3.1 Facility Effluent Monitoring

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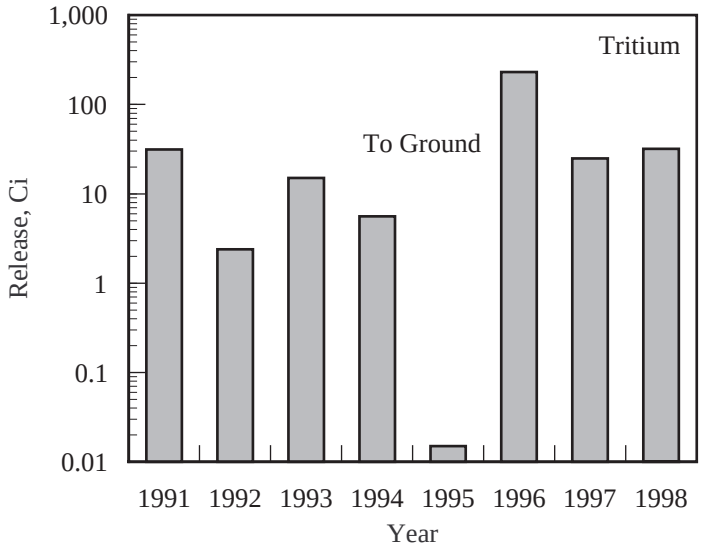
Liquid and airborne effluents that may contain radioactive or hazardous constituents are continually monitored when released to the environment at the Hanford Site. Facility operators perform the monitoring mainly through analyzing samples collected near points of release into the environment. Effluent monitoring data are evaluated to determine the degree of regulatory compliance for each facility or the entire site, as appropriate. The evaluations are also useful in assessing the effectiveness of effluent treatment and control systems and 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, Rev. 2).

Measuring devices quantify most facility effluent flows, but some flows are calculated using process information. Effluent sampling methods include continuous sampling or periodic confirmatory measurements for most radioactive air emission units and proportional or grab sampling for most liquid effluent streams. Liquid and airborne effluents with a potential to contain radioactive materials at prescribed threshold levels are measured for gross alpha and beta activity and, as warranted, specific radionuclides. Nonradioactive constituents are also either monitored or sampled, as applicable.

Small quantities of tritium, cobalt-60, strontium-90, technetium-99, antimony-125, iodine-129, cesium-137, plutonium-238, plutonium-239,240, plutonium-241, and americium-241 were released to the environment through state and federally permitted release points. However, most radionuclides in effluents at the site are approaching levels indistinguishable from background or naturally occurring activities. The site mission of environmental cleanup is largely responsible for the improved trend in radioactive emissions. This decreasing trend results in smaller offsite radiation doses to the maximally exposed individual attributable to site activities. Figures 3.1.1 and 3.1.2 depict quantities of several prominent dose-contributing radionuclides released from the site over recent years. In 1998, releases of radioactive and nonradioactive constituents in effluents were less than applicable standards.

Effluent release data are documented in several reports, in addition to this one, and all are available to 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-99-41) in compliance with Title 40, Code of Federal Regulations, Part 61 (40 CFR 61), "National Emission Standards for Hazardous Air Pollutants," and Washington Administrative Code (WAC) 246-247, "Radiation Protection–Air Emissions." Data quantifying the radioactive liquid and airborne effluents are reported to DOE annually in the environmental releases report (HNF-EP-0527-8). Monitoring results for liquid streams regulated by the National Pollutant Discharge Elimination System permit (40 CFR 122) are reported to EPA. Monitoring results from liquid effluent streams regulated by WAC 173-216 are reported to the Washington State Department of Ecology. Nonradioactive air emissions are reported annually to the Washington State Department of Ecology.



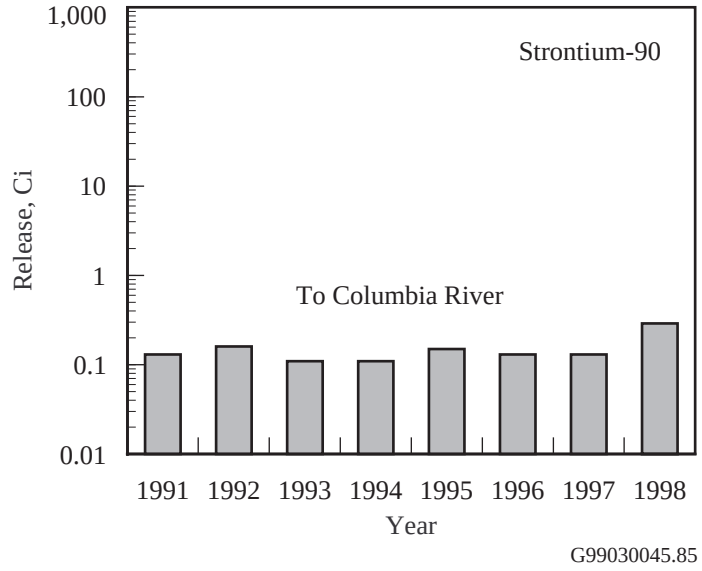


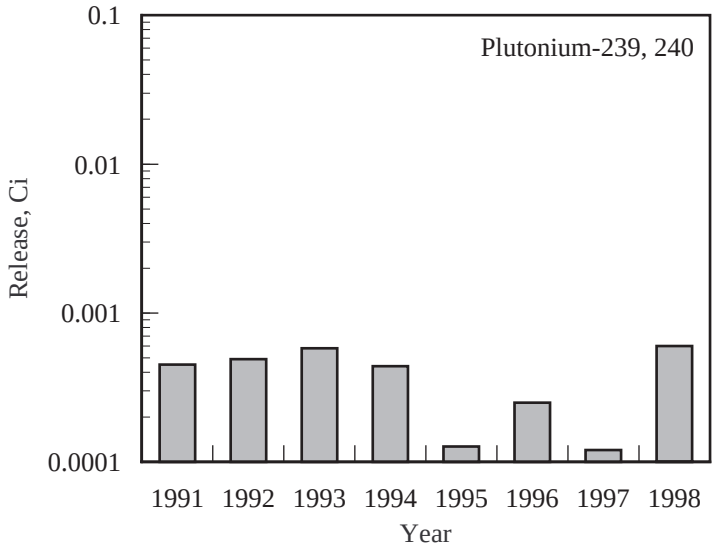
Figure 3.1.1. Liquid Releases of Selected Radionuclides from Hanford Site Facilities, 1991 Through 1998

3.1.1 Airborne Emissions

3.1.1.1 Radioactive Airborne Emissions

Radioactive airborne emissions from site activities contain at least one of these forms of radionuclides: particles, noble gases, or volatile compounds. Emissions having the potential to exceed 1% of the 10-mrem/yr standard for offsite doses are monitored continuously.

The continuous monitoring of radioactive emissions involves analyzing samples collected at points of discharge to the environment, usually from a stack or vent. Samples are analyzed for gross alpha and beta



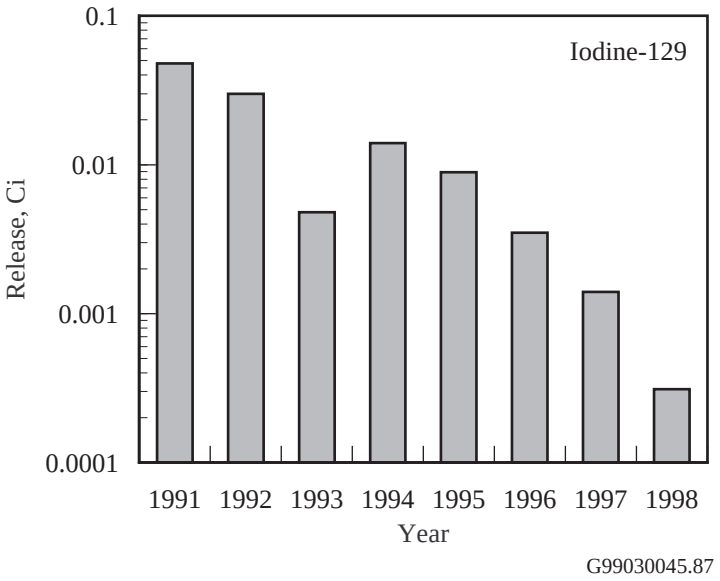


Figure 3.1.2. Airborne Releases of Selected Radionuclides from Hanford Site Facilities, 1991 Through 1998

