



Portland General Electric Company

Stephen M. Quennoz
Trojan Site Executive

April 17, 1997

VPN-027-97

Trojan Nuclear Plant
Docket 50-344
License NPF-1

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Dear Sirs:

PGE-1006-96, Trojan Nuclear Plant Annual Radiological Environmental Monitoring Report for 1996

This letter transmits Portland General Electric Company's Trojan Nuclear Plant Annual Radiological Environmental Monitoring Report for the calendar year 1996. This report is submitted in accordance with Trojan Permanently Defueled Technical Specification (PDTS) 5.8.1.2 and Sections IV.B.2, IV.B.3, and IV.C of Appendix I to Title 10 CFR 50.

Sincerely,

Stephen M. Quennoz
Trojan Site Executive

Enclosure

c: R. A. Scarano, NRC Region IV
M. T. Masnik, NRC, NRR
D. Stewart-Smith, ODOE

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PDR ADOCK 05000344
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Portland General Electric Company

HRP-032-97

To: Distribution
From: H. R. Pate *H. R. Pate*
Date: April 17, 1997
Subject: Transmittal of PGE-1006-96,
Trojan Nuclear Plant Annual Radiological Environmental Monitoring Report for 1996

Enclosed is your copy of PGE-1006-96, Trojan Nuclear Plant Annual Radiological Environmental Monitoring Report for 1996.

Please acknowledge receipt of your copy by completing the lower portion of this transmittal and returning it to the location given below.

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Enclosure

4/17/97

ACKNOWLEDGMENT

PGE-1006-96
Trojan Nuclear Plant Annual Radiological Environmental Monitoring Report for 1996

I hereby acknowledge receipt of Controlled Copy Number(s) _____ of the subject document. All pages have been made in accordance with the instructions, and superseded pages have been destroyed.

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Date

Delivered to:
Pat Schaffran, TCB-3/Licensing
Trojan Nuclear Plant
71760 Columbia River Highway
Rainier, Oregon 97048



Portland General Electric Company

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Return to: Pat Schaffran, TCB-3/Licensing
Trojan Nuclear Plant
71760 Columbia River Highway
Rainier, Oregon 97048

Trojan Nuclear Plant

Radiological Environmental Monitoring Report
for Calendar Year 1996

PORTLAND GENERAL ELECTRIC COMPANY

PGE-1006-96

TROJAN NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT

January through December 1996

April 1997

Prepared by

PORTLAND GENERAL ELECTRIC COMPANY

With Analyses By

Thermo NUtech

ALBUQUERQUE, NEW MEXICO

TROJAN NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT

TABLE OF CONTENTS

Section	Title	Page
	TABLE OF CONTENTS	-i-
	LIST OF TABLES	-iii-
	LIST OF FIGURES	-iv-
	ABSTRACT	-v-
1.0	INTRODUCTION	1-1
2.0	SAMPLING AND PROGRAM PROCEDURES	2-1
2.1	SAMPLING LOCATIONS	2-1
2.2	SAMPLING PROCEDURES	2-1
	2.2.1 Air Particulate	2-1
	2.2.2 Ambient Radiation Measurements Using TLDs	2-1
	2.2.3 Well Water	2-2
	2.2.4 Drinking Water	2-2
	2.2.5 Shoreline Soil	2-2
3.0	ANALYTICAL PROCEDURES AND COUNTING METHODS	3-1
3.1	ANALYTICAL DETECTION LIMITS AND UNCERTAINTY	3-1
3.2	AIR PARTICULATES	3-1
3.3	DRINKING AND WELL WATER	3-1
3.4	SHORELINE SOIL	3-2
3.5	AMBIENT RADIATION MