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Westinghouse Hanford Company 100 Areas Environmental Releases for 1989

Prepared for the U.S. Department of Energy
Assistant Secretary for Defense Programs

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Title: **Westinghouse Hanford Company 100 Areas Environmental Releases for 1989**

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LIST OF TERMS

ACV	Administrative Control Guide
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
EDE	Effective Dose Equivalent
EF	Exhaust Fan
ENU	Elementary Neutralization Unit
EPA	U.S. Environmental Protection Agency
FS	Fog Spray
ICV	Interim Control Guide
LWDF	Liquid Waste Disposal Facility
NPDES	National Pollutant Discharge Elimination System
ND	Not Detected
RWR	Raw Water Return
SCS	Secondary Cooling System
Westinghouse Hanford	Westinghouse Hanford Company

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WESTINGHOUSE HANFORD COMPANY
100 AREAS ENVIRONMENTAL RELEASES FOR 1989

1.0 INTRODUCTION

1.1 OVERVIEW

This document contains information on nonradioactive and radioactive substances released to the environment from Westinghouse Hanford Company (Westinghouse Hanford) facilities in the 100 Areas during calendar year 1989.

Analyses of samples routinely collected from radioactive liquid and airborne streams were performed by a contract laboratory and the Westinghouse Hanford 100-N radioanalytical laboratory. Analyses of nonradioactive constituents were performed by the Hanford Environmental Health Foundation and the Westinghouse Hanford 100-N water chemistry laboratory.

The N Reactor has been shutdown since January 7, 1987. Because of this continued shutdown, both the radiological and chemical releases in 1989 were generally less than in previous years. The extended shutdown was initially ordered to allow upgrading of reactor safety systems. Following completion of most upgrades, N Reactor has remained shutdown, in "cold standby." The reactor has been kept in cold standby due to recent decisions affecting its role in the production of special nuclear materials.

No adverse trends were observed in the routine discharges of radioactive and chemical constituents. Releases from 100-N Area were within the Westinghouse Hanford technical specifications that limit operation of the N Reactor.

1.2 STRONTIUM-90 DISCHARGES TO THE COLUMBIA RIVER

Strontium-90 continues to be the most significant radionuclide released from the 100 Areas. The majority of it is found in liquid discharges entering the Columbia River from the riverbank near N Reactor. This region of discharge is known as the N Springs. Both the activity and the average concentration of ^{90}Sr released at the N Springs decreased by 15% in 1989, as compared to releases in 1988. For 1989, releases totaled 1.8 Ci, while averaging 5.9 x 10^{-6} μCi/mL; the total release in 1988 was 2.0 Ci, with a 6.5 x 10^{-6} μCi/mL average concentration.

For approximately the past 3 yr, operational activities at 100-N have had little or no influence on the level of ^{90}Sr discharged at the N Springs. This is because the primary source term of this ^{90}Sr discharge is the 1301-N Liquid Waste Disposal Facility (LWDF), situated about 800 ft from the river shoreline. For over 20 yr, ^{90}Sr in radioactive liquid discharged from N Reactor accumulated in the 1301-N LWDF soil column. In the latter years of the designed operational period of 1301-N, the capability of its soil column to retain ^{90}Sr, and other radionuclides, diminished. As a result, 1301-N was retired in September 1985, replaced by the then newly constructed 1325-N LWDF, which lies 2,600 ft inland. Discontinuing use of 1301-N, however, did not immediately mitigate the rising concentrations of ^{90}Sr at the N Springs, because groundwater movement under this facility continued to remobilize the old ^{90}Sr deposits. In 1988, though, concentrations peaked, and a downward trend is now evident, indicating the source term is depleting.

Effluent from 1325-N has had a negligible effect on the elevated concentrations at the N Springs, as strongly suggested by monitoring data. Compared to the N Springs average, groundwater concentrations of ^{90}Sr near 1325-N, between 1325-N and 1301-N, are about 0.03%. Yet near 1301-N, between 1301-N and the riverbank, concentrations are typically between 50% to 70% of the N Springs average. In addition, the continuous monitoring well from which record samples for the N Springs are collected is directly in line of the historical flowpath of 1301-N. This well continues to exhibit the highest average concentrations of radionuclides of all monitoring wells and seepage spots along the roughly 2,000-ft length of riverbank routinely sampled.

