subsurface systems manage potentially contaminated liquid waste by promoting percolation into the soil. The natural filtration properties of the soil remove radioactive material from effluent water. Diffuse emissions from French drains and reverse

wells may occur through erosion, uptake and intrusion by biota, followed by wind-caused resuspension-caused resuspension.

**4.3.1.9 Tank.** A tank generally is a large reinforced metal structure that receives liquid effluent for storage. Examples are the double-shell tanks (DSTs) and single shell tanks (SSTs) in the 200 Areas, which typically are arrayed in clusters called tank farms. Pathways for diffuse emissions from tanks include vents and exhausters open to the atmosphere and deposition and resuspension.

**4.3.1.10 Burial Ground.** Burial grounds are shallow trenches in which contaminated solid waste is buried. This waste is generated by various activities on the Hanford Site. Waste packaging procedures and burial practices used depend on the type of waste. Diffuse emissions occur at burial grounds through direct release to the atmosphere before the waste is buried, followed by erosion, uptake and intrusion by biota, and wind-caused resuspension.

**4.3.1.11 Decontamination and Decommissioning Activities.** Westinghouse Hanford activities also involve decontaminating and decommissioning retired facilities, equipment, and waste disposal sites. These activities are aimed at preventing the release or spread of contamination and reducing the number of acres of surface contamination. In some cases, contaminated material may be exposed to the atmosphere, but steps are taken to isolate and reduce spreading of contamination as it is identified. Diffuse emissions are caused primarily by exposing contaminated surfaces such as the inside of contaminated structures. Planning and using procedures usually minimize these exposures, however. Increased monitoring around demolition activities can detect heightened levels of contamination on surfaces and in the atmosphere. To date, no significant increases at demolition sites have been observed.

**4.3.1.12 Radioactively Contaminated Surface Areas.** All of the following radioactive contaminated areas are routinely surveyed: burial grounds, cribs, trenches, retention basins, and unplanned release sites. The surveys are performed at least annually, but more frequently when needed. The number of surface-contaminated acres varies. The number is not fixed because there is a continuing effort to clean, stabilize, or remediate known contaminated areas while new areas of contamination are continuing to be identified. Newly identified contamination may be because of preexisting contamination that has migrated, by way of wind or biological intrusion, to previously uncontaminated areas or because the radiological criteria have become more stringent. Eighty percent of all areas of surface contamination are estimated to have dose rates less than 1 mrem/h.

Contaminated areas are posted as "Surface Contamination Area," "Radiologically Controlled Area," or "Underground Radioactive Material." Radiologically controlled areas are large areas with a potential for speck contamination. Surface contamination areas have more widespread contamination. "Underground Radioactive Material" signs mark cribs, burial grounds, covered trenches, and ponds, but not underground plumes that extend away from these sites. If an area has surface and underground contamination, such as a surface contaminated crib, it will have both postings. The general location, by area, and the approximate area of surface contamination and volume of underground contamination are

shown in Table 4-4. Diffuse emissions from areas of surface contamination are caused primarily by erosion, uptake and intrusion by biota, followed by wind-caused resuspension.

**Table 4-4. Hanford Site Surface and Underground Contamination.**

Hanford Site Area	Surface Contamination <sup>a</sup> (acres [ha])	Underground Radioactive Material <sup>b</sup> (acres [ha])
100 Areas	160 (65)	460 (186)
200 Areas	318 (129)	380 (154)
600 Area	2,627 (1,063)	260 (105)
300 Area (north)	45 (18)	30 (12)
<b>Total</b>	<b>3,150 (1,275)</b>	<b>1,130 (457)</b>

<sup>a</sup>Includes areas posted as "Surface Contamination Areas" or as "Radiological Controlled Areas" and areas that have both underground and surface contamination.

<sup>b</sup>Only includes areas with underground contamination, exclusive of groundwater plumes.

The following sections (4.3.1.13 through 4.3.1.32) briefly describe the sites and facilities considered as potential or known sources of diffuse emissions and the radionuclides primarily associated with them.

**4.3.1.13 100-K Area Basins.** Two identical reactors are located in the 100-K Area. One reactor is in the 100-KE Area while the other is in the 100-KW Area. The reactors and their support facilities were constructed between 1952 and 1954, beginning service in 1955. The 100-KW Area reactor ceased operating in 1970 and the 100-KE reactor in 1971.

The 100-KE and -KW reactor systems underwent D&D (decontamination and decommissioning) after shutdown. Most of the fuel was sent to 200 East Area for processing. After the initial D&D was completed, the fuel storage basins within the 105-KE and 105-KW buildings were modified to store N Reactor irradiated fuel. Storing this fuel began in 1975 at 105-KE and in 1981 at 105-KW; fuel is still stored in both basins. Shipments of fuel to the basins from 100-N Area ceased in 1989.

The primary radionuclides that may be included in diffuse emissions from the 100-K Basins include <sup>60</sup>Co, <sup>90</sup>Sr, <sup>137</sup>Cs, <sup>239,240</sup>Pu, and <sup>241</sup>Am. The potential primary release

points of diffuse emission include personnel and equipment access doors, which are normally closed.

**4.3.1.14 N Reactor.** The N Reactor was designed to produce special nuclear materials (SNM) and byproduct steam for electrical power generation. It began operations in 1963, and ceased operating in January 1987. The 100-N Area reactor complex consists of 126 buildings for reactor operations, maintenance, support facilities, and offices. Some of the more important reactor operations facilities with radioactive materials are identified below.

The 105-N Reactor Building contains the reactor, the reactor control room, the fuel loading area, and the spent fuel storage basin. The N Reactor is a graphite-moderated, light-water-cooled, horizontal-pressure-tube nuclear reactor designed to produce SNM using slightly enriched uranium. Radioactively contaminated facilities associated with the N Reactor are:

- The 1301-N and 1325-N Liquid Waste Disposal Facilities consists of a crib and trench.
- The 109-N Heat-Exchanger Building transferred the heat from the primary loop to the secondary loop through steam generators.
- The 117-N Filter Building houses charcoal and HEPA filters.
- The 107-N Basin Recirculating Building removes radionuclides from the N Basin Fuel Storage Facility water by filtering and demineralizing it.

The primary radionuclides that may be included in diffuse emissions from the 100-N facilities include  $^{60}\text{Co}$ ,  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . The potential primary diffuse emission release points include railroad rollup doors, personnel and other equipment access doors (all of which are normally closed), and inactive exhaust vents and risers. A special case at the Hanford Site is the N Springs, which discharge low-level contamination (primarily  $^{90}\text{Sr}$ ) into the Columbia River. These springs are perhaps more closely monitored than any comparable component of the Hanford Site ecosystem. Other means of diffuse emissions include erosion, uptake or intrusion of biota, and wind-caused resuspension.

**4.3.1.15 Plutonium-Uranium Extraction (PUREX) Facility.** The PUREX Plant is a collection of buildings and facilities located in the 200 East Area at the Hanford Site. The main building, 202-A, is a heavily shielded, reinforced concrete structure known as a canyon. This building contains the main equipment used in the PUREX process of chemically separating and purifying actinides from the irradiated nuclear fuel.

Radionuclides primarily associated with the PUREX Plant include  $^{14}\text{C}$ ,  $^{85}\text{Kr}$ ,  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{129}\text{I}$ ,  $^{137}\text{Cs}$ ,  $^{147}\text{Pm}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Pu}$ , and  $^{241}\text{Am}$ . Potential diffuse emission release

points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.16 Uranium Oxide Plant.** The Uranium Oxide ( $\text{UO}_3$ ) Plant, located in the 200 West Area, is used to produce  $\text{UO}_3$  powder by calcining uranyl nitrate solutions from the PUREX Plant. The  $\text{UO}_3$  powder is sealed in steel drums for shipment offsite.

Uranium is the potential primary source of radioactive diffuse emissions from the  $\text{UO}_3$  Plant. Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17 Plutonium Finishing Plant (PFP).** This facility is located in the 200 West Area and is used to recover, stabilize, and store plutonium. Recovered plutonium nitrate and plutonium nitrate solutions received from the PUREX Plant are reduced to plutonium dioxide. The reduction process stabilizes the plutonium into the state best suited for long-term storage. PFP's mission no longer includes the production of finished plutonium metal.

Radionuclides primarily associated with PFP include  $^{239,240}\text{Pu}$ ,  $^{241}\text{Pu}$ , and  $^{241}\text{Am}$ . Potential diffuse emission release points from PFP include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17.1 234-5Z Building (active).** The 234-5Z Building is also known as PFP or the 234-5 Building. The 234-5Z Building basement mostly consists of pipe tunnels carrying drain piping. The first floor houses the following: (1) two plutonium processing lines (Remote Mechanical A and Remote Mechanical C Lines) and their control rooms, (2) scrap stabilization gloveboxes, (3) plutonium storage vaults, and (4) the plutonium nitrate feed load-in/load-out (LI/LO), blending, and storage facilities.

Radionuclides primarily associated with the 234-5Z Building include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17.2 236-Z Building.** The 236-Z Building, commonly known as PRF (Plutonium Reclamation Facility), is located south of the southeastern corner of the 234-5Z Building, connected to it by the 242-Z Building. The building air exhausts through the 291-Z-1 stack.

Radionuclides primarily associated with the 236-Z Building include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17.3 232-Z Building.** The 232-Z Building houses the layaway Contaminated Waste Recovery Process. It was commonly called the "Incinerator." It was constructed by Project CGC-013, "Plutonium Recovery from Contaminated Material." The Contaminated Waste Recovery Process was partially decontaminated and decommissioned in 1984.

Radionuclides primarily associated with the 232-Z Building include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse emission release points include access doors and inlet-exhaust ventilation systems, all of which are controlled.

**4.3.1.17.4 241-Z and 242-Z Buildings.** The 241-Z and 242-Z Buildings are designated as waste treatment facilities. 241-Z houses sumps, which are five separate enclosures or ventilated cells, each containing a 5,300-gal (20,000-L) tank used to accumulate the liquid wastes generated by PFP before being transferred to the tank farms. The 241-Z is ventilated by the 296-Z-3 stack.

The 242-Z Building houses abandoned waste treatment process equipment, once used to recover americium. This facility was permanently shut down after a process upset in 1979 spread contamination and caused irreparable equipment damage inside. The structural integrity of the facility was not compromised, however. The facility was then decontaminated extensively before being placed in layaway pending decommissioning work. The 242-Z Building shares the main ventilation system of the 234-5Z and 236-Z Buildings, exhausting its building air through the 291-Z-1 stack.

Radionuclides primarily associated with the 241-Z and 242-Z Buildings include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17.5 2736-ZB Building.** The 2736-ZB shipping area and receiving area both accommodate a maximum of 100 shipping containers, each of which is about the size of a 55-gal (210-L) drum. Adequate spacing is provided between containers to meet Westinghouse Hanford criticality prevention requirements, personnel exposure specifications, and corridor access standards to emergency staging areas. The two areas are physically separated by a wall.

Radionuclides primarily associated with the 2736-ZB Building include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.17.6 216-Z-20 Crib Effluent Facility.** The 216-Z-20 Crib was constructed and commissioned for use in September 1981 to dispose of waste water previously discharged to the 216-U-10 Pond through the 216-Z-19 Ditch. Use of the new crib allowed the radioactively contaminated 216-Z-19 Ditch and 216-U-10 Pond to be decommissioned.

Two liquid waste facilities were built. The 216-Z-20 Crib was designed and constructed to dispose of potentially radioactive liquid effluents from the 231-Z, 232-Z, 236-Z, 242-Z, 291-Z, 234-5Z, and 2736-ZB Buildings. The same building effluent headers and piping that served the 216-Z-19 Ditch were used. These headers and piping contain some residual contamination. The 207-Z Seepage Basin, later renamed 216-Z-21 Seepage Basin, was designed and constructed to dispose of noncontaminated water from the storm sewer north of the 234-5Z Building, water-tank overflow, and swamp-cooler waste water.

The 216-Z-20 Crib is approximately 460 m (1,500 ft) long with a cross section at the bottom that is approximately 3 m (10 ft) wide. Gravel was used as backfill to distribute effluents throughout the crib. A vapor barrier was placed above the gravel backfill. Soil was placed over the top to bring the area back to the surrounding grade.

Radionuclides primarily associated with the 216-Z-20 Crib include  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Diffuse emissions may be released by way of vents, risers, erosion, biotic uptake and intrusion, and wind-caused resuspension.

**4.3.1.18 T Plant.** Originally, T Plant was a fuel separations facility using the bismuth phosphate process. Now the facility is used for radioactive decontamination and repair of equipment. This facility currently is active.

T Plant is located in the 200 West Area of the Hanford Site. Buildings, structures, or special facilities included as part of this facility are the 221-T and 2706-T Buildings, deactivated 221-T Building Head-end, and 214-T Chemical Storage Building. Ancillary buildings, structures, and areas included are the 271-T, 291-T and 221-TA Buildings, and the 211-T Chemical Storage Area. Decontamination processes are conducted in the 221-T and 2706-T Buildings. The 221-T Building Head-end was used for special experiments and operations. The 214-T Building stores chemicals. The 211-T Chemical Storage Area consists of a 90-day permitted pad that stores nonradioactive hazardous waste and a tank that stores bulk chemicals. The 271-T Building provides office space to Westinghouse Hanford staff supporting T Plant operations. The 291-T Building houses the exhaust ventilation fans for the 291-T-1 main stack. The 221-TA Building houses the supply ventilation fans for the 221-T Building canyon.

Radioactive decontamination activities are performed in the canyon area. The canyon area consists of 37 cells and one railroad tunnel door. The railroad tunnel (used for transporting equipment into and out of the canyon, as well as for some decontamination) enters the plant at cell 2L. A motor-driven rolling steel door, provides railroad canyon access.

Primary radionuclides associated with T Plant include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.18.1 2706-T Building.** The 2706-T Building is a ground-level structure constructed of prefabricated steel. It has two openings on the west end that are fitted with rollup metal doors that allow access to the pit areas. Low-level radioactive decontamination activities are performed in these two pits.

Radionuclides primarily associated with the 2706-T Building include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.18.2 221-T Building — Head-End Operations.** The 221-T Building head-end consists of a canyon area extending from the basement floor to the roof. This canyon area has several deck levels and a parapet wall. Four floor levels adjacent to the canyon house include: (1) an electrical switchgear room, (2) a chemistry laboratory, (3) office areas, (4) a change room, (5) a lunch room, (6) a control room, (7) an instrument shop, (8) maintenance shop, (9) and storage areas. Flow from eight process sewer lines originating in the Head-End is discharged to the 216-T-1 Ditch.

Radionuclides primarily associated with 221-T Head-End Operations include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Potential diffuse emission release points include access doors and inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.18.3 221-T Building - Pressurized-Water (Cooled) Reactor Fuel Assembly Storage.** Canyon cell 2R has been modified to store approximately 76 pressurized-water reactor Core 2 blanket fuel assemblies that were used to power DOE's Shippingport Reactor. Provisions have been made to store the assemblies at the Hanford Site for up to 20 years.

The 221-T Building galleries are maintained at atmospheric pressure, while the 221-T Building canyon area is maintained at a negative pressure with respect to atmosphere. A primary design feature of these systems is to ensure that potentially contaminated canyon air is completely separate from the clean air in the 221-T Building galleries and the 271-T Building, which is the office space connected to the 221-T Building. In addition, the canyon air system is operated at negative pressures with respect to the other systems.

The 271-T building is adjacent to the 221-T Operating Gallery. While most of this building is used for office space, portions are used by T-Plant Operations.

Radionuclides primarily associated with 221-T-PWR Fuel Assembly Storage include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.18.4 Transuranic Waste Storage and Assay Facility.** Originally, the function of the 224-T Building was to purify plutonium nitrate by the lanthanum-fluoride process. The plant remained inactive following phase-out of the bismuth phosphate plants until the early 1970s. At that time, the building was modified for storage of plutonium scrap in liquid and solid forms.

In 1984, the 224-T Building was chosen to house the transuranic (TRU) waste storage and assay operation. The Transuranic Waste Storage and Assay Facility (TRUSAF) operation consists of a nondestructive analysis of TRU waste. The analysis is used as an overview for sealed, certified, contact-handled, TRU solid-waste packages, to verify general compliance with the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). Those containers meeting WIPP WAC criteria are stored at 224-T and maintained in a manner to retain their certification pending shipment to WIPP. The TRUSAF operation also performs a sorting function for the PFP.

In 1985, the removal of plutonium scrap from 224-T was completed, and the building was officially designated as the TRUSAF.

Radionuclides primarily associated with TRUSAF include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.19 B Plant.** B Plant was originally designed to chemically process spent nuclear fuels. Radiological containment and confinement features were incorporated in the various facilities and support systems to prevent exposure of plant personnel and the general public to excessive radiation. The plant was then modified to separate strontium and cesium from the fission product waste stream following plutonium and uranium recovery from irradiated reactor fuels in the PUREX Plant. The recovered purified and concentrated strontium and cesium solutions were then transferred to the Waste Encapsulation Storage Facility (WESF) for conversion to solid compounds, encapsulation, and interim storage. After strontium and cesium removal, the remaining waste was transferred from B Plant to the tank farms.

B Plant is an operating facility used to ensure safe storage and management of the WESF cesium and strontium capsules and a radiological inventory remaining in the plant from previous campaigns. There are currently no production activities at B Plant, but several systems are operating systems to perform the current B Plant mission. B Plant receives and stores various chemicals from: (1) commercial suppliers for treatment of low-level waste generated at WESF and B Plant; (2) generation of demineralized water; (3) and conditioning of water used in HVAC units.

B Plant consists of three main buildings. They are the 221-B Processing Building, 271-B Service and Office Building, and 225-B Building (WESF). The 221-B Process Building and its attached 271-B Service Building were constructed in 1943. Construction of the WESF was completed in 1974.

Radionuclides primarily associated with B Plant include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.20 222-S Facility.** The 222-S Laboratory Complex is located in the southeast corner of the 200 West Area. The facility is composed of the main laboratory complex (222-S) and a number of ancillary buildings and structures.

**4.3.1.20.1 222-S Laboratory.** The 222-S Laboratory is a two-story, aboveground building with a subterranean service level. This building is divided into laboratory support spaces, office spaces, a multicurie wing, seven environmental hot cells, and supplemental service areas. The building is designed with its own waste disposal facility, decontamination facility, fire protection and alarm system, ventilation system, and radiation monitoring systems.

The 222-S Laboratory Annex houses the maintenance shop, instrument shop, and the counting room filter building.

Radionuclides primarily associated with the 222-S Laboratory include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.20.2 222-SA Laboratory.** The 222-SA Laboratory is a five-wide modular building located southeast of the 222-S Laboratory. Part of this laboratory prepares nonradioactive standards for Hanford Site laboratories. The other section of the laboratory is used for cold-process development work and standards preparation. The 222-SA Laboratory only has the potential for nonradioactive diffuse emissions.

**4.3.1.20.3 2716-S Storage Building.** The 2716-S Storage Building, located south of the 222-S Laboratory, is partitioned off for the storage of acids and bases. It provides both long- and short-term storage capability for laboratory materials and contains no radioactive materials.

There are no radioactive diffuse emissions from the 2716-S Storage Building.

**4.3.1.20.4 207-SL Retention Basin.** The 207-SL Retention Basin acts as a temporary holding facility for potentially radioactive or hazardous liquid effluents before discharge to the 216-S-26 Crib. Waste water from the laboratory, normally free of radioactive and hazardous chemical contamination, is routed to the 207-SL Retention Basin. This facility is a covered, below-grade concrete structure, directly east of the 222-S Building. Two 25,000-gal (95,000-L) compartments allow batch collection, sampling, and discharge of the waste. Two 20,000-gal (75,708-L) storage tanks were added in 1994 to improve waste transfer and storage capabilities.

Radionuclides primarily associated with the 207-SL Retention Basin include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse release points include access doors and seams in the basin cover blocks.

**4.3.1.20.5 219-S Waste Handling Facility.** The 219-S Waste Handling Facility collects liquid waste generated by the 222-S Laboratory operations that is contaminated radioactively and/or with hazardous chemicals. This facility consists of two below-grade vaults (A and B, also called cells); a below-grade concrete vault, containing three stainless-steel tanks; a transite building; the pipe trench and operating gallery; and an attached concrete-walled sample gallery. Tanks TK-101 and TK-102 are in vault A and tank TK-103 is in vault B.

Radionuclides primarily associated with the 219-S Waste Handling Facility include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse release points include access doors and seams in the vault cover blocks.

**4.3.1.20.6 222-SC Filter Building.** The 222-SC Filter Building contains the filtration for hot-cells 1-A, 1-E-1, 1-E-2, and 1-F. The hot-cells in rooms 1-A, 1-E, and 1-F are serviced by the main building supply and exhaust ventilation, but additional features are present to increase safety and containment.

Radionuclides primarily associated with the 222-SC Filter Building include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.20.7 222-SB Filter Building.** The 222-SB Filter Building houses 96 single-stage HEPA filters to provide final filtration for the 222-S Laboratory. Under normal operation of the ventilation system, two fans exhaust air from the laboratory. Exhaust air leaves the 222-S Building through the 296-S-21 stack. A third exhaust fan, driven by a diesel engine, will provide half of the normal operation of the exhaust system if the electrically powered fans fail.

Radionuclides primarily associated with the 222-SB Filter Building include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.20.8 218-W-7 Dry Waste Burial Vault.** The 218-W-7 Dry Waste Burial Vault is located 40 ft southeast of 222-S. This underground concrete vault was removed from service sometime around 1960. It was used primarily for disposal of plutonium-contaminated dry-hood waste generated by the 222-S Laboratory. Access to the tank is through a locked hatchway.

Plutonium-239 and -240 are the radionuclides primarily associated with the 218-W-7 Dry Waste Burial Vault. A locked access hatchway is the only potential release point for diffuse emissions.

**4.3.1.20.9 216-S-26 Crib.** The 216-S-26 Crib receives all waste water collected in the 207-SL Retention Basins that meets radiological and chemical limits. Additionally, the crib also receives 222-SA Laboratory waste water and steam condensate from the 291-S Stack Fan House, which bypasses the 207-SL Retention Basins.

Radionuclides primarily associated with the 216-S-26 Crib include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{239,240}\text{Pu}$ . Diffuse emissions may be released by way of vents, risers, erosion, biotic uptake and intrusion, and wind-caused resuspension.

**4.3.1.21 2724-W Protective Equipment Decontamination Facility.** The 2724-W Protective Equipment Decontamination Facility (PEDF) is located in the 200 West Area of the Hanford Site. The facility has been shut down and is scheduled for demolition in 1994. Laundry operations have been transferred to an off-site vendor.

Radionuclides primarily associated with the 2724-W PEDF include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.22 Solid Waste Compactor Facility.** The Solid Waste Compactor Facility, the 213-W Building, is located in the 200 West Area of the Hanford Site. The 213-W Building is adjacent to the 272-WA Building (the Operations Support Building) at the 218-W-5 Burial Grounds at the west end of the 200 West Area. Systems ancillary to the 213-W Building also are included.

The primary function or process associated with the Solid Waste Compactor Facility has changed from waste compaction and packaging to waste confirmation and verification. The compactor is scheduled to be removed from the facility in 1994.

Radionuclides primarily associated with the 213-W Building include  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ ; low-level waste is present also. Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.23 Central Waste Complex.** The Central Waste Complex (CWC) is a group of structures located on the west side of 200 West Area exclusion zone. The primary function or process associated with the CWC Facility is the receipt and storage of radioactive and mixed waste (MW), which is currently ongoing. This facility has the potential to generate radioactive and/or hazardous chemical emissions and radioactive and/or hazardous chemical liquid effluent.

Radionuclides associated with the Central Waste Complex are from a wide group of mixed fission, mixed waste, and transuranic radionuclides. Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled. The facility consists of the following.

**4.3.1.23.1 Pu and PCB Storage Facility.** This facility is a steel building with concrete curbing within its perimeter. The building has a water-based fire suppression system and continuous air monitors (CAM) for detection of airborne radioactive particulates.

**4.3.1.23.2 Low-Flashpoint MW Storage Modules.** Each of the low-flashpoint MW storage modules has a catch sump with a holding capacity of 750 gal (2,800 L). Modules used for storage of TRU-mixed waste also have draft ventilation.

**4.3.1.23.3 Mixed-Waste Storage Facilities.** The buildings 2402-WB through 2402-WL, 2402-W, and 2403-W are metal structures with concrete floors, ventilation systems, and water-based fire protection. The concrete floors have provisions to collect any spilled liquids. The facilities have CAMs for detection of airborne radioactive particulates.

**4.3.1.23.4 Mixed-Waste Storage Pad.** The MW Storage Pad is a 9,000 ft<sup>2</sup> (320 m<sup>3</sup>) concrete storage pad with 6-in. (15-cm) curbing around its perimeter. The pad has a

stormwater collection system that allows for disposing of the stormwater after sampling and analysis.

**4.3.1.23.5 Waste Receiving and Storage Pad.** The Waste Receiving and Storage Pad is a 61-m-by-46-m (200-ft-by-150-ft) asphalt pad.

**4.3.1.24 Tank Farms.** Liquid waste from chemical processing operations containing high concentrations of radionuclides is stored on an interim basis in underground tanks. The Hanford Site tank farms contain 177 tanks (149 SSTs and 28 DSTs) with capacities ranging from 50,000 to 1.2 million gal (190,000 to 4.5 million L). Since 1967, newly generated liquid waste has been stored in DSTs. The SSTs are no longer receiving waste.

The location of all the tank farms is the 200 East and 200 West Areas. Both DSTs and SSTs are present in these areas. Tank farms in the 200 East Area include the A, AX, B, BX, BY, C (SSTs), AN, AZ, AY, AP, and AW (DSTs). Those in the 200 West Area are the S, SX, T, TX, TY, U (SSTs) and the SY (DST).

Hanford Site tank farms comprise transfer routes, diversion boxes, storage vaults, double-contained receiver tanks (DCRT), and evaporators.

A system of underground pipes is used to transfer wastes from the 200 East Area waste generators to the DSTs, between the DSTs, and from the DSTs to treatment and storage units in the 200 East and 200 West Areas.

Radionuclides primarily associated with the tank farms include  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$ ,  $^{137}\text{Cs}$ ,  $^{239,240}\text{Pu}$ , and  $^{241}\text{Am}$ . Diffuse emission release locations may include vents, risers, access hole covers, inlet-exhaust ventilation systems, diversion boxes, transfer lines, and storage vaults.

**4.3.1.24.1 Double-Shell Waste Tanks.** The DSTs are of two distinctly different types. The capacity of the first type is 1 to 1.2 million gal (3.79 to 4.54 million L), and is designed for long-term storage (up to 50 years) of high-activity mixed waste. Twenty-four 1.2-million-gal (4.5-million-L) non-aging waste DSTs and four 1.0-million-gal (3.8-million-L) aging waste DSTs have been built. For efficiency during construction and operation, the 1-million-gal tanks were grouped into six tank farms.

The second type of DST is smaller, with storage capacities ranging from 800 to 45,000 gal (3,028 to 170,370 L). These tanks were used primarily for lag storage of waste before transfer to the larger tanks or to other facilities. These smaller tanks are called DCRTs.

All DSTs were fabricated as three concentric tanks. Waste is stored in the free-standing primary tank. The secondary tank sits on a concrete pad. The completely enclosed annulus serves as a containment barrier if the primary tank should leak. The annulus is ventilated and continually monitored for evidence of primary tank leakage. The third tank is

a concrete shell that encloses the sides of both primary and secondary tanks for additional containment, radiation shielding, and structural support.

Ancillary equipment also is present, such as transfer lines between tank farms and DCRTs, valve pits, diversion boxes, and tank-farm piping.

**4.3.1.25 242-A Evaporator.** The 242-A Evaporator complex is located in the 200 East Area of the Hanford Site. The 242-A Building is located south of the 241-A and 241-AX Tank Farms and north of the 242-AW Tank Farm. The 242-A Building contains the evaporator vessel and supporting process equipment. The building ventilation exhaust fans and HEPA filter housings are located on the north side of the building. An emergency diesel generator is located on the south side of the building. Raw water, steam, and electrical power are provided to the 242-A Building from existing service facilities in the 200 East Area.

In general, the 242-A Evaporator Facility can be divided into three areas: process, service, and operating. The process area includes: the evaporator room, pump room, condenser room, and ion exchange enclosure. The service area includes: the aqueous make-up (AMU) room, loadout and hot equipment storage room, loading room, and HVAC room. The operating areas include: the control room, personnel change rooms, lunchroom, office, and storage rooms.

Radionuclides primarily associated with 242-A include  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$ ,  $^{137}\text{Cs}$ ,  $^{239,240}\text{Pu}$  and  $^{241}\text{Am}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.26 242-S Evaporator.** The 242-S Evaporator, currently on standby, is located in the 200 West Area, west of the 241-SY Tank Farm. It consists of an evaporator vessel and supporting process equipment. The building ventilation exhaust fans and HEPA filter housings are on the north side of the building. An emergency diesel generator is on the south side of the building. Raw water, steam, and electrical power are provided from existing service facilities in the 200 East Area. There are three main areas: process, service, and operations. The process area includes: the evaporator room, pump room, condenser room, and ion-exchange enclosure. The service area includes: the Aqueous Make-up (AMU) room, loadout and hot equipment storage room, loading room, and the HVAC room. The operating areas include: the control room, personnel change rooms, lunchroom, offices, and storage rooms.

Radionuclides primarily associated with 242-S include  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$ ,  $^{129}\text{I}$ ,  $^{137}\text{Cs}$ ,  $^{239,240}\text{Pu}$ , and  $^{241}\text{Am}$ . Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.27 242-T Evaporator.** The 242-T Evaporator, currently inactive, is located in the 200 West Area, east of the 241-TX and 241-TY Tank Farms. It consists of evaporator vessel and supporting process equipment. The building ventilation exhaust fans and HEPA-

filter housings are on the north side of the building. An emergency diesel generator is on the south side of the building. Raw water, steam, and electrical power are provided from existing service facilities in the 200 East Area. There are three main areas: process, service, and operations. The process area includes: the evaporator room, pump room, condenser room, and ion-exchange enclosure. The service area includes: the AMU room, loadout and hot equipment storage room, loading room, and the HVAC room. The operating areas include: the control room, personnel change rooms, lunchroom, offices, and storage rooms.

**4.3.1.28 Grout Treatment Facility (GTF).** The GTF combines low-level radioactive liquid waste with a cement mixture that is pumped into disposal vaults. The GTF was placed in cold standby in 1993.

Radioactive constituents primarily associated with GTF include  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and other low-level radioactive waste from the tank farms. Potential diffuse emission release modes include vents, risers, and the inlet-exhaust ventilation system.

**4.3.1.29 Low-Level Burial Grounds.** The active low-level radioactive solid waste burial grounds are located in the 200 Areas of the Hanford Site. The active sites to be considered are those addressed in the Part A, *Dangerous Waste Permit Application for the Low-Level Burial Grounds* (DOE/RL 1988). In the 200 West Area, the burial grounds to be considered include 218-W-5, 218-W-6, 218-W-3A, 218-W-3AE, 218-W-4B, and 218-W-4C. In the 200 East Area, the burial grounds to be considered include 218-E-10 (Expansion), 218-E10, and 218-E12B.

The entire array of low-level radionuclides from operations on the Hanford Site is associated with the Low-Level Burial Grounds. Diffuse emissions may be released by way of open burials (before covering), ruptured containment vessels, biotic intrusion, erosion, and wind-caused resuspension.

**4.3.1.29.1 Burial Ground 218-W-3A.** Burial Ground 218-W-3A began receiving waste in 1970. It consists of 61 trenches covering 50.3 acres (20.4 hectares). Waste stored or disposed of in this burial ground includes mixed, transuranic, low-level, and retrievable waste. Other types of waste include ion-exchange resins and industrial waste (such as failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories). This burial ground also stores spent fuel.

**4.3.1.29.2 Burial Ground 218-W-3AE.** Burial Ground 218-W-3AE began receiving waste in 1981. It consists of 31 trenches covering 49.4 acres (20 hectares). Waste in this burial ground includes low-level and mixed waste. Other types of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and industrial waste.

**4.3.1.29.3 Burial Ground 218-W-4B.** Burial Ground 218-W-4B began receiving waste in 1968. It consists of 13 trenches and 12 caissons covering 8.6 acres (3.5 hectares).

The trenches contain mixed and retrievable TRU waste and were filled before 1980. Caisson Alpha 4 is believed to contain mixed waste.

**4.3.1.29.4 Burial Ground 218-W-4C.** Burial Ground 218-W-4C began receiving waste in 1978. It consists of 69 trenches covering 51.7 acres (20.9 hectares). Some of the waste in this facility is TRU, mixed, and low-level. Other types of waste placed in these trenches include contaminated soil, decommissioned pumps, pressure vessels and hardware, and stored spent fuel. Some of the trenches are designed for retrievable storage of waste.

**4.3.1.29.5 Burial Ground 218-W-5.** Burial Ground 218-W-5 began receiving waste in 1986. It consists of 35 trenches (with room to expand to 57 trenches) covering 84.0 acres (34 hectares). The trenches contain low-level mixed waste that includes lead bricks and shielding. Low-level waste also was placed in these trenches.

**4.3.1.29.6 Burial Ground 218-W-6.** Burial Ground 218-W-6 has not received any waste to date. When developed, this burial ground will consist of 35 trenches and cover approximately 44.5 acres (18 hectares).

**4.3.1.29.7 Burial Ground 218-E-10.** Burial Ground 218-E-10 began receiving waste in 1960. It consists of 18 trenches covering 56.7 acres (22.9 hectares). Waste was received from PUREX, B Plant, and N Reactor. The waste includes low-level and low-level mixed waste such as dragoff waste, failed equipment, and industrial waste.

**4.3.1.29.8 Burial Ground 218-E-12B.** Burial Ground 218-E-12B began receiving wastes in 1967. It consists of 94 trenches covering about 173 acres (70 hectares). Areas are set aside for future expansion of this burial ground. Some of the waste contained in this burial ground is TRU, mixed, and low-level. Trench 94 contains decommissioned U.S. Navy submarine reactor compartments.

**4.3.1.30 300 Area Waste Service Facility.** The 340 Complex is located in the 300 Area of the Hanford Site near the Columbia River. The 340 Complex was constructed to collect, store, and transport radioactive liquid wastes. Buildings 324, 325, 326, 327, and 329 were built in the mid-1950's and can discharge liquid radioactive waste to the Radioactive Liquid Waste System or potentially radioactive wastes to the Retention Process Sewer (RPS). The 308 building can discharge wastes only to the RPS. Except for the 308 building, which is managed by Westinghouse Hanford for the U.S. Department of Energy, Richland Operations Office, PNL manages all facilities generating waste destined for the 340 Complex. Only the 324 and 325 buildings can accumulate wastes in tanks and then pump the wastes to the complex.

Uranium,  $^{60}\text{Co}$ , and  $^{90}\text{Sr}$  primarily are associated with the 340 Complex. Potential diffuse emission release points include access doors and the inlet-exhaust ventilation system, all of which are controlled.

**4.3.1.31 300 Area N Reactor Fuels Fabrication Facility.** The N Reactor Fuels Fabrication Facility is located in the 300 Area of the Hanford Site. It consists of 16 buildings, two tank farms, and associated pipe trenches and drains. The structures are located on the north side of the 300 Area. The 300 Area Fuels Fabrication facilities began operation in 1944 with some structures being added in the 1950's and 1960's. The following sections provide information on each of the facilities.

**4.3.1.31.1 333 Building.** The primary N Reactor Fuels Fabrication activities were conducted in the 333 Building. The fuel fabrication operation produced N Reactor fuel from 1961 until 1987 when operations were stopped.

This facility used a variety of mechanical, chemical, and electrical processes to convert uranium billets and assorted components into finished fuel assemblies for irradiation at N Reactor.

Operations and resulting radionuclide air emissions in the 333 Building ceased in January 1987. Emission monitoring equipment was shut down at that time. Process liquid effluents also have stopped; however, steam condensate water, air conditioning water, and stormwater still discharge to the process trench by way of the process sewer.

Uranium and <sup>99</sup>Tc primarily are associated with the 333 Building. Operation of the heating and cooling ventilation system results in potential diffuse emission release points from equipment and personnel access doors.

**4.3.1.31.2 313 Building.** The 313 Building (N Fuels Fabrication Support Facility) houses: the uranium laboratory, copper casting, waste-acid treatment facility, extrusion press, engineering development laboratory, training rooms, and staff offices.

The 313 Building was used from 1944 to 1971 for fabricating uranium fuel elements for the eight retired, single-pass reactors in the 100 Areas. The function of the building changed when those reactors ceased operating. The building then was used as an N Fuels Fabrication Support Facility to treat uranium-bearing acid in the waste-acid treatment system. The recovered uranium sludge was recycled to form new uranium billets at Fernald, Ohio.

The waste-acid treatment system is still active in treating uranium bearing clean-up solutions in preparation for Resource Conservation and Recovery Act (RCRA) closure of the waste-acid treatment system. Engineering development laboratory work and continuous monitoring of airborne emissions was terminated in 1991.

Uranium and <sup>99</sup>Tc are the potential primary radioactive constituents in diffuse emissions from the 313 Building. Operation of the heating and cooling ventilation system results in potential diffuse emission release points from equipment and personnel access doors.

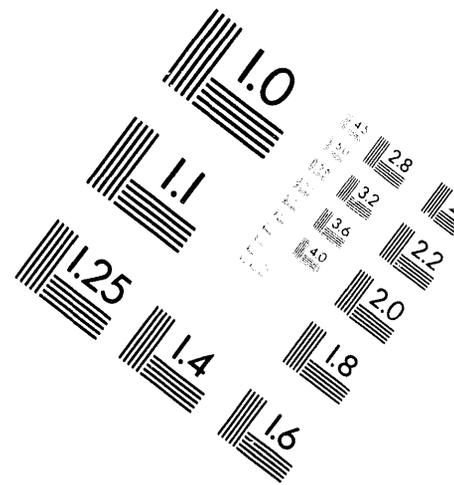
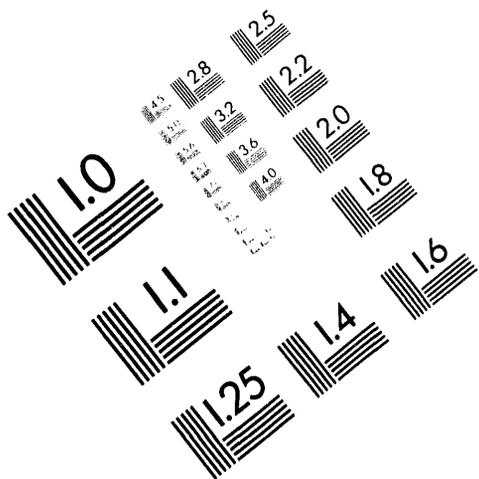
**4.3.1.31.3 303-K Radioactive Mixed Waste Storage Facility.** The 303-K Facility was designed and constructed in 1943. The facility is a concrete-block building with a



