3.1 Facility Effluent and Emissions Monitoring

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Liquid effluent and airborne emissions that may contain radioactive or hazardous constituents are continually monitored when released to the environment at the Hanford Site. Facility operators perform the monitoring mainly through analyzing samples collected near points of release to the environment. Effluent and emissions monitoring data are evaluated to determine the degree of regulatory compliance for each facility and/or the entire site. The evaluations are also useful to assess the effectiveness of effluent and emissions treatment and control systems and pollution-management practices. Major facilities have their own individual effluent monitoring plans, which are part of the comprehensive Hanford Site Environmental Monitoring Plan (DOE/RL-91-50).

Measuring devices quantify most facility effluent and emissions, but some are calculated using process information. For most radioactive air emission units, which are primarily ventilation stacks, sampling methods include continuous sampling or periodic measurements. For most liquid effluent streams, proportional sampling or grab sampling is used. Liquid effluent and airborne emissions with the potential to contain radioactive materials at prescribed threshold levels are monitored for gross alpha and gross beta concentrations, and, as warranted, specific radionuclides. Non-radioactive constituents in airborne emissions are either sampled and analyzed or estimated using regulator-approved methods.

Tritium, strontium-90, iodine-129, cesium-137, plutonium-238, plutonium-239/240, plutonium-241, americium-241, and several other radionuclides were released to the environment through state and federally permitted release points. Most of the radionuclides in effluent at the Hanford Site are nearing levels indistinguishable from the low concentrations of radionuclides in the environment that occur naturally or originated from historical atmospheric nuclear weapons testing. The cessation of nuclear processing operations and the evolution of the site mission to environmental cleanup are largely responsible for the downward trend in radioactive effluent and the resulting lower radiological doses to the public. Figures 3.1.1 and 3.1.2 depict quantities of several longer-lived radionuclides released from the site over the past 12 years.

Effluent and emissions release data are documented in several reports besides this one, and all are available to

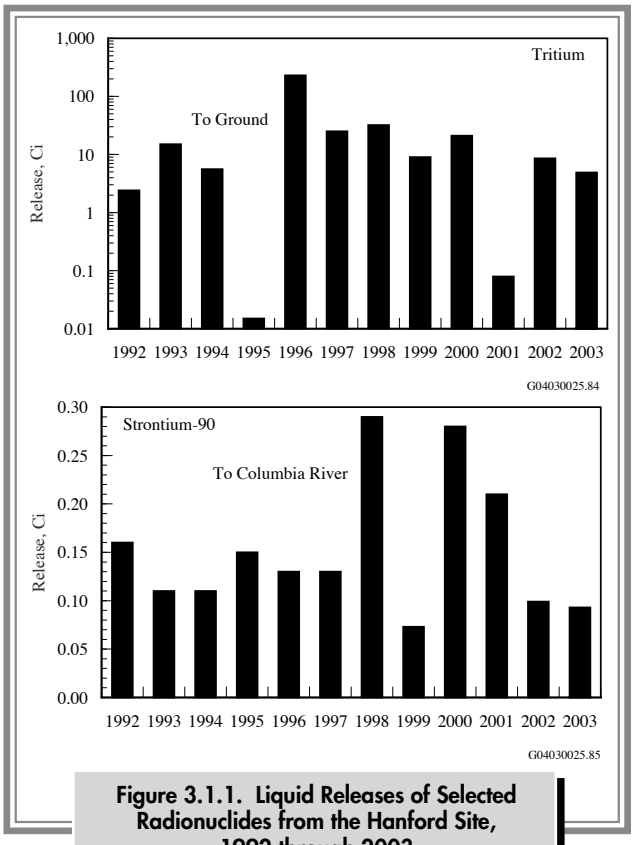

Figure 3.1.1. Liquid Releases of Selected Radionuclides from the Hanford Site, 1992 through 2003

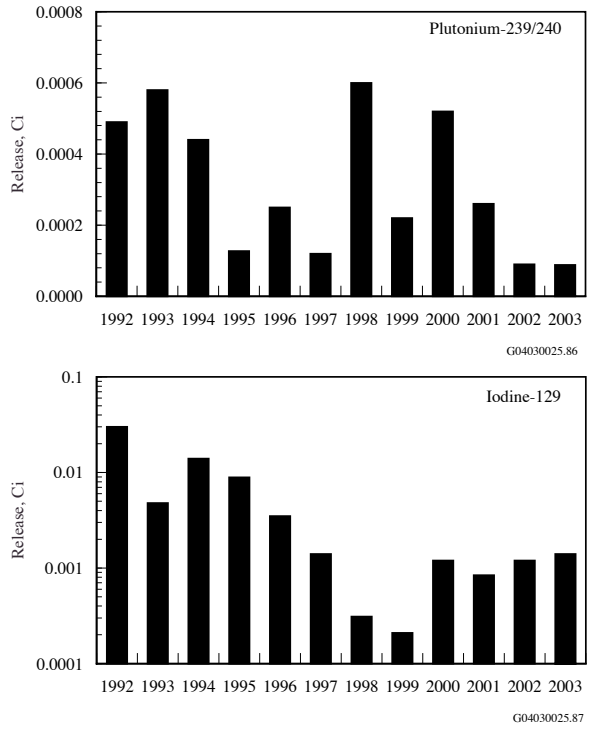

Figure 3.1.2. Airborne Releases of Selected Radionuclides from the Hanford Site, 1992 through 2003

the public. For instance, the U.S. Department of Energy (DOE) annually submits to the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Health a report of radioactive airborne emissions from the site (DOE/RL-2004-09), in compliance with Title 40, Code of Federal Regulations, Part 61 (40 CFR 61) and Washington Administrative Code (WAC) 246-247. Data quantifying radioactive liquid effluent and airborne emissions are reported to the DOE annually in an environmental releases report (HNF-EP-0527-13). That report includes summaries of monitoring results on liquid effluent discharged to the Columbia River, regulated by the National Pollutant Discharge Elimination System permit and reported quarterly to the EPA; liquid effluent discharges to the soil regulated by WAC 173-216 and reported quarterly to the Washington State Department of Ecology; and non-radioactive air emissions, which are reported annually to the Washington State Department of Ecology.

3.1.1 Radioactive Airborne Emissions

Radioactive airborne emissions from Hanford Site activities contain particulate and volatile forms of radionuclides. Emissions having the potential to exceed 1% of the 10 mrem (100 mSv) per year standard for public dose are monitored continuously.

The continuous monitoring of radioactive emissions involves analyzing samples collected at points of discharge to the environment. The selection of the specific radionuclides sampled, analyzed, and reported is based on (1) an evaluation of potential unabated emissions from known radionuclide inventories in a facility or an outside activity area, (2) the sampling criteria given in contractor environmental compliance manuals, and (3) the potential each radionuclide has to contribute to the public dose. Continuous air monitoring systems with alarms are also used at selected emissions points when the potential exists for radioactive emissions to exceed normal operating ranges at levels requiring immediate personnel alert.

Radioactive emissions discharge points, which usually are active ventilation stacks, are located in the 100, 200, 300, 400, and 600 Areas. The number of emissions points by operating area is summarized as follows:

- In the 100 Areas, emissions originated from evaporation at two water-filled storage basins (100-K East and 100-K West Basins [i.e., K Basins]), which contain irradiated nuclear fuel, the Cold Vacuum Drying Facility, the 105-KW Integrated Water Treatment filter backwash system, and a low-level radiological laboratory in the 1706-KE Building. During 2003, there were five active radioactive emissions points in the 100 Areas.
- In the 200 Areas, the primary sources of radioactive emissions were the Plutonium Finishing Plant, T Plant, Waste Encapsulation and Storage Facility, underground tanks storing high-level radioactive waste, waste evaporators, and the inactive Plutonium-Uranium Extraction Plant. During 2003, there were 63 radioactive emissions points in the 200 Areas, the majority of which were active.
- The 300 Area primarily has laboratories and research facilities. Principle sources of airborne radioactive

emissions were the 324 Waste Technology Engineering Laboratory, the 325 Applied Chemistry Laboratory, the 327 Post-Irradiation Laboratory, and the 340 Complex Vault and Tanks. During 2003, there were 22 radioactive emissions points in the 300 Area, the majority of which were active.

- The 400 Area has the shutdown Fast Flux Test Facility, the Maintenance and Storage Facility, and the Fuels and Materials Examination Facility. Operations and support activities at the Fast Flux Test Facility and Maintenance and Storage Facility released small quantities of radioactive material to the environment. During 2003, there were five active radioactive emissions points in the 400 Area.
- The 600 Area has the Waste Sampling and Characterization Facility, where low-level radiological and chemical analyses are performed on various types of samples (e.g., particulate air filters, liquids, soil, and vegetation). This facility had two active radioactive emissions points during 2003. For dose-modeling purposes, emissions from the Waste Sampling and Characterization Facility, which is very close to the eastern entrance to the 200-West Area, were grouped with emissions reported for the 200-West Area.