1.3 RADIOACTIVE DISCHARGES TO THE 1325-N LIQUID WASTE DISPOSAL FACILITY

In 1989, 28 Ci of ^{90}Sr were discharged to the 1325-N LWDF, an 87% increase over the 15 Ci discharged in 1988 (Rokkan 1989). Although the 1989 release was greater than that in 1988, it was 22% less that the 36 Ci discharged in 1986 (Rokkan 1987)--the last full year of operation at N Reactor. The concentration of ^{90}Sr averaged 4.5×10^{-5} μCi/mL in 1989 and 2.5×10^{-5} μCi/mL in 1988. The increase in concentration was not surprising, due to a reduction in the amount of less-radioactive process water being discharged. Normally, a higher amount of less-radioactive process water had been part of the total reactor effluent. A major source of discharges to 1325-N in 1989 was the N Basin. The water in this basin had comparatively higher concentrations of ^{90}Sr than other sources, averaging 1.7×10^{-4} μCi/mL. As the work of laying-up N Reactor continued, many reactor piping systems were drained, reducing the amount of process water. The volume of this water was purposely not accounted for when calculating the curies released to 1325-N. Instead, the flow to 1325-N was conservatively over-estimated. This was because flows had dropped to such a low rate they could no longer be routinely measured by the magnetic flow meter monitoring 1325-N influent. Inherent performance limitations in the meter prevented measuring these reduced flows. The lack of verifiable data on the smaller flows led to using conservatively higher values, based on the minimum flow rate detectable by the magnetic meter. As a result, the total curies of ^{90}Sr reported as discharged to 1325-N are artificially inflated.

In spite of the higher concentration of ^{90}Sr received at 1325-N, the concentration at the N Springs decreased, as already noted. This fact offers further evidence that discharges to 1325-N did not significantly add to river releases that originated from 1301-N.

Approximately 170 Ci of radionuclides with half-lives greater than 48 h were discharged to 1325-N in 1989, as compared to about 110 Ci in 1988, a 55% increase. The same explanation for the increase in ^{90}Sr applies to this overall increase. About 2,000 Ci of radionuclides with half-lives shorter than 48 h were measured in 1987 (Rokkan 1987). In 1988 and 1989, these radionuclides could not be measured, all having previously decayed to less than detectable levels.

1.4 ATMOSPHERIC RADIONUCLIDE EMISSIONS

Releases of airborne radionuclides at the 100 Areas have stabilized at lower levels compared to when N Reactor operated. This is due mainly to the absence of short-lived halogenated and noble gases, for example, ^{131}I and ^{41}Ar, respectively. Radionuclides with longer half-lives, such as ^{60}Co, ^{90}Sr, ^{137}Cs, and ^{239}Pu, continue to be emitted, although concentrations average 2 to 3 orders of magnitude beneath control limits.

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2.0 ATMOSPHERIC EMISSIONS TO THE ENVIRONMENT FROM THE 100 AREAS

2.1 ATMOSPHERIC RADIONUCLIDE EMISSIONS FROM THE 100-N AREA

Atmospheric radionuclide emissions from the 100-N Area are shown in Tables 2-1 through 2-4. The tables show the radionuclides measured, total activities released, and average concentrations. Also, the average concentration of each radionuclide is compared to the U.S. Department of Energy (DOE) Derived Concentration Guide (DCG) for that nuclide. The DCGs serve as the Westinghouse Hanford release guides for radionuclides discharged to the atmosphere at the points of release in the 100 Areas during 1989.

2.2 ATMOSPHERIC RADIONUCLIDE EMISSIONS FROM THE 100-K AREA

Radioactive airborne emissions from the 100-K Area are shown in Tables 2-5 through 2-8.

2.3 FLOW RATES OF ATMOSPHERIC RADIONUCLIDE EMISSIONS FROM THE 100 AREAS

The flow rates of radioactive airborne emissions at the 100 Areas are listed in Table 2-9.

2.4 ATMOSPHERIC NONRADIOACTIVE EMISSIONS FROM THE 100-N AREA

Table 2-10 lists the calculated atmospheric nonradioactive emissions produced at 100-N Area from the combustion of No. 2 diesel oil and No. 6 fuel oil. The weights of listed materials emitted were determined using the factors and formulas published by the U.S. Environmental Protection Agency (EPA 1985).

Table 2-1. Radionuclide Emissions from the 116-N Stack.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	4.7 E-04	1.5 E-13	8.0 E-11	1.9 E-03
^{90}Sr	3.7 E-07	1.2 E-16	9.0 E-12	1.3 E-05
^{137}Cs	2.0 E-04	6.4 E-14	4.0 E-10	1.6 E-04
^{238}Pu	7.1 E-08	2.3 E-17	3.0 E-14	7.7 E-04
^{239}Pu	1.0 E-07	3.2 E-17	2.0 E-14	1.6 E-03
			TOTAL	4.4 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-2. Radionuclide Emissions from the 109-N Zone I Vent.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{54}Mn	1.0 E-04	5.9 E-14	2.0 E-09	3.0 E-05
^{60}Co	5.3 E-04	3.0 E-13	8.0 E-11	3.8 E-03
^{90}Sr	2.1 E-06	1.2 E-15	9.0 E-12	1.3 E-04
^{137}Cs	1.1 E-04	6.0 E-14	4.0 E-10	1.5 E-04
^{155}Eu	1.7 E-04	1.0 E-13	3.0 E-10	3.3 E-04
^{238}Pu	2.6 E-08	1.4 E-17	3.0 E-14	4.7 E-04
^{239}Pu	5.7 E-08	3.2 E-17	2.0 E-14	1.6 E-03
			TOTAL	6.5 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-3. Radionuclide Emissions from the 109-N Cell 6 Vent.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{54}Mn	1.6 E-05	7.8 E-14	2.0 E-09	3.9 E-05
^{60}Co	2.3 E-04	1.1 E-12	8.0 E-11	1.4 E-02
^{90}Sr	7.2 E-07	3.5 E-15	9.0 E-12	3.9 E-04
^{137}Cs	1.5 E-05	7.5 E-14	4.0 E-10	1.9 E-04
^{155}Eu	2.1 E-05	1.1 E-13	3.0 E-10	3.7 E-04
^{238}Pu	1.3 E-08	6.3 E-17	3.0 E-14	2.1 E-03
^{239}Pu	7.8 E-08	3.8 E-16	2.0 E-14	1.9 E-02
			TOTAL	3.6 E-02

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-4. Miscellaneous Radionuclide Emissions at 100-N.

Emission Point	Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
Zone II EF 7,8	^{60}Co	6.5 E-05	1.9 E-13	8.0 E-11	2.4 E-03
Zone III EF 10	^{60}Co	3.2 E-04	1.7 E-13	8.0 E-11	2.1 E-03
Zone IV EF 14,15	^{60}Co	1.8 E-05	7.5 E-14	8.0 E-11	9.4 E-04
105-N Transfer Area	^{60}Co	3.0 E-06	7.3 E-15	8.0 E-11	9.1 E-05
105-N Spacer DF	^{60}Co	1.3 E-06	1.8 E-14	8.0 E-11	2.3 E-04
	^{134}Cs	5.2 E-07	7.3 E-15	2.0 E-10	3.7 E-05
	^{137}Cs	5.4 E-07	7.5 E-15	4.0 E-10	1.9 E-05
				Facility Subtotal	2.9 E-04
105-N 14-ft DF	^{60}Co	1.1 E-05	1.1 E-13	8.0 E-11	1.4 E-03
107-N Exhaust	^{54}Mn	6.2 E-06	5.7 E-14	2.0 E-09	2.9 E-05
	^{60}Co	1.5 E-05	1.3 E-13	8.0 E-11	1.6 E-03
	^{137}Cs	6.4 E-06	5.9 E-14	4.0 E-10	1.5 E-04
				Facility Subtotal	1.8 E-03
				TOTAL	9.0 E-03

ND = Not Detected.
EF = Exhaust Fan.
DF = Decontamination Facility
DOE = U.S. Department of Energy
DCG = Derived Concentration Guide.

Table 2-5. Radionuclide Emissions from the 105-KE Basin Vents.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	3.7 E-05	9.3 E-14	8.0 E-11	1.2 E-03
^{90}Sr	1.9 E-05	4.7 E-14	9.0 E-12	5.2 E-03
^{134}Cs	2.5 E-05	6.3 E-14	2.0 E-10	3.2 E-04
^{137}Cs	4.4 E-05	1.1 E-13	4.0 E-10	2.8 E-04
^{238}Pu	5.7 E-08	1.4 E-16	3.0 E-14	4.7 E-03
^{239}Pu	3.2 E-07	8.0 E-16	2.0 E-14	4.0 E-02
			TOTAL	5.2 E-02