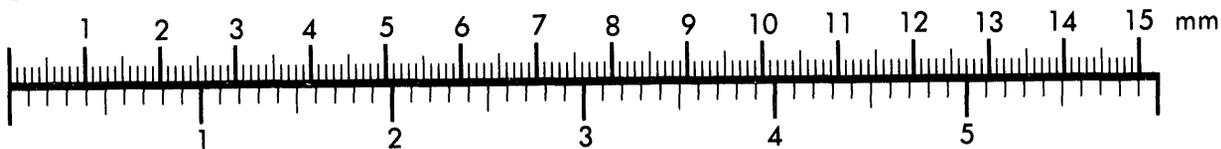
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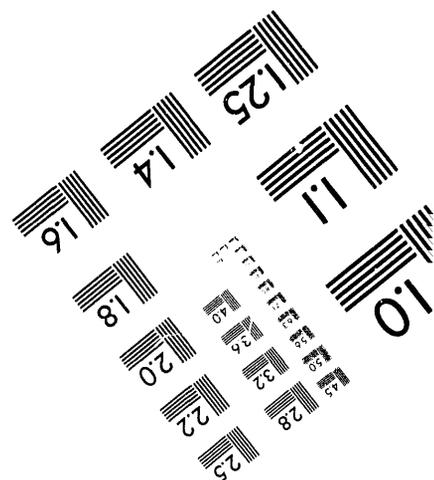
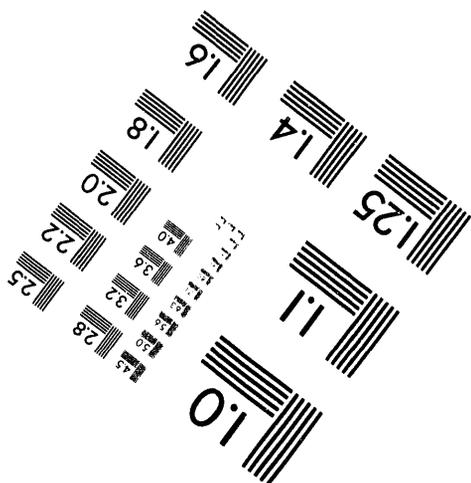
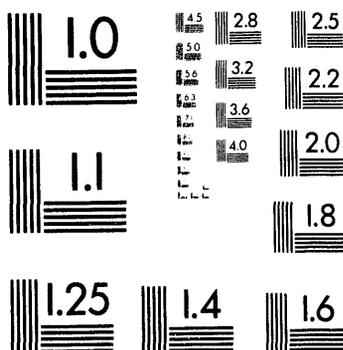
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poured concrete ceiling. Outside, the storage area consists of two concrete pads, two asphalt pads, and a gravel area. The north room of the 303-K Facility originally had one roof exhaust fan. The fan was used from 1953 to 1977 while aluminum spacer and equipment decontaminating was done. The roof vent fan was replaced with a HEPA-filtered exhaust system in 1977, which was used until the fall of 1982. The exhaust system was only turned on at the end of the curing operation for the concreted billets of recyclable scrap uranium chips and fines, or if hydrogen levels indicated a billet fire had occurred. The HEPA exhaust system has not operated since the concrete curing operation was discontinued in 1982. The facility no longer discharges either air emissions or liquid effluents to the environment. It has been used to store radioactive and mixed waste since 1982.

Uranium and  $^{99}\text{Tc}$  are the primary radioactive constituents in potential diffuse emissions from the 303-K Facility. Operation of the heating and cooling ventilation system results in potential diffuse emission release points from equipment and personnel access doors.

**4.3.1.31.4 303-M Uranium Oxide Facility.** The 303-M Uranium Oxide Facility is adjacent to the 333 Building and consists of one building, an adjacent outdoor drum storage area, and a small process sewer filter building. The 303-M Uranium Oxide Facility stored and treated recycled material generated during the N Reactor fuel fabrication processes. The fuel fabrication waste material consisted of pyrophoric saw fines and lathe turnings, known as chips, composed of slightly enriched uranium and Zircaloy-2. The wastes were calcinated to remove their pyrophoric properties, eliminating the possibility of spontaneous combustion during transportation.

The 303-M Uranium Oxide Facility operated from 1983 to 1987 for the calcination of wastes generated by Westinghouse Hanford and previous operators. The facility ceased operating in 1987.

During operation, the facility operated under negative pressure and the building exhaust was released to the atmosphere through a single stack. The emissions were controlled with a bag-house and HEPA filters.

The 303-M Building is currently closed. The water and electricity have been shut off and the exhaust stack capped. The primary radionuclides associated with the facility are uranium and  $^{99}\text{Tc}$ .

**4.3.1.31.5 304 Uranium Concretion Facility.** The 304 Building was designed and constructed in 1952 as a pilot plant for the lead-dip canning process. The 304 Uranium Concretion Facility was installed in 1971 with a drainage trench and sump to remove liquids resulting from spills, leaks, and daily operations. Standard spill-response procedures inside the building included washing the spilled waste to the sump where the fines would settle out. The waste water was drained into the 300 Area process sewer, and the fines were shoveled from the sump and concreted. Additionally, an outside storage area is on the north side of the facility. The storage area is a concrete pad surrounded by asphalt.

The 304 Building is currently in transition to closure under the Resource Conservation and Recovery Act (RCRA). The building has no inlet air supply system, the water is shut off, and drains have been plugged. The exhaust stack is scheduled to be capped in 1994. Uranium and  $^{99}\text{Tc}$  are the primary potential diffuse emissions from personnel and equipment access doors.

**4.3.1.31.6 311 Tank Farm.** The recoverable and nonrecoverable uranium-bearing neutralized waste solutions from the 313 Building were combined in aboveground tanks (tanks 40 and 50) in the 311 Tank Farm. These liquid wastes eventually were transferred to tanker trucks and disposed of in the 183-H Basins or the 200 Areas. After 1988, if the wastes were below radioactive release limits, they were shipped to offsite contractors for treatment, storage, and/or disposal. The two tanks received approximately 420,000 gal (1.6 million L) of waste per year during periods of peak production.

In addition to waste tanks 40 and 50, the 311 Tank Farm has a 4,000-gal (15,000-L) tank that was used to store nitric acid and two 10,000-gal (38,000-L) tanks that were used to store sodium hydroxide. The tanks were emptied in 1991 and no longer contain nitric acid or sodium hydroxide.

Uranium and  $^{99}\text{Tc}$  are the potential primary radioactive constituents in diffuse emissions from the 311 Tank Farm. Diffuse emissions may be released by way of uranium-bearing material transfers and unplanned releases.

**4.3.1.31.7 334-A Waste Acid Storage Building.** The 334-A Waste Acid Storage Building was completed in late 1974 and placed in use in January 1975. For four months in 1973, an underground tank and tank 4 in the 334 Tank Farm were used to collect acid waste that would be transferred to the 313 Building for neutralization. The underground tank began to leak in August 1973 and was removed during construction of the 334-A Building. The waste acids were discharged directly into the process sewer until the 334-A Building was built in December 1974. The tanks in the 334-A building received approximately 210,000 gal (790,000 L) of waste acids per year. These waste acids consisted of hydrofluoric, nitric, and sulfuric acids with copper, zirconium, chromium, and uranium in solution. Following storage, the acids were pumped from the 334-A Building to the south end of the 313 Building for neutralization.

The 334-A Building is currently shut down and scheduled for RCRA closure. The building heating and cooling air handling systems have been shut down, the water and electricity have been shut off, and drains have been plugged. The storage tanks in the building have been isolated and cleaned. Uranium and  $^{99}\text{Tc}$  are the potential primary radioactive constituent in diffuse emissions from the 334-A Building. The potential primary diffuse emission release points include personnel and equipment access doors.

**4.3.1.32 Fast Flux Test Facility (FFTF).** The FFTF is a 400-megawatt-thermal, sodium-cooled, fast-neutron-flux reactor designed specifically for irradiation testing of nuclear reactor fuels and materials for liquid-metal, fast-breeder reactors. The reactor is capable of

extensive in-core irradiation testing, including eight core positions that may be used with independent instrumentation for the test loops. In addition to irradiation-testing capabilities, FFTF is designed for long-term testing and evaluation of plant components and systems for liquid-metal, fast-breeder reactors.

The FFTF is a complex of buildings and equipment arranged around the reactor containment building. This arrangement includes the reactor, equipment, and structures for heat removal, containment, core component handling and examination, instrumentation and control, and buildings for supplying utilities and other essential services.