A summary of Hanford Site radioactive airborne emissions in 2003 is provided in Table 3.1.1.

3.1.2 Non-Radioactive Airborne Emissions

Non-radioactive airborne emissions from power-generating and chemical processing facilities are monitored when activities at a facility are known to generate potential emissions of concern.

In past years, gaseous ammonia has been emitted from the Plutonium-Uranium Extraction Plant, 242-A evaporator,

Table 3.1.1. Radionuclides Discharged to the Atmosphere at the Hanford Site, 2003

		Release, Ci[a]				
Radionuclide	**Half-Life**	**100 Areas**	**200-East Area**	**200-West Area**	**300 Area**	**400 Area**
Tritium (as HT)[b]	12.3 yr	NM[c]	NM	NM	7.8	NM
Tritium (as HTO)[b]	12.3 yr	NM	NM	NM	3.5×10^{1}	6.6×10^{-1}
Cobalt-60	5.3 yr	ND[d]	3.9×10^{-8}	ND	ND	NM
Strontium-90	29.1 yr	9.0×10^{-6}[e]	1.2×10^{-4}[e]	3.0×10^{-5}[e]	1.3×10^{-6}[e]	NM
Ruthenium-106	373 d	1.1×10^{-6}	ND	ND	ND	NM
Iodine-129	16,000,000 yr	NM	1.4×10^{-3}	NM	NM	NM
Cesium-137	30 yr	7.5×10^{-6}	6.3×10^{-5}	1.5×10^{-5}	1.1×10^{-5}[f]	4.9×10^{-6}[f]
Radon-220	55.6 s	NM	NM	NM	2.3×10^{2}	NM
Uranium-234	240,000 yr	NM	NM	NM	6.3×10^{-11}	NM
Uranium-235	704,000,000 yr	NM	NM	NM	4.6×10^{-11}	NM
Neptunium-237	2,140,000 yr	NM	NM	NM	ND	NM
Uranium-238	4,500,000,000 yr	NM	NM	NM	3.5×10^{-11}	NM
Plutonium-238	87.7 yr	3.4×10^{-7}	3.8×10^{-8}	1.3×10^{-6}	4.9×10^{-9}	NM
Plutonium-239/240	24,000 yr	2.5×10^{-6}[g]	1.7×10^{-6}[g]	8.3×10^{-5}[g]	1.1×10^{-7}[g]	1.4×10^{-7}[g]
Plutonium-241	14.4 yr	2.3×10^{-5}	ND	7.2×10^{-5}	ND	NM
Americium-241	432 yr	1.7×10^{-6}	2.0×10^{-6}	1.4×10^{-5}	8.7×10^{-8}[h]	NM

(a) 1 Ci = 3.7×10^{10} becquerels.
(b) HT = Elemental tritium; HTO = tritiated water vapor.
(c) NM = Not measured.
(d) ND = Not detected (i.e., either the radionuclide was not detected in any sample during the year or the average of all the measurements for that given radionuclide or type of radioactivity made during the year was below background levels).
(e) This value includes unspecified gross beta release data, treated as strontium-90 in dose calculations.
(f) This value includes unspecified gross beta release data, treated as cesium-137 in dose calculations.
(g) This value includes gross alpha release data, treated as plutonium-239/240 in dose calculations.
(h) This value includes unspecified gross alpha release data, treated as americium-241 in dose calculations.

AP Tank Farm, and AW Tank Farm, all located in the 200-East Area. Ammonia emissions are tracked only when activities at these facilities are capable of generating them. During 2003, the 200 Areas tank farms produced reportable ammonia emissions, summarized in Table 3.1.2.

Onsite diesel-powered electrical generating plants emitted particulate matter, sulfur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead. The total annual releases of these constituents are reported in accordance with the air quality standards established in WAC 173-400. Power plant emissions are calculated from the quantities of fossil fuel consumed, using EPA-approved formulas (AP-42).

Should activities result in chemical emissions in excess of quantities reportable under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), the release totals are immediately reported to the EPA. If the emissions remain stable at predicted levels, they may be reported annually with the EPA's permission. Table 3.1.2 summarizes the emissions of non-radioactive pollutants discharged to the atmosphere at Hanford during 2003 (Note: the 100, 400, and 600 Areas have no non-radioactive emissions sources of regulatory concern). Table 3.1.2 also includes emissions estimates from the carbon tetrachloride vapor extraction work in the 200-West Area. Those emissions are accounted for in the table category of "other toxic air pollutants" and do not require reporting, because they are below the respective reportable quantity.