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-6. Radionuclide Emissions from the 105-KW Basin Vents.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	3.3 E-05	8.2 E-14	8.0 E-11	1.0 E-03
^{90}Sr	4.1 E-07	1.0 E-15	9.0 E-12	1.1 E-04
^{137}Cs	2.4 E-05	6.1 E-14	4.0 E-10	1.5 E-04
^{238}Pu	6.0 E-09	1.5 E-17	3.0 E-14	5.0 E-04
^{239}Pu	1.1 E-08	2.9 E-17	2.0 E-14	1.5 E-03
			TOTAL	3.3 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-7. Radionuclide Emissions from the 1706-KE Laboratory Exhaust.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	3.2 E-06	1.8 E-15	8.0 E-11	2.3 E-05
^{238}Pu	2.4 E-09	1.4 E-17	3.0 E-14	4.7 E-04
^{239}Pu	3.0 E-09	1.7 E-17	2.0 E-14	8.5 E-04
			TOTAL	1.3 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-8. Radionuclide Emissions from the 105-KER (-27 ft) Exhaust.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	1.0 E-06	2.6 E-14	8.0 E-11	3.3 E-04
^{90}Sr	2.1 E-08	5.7 E-16	9.0 E-12	6.3 E-05
^{137}Cs	6.9 E-07	1.9 E-14	4.0 E-10	4.8 E-05
^{238}Pu	5.5 E-10	1.5 E-17	3.0 E-14	5.0 E-04
^{239}Pu	1.8 E-09	4.8 E-17	2.0 E-14	2.4 E-03
			TOTAL	3.3 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 2-9. Emission Flow Rates at the 100 Areas.

Emission Point	Flow Rate (f^3/min)
116-N Stack	210,000
109-N Zone I Vent	120,000
109-N Cell 6 Vent	28,000
Zone II, EF 7,8	23,000
Zone III, EF 10	130,000
Zone IV, EF 14,15	16,000
105-N Transfer Area	28,000
105-N Spacer Decontamination Facility	4,800
105-N 14-ft Decontamination Facility	6,400
107-N Exhaust	7,300
105-KE Basin Exhaust Vents	27,000
105-KW Basin Exhaust Vents	27,000
1706-KE Exhaust	12,000
1706-KER Exhaust	2,500

EF = Exhaust Fan.

Table 2-10. Nonradioactive Emissions from the 184-N Boiler Stacks.

Material	No. 2 Oil (lb)	No. 6 Oil (lb)
Particulate	29,000	19,000
Sulfur dioxide	930,000	250,000
Sulfur trioxide	13,000	3,200
Carbon monoxide	71,000	4,500
Hydrocarbons	14,000	910
Nitrogen oxides	310,000	54,000

3.0 LIQUID DISCHARGES TO THE ENVIRONMENT IN THE 100 AREAS

3.1 LIQUID RADIONUCLIDE DISCHARGES FROM THE 100-N AREA

Liquid radionuclide discharges from the 100-N Area are shown in Tables 3-1 through 3-6. The tables show radionuclides measured, the total activities released, and the average concentrations. Also, the average concentration of each radionuclide is compared to either the DOE DCG for that nuclide or the applicable Westinghouse Hanford environmental release guide.

Westinghouse Hanford release guides, most of which are also known as administrative control values (ACV) or interim control values (ICV), are listed in WHC-CM-7-5, *Environmental Compliance* (WHC 1988). Each of these guides is a multiple of a DCG. For instance, the ICV for ^{54}Mn discharged to the 1325-N LWDF is 5.0 x 10^{-4} μCi/mL, which is 10 times greater than the DCG.

Limiting radionuclide discharges to the Columbia River to less than DCGs is the objective of ICVs that govern discharges to the 1325-N soil column. While this is the purpose of ICVs, they themselves are permitted to be at higher concentrations than respective DCGs. This is because soil column retention factors are included in determining ICVs. After radionuclides, in concentrations not surpassing their ICVs, are filtered by the soil column, the resulting concentrations released to the river should be beneath DCGs. This is virtually assured, because conservatism is factored into each ICV.

The DCG for ^{90}Sr in liquid discharges to surface water is 1.0 x 10^{-6} μCi/mL. Meeting this limit at the N Springs has not been possible for the past 7 yr, at least not without costly remedial actions affording debatable offsite benefits. Average concentrations of ^{90}Sr rose to a peak of 6.5 x 10^{-6} μCi/mL in 1988. Since then, concentrations have steadily declined. Left untreated, the N Springs concentrations of ^{90}Sr will probably remain above the DCG for at least several more years. Because of these conditions, an exemption was implemented on applying the DCG of ^{90}Sr for the discharge of that radionuclide to the Columbia River (WHC 1988), based on the "as low as reasonably achievable" concept. This exemption consists of 3 separate limits that collectively substitute for the DCG:

- limit 1--the total releases of ^{90}Sr shall not exceed 15 Ci during any calendar year;
- limit 2--the ^{90}Sr concentration measured at the N Springs shall not exceed 5.0 x 10^{-5} μCi/mL applied on an annual average;
- limit 2--the offsite maximally exposed individual shall not annually receive a dose from ^{90}Sr that exceeds 1 mrem effective dose equivalent (EDE).