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

Radioactive emission discharge points are located in the 100, 200, 300, and 400 Areas. The sources for these emissions are summarized below.

- In the 100 Areas, emissions resulted from the deactivation of N Reactor, the two water-filled storage basins (K-East and K-West Fuel Storage Basins [K Basins]) that contain irradiated fuel, a recirculation facility that filtered radioactive water from the N Reactor basin that was used for storage of irradiated fuel, and from sample preparation activities at the radiological counting facility. Five radioactive emission points were active in the 100 Areas during 1998; however, the last two stacks operating at N Reactor were permanently shut down following the completion of the N Basin project (see Section 2.3.12.3, "100-N Area Project").
- The 200 Areas contain inactive facilities for nuclear fuel chemical separations, reprocessing, and steam generation. The active facilities are for waste handling and disposal. Primary sources of radionuclide emissions are the Plutonium-Uranium Extraction Plant, Plutonium Finishing Plant, T Plant, 222-S Laboratory, underground tanks for storage of high-level radioactive waste, and waste evaporators. During 1998, 54 radioactive emission points were active in the 200 Areas.
- The 300 Area primarily contains laboratories and research facilities. Primary sources of airborne radionuclide emissions are the 324 Waste Technology Engineering Laboratory, 325 Applied Chemistry Laboratory, 327 Post-Irradiation Laboratory, and 340 Vault and Tanks. Radioactive emissions arise from research and development and waste handling activities. During 1998, 27 radioactive emission discharge points were active in the 300 Area.
- The 400 Area has the 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, even though the reactor did not operate in 1998. The 400 Area had five radioactive emission discharge points active during 1998.

A summary of the Hanford Site's 1998 radioactive airborne emissions is provided in Table 3.1.1. Several constituents not detected or not measured are included in the table for historical comparisons.

3.1.1.2 Nonradioactive Airborne Emissions

Nonradioactive air pollutants emitted from power generating and chemical processing facilities are monitored when activities at a facility are known to generate potential pollutants of concern.

In past years, gaseous ammonia has been emitted from the Plutonium-Uranium Extraction Plant, 242-A Evaporator, 241-AP Tank Farm, and 241-AW Tank Farm all located in the 200-East Area. Ammonia emissions are monitored only when activities at these facilities are capable of generating them. The 200 Areas tank farms produced reportable ammonia emissions in 1998, which are 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 fuel consumed, using EPA-approved formula (AP-42).

Should activities lead to chemical emissions in excess of quantities reportable under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the release totals are reported immediately 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 summarized the 1998 emissions of nonradioactive constituents (it should be noted that the 100, 400, and 600 Areas have no nonradioactive emission sources of regulatory concern). Table 3.1.2 also included emissions estimates from the 200-West Area's carbon tetrachloride vapor extraction project, even though these emissions do not require reporting because they are below reportable quantities.

Table 3.1.1. Radionuclides Discharged to the Atmosphere, 1998

Radionuclide	Half-Life	Release, Ci[a] 100 Areas	200-East Area	200-West Area	300 Area	400 Area
Tritium (as HT)[b]	12.3 yr	NM[a]	NM	NM	1.1×10^{2}	NM
Tritium (as HTO)[b]	12.3 yr	NM	NM	NM	1.71×10^{2}	4.0×10^{0}
Cobalt-60	5.3 yr	ND[a]	ND	ND	ND	NM
Zinc-65	244.4 d	ND	ND	ND	ND	NM
Strontium-90	29.1 yr	1.7×10^{-5}	1.2×10^{-4}[c]	2.3×10^{-4}[c]	9.62×10^{-6}[c]	NM
Zirconium-95	64.02 d	ND	ND	ND	ND	NM
Ruthenium-106	368 d	ND	ND	NM	ND	NM
Tin-113	115.1 d	ND	ND	NM	ND	NM
Antimony-125	2.77 yr	ND	4.8×10^{-7}	NM	ND	NM
Iodine-129	1.6×10^{7} yr	NM	3.1×10^{-4}	NM	4.6×10^{-8}	NM
Cesium-134	2.1 yr	ND	ND	ND	ND	NM
Cesium-137	30 yr	3.0×10^{-5}	1.9×10^{-4}	3.2×10^{-9}	5.83×10^{-7}	5.5×10^{-6}[d]
Plutonium-238	87.7 yr	5.2×10^{-7}	7.9×10^{-10}	3.4×10^{-6}	1.7×10^{-9}	NM
Plutonium-239,240	2.4×10^{4} yr	3.4×10^{-6}	1.1×10^{-6}[e]	2.0×10^{-4}[e]	1.07×10^{-6}[e]	5.0×10^{-7}[e]
Plutonium-241	14.4 yr	3.8×10^{-5}	2.9×10^{-8}	4.4×10^{-5}	NM	NM
Americium-241	432 yr	2.0×10^{-6}	5.0×10^{-7}	3.0×10^{-5}	2.27×10^{-8}	NM
Uranium	4.5×10^{9} yr	NM	NM	NM	ND	NM

(a) 1 Ci = 3.7×10^{10} Bq; NM = not measured; 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).
(b) HT = elemental tritium; HTO = tritiated water vapor.
(c) This value includes gross beta release data. Gross beta and unspecified beta results assumed to be strontium-90 for dose calculations.
(d) This value includes gross beta release data. Gross beta results assumed to be cesium-137 for dose calculations from Fast Flux Test Facility emissions
(e) This value includes gross alpha release data. Gross alpha and unspecified alpha results assumed to be plutonium-239,240 for dose calculations.

3.1.2 Liquid Effluents

3.1.2.1 Radioactive Liquid Effluents

Liquid effluents are discharged from facilities in all areas of the Hanford Site. Effluents that normally or potentially contain radionuclides include cooling water, steam condensates, process condensates, and wastewater from laboratories and chemical sewers. These wastewater streams are sampled and analyzed for gross alpha and beta activity, as well as selected radionuclides.

In 1998, only 200 Areas' facilities discharged radioactive liquid effluents to the 616-A-Crib (also known as the State-Approved Land Disposal Site. A summary of these radioactive liquid effluents is provided in Table 3.1.3. Table 3.1.4 summarizes data on radionuclides in liquid effluents released from the 100 Areas to the Columbia River. These measurements are used to determine potential radiation doses to the public. Several constituents not detected are included in the tables for historical comparisons.

Table 3.1.2. Nonradioactive Constituents Discharged to the Atmosphere, 1998[a]

Constituent	Release, kg	
	200 Areas	300 Area
Particulate matter	6.27×10^{2}	3.26×10^{3}
Nitrogen oxides	3.89×10^{4}	1.21×10^{4}
Sulfur oxides	2.43×10^{2}	4.43×10^{4}
Carbon monoxide	2.97×10^{3}	1.98×10^{3}
Lead	3.7×10^{-1}	6.3×10^{0}
Volatile organic compounds[b]	1.32×10^{3}	1.13×10^{2}
Ammonia[c]	6.72×10^{3}	NM[d]
Beryllium	NE[d]	1.36×10^{-1}
Cadmium	NE	6.85×10^{0}
Carbon tetrachloride	8	NE
Chromium	NE	4.15×10^{0}
Cobalt	NE	3.93×10^{0}
Copper	NE	9.02×10^{0}
Formaldehyde	NE	1.13×10^{1}
Selenium	NE	1.23×10^{0}

(a) The estimate of volatile organic compound emissions do not include emissions from certain laboratory operations.
(b) Produced from burning fossil fuel for steam and electrical generators.
(c) Ammonia releases are from the 200-East and 200-West Area tank farms and operation of the 242-A Evaporator.
(d) NE = no emissions; NM = not measured.

3.1.2.2 Nonradioactive Hazardous Materials in Liquid Effluents

Nonradioactive hazardous materials in liquid effluents are monitored in the 100, 200, 300, and 400 Areas. These effluents are discharged to the State-Approved Land Disposal Site and the Columbia River. Effluents entering the environment at designated discharge points are 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 liquid effluents exceed quantities reportable under CERCLA, the release totals are reported immediately to the EPA. If emissions remain stable at predicted levels, they may be reported annually with the EPA's permission. A synopsis of the National Pollutant Discharge Elimination System and state waste discharge permit violations in 1998 is given in Section 2.2.7, "Clean Water Act."

Liquid effluents containing both radioactive and hazardous constituents are stored in the 200 Areas in underground waste storage tanks or monitored interim-storage facilities. Activities in the 600 Area and former 1100 Area generated neither radioactive nor nonradioactive hazardous liquid effluents.

Table 3.1.3. Radionuclides in 200 Areas' Liquid Effluents Discharged to the State-Approved Land Disposal Site in 1998

Radionuclide	Half-Life	Release, Ci[a]
Tritium	12.3 yr	3.2×10^{1}
Strontium-90	29.1 yr	5.9×10^{-5}
Technetium-99	2.6×10^{6} yr	2.8×10^{-5}
Radium-226	1,600 yr	6.7×10^{-7}
Neptunium-237	2.14×10^{6} yr	1.0×10^{-5}
Plutonium-238	87.7 yr	1.3×10^{-5}
Plutonium-239,240	2.4×10^{4} yr	1.2×10^{-5}
Americium-241	432 yr	1.6×10^{-5}

(a) 1 Ci = 3.7×10^{10} Bq.
All other radionuclides are not detected.

Table 3.1.4. Radionuclides in 100 Areas' Liquid Effluents Discharged to the Columbia River, 1998

Radionuclide	Half-Life	Release, Ci[a]
Tritium	12.3 yr	0.29
Strontium-90	29.1 yr	0.29
Plutonium-239,240	2.4×10^{4} yr	1.3×10^{-6}
Americium-241	432 yr	1.7×10^{-5}

(a) 1 Ci = 3.7×10^{10} Bq.

3.1.3 CERCLA and Washington Administrative Code Chemical Releases

Reportable releases include spills or discharges of hazardous substances or dangerous wastes to the environment, other than releases permitted under federal or state law. These releases almost entirely consist of accidental spills. Releases of hazardous substances exceeding specified quantities that are continuous and stable in quantity and rate must be reported as required by Section 103(f)(2) of CERCLA.

Spills or nonpermitted discharges of dangerous wastes or hazardous substances to the environment are required to be reported (WAC 173-303-145). This requirement applies to spills or discharges onto the ground, into groundwater, into surface water, or into air such that human health or the environment is threatened, regardless of the quantity of dangerous waste or hazardous substance.

There were five releases reported under the Act's reportable quantity or WAC 173-303-145 requirements by Hanford Site contractors in 1998. Table 3.1.5 contains a synopsis of these reportable releases pursuant to these regulations.

Table 3.1.5. Reportable Spills, 1998

Material	Quantity	Location
Oil	0.10 kg (0.22 lb)	2721-Z Building, 200-West Area, old leak from Tank 2721-Z1
Radioactive air	Trace	AN Tank Farm, 200-East Area, overpressurized 208-L (55-gal) drum
Radioactive water	Trace	SX Tank Farm, 200-West Area, splashed out of pit during cleaning
Volatile organic compounds	>50 ppm	C Tank Farm, 200-East Area, volatile organic chemical vapor vented
Radioactive water	2,304 kg (5,080 lb)	327 Building, 300 Area, broken fire line