

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 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, 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 concentrations. 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 dose-contributing radionuclides released from the site over recent years. In 1999, 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-2000-37), in compliance with 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," and 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-0527-9). Monitoring results for liquid streams regulated by the National Pollutant Discharge Elimination System permit 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.

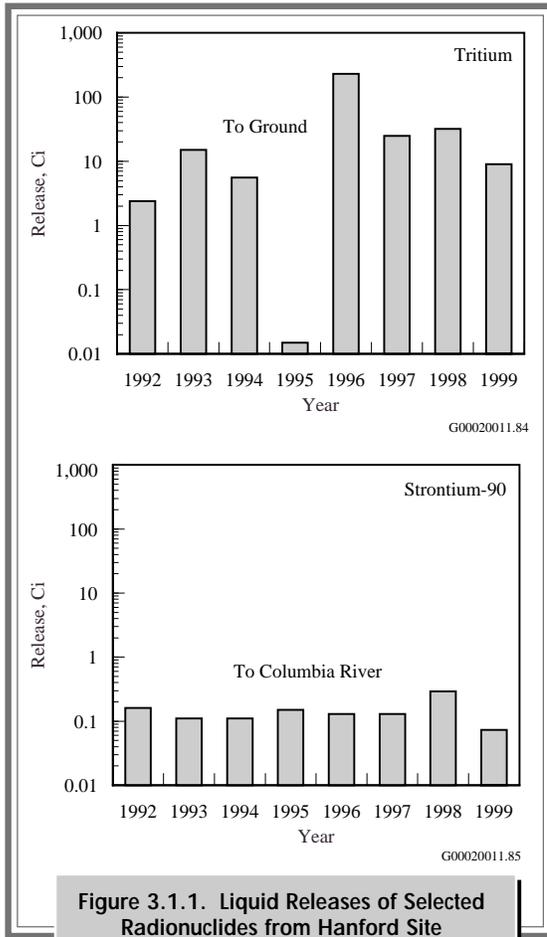


Figure 3.1.1. Liquid Releases of Selected Radionuclides from Hanford Site Facilities, 1992 Through 1999

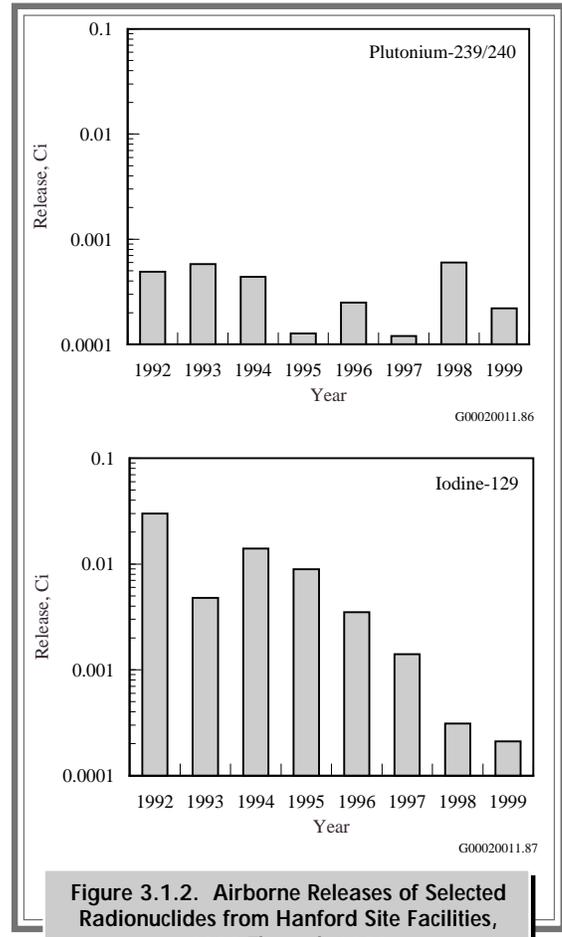


Figure 3.1.2. Airborne Releases of Selected Radionuclides from Hanford Site Facilities, 1992 Through 1999

3.1.1 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 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.

- Five radioactive emission points were active in the 100 Areas during 1999. In these areas,



emissions originate from the deactivation of N Reactor, the two water-filled storage basins (K-East and K-West Fuel Storage Basins) that contain irradiated fuel, the 1706-KE laboratory facility, and from sample preparation at the radiological counting facility.

- During 1999, 49 radioactive emission points were active in the 200 Areas. 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 1999, 23 radioactive emission discharge points were active in the 300 Area. 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 work and waste handling operations.

- The 400 Area had five radioactive emission discharge points active during 1999. The Fast Flux Test Facility, the Maintenance and Storage Facility, and the Fuels and Materials Examination Facility are located in this area. Operations 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 1999.
- The 600 Area had two radioactive emission points active during 1999. The Waste Sampling and Characterization Facility, at which low-level radiological and chemical analyses on various types of samples are performed, is located in this area.

A summary of the Hanford Site's 1999 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.

3.1.2 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, 200 Areas Effluent Treatment Facility, tank farm 241-AP, and tank farm 241-AW all located in the 200-East Area. Ammonia emissions are estimates calculated when activities at these facilities are capable of generating them. The 200 Area tank farms discharged ammonia to the atmosphere during 1999 (Table 3.1.2).

Onsite, fossil fuel powered steam and electrical generators 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. Steam and electrical generator emissions are calculated from the quantities of fossil fuel consumed, using approved emission factors (AP-42 or applicable notice of construction).

Should activities lead to chemical emissions in excess of quantities reportable under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), the release totals are reported immediately to 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 1999 emissions of nonradioactive constituents (it should be noted that the 100, 400, and 600 Areas have no nonradioactive emission sources of regulatory concern).