All three of these limits were derived conservatively. Limits 1 and 2, from WHC-CM-7-5 (WHC 1988), serve to prevent limit 3 from being exceeded. Limit 3 is more stringent than the dose limits in the environmental compliance manual applying to N Springs ^{90}Sr releases; it is 1% of the DOE-authorized annual dose limit of 100 mrem EDE, upon which each DCG is based.

Limit 1 (15 Ci/yr) is equivalent to an offsite dose of about 6.4×10^{-2} mrem EDE. This is 6.4% of limit 3 (1 mrem EDE).

Limit 2 (5.0×10^{-5} μCi/mL) was formulated on the basis that offsite dose is a function of ^{90}Sr concentration and N Springs flow. Flow from the N Springs in relation to river flow is vastly smaller. Historically, river flow has reduced any offsite environmental impact from N Springs discharges to levels approaching statistical insignificance. The N Springs flow for 1989 was 8.2×10^{7} gal. If this flow had the unlikely high ^{90}Sr concentration of 5.0×10^{-5} μCi/mL, 16 Ci would have been released to the river. Although this surpasses the 15 Ci/yr limit, the resulting offsite dose would be approximately 6.8×10^{-2} mrem EDE, just 6.8% of the 1 mrem EDE limit. Again, conservatism is evident, even in a control guide of 5.0×10^{-5} μCi/mL.

Potential offsite doses are annually calculated and published by Pacific Northwest Laboratory (PNL). For 1989, PNL calculated a dose of 0.05 mrem EDE to the "maximum individual" (MI) (Jaquish 1990). This individual is hypothetical, and is constructed conservatively for dose modeling purposes. The MI is depicted living near the Hanford Site so as to receive maximum exposure from all forms of radioactive releases originating from the Site. Of the 0.05 mrem EDE received by the MI, 0.01 mrem, or 20%, came from the 1.8 Ci of ^{90}Sr discharged via the N Springs in 1989. This 0.01 mrem also represents 0.25% of the drinking water standard of 4 mrem; 1% of the N Reactor technical specification dose limit of 1 mrem; and 0.01% of the DOE dose limit of 100 mrem.

3.2 LIQUID RADIONUCLIDE DISCHARGES FROM THE 100-K AREA

Liquid radionuclide discharges from the 100-K Area are shown in Table 3-6.

3.3 FLOW RATES OF LIQUID RADIONUCLIDE DISCHARGES FROM THE 100 AREAS

The flow rates of liquid radionuclide discharges in the 100 Areas are listed in Table 3-7.

Table 3-1. Radionuclide Discharges to the 1325-N Liquid Waste Disposal Facility.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG* or ICV (μCi/mL)	Fraction of DCG or ICV
^{3}H	7.4 E+01	1.2 E-04	2.0 E-03*	6.0 E-02
^{54}Mn	5.0 E+00	8.0 E-06	5.0 E-04	1.6 E-02
^{60}Co	3.3 E+01	5.3 E-05	2.5 E-04	2.1 E-01
^{90}Sr	2.8 E+01	4.5 E-05	2.5 E-04	1.8 E-01
^{125}Sb	1.0 E+00	1.6 E-06	5.0 E-05*	3.2 E-02
^{134}Cs	5.2 E-01	8.3 E-07	2.0 E-05	4.2 E-02
^{137}Cs	2.3 E+01	3.6 E-05	3.0 E-04	1.2 E-01
^{144}Ce	1.8 E+00	2.9 E-06	1.0 E-04	2.9 E-02
^{238}Pu	4.6 E-03	7.4 E-09	8.0 E-08	9.3 E-02
^{239}Pu	2.3 E-02	3.7 E-08	5.4 E-08	6.9 E-01
			TOTAL	1.5 E+00

*Indicates U.S. Department of Energy DCGs; all other values in this column are Westinghouse Hanford Company ICVs.
DCG = Derived Concentration Guide
ICV = Westinghouse Hanford Company Interim Control Value

Table 3-2. Radionuclide Discharges to the Columbia River via Seepage from the N Springs.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG or ICV
^{3}H	7.4 E+01[a]	6.2 E-05	2.0 E-03	3.1 E-02
^{60}Co	1.2 E-02	3.9 E-08	5.0 E-06	7.8 E-03
^{90}Sr	1.8 E+00	5.9 E-06	5.0 E-05[b]	1.2 E-01
^{125}Sb	1.2 E-02	3.6 E-08	5.0 E-05	7.2 E-04
^{137}Cs	1.6 E-03	4.9 E-09	3.0 E-06	1.6 E-03
^{238}Pu	5.3 E-06	1.7 E-09	4.0 E-08	4.3 E-02
^{239}Pu	4.5 E-06	1.4 E-09	3.0 E-08	4.7 E-02
			TOTAL	2.5 E-01

[a]This release value is the same as for ^{3}H (tritium) discharged to 1325-N. Because of its high affinity with water, all ^{3}H discharged to 1325-N is conservatively assumed to reach the Columbia River, although probably not within 1 yr from the time of discharge. The average concentration of ^{3}H at the N Springs for 1989 was calculated from analyses of samples routinely collected using a continuous composite sampling system located there.

[b]Represents Westinghouse Hanford Company limit for concentration of ^{90}Sr discharges via the N Springs at 100-N Area. The basis for this value is that concentrations not exceeding it will not jeopardize the offsite dose limit of 1 mrem effective dose equivalent in the Westinghouse Hanford Company technical specifications.

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 3-3. Radionuclide Discharges to the Columbia River via the 009 (102-in.) Outfall.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	7.6 E-02	3.2 E-10	5.0 E-06	6.4 E-05
^{137}Cs	3.1 E-02	1.3 E-10	3.0 E-06	4.3 E-05
			TOTAL	1.1 E-04

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 3-4. Radionuclide Discharges to the Columbia River via the 005 (36-in.) Outfall.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	3.4 E-02	1.4 E-10	5.0 E-06	2.8 E-05
^{137}Cs	2.9 E-02	1.2 E-10	3.0 E-06	4.0 E-05
			TOTAL	6.8 E-05

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 3-5. Radionuclide Discharges to the Columbia River via the 006 (42-in.) Outfall.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{60}Co	2.1 E-03	1.8 E-10	5.0 E-06	3.6 E-05
^{137}Cs	1.4 E-03	1.1 E-10	3.0 E-06	3.7 E-05
			TOTAL	7.3 E-05

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 3-6. Radionuclide Discharges to the Columbia River via the 004 (1908-K) Outfall.

Radionuclide	CY 1989 Release (Ci)	CY 1989 Average Concentration (μCi/mL)	DOE DCG (μCi/mL)	Fraction of DCG
^{3}H	2.6 E-01	1.2 E-07	2.0 E-03	6.0 E-05
^{60}Co	6.6 E-02	2.9 E-08	5.0 E-06	5.8 E-03
^{90}Sr	1.0 E-03	4.3 E-10	1.0 E-06	4.3 E-04
^{137}Cs	1.0 E-02	4.6 E-09	3.0 E-06	1.5 E-03
^{239}Pu	9.2 E-06	4.1 E-12	3.0 E-08	1.4 E-04
			TOTAL	7.9 E-03

DOE = U.S. Department of Energy
DCG = Derived Concentration Guide

Table 3-7. Flow from the 100 Areas.

Stream	Total Flow (gal)
To 1325-N	1.6 E+08
To river via N Springs	8.2 E+07
To river via 005 (36-in.) Outfall	6.5 E+08
To river via 006 (42-in.) Outfall	3.2 E+07
To river via 009 (102-in.) Outfall	6.0 E+10
To river via 004 (1908-K) Outfall	5.9 E+08

3.4 LIQUID NONRADIOACTIVE DISCHARGES FROM THE 100 AREAS

Nonradioactive parameters of water discharged to the Columbia River from the 100 Areas are regulated under the National Pollutant Discharge Elimination System (NPDES) permit for the Hanford Site. Table 3-8 shows the NPDES discharge points and a summary of the analytical results of samples collected from these locations during 1989.

Table 3-8. Summary of National Pollutant Discharge Elimination System (NPDES) Data for 1989.

NPDES Discharge Points	
Designation	Description
003	181-KE Inlet Screen Backwash
004	1908-K Outfall
005	182-N Tank Farm Overflow (36-in. RWR[a])
006	182-N Drain System (42-in. RWR)
007	181-N Inlet Screen Backwash
009	102-in. Outfall (RWR)
N Springs	100-N Riverbank Springs

Sample Parameter		003	004	005[b]	005[c]	006[d]	006[e]	007	009	N Springs
Flow (Mgal/d)	Max.	0.01	3.8	3.8	24.8	0.23	1.9	1.38	302	1.4
	Avg.	0.005	1.6	1.7	-[f]	0.007	-	0.40	114	0.22
Temp. (°F)	Max.	-	75	72	-	68	-	-	77	72
	Avg.	-	56	56	-	59	-	-	54	61
pH	Max.	-	8.0	8.4	-	8.4	-	-	8.5	8.3
	Min.	-	7.2	6.6	-	7.7	-	-	7.8	7.8
	Avg.	-	7.6	7.8	-	7.4	-	-	7.1	7.5
TSS[g] (mg/L)	Max.	28	7.9	3.5	-	3.1	-	-	7.2	-
	Avg.	9.3	1.7	3.8	-	-	1.5	-	3.4	-
Oil and Grease (mg/L)	Max.	-	-	3.0	-	2.7	-	-	-	<1.0
	Avg.	-	-	<0.4	-	<0.3	-	-	-	<1.0
Iron (mg/L)	Max.	-	-	-	-	-	-	-	-	<0.08
	Avg.	-	-	-	-	-	-	-	-	<0.08
Ammonia (mg/L)	Max.	-	-	-	-	-	-	-	-	<0.050
	Avg.	-	-	-	-	-	-	-	-	<0.050
Chromium (mg/L)	Max.	-	-	-	-	-	-	-	-	<0.018
	Avg.	-	-	-	-	-	-	-	-	<0.01
Chlorine (mg/L)	Max.	<0.04	-	<0.04	-	-	-	-	<0.04	-
	Avg.	<0.04	-	<0.04	-	-	-	-	<0.04	-

[a]Raw water return.
[b]Without low-lift pumps.
[c]With low-lift pumps.
[d]Without fog sprays.
[e]With fog sprays.
[f]Measurement not required.
[g]Total suspended solids.

4.0 CONSUMPTION OF CHEMICALS

4.1 CHEMICALS CONSUMED IN THE 100 AREAS

Shown in Table 4-1 are the primary chemicals consumed by operation processes in the 100 Areas during 1989. Descriptions of the uses and dispositions of these chemicals are in Section 4.3.

Table 4-1. Chemicals Consumed in the 100 Areas.

Material	100-K (lb)	100-N (lb)
Aluminum sulfate	110,000	400,000
Chlorine	8,000	14,000
Hydrazine		15,000
Morpholine		5,500
Polyacrylamide		550
Sodium hydroxide		580,000
Sulfuric acid		880,000
1,1,2-Trichloro-1,2,2-trifluoroethane		990

4.2 CHEMICALS RELEASED TO THE ENVIRONMENT FROM THE 100 AREAS

Table 4-2 shows the primary chemicals released to the environment from the 100 Areas during operations in 1989. Section 4.3 describes the uses and dispositions of these chemicals.

Table 4-2. Chemicals Released to the Environment from the 100 Areas.

Material	100-K	100-N
Aluminum sulfate	110,000	400,000
Hydrazine		55
1,1,2-Trichloro-1,2,2-trifluoroethane		990

4.3 DISPOSITION OF CHEMICALS CONSUMED IN THE 100 AREAS

Sections 4.3.1 through 4.3.6 describe chemicals used in the 100 Areas and the environmental discharges related to their use.

4.3.1 Aluminum Sulfate

Aluminum sulfate is used as a flocculent in the production of filtered water at the 100-N and 100-KE Areas. It is routinely backwashed from the 183-N filter beds to the 183-N filter backwash pond. After being used at 100-KE, this chemical is backwashed from filter beds to a settling basin instead of a backwash pond.

4.3.2 Chlorine

Chlorine is used in the 100-N and 100-K Areas as an algicide and to produce potable water. After reacting with water, chlorine changes to a chloride ion. In this ionic form it is discharged at 100-N to the sanitary sewage lagoon, the river via the 009 (102-in.) outfall, and the 1325-N LWDF, or at 100-K to a sanitary tile field.

4.3.3 Sulfuric Acid

Sulfuric acid is used at 100-N Area to regenerate the cation resins in the demineralized water plant. In November 1988, the lined 1324-N facility was retired when the Elementary Neutralization Unit (ENU) began operation. The acid is completely neutralized in the ENU before being released to 1324-NA. Prior to installation of the ENU, acid used in resin regeneration was flushed to 1324-N, neutralized with sodium hydroxide, and then released as sodium sulfate to the 1324-NA percolation pond.

4.3.4 Sodium Hydroxide

Sodium hydroxide is used at 100-N Area to regenerate the anion resins in the demineralized water plant. In November 1988, the lined 1324-N facility was retired when the ENU began operation. The caustic is completely neutralized before being released to 1324-NA. Prior to installation of the ENU, caustic used in resin regeneration was flushed to 1324-N, neutralized with sulfuric acid, and then released as sodium sulfate to the 1324-NA percolation pond.

4.3.5 Hydrazine

Hydrazine is used to suppress the oxygen concentration in the secondary cooling system (SCS), rod cooling system, primary cooling system, and graphite shield cooling system. Small quantities of unreacted hydrazine were discharged to the 1325-N LWDF because of system purity bleeds and leaks.

4.3.6 Morpholine

Morpholine is used to control the pH of the SCS and may be discharged to the Columbia River in the same way as described for hydrazine, although it has never been detected there.

4.3.7 Polyacrylamide

Polyacrylamide is used as a filter aid and coagulant in the production of filtered water at the 100-N and 100-K Areas. This chemical is backwashed to the 183-N filter backwash pond at 100-N and the settling basin at 100-KE.

4.3.8 1,1,2-Trichloro-1,2,2-trifluoroethane

This chlorinated hydrocarbon is used in a special device to clean contaminated tools at the 100-N Area. Releases of this substance to the atmosphere have occurred due to worn seals and formerly inefficient operating procedures. Replacing the seals, which is now done regularly, and improving the procedures have reduced releases to practically zero.

4.3.9 Miscellaneous Chemicals

After their use in laboratory facilities or by maintenance crafts personnel, small quantities of chemicals are properly packaged and disposed of by way of the 616 Nonradioactive Dangerous Waste Storage Facility, located near the 200 Areas.

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5.0 UNPLANNED RELEASES

5.1 HYDRAZINE RELEASE TO 1325-N LIQUID WASTE DISPOSAL FACILITY

On May 10, 1989, in an attempt to maintain water quality standards, extra hydrazine was added to the N Reactor coolant. This caused an excess of unreacted hydrazine in effluent discharged to the 1325-N LWDF. Calculations, based on effluent flow rates and sample analyses, indicated the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (CERCLA 1980) reportable quantity for hydrazine (1 lb/d) had been exceeded. The hydrazine released was estimated to range between 2.0 and 11.9 lb. All necessary notifications were made. The occurrence was reported in WHC-UO-89-026-100N-01 (WHC 1989a).

5.2 HYDRAZINE RELEASE TO 1325-N LIQUID WASTE DISPOSAL FACILITY

Approximately 1.3 lb of hydrazine were discharged to the 1325-N LWDF on August 8, 1989, exceeding the CERCLA reportable quantity. This release occurred when the concentration of hydrazine in the graphite shield cooling system was found to be inadequately low for impeding corrosion; therefore, additional hydrazine was injected into the system. However, the injection pump was inadvertently allowed to operate for a longer time and at a higher pumping rate than normal. Effluent samples taken while the pump was still running showed elevated hydrazine levels. When the pump was shut off, hydrazine discharge levels returned to an acceptable range. All necessary notifications were made. The occurrence was reported in WHC-CM-89-042-100N-03 (WHC 1989b).

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6.0 SANITARY SEWAGE DISCHARGED TO THE GROUND IN THE 100 AREAS

Sewage flows in the 100 Areas (see Table 6-1) are calculated by assuming 25 gal of sewage discharged per person per day.

Table 6-1. Sanitary Sewage Discharges in the 100 Areas.

100 Area	Discharge (gal/d)
100-B	50
100-D	100
100-H	200
100-K	3,800
100-N*	15,000

*In addition to the daily flow of sanitary sewage from 100-N facilities, a total of 280,000 gallons of septic tank sewage from the 200 and 600 Areas were discharged to the 100-N sanitary sewage lagoon.

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7.0 IN-GROUND DISPOSAL OF SOLID WASTE

7.1 RADIOACTIVE SOLID WASTE

Radioactive solid waste from operations in the 100 Areas is buried in the 200 Areas waste disposal sites. The waste site managers report the volume of waste received for disposal.

7.2 NONRADIOACTIVE SOLID WASTE

Nonradioactive solid waste from operations in the 100 Areas is compacted, when possible, and buried in the 200 Areas central landfill. The waste site managers report the volume of waste received for disposal.

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8.0 REFERENCES

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