Table 3.1.2. Non-Radioactive Emissions Discharged to the Atmosphere at the Hanford Site, 2003

Constituent	Release, kg (lb)	
Particulate matter	1,800	(3,900)
Nitrogen oxides	16,000	(34,000)
Sulfur oxides	3,800	(8,300)
Carbon monoxide	17,000	(38,000)
Lead	0.64	(1.4)
Volatile organic compounds[a,b]	11,000	(25,000)
Ammonia[c]	16,000	(36,000)
Other toxic air pollutants[d]	8,100	(18,000)

(a) The estimate of volatile organic compounds does not include emissions from certain laboratory operations.
(b) Produced from burning fossil fuel for steam and electrical generators, calculated estimates from the 200-East and 200-West Areas tank farms, and operation of the 242-A evaporator and the 200 Area Effluent Treatment Facility.
(c) Ammonia releases are calculated estimates from the 200-East and 200-West Areas tank farms and operation of the 242-A evaporator and the 200 Area Effluent Treatment Facility.
(d) Releases are a composite of calculated estimates of toxic air pollutants, excluding ammonia, from the 200-East and 200-West Areas tank farms and operation of the 242-A evaporator and the 200 Area Effluent Treatment Facility.

3.1.3 Radioactive Liquid Effluent

Liquid effluent is discharged from facilities at the Hanford Site. Effluent that normally or potentially contains radionuclides includes cooling water, steam condensates, process condensates, and wastewater from laboratories and chemical sewers. Those wastewater streams are sampled and analyzed for gross alpha and gross beta, as well as selected radionuclides.

During 2003, only facilities in the 200 Areas discharged radioactive effluent to the ground, which went to a single location, the 616-A crib, also known as the State-Approved Land Disposal Site. A summary of radioactive effluent is provided in Table 3.1.3. Table 3.1.4 summarizes

Table 3.1.3. Radionuclides in 200 Area Liquid Effluent Discharged to the State-Approved Land Disposal Site at the Hanford Site, 2003

Radionuclide	Half-Life	Release, Ci[a]
Tritium	12.3 yr	4.9

(a) 1 Ci = 3.7×10^{10} becquerels.

Table 3.1.4. Radionuclides in Liquid Effluent from the Hanford Site's 100 Areas Discharged to the Columbia River, 2003

Radionuclide	Half-Life	Release, Ci[a]
Tritium	12.3 yr	0.015
Strontium-90	29.1 yr	0.094
Plutonium-238	87.7 yr	0.00000038
Plutonium-239/240	24,000 yr	0.0000071

(a) 1 Ci = 3.7×10^{10} becquerels.

data on radionuclides in effluent released from the 100 Areas to the Columbia River, the sources of which include secondary cooling water used at the K Basins and shoreline seepage of groundwater that has passed near the retired 116-N-1 and 116-N-3 cribs in the 100-N Area.

3.1.4 Non-Radioactive Hazardous Materials in Liquid Effluent

Non-radioactive hazardous materials in liquid effluent are monitored in the 100, 200, 300, and 400 Areas. The effluent is discharged to the State-Approved Land Disposal Site and to the Columbia River. Effluent entering the environment at designated discharge points is sampled and analyzed to determine compliance with the National Pollutant Discharge Elimination System permits and the state waste discharge permits for the site (40 CFR 122 and WAC 173-216). Should chemicals in effluent exceed reportable CERCLA quantities, the release totals are immediately reported to the EPA. If the effluent remains stable at predicted levels, it may, with the EPA's permission, be reported annually. Section 2.2.8 provides a synopsis of the National Pollutant Discharge Elimination System and state waste discharge permit.

3.1.5 CERCLA and Washington Administrative Code Reportable Releases to the Environment

Releases that are reportable to the state and/or EPA include spills or discharges of hazardous substances or dangerous waste to the environment, other than releases permitted under state or federal law. Accidents and equipment failures cause the majority of those types of releases. Releases of hazardous substances that are continuous and stable in quantity and rate but exceed specified limits must be reported as required by CERCLA Section 103(f)(2).

Reporting of spills or non-permitted discharges of dangerous waste or hazardous substances to the environment is required (WAC 173-303-145). That requirement applies to spills or discharges onto the ground, into the groundwater, into the surface water (e.g., Columbia River), or into the air such that human health or the environment are threatened, regardless of the quantity of dangerous waste or hazardous substance.

In accordance with both CERCLA and Washington Administrative Code (WAC 173-303-145) reporting requirements, no known releases occurred during 2003.