Table 3.1.1. Radionuclides Discharged to the Atmosphere at the Hanford Site, 1999

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	4.0E+01	NM
Tritium (as HTO) ^(b)	12.3 yr	NM	NM	NM	1.5E+02	1.4E+00
Cobalt-60	5.3 yr	3.9E-08	1.6E-09	ND ^(a)	ND	NM
Strontium-90	29.1 yr	1.9E-05	9.6E-05 ^(c)	2.9E-04 ^(c)	1.0E-05 ^(c)	NM
Ruthenium-106	368 d	ND	ND	NM	ND	NM
Antimony-125	2.77 yr	5.0E-08	ND	ND	1.1E-07	NM
Iodine-129	1.6 x 10 ⁷ yr	NM	1.9E-04	NM	NM	NM
Cesium-134	2.1 yr	ND	ND	ND	ND	NM
Cesium-137	30 yr	4.5E-05	3.9E-05	2.5E-09	4.2E-07	1.9E-06 ^(d)
Europium-154	8.8 yr	4.8E-08	ND	ND	ND	NM
Plutonium-238	87.7 yr	5.8E-07	1.9E-08	4.9E-06	ND	NM
Plutonium-239/240	2.4 x 10 ⁴ yr	4.2E-06	6.9E-07 ^(e)	2.1E-04 ^(e)	1.1E-06 ^(e)	3.0E-07 ^(e)
Plutonium-241	14.4 yr	5.1E-05	1.2E-06	1.2E-04	7.9E-08	NM
Americium-241	432 yr	2.4E-06	5.6E-07	4.5E-05	1.4E-07	NM

(a) 1 Ci = 3.7E+10 becquerel; 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.

3.1.3 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 1999, facilities in the 200 Areas 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 at the Hanford Site, 1999^(a)

Constituent	Release, kg (lb)	
	200 Areas	300 Area
Particulate matter	886 (1,954)	596 (1,314)
Nitrogen oxides	24,000 (52,920)	3,680 (8,114)
Sulfur oxides	3,370 (7,431)	40 (88)
Carbon monoxide	17,700 (39,029)	12,700 (28,004)
Lead	53 (117)	0
Volatile organic compounds ^(b)	6,920 (15,259)	809 (1,784)
Ammonia ^(c)	9,810 (21,631)	NE ^(d)
Other toxic air pollutants ^(e)	2,970 (6,549)	NE

- (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 Area tank farms, and operation of the 242-A Evaporator and the 200 Areas Effluent Treatment Facility.
- (c) Ammonia releases are calculated from the 200-East and 200-West Area tank farms and operation of the 242-A Evaporator and the 200 Areas Effluent Treatment Facility.
- (d) NE = No emissions.
- (e) Releases are a composite of calculated estimates of toxic air pollutants, excluding ammonia, from the 200-East and 200-West Area tank farms, and operation of the 242-A Evaporator and the 200 Areas Effluent Treatment Facility.

Table 3.1.3. Radionuclides in 200 Areas' Liquid Effluents Discharged to the State-Approved Land Disposal Site in 1999

Radionuclide	Half-Life	Release, Ci
Tritium	12.3 yr	9

Table 3.1.4. Radionuclides in 100 Areas' Liquid Effluents Discharged to the Columbia River, 1999

Radionuclide	Half-Life	Release, Ci
Strontium-90	29.1 yr	0.073 ^(a)
Plutonium-239/240	2.4 x 10 ⁴ yr	0.000015
Americium-241 ^(b)	432 yr	0.000016

- (a) Includes releases from N Springs (0.072 Ci) and the 1908-K Outfall (0.00054 Ci).
- (b) Releases from the 1908-K Outfall.



3.1.4 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 1999 is given in Section 2.2.8, "Clean Water Act."

Liquid waste containing both radioactive and hazardous constituents is stored at the 200 Areas in underground waste storage tanks or monitored interim storage facilities.

3.1.5 CERCLA and WAC Chemical Releases

Reportable releases include spills or discharges of hazardous substances or dangerous wastes to the environment, other than releases permitted under state or federal 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 the groundwater, into surface water, or into the air such that human health or the environment is threatened, regardless of the quantity of dangerous waste or hazardous substance.

There were seven releases reported under CERCLA reportable quantities or WAC 173-303-145 requirements by Hanford Site contractors in 1999. Table 3.1.5 contains a synopsis of these reportable releases.



Table 3.1.5. Releases to the Environment at the Hanford Site, 1999

Material	Quantity	Location
Radioactive air	8.5E-12 μ Ci/ml of plutonium	291-Z-1 stack (200-West Area), fixed contamination release during high wind, conservative estimate made
Chlorine gas	Detectable	283 Water Filter Plant (200-East Area), high alarm annunciated during changeout of chlorine gas cylinder, vented to atmosphere
Radioactive water	7.7 to 11.5 kg	SX Tank Farm Complex (200-West Area), contaminated water accidentally released from contaminated, bagged, equipment
Radioactive air	Undetermined amount of strontium-90 Gross alpha 2.02E-12 μ Ci/ml Gross beta 3.77E-10 μ Ci/ml	241-U Tank Farm Complex (200-West Area), job specific air sampler indicated release of strontium-90
Radioactive air	Undetermined amount of strontium-90 Gross alpha 5.6E-13 μ Ci/ml Gross beta 2.53E-10 μ Ci/ml	AY-AZ Tank Farm Complex (200-East Area), job specific air sampler indicated release of strontium-90
Radioactive air	Undetermined	241-U Tank Farm Complex (200-West Area), air leak discovered in plastic bag around piping
Radioactive air	Undetermined	B Plant (200-East Area), radioactive air release during stack filter changeout