

ENCLOSURE

**HUMBOLDT BAY POWER PLANT UNIT 3  
ANNUAL RADIOACTIVE  
EFFLUENT RELEASE REPORT**

**January 1 through December 31, 1996**

PACIFIC GAS AND ELECTRIC COMPANY  
HUMBOLDT BAY POWER PLANT  
DOCKET NO. 50-133, LICENSE NO. DPR-7

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
JANUARY 1, 1996 THROUGH DECEMBER 31, 1996

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## HUMBOLDT BAY POWER PLANT

### ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT 1996

#### INTRODUCTION

This report summarizes gaseous and liquid radioactive effluent releases from Humboldt Bay Power Plant Unit 3 for the four quarters of 1996. The report includes calculated potential radiation doses from these radioactive effluents and a comparison with the numerical guidelines of 10 CFR 50, Appendix I, as well as a summary of shipments of solid radioactive waste. The concentrations of plant effluent releases during the reporting period were well below Technical Specification limits.

The information is reported as required by Section VII.H.3 of the Technical Specifications, and it is presented in the general format of Regulatory Guide 1.21, Appendix B (except for the topics identified below).

#### Meteorology

The meteorological data logging system was removed from service in 1967 so the information specified by Regulatory Guide 1.21, Appendix B, Section F, is not available. Previous Humboldt Bay Power Plant Annual Radioactive Effluent Release Reports summarized the cumulative joint frequency distribution of wind speed, direction, and atmospheric stability for the period April 1962 through June 1967, when the meteorological data logging system was in service.

#### Short-lived Nuclides

The Unit was last operated on July 2, 1976. Due to the long decay time since operation, short-lived radionuclides are neither expected nor reported. This includes iodines and noble gases other than Krypton-85.

#### Air Particulate Filter Composites - Sr-90

For each quarter, alternate (every other week) sample filters are combined and analyzed off-site for Sr-90 to determine a ratio for Sr-90 to Cs-137. The alternate set of filters is retained as insurance against loss in transport or errors in analysis. The total Sr-90 release for the calendar quarter is reported in proportion to the Cs-137 measured on all samples collected for the quarter.

#### Air Particulate Filter Composites - Gross Alpha

Each weekly sample filter is individually counted for gross alpha activity, rather than analyzing a monthly composite of the filters, as described Regulatory Guide 1.21.

#### Gaseous Effluents - Tritium

Tritium releases during plant operation were less than detection levels. Since the plant was permanently shutdown in 1976, current tritium release levels are less than the release levels that occurred during plant operations. Therefore, no tritium samples were collected during this reporting period

#### Liquid Composites - Gross Alpha & Tritium

Gross alpha and tritium data are based on monthly composites, as described in Regulatory Guide 1.21, but they are maintained separately for the batch and (semi-) continuous releases.

#### Errata

A review of gamma spectrometry calibration indicated that the reported values for the Fourth Quarter of 1995, for detected gamma emitting nuclides, were slightly low (typically between 0.4 to 0.8%). Since this change is too small to affect the reported public exposure, and the difference is well within the uncertainty for the analyses, no specific correction to the 1995 Radioactive Effluent Release Report will be made.

## I. SUPPLEMENTAL INFORMATION

### Regulatory Limits<sup>1</sup>

#### 1. Gaseous Effluents

##### Noble Gas Release Rate Limit

The noble gas release rate limit is based on the Maximum Permissible Concentrations (MPC) of 10 CFR 20, divided by an atmospheric dispersion factor of  $1.4\text{E}-6$  seconds per cubic meter. This dispersion factor is the annual average dispersion factor for the sector with the least favorable atmospheric dispersion.

##### b. Iodine Release Rate Limit

Due to the long decay time since the Unit was shutdown, the license does not define an iodine release rate limit.

##### c. Particulate Release Rate Limit

The radioactive particulate release rate limit is based on the Maximum Permissible Concentrations of 10 CFR 20, divided by a dispersion factor of  $1.4\text{E}-6$  seconds per cubic meter. This dispersion factor is the annual average dispersion factor for the sector with the least favorable atmospheric dispersion.

#### 2. Liquid Effluents

##### a. Concentration Limit

Liquid effluent radioactivity concentrations released to Humboldt Bay are limited to the Maximum Permissible Concentrations of 10 CFR 20.

### B. Maximum Permissible Concentrations

#### 1. Gaseous Effluents

Maximum Permissible Concentrations for gaseous effluents are taken from 10 CFR 20, Appendix B, Table II, Column I.

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<sup>1</sup> Regulatory limits in this report are based on the version of 10 CFR 20 in effect prior to January 1, 1994 (20.1-20.602), as referenced in the Technical Specifications.

## 2. Liquid Effluents

Maximum Permissible Concentrations for liquid effluents are taken from 10 CFR 20, Appendix B, Table II, Column II.

## C. Measurements and Approximations of Total Radioactivity

### 1. Gaseous Effluents

#### a. Fission and Activation Gases

All ventilation and system vents are routed to the Unit 3 stack. The gaseous activity released from the stack is monitored by an off-line monitor equipped with a beta scintillator, with its response calibrated for Kr-85.

The "less than" value reported for Kr-85 is based on the estimated sensitivity of the stack Kr-85 monitor.

#### b. Iodines

Due to the long decay time since operation (shutdown July 2, 1976), no detectable releases of radioactive iodines can be expected. Therefore, the Technical Specifications do not require that these radionuclides be monitored.

#### c. Particulates

Radioactive particulates released from the plant stack are monitored by continuous sample collection on particulate filters. Filter papers are removed from the stack sampling system weekly. After decaying 48 hours, they are analyzed for gross alpha (internal proportional counter) and for the concentration of gamma-emitting nuclides (intrinsic germanium detector).

All statistically significant peaks are identified. Filters for each quarter are analyzed for radioactive strontium-90 (the only strontium present).

The estimated error of the reported particulate release values is based on uncertainty in sample flow rate, stack flow rate, detector calibration, and typical sample counting statistics.

## 2. Liquid Effluents

### a. Batch Releases

All water from contaminated plant systems was collected, filtered, and analyzed before discharge (on a batch basis) through the liquid radwaste process monitor. Analysis of weekly composite samples from the plant intake and the plant effluent canal did not detect any significant additional release of radioactive liquids during the report period.

Samples of liquid waste batches were analyzed for the concentration of gamma-emitting nuclides (intrinsic germanium detector). All statistically important peaks were identified. Quarterly composites of all batches were analyzed for radioactive strontium (Sr-90), and monthly composites of all batches were analyzed for gross alpha and tritium.

The error of the reported release values is estimated based on uncertainty in sample volume, batch volume, detector calibration, and typical sample counting statistics.

### b. Continuous Releases

Beginning in August, 1996, Humboldt Bay Power Plant was able to determine conditions when groundwater leakage into the reactor caisson sump did not require treatment in the Radwaste Treatment System. When treatment was not required, this groundwater was discharged through the liquid radwaste process monitor, and a continuous composite sample was collected during discharge. The composite sample was analyzed weekly (or more frequently) for the concentration of gamma-emitting nuclides (intrinsic germanium detector). All statistically important peaks were identified. These analyses did not detect radioactivity above the normal effluent LLD (lower limit of detection) guidance of Regulatory Guide 1.21.

Quarterly composites of the weekly samples were analyzed for radioactive strontium (Sr-90), and monthly composites of the weekly samples were analyzed for gross alpha and tritium.

The error of the reported release values is estimated based on uncertainty in sample volume, flow measurement, detector calibration, and typical sample counting statistics.



#### D. Batch Release Statistics

##### 1. Liquid

- a. Number of batch releases ..... 206
- b. Total time period for batch releases ..... 6.58E4 minutes
- c. Maximum time period for a batch release ..... 4.19E2 minutes
- d. Average time period for a batch release ..... 3.19E2 minutes
- e. Minimum time period for a batch release ..... 1.97E2 minutes

##### 2. Gaseous

- a. Number of batch releases ..... 0
- b. Total time period for batch releases ..... N/A
- c. Maximum time period for a batch release ..... N/A
- d. Average time period for a batch release ..... N/A
- e. Minimum time period for a batch release ..... N/A

#### E. Abnormal Release Statistics

##### 1. Liquid

- a. Number of abnormal releases ..... 0
- b. Total activity released ..... N/A



## II. GASEOUS AND LIQUID EFFLUENTS

### A. Gaseous Effluents

Table 1 summarizes the total quantities of radioactive gaseous effluents. Table 2 presents the quantities of each of the nuclides determined to be released.

### B. Liquid Effluents

Table 3 summarizes the total quantities of radioactive liquid effluents. Table 4 presents the quantities of each of the nuclides determined to be released.

# HUMBOLDT BAY POWER PLANT

## ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT 1996

**TABLE 1**

### GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

Units	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Est. Total Error, %
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#### A. Fission & Activation Gases

1. Total release	Ci	<5.52E1	<5.52E1	<5.58E1	<5.58E1	3.20E1
2. Average release rate	μCi/sec	<7.02E0	<7.02E0	<7.02E0	<7.02E0	
3. Percent of applicable limit	%	<3.28E-3	<3.28E-3	<3.28E-3	<3.28E-3	

#### B. Particulates

1. Total release	Ci	6.26E-6	3.06E-6	1.83E-5	4.53E-5	2.70E1
2. Average release rate	μCi/sec	7.97E-7	3.89E-7	2.30E-6	5.70E-6	
3. Percent of applicable limit	%	3.67E-7	1.36E-7	2.18E-6	3.41E-6	
4. Applicable limit (mixture MPC)	μCi/cc	3.04E-10	3.99E-10	1.48E-10	2.34E-10	
5. Gross alpha radioactivity	Ci	5.08E-7	3.40E-7	5.69E-7	5.75E-7	

Note: The < symbol used in this table means the numerical value is less than the lower limit of detection (LLD).

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**TABLE 2**

### GASEOUS EFFLUENTS - NUCLIDES RELEASED

Nuclides Released	Unit	Continuous Mode			
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission Gasses					
Krypton-85	Ci	<5.52E1	<5.52E1	<5.58E1	<5.58E1
Total for period	Ci	<5.52E1	<5.52E1	<5.58E1	<5.52E1
2. Particulates					
Strontium-90	Ci	1.29E-7	< 2.49E-7	2.56E-6	2.99E-6
Cesium-137	Ci	3.11E-6	1.90E-6	1.04E-5	3.55E-5
Cobalt-60	Ci	3.02E-6	1.16E-6	5.38E-6	6.88E-6
Unidentified	Ci	<1.51E-6	<1.22E-6	<1.41E-6	<1.81E-6
Total for period	Ci	6.26E-6	3.06E-6	1.83E-5	4.53E-5

Note: The < symbol used in this table means the numerical value is less than the lower limit of detection (LLD). The LLD for unidentified isotopes is the LLD for Cesium-137. The LLD for Cesium-137 is the upper limit for gamma emitting nuclides that were not detected and are not included in the total value calculations.

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**TABLE 3**

### LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

Units	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Est. Total Error, %
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#### A. Fission & Activation Products

1. Total release (not including tritium, gases, alpha)	Ci	2.67E-3	1.64E-3	2.03E-3	1.48E-3	1.30E1
2. Average diluted concentration	μCi/ml	1.19E-10	1.06E-10	1.22E-10	6.93E-11	
3. Percent of applicable limit	%	1.11E-3	2.25E-3	1.42E-3	1.25E-3	
4. Applicable limit (Mixture MPC)	μCi/ml	1.07E-5	4.73E-6	8.60E-6	5.54E-6	

#### B. Tritium

1. Total release	Ci	1.98E-3	<8.39E-4	<1.34E-3	<1.50E-3	5.00E1
2. Average diluted concentration	μCi/ml	8.83E-11	<5.45E-11	<8.02E-11	<7.04E-11	
3. Percent of applicable limit	%	2.94E-6	<1.82E-6	<2.67E-6	<2.35E-6	

#### C. Gross Alpha Radioactivity

1. Total release	Ci	6.43E-6	5.03E-6	<9.04E-6	<1.48E-5	5.00E1
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D. Volume of waste released (prior to dilution)	Liters	1.48E6	1.68E6	2.47E6	2.98E6	1.00E1
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E. Volume of dilution water	Liters	2.24E10	1.54E10	1.67E10	2.14E10	1.50E1
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Note: The < symbol used in this table means the numerical value is less than the lower limit of detection (LLD).

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**TABLE 4**

### LIQUID EFFLUENTS - NUCLIDES RELEASED

Nuclides Released	Unit	Batch Mode			
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Strontium-90	Ci	3.55E-5	8.05E-5	4.12E-5	5.91E-5
Cesium-137	Ci	2.62E-3	1.54E-3	1.95E-3	1.38E-3
Cobalt-60	Ci	2.00E-5	1.58E-5	3.75E-5	3.46E-5
Unidentified	Ci	<2.61E-5	<2.80E-5	<1.83E-5	<1.24E-5
Total for period	Ci	2.67E-3	1.64E-3	2.03E-3	1.47E-3

Nuclides Released	Unit	Continuous Mode			
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Strontium-90	Ci	N/A	N/A	<1.47E-5	<3.26E-5
Cesium-137	Ci	N/A	N/A	5.40E-6	7.95E-6
Cobalt-60	Ci	N/A	N/A	1.71E-6	<1.87E-5
Unidentified	Ci	N/A	N/A	<1.34E-5	<1.87E-5
Total for period	Ci	N/A	N/A	7.11E-6	7.95E-6

Note: The < symbol used in this table means the numerical value is less than the lower limit of detection (LLD). The LLD for unidentified isotopes is the LLD for Cesium-137. The LLD for Cesium-137 is the upper limit for gamma emitting nuclides that were not detected and are not included in the total value calculations.

### III. SOLID RADIOACTIVE WASTE

Table 5 summarizes the shipments of solid radioactive waste made during the report period. The volume reported is the 'as-buried' quantity.

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**TABLE 5**

### SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

#### A. Solid Waste Shipped Offsite For Burial Or Disposal

1. Type of Waste	Unit	First Half	Second Half	Est. Total Error, %
a. Spent resins, filter sludges, evaporator bottoms, etc.	Cubic Meter	None	None	N/A
	Ci	N/A	N/A	N/A
b. Dry compressible waste, contaminated equipment, etc.	Cubic Meter	7.94E-1	None	2.00E0
	Ci	2.02E-5	N/A	5.60E1
c. Irradiated components, control rods, etc.	Cubic Meter	None	None	N/A
	Ci	N/A	N/A	N/A
d. Other (dewatered sludge)	Cubic Meter	None	2.63E1	2.00E0
	Ci	N/A	1.31E-4	5.60E1

2. Estimate of major nuclide composition (by type of waste)	Nuclide	Unit	First Half	Second Half
b. Dry compressible waste, contaminated equipment, etc.	H-3	%	1.93E1	N/A
	Fe-55	%	3.24E1	N/A
	Co-60	%	1.26E1	N/A
	Ni-63	%	1.37E1	N/A
	Sr-90	%	1.48E0	N/A
	Cs-137	%	1.50E1	N/A
	Pu-241	%	5.45E0	N/A
d. Other (dewatered sludge)	H-3	%	N/A	9.80E1
	Fe-55	%	N/A	2.72E0
	Co-60	%	N/A	1.09E-1
	Ni-63	%	N/A	1.21E-1
	Sr-90	%	N/A	1.06E-1
	Cs-137	%	N/A	1.06E0
	Pu-241	%	N/A	3.78E-1

3. Solid Waste Disposition	Period	Number of Shipments	Mode of Transportation	Destination
	First Half	1	Truck	Barnwell, SC
	Second Half	2	Truck	Clive, UT



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TABLE 5 - Continued

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

B. Irradiated Fuel Shipments

1. Irradiated Fuel Disposition	Period	Number of Shipments	Mode of Transportation	Destination
	First Half	None	N/A	N/A
	Second Half	None	N/A	N/A

#### IV. RADIOLOGICAL IMPACT ON MAN

A comparison of calculated doses from various paths has shown that the offsite doses are primarily due to direct radiation and to the consumption of aquatic foods. Maximum doses to individuals (for the maximally exposed organs and age groups) are summarized in Table 6. These doses comply with 40 CFR 190 as there are no other uranium fuel cycle facilities within 8 km of the Humboldt Bay Power Plant.

- A. Doses to the average individual in the population from all receiving-water-related pathways were calculated for releases, based on the guidance of Regulatory Guide 1.109. The results were 0.002 mrem/yr (total body) for the Adult age group, and 0.004 mrem/yr for the bone of the Child age group.

These doses are well below the 10 CFR 50, Appendix I numerical guidelines for limiting effluents as low as is reasonably achievable (ALARA) (3 mrem/yr to the total body and 10 mrem/yr to any organ).

- B. Total body doses to the average individual in the population from gaseous effluents to a distance of 50 miles from the site are not calculated, but this dose is less than the total body dose to an average individual present at the maximally exposed location. For an average individual at the maximally exposed location, the total body dose (calculated with the same dispersion and deposition parameters as were used to calculate maximum exposure) was less than 0.001 mrem/yr.

This maximum calculated dose is well below the 10 CFR 50, Appendix I numerical ALARA guidelines (10 mrad/yr for gamma radiation and 20 mrem/yr for beta radiation from noble gases and <15 mrem/yr to any organ from tritium and radionuclides in particulate form).

- C. Total body doses (to the average individual in unrestricted areas from direct radiation from the facility) are based on TLD results of stations at the site boundary, using the shoreline occupancy factors given in Regulatory Guide 1.109 for the highest average potential individual (Teen age group). For this group, direct radiation would result in an exposure of 0.014 mrem/yr.

This maximum potential dose is well below the 10 CFR 20.1302(b)(2)(ii) limit of 50 mrem/yr from external sources necessary to demonstrate compliance with the 10 CFR 20.1301 dose limit for individual members of the public.

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**TABLE 6**

### RADIATION DOSE FOR MAXIMALLY EXPOSED INDIVIDUALS

Dose Source	Annual Dose, milli-rem (8)				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Average
<b>Liquid Effluents</b>					
Water-related Pathways (1)	0.01(5)	0.01(5)	0.01(5)	0.01(5)	0.01(5)
	0.01(6)	0.02(6)	0.01(6)	0.01(6)	0.01(6)
<b>Airborne Effluents</b>					
Particulates (2)	<0.01(7)	<0.01(7)	0.01(7)	0.01(7)	<0.01(7)
	<0.01(6)	<0.01(6)	0.02(6)	0.03(6)	0.02(6)
Noble Gases (3)	-	-	-	-	-
Direct Radiation (4)	0.04	<0.01	<0.01	0.03	0.02

#### Notes

1. Maximum total body and organ doses to individuals in unrestricted areas from receiving-water-related exposure pathways were calculated from the average concentrations of liquid releases detected during the report period, following the applicable portions of Regulatory Guide 1.109.
2. Maximum total body and organ doses to individuals in unrestricted areas from airborne-particulate-related exposure pathways were calculated from the average concentrations of airborne particulate releases detected during the report period, following the applicable portions of Regulatory Guide 1.109.
3. Total body and skin doses to potentially exposed individuals located at the point of maximum offsite ground-level concentrations of radioactive gaseous effluents were not calculated because there were no detected releases of radioactive noble gases, and because the doses would be less than 0.005 milli-rem/yr at the level at which the releases could be detected.
4. Total body doses (to the maximum individual in the population) are based on TLD results of stations at the site boundary, using the shoreline occupancy factors of Regulatory Guide 1.109 for the maximum potential individual (Teen age group).
5. Total body (Adult age group).
6. Bone (Child age group).
7. Total body (Child age group).
8. The dose shown for each quarter is calculated on an annual basis for four identical quarters.