Radionuclides primarily associated with FFTF include  $^{41}\text{Ar}$ ,  $^{85}\text{Kr}$ ,  $^{90}\text{Sr}$ , and  $^{131}\text{I}$ . The potential primary diffuse emission release points include the personnel and equipment access doors and the inlet-exhaust ventilation system, all of which are controlled.

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## 5.0 SUPPLEMENTAL INFORMATION

This section has supplemental information related to Hanford Site radionuclide air emissions in 1992. The information consists of:

- Population dose estimate
- Compliance status with Subparts Q and T of 40 CFR 61 (EPA 1992)
- Discussion on  $^{220}\text{Rn}$  emissions
- Emission points subject to monitoring requirements of 40 CFR 61.93(b) and costs to upgrade noncompliant monitoring systems
- Periodic confirmatory measurement plans
- Status of quality assurance (QA) program intended to comply with description in 40 CFR 61, Appendix B, Method 114.

### 5.1 POPULATION DOSE

The regional dose from 1993 Hanford Site air emissions was estimated by calculating the radiation dose to the population of approximately 376,000 residing within an 80-km (50-mi) radius of the onsite operating areas. Pathways of exposure to the population from releases of radionuclides to the atmosphere include inhalation, air submersion, and consumption of food. Population exposure to radionuclide air emissions was determined using values of population-weighted atmospheric dispersion factors for distance and each compass sector. The collective effective dose equivalent (using the GENII computer code, [Napier et al. 1988]) from air emissions to the population within 80-km of the Hanford Site during 1993 was 0.3 person-rem. Releases to surface water added another 0.1 person-rem so the population dose from all Hanford Site radionuclide emissions was 0.4 person-rem in 1993.

### 5.2 COMPLIANCE STATUS WITH SUBPARTS Q AND T OF 40 CFR 61

In 40 CFR 61 (EPA 1992), Subpart Q, "National Emission Standards for Radon Facilities From Department of Energy Facilities," paragraph 61.190 states that the provisions of Subpart Q apply to the design and operation of all storage and disposal facilities for radium-bearing material that emit  $^{222}\text{Rn}$  to the air. Paragraph 61.191(b) states that a source means any building, structure, pile, impoundment, or area used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit  $^{222}\text{Rn}$  in excess of the 20 pCi/m<sup>2</sup>/s. At the Hanford Site, no storage and disposal

facilities for radium-bearing waste materials are established. Therefore, the provisions of this subpart are not applicable to the Hanford Site.

Activities at the Hanford Site were evaluated for compliance with 40 CFR 61 Subpart T, "National Emissions Standards for Radon Emissions From the Disposal of Uranium Mill Tailings" (EPA 1992). In paragraph 61.220, "Designation of Facilities," owners and operators of all sites used for the disposal of tailings and that managed residual radioactive material or uranium byproduct materials during and following the processing of uranium ores and that are listed in or designated by the Secretary of Energy under Title I of the *Uranium Mill Tailings Control Act of 1978* or regulated under Title II of that act are subject to the provisions of the subpart. At the Hanford Site, uranium milling and uranium-ore processing activities are not conducted. Therefore, the provisions of this subpart are not applicable to the Hanford Site.

### 5.3 EMISSION OF RADON-220 FROM SOURCES CONTAINING URANIUM-232 AND THORIUM-232

At the PUREX facility, atmospheric emissions of  $^{220}\text{Rn}$  are calculated from  $^{212}\text{Pb}$  values measured in particulate samples collected from the 291-A-1 stack because  $^{220}\text{Rn}$  gas is not directly measured. At the 327 Building, emissions of  $^{220}\text{Rn}$  were directly measured with a continuous air monitor. Calculating  $^{220}\text{Rn}$  emissions is usually required because  $^{232}\text{Th}$  decays to  $^{220}\text{Rn}$ , which has a half-life of 55.6 seconds. Because  $^{220}\text{Rn}$  is a gas, it passes unimpeded through the HEPA filters and sample filters. However,  $^{212}\text{Pb}$  is a  $^{220}\text{Rn}$  decay product, has a half-life of 10.64 hours, and is a particle that can be captured on record sample filters. Sample filters are collected daily from the PUREX stack and analyzed on the Hanford Site within 5 hours from the time of collection.

Radon emissions and doses for 1993 are being reported separately from other site stack emissions because a new project initiated in the 327 Building during late September increased emissions for  $^{220}\text{Rn}$  and  $^{222}\text{Rn}$  from the 300 Area. The  $^{220}\text{Rn}$  released from the 327 Building was derived from a  $^{228}\text{Th}$  source. Releases from this facility and the  $^{220}\text{Rn}$  from the PUREX facility are listed in Table 2-1. Previous annual reports have included the  $^{220}\text{Rn}$  emissions from the PUREX facility with the emissions of other radionuclides, because they did not contribute significantly to the total. The resulting  $^{220}\text{Rn}$  dose was 0.008 mrem to the maximally exposed individual at the Sagemore Road farm. The  $^{220}\text{Rn}$  emissions from the 327 Building contributed essentially the entire dose. The calculation was performed assuming that all  $^{220}\text{Rn}$  was converted to its first long-lived decay product,  $^{212}\text{Pb}$ , prior to reaching the receptor. This was necessary because CAP88-PC does not account for ingrowth of decay products for the short-lived  $^{220}\text{Rn}$  radionuclide. The  $^{222}\text{Rn}$  dose added another 0.002 mrem to the MEI. Because of the increased emissions of  $^{220}\text{Rn}$  during 1993, the dose from these radionuclides was roughly equivalent to the dose to the MEI from all other radionuclides. The total dose to the MEI at Sagemore from all radionuclides, including radon, was less than 0.2% of the 10 mrem/year regulatory standard.

#### 5.4 SOURCES OF RADON-222

Radon-222 is a decay product in the  $^{238}\text{U}$  decay chain. The contribution of  $^{222}\text{Rn}$  to the dose received by any member of the public can be calculated after removing the background uranium activity from soil analytical data. The radon flux that could be derived from any residual or above-background radioactivity, as a measure of the Hanford Site component, appears to be extremely small and would result in an offsite dose much smaller than 0.1 mrem/yr EDE.

Surface-soil samples were collected at locations both on and off the Hanford Site. The purpose of this sampling is to detect the possible buildup of radionuclides deposited by air emissions from Hanford Site facilities. Samples are collected at relatively undisturbed nonagricultural sites so that natural deposition and buildup processes would be represented. Because the radionuclides of interest were present in worldwide fallout or occurred both naturally and in Hanford Site emissions, these radionuclides were expected in all samples.

An assessment of radionuclide contributions from Hanford Site operations was made by comparing results from samples collected: (1) on the Hanford Site with those collected off the Hanford Site, (2) around the Hanford Site perimeter with those collected at distant locations, and (3) downwind (primarily east and south of the Hanford Site) with those collected from generally upwind and distant locations. Analytical results obtained from each location in 1992 were compared to results obtained from the same location in previous years. The comparison revealed no indication of trends or increases in the concentrations of radionuclides in the offsite environment that could be attributed to Hanford Site activities. Because the onsite concentrations of these radionuclides are not significantly different than the offsite concentrations, there does not appear to have been a long-term buildup of radon decay products in the soil resulting from unmonitored  $^{222}\text{Rn}$  emissions from the Hanford Site. The only measured release was from the 327 Building which was reported to be 1.5 Ci of  $^{222}\text{Rn}$  and is described in Section 3.3.

#### 5.5 EMISSION POINTS SUBJECT TO MONITORING REQUIREMENTS OF 40 CFR 61.93(b) AND THE COSTS TO UPGRADE NONCOMPLIANT MONITORING SYSTEMS

All Hanford Site facilities were evaluated for compliance with 40 CFR 61 (EPA 1992). As of 1993, 116 emission point sources were registered with the Washington State Department of Health. Of these 116 sources, 19 facility emission points were identified as having the potential to exceed the threshold limit of 0.1 mrem/yr EDE (40 CFR 61.93(b)(4)(i)). Westinghouse Hanford manages 14 of these emission points, and PNL manages five. These 19 emission points, referred to as major stacks, either have been or are being evaluated for monitoring upgrades to comply with the requirements of 40 CFR 61. All 19 stacks (with each respective facility and managing DOE contractor) are listed below, by area. (EPA Region 10 has still not accepted a Westinghouse Hanford

method for determining potential emissions from stacks it manages having multiple stages of HEPA filters, assuming the treatment controls have been removed. The final resolution may change the current list of 19 stacks.)

- **200 East Area**

- 291-A-1 (PUREX; Westinghouse Hanford)
- 291-B-1 (B Plant; Westinghouse Hanford)
- 296-A-22 (242-A Evaporator; Westinghouse Hanford)
- 296-A-40 (241-AP Tank Farm; Westinghouse Hanford)
- 296-A-1 (PUREX; Westinghouse Hanford)
- 296-A-17 (Tank Farms; Westinghouse Hanford)
- 296-A-27 (Tank Farms; Westinghouse Hanford)
- 296-A-29 (Tank Farms; Westinghouse Hanford)
- 296-P-16 (Tank Farms; Westinghouse Hanford)

- **200 West Area**

- 291-Z-1 (PFP; Westinghouse Hanford)
- 296-Z-3 (PFP; Westinghouse Hanford)
- 296-P-23 (Tank Farms; Westinghouse Hanford)
- 296-S-15 (Tank Farms; Westinghouse Hanford)

- **300 Area**

- 340-NT-EX (340 Waste Handling; Westinghouse Hanford)
- EP-324-01-S (324 Building; PNL)
- EP-325-01-S (325 Building; PNL)
- EP-327-01-S (327 Building; PNL)
- EP-327-02-V (327 Decontamination Cell; PNL)
- EP-3720-01-S (3720 Building; PNL).

Westinghouse Hanford compared the monitoring systems of seven of the major stacks it manages to the continuous monitoring criteria of 40 CFR 61.93(b) (EPA 1989). The findings of the point-by-point comparisons were submitted to EPA Region 10 for review. The results of point-by-point comparisons for the additional seven stacks identified in 1993 as major stacks will be provided to EPA in 1994. Westinghouse Hanford is continuing engineering studies on modifications that potentially may be required to the monitoring systems.

Pacific Northwest Laboratory completed upgrades of the monitoring systems of the five major stacks it operates. Costs for individual system upgrades ranged from \$20,000 to \$450,000. Compared to the PNL-managed stacks, those managed by Westinghouse Hanford are larger, more complex, and have considerably greater contamination. Because of these factors, monitoring system upgrades for each of the seven stacks managed by Westinghouse

Hanford are estimated to cost between approximately \$200,000 and \$5 million. The number of stack monitoring systems requiring upgrading possibly could increase, depending on the method EPA Region 10 approves for determining whether a stack is "major."

## 5.6 PERIODIC CONFIRMATORY MEASUREMENT PLANS

The Hanford Site air emission points with exhaust fans potentially discharging radionuclides to the environment have permanently installed sampling systems. Nearly all of these sampling systems are operated continuously, with samples removed at various intervals for radioanalysis. The most common interval is weekly, for gross alpha and gross beta analyses. For those stacks having radioactivity above background levels, sample filters typically are composited on a quarterly interval and then analyzed for specific radionuclides, such as  $^{90}\text{Sr}$  and  $^{239,240}\text{Pu}$ .

At least half of the 116 registered stacks on the Hanford Site are discharging air without any radioactivity (i.e., none that is detectable above background levels). Samples are collected from these stacks either weekly, biweekly, monthly, or quarterly and analyzed. The analysis results are reported annually and used in calculating the offsite dose for determining compliance with EPA and DOE standards.

## 5.7 STATUS OF COMPLIANCE WITH QA PROGRAM CRITERIA DESCRIBED IN APPENDIX B, METHOD 114, 40 CFR 61

In July 1993, a document describing the Westinghouse Hanford Quality Assurance program was revised and submitted to EPA. The document, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring* (WHC 1993) contained appendices providing a point-by-point comparison of current monitoring systems for the major stacks with the recommendations of 40 CFR 61, Appendix B, Method 114, (EPA 1992). In February 1994, a second document, *Quality Assurance Project Plan for Radioactive Airborne Emissions Data Compilation and Reporting* (WHC 1994), also was revised and submitted to EPA.

In May 1992, PNL implemented the *Quality Assurance Plan for Facility Effluent Monitoring*, Quality Assurance Plan No. F0-011. The QA program described by this plan is based on the following documentation:

- EPA QAMS-005/80, *Interim Guidelines for Preparing Quality Assurance Project Plans*
- DOE 5700.6C, *Quality Assurance*
- DOE 5400.1, *General Environmental Protection Program*
- DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*
- applicable criteria of ASME NQA-1, *Quality Assurance Requirements for Nuclear Facilities*, as reflected in PNL's *Quality Assurance Manual*, PNL-MA-70, and associated implementing procedures.

## 6.0 REFERENCES

- Bisping, L. E. 1994. *Hanford Site Environmental Data for Calendar Year 1993 -- Surface and Columbia River*. PNL-9824. Pacific Northwest Laboratory. Richland, WA.
- Brown, R. M., 1990, *Oxidation and Dispersion of HT in the Environment: The August 1986 Field Experiment at Chalk River*. Health Physics 58(2):171-181.
- Dirkes, R. L., R. W. Hanf, R. K. Woodruff, and R. E. Lundgren. 1994. *Hanford Site Environmental Report for Calendar Year 1993*. PNL-9823. Pacific Northwest Laboratory. Richland, WA.
- DOE, 1988, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C.
- DOE, 1991, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T, U.S. Department of Energy, Washington D.C.
- DOE-RL, 1988, *Hanford Site Dangerous Waste Part A Permit Application*, DOE/RL-88-21, U.S. Department of Energy, Richland Field Office, Richland, Washington.
- DOE-RL, 1991, *Calendar Year 1990 Air Emissions Report for the Hanford Site*, DOE/RL-91-10, U. S. Department of Energy, Richland Field Office, Richland, Washington.
- DOE-RL, 1992, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 1991*, DOE/RL-92-30, U. S. Department of Energy, Richland Field Office, Richland, Washington.
- DOE-RL, 1993, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 1992*, DOE/RL-93-36, U.S. Department of Energy, Richland Field Office, Richland, Washington.
- EPA, 1989, "National Emission Standards for Hazardous Air Pollutants," Subpart H, Title 40, Code of Federal Regulations, Part 61, U.S. Environmental Protection Agency, Washington, D.C.
- Leigh, C. D., B. M. Thompson, J. E. Campbell, D. E. Longsine, R. A. Kennedy, and B. A. Napier, 1992, *User's Guide for GENII-S: A Code for Statistical and Deterministic Simulations of Radiation Doses to Humans from Radionuclides in the Environment*, SAND91-0561A, Sandia National Laboratories, Albuquerque, New Mexico.

**6.0 REFERENCES (continued)**

- Napier, B. A., R. A. Peloquin, D. L. Streng, and J. V. Ramsdell, 1988, *GENII - The Hanford Environmental Radiation Dosimetry Software System*, PNL-6584, Vols. 1-3, Pacific Northwest Laboratory, Richland, Washington.
- Parks, B. S. 1992. User's Guide for CAP88-PC. Version 1.0. 402-B-92-001. Office of Radiation Programs, U.S. Environmental Protection Agency, Las Vegas, Nevada.
- Schreckhise, R. G., K. Rhoads, J. S. Davis, B. A. Napier, and J. V. Ramsdell. 1993. *Recommended Environmental Dose Calculation Methods and Hanford-Specific Parameters*. PNL 377, Rev. 2. Pacific Northwest Laboratory, Richland, Washington.
- Uranium Mill Tailings Radiation Control Act of 1978*, Public Law 95-604, 42 USC 7901.
- WHC, 1991, *Unit Dose Calculation Methods and Summary of Facility Effluent Monitoring Plan Determinations*, WHC-EP-0498, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1993, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring*, WHC-EP-0536-1, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1994, *Quality Assurance Project Plan for Radioactive Airborne Emissions Data Compilation and Reporting*, WHC-EP-0528-1, Westinghouse Hanford Company, Richland, Washington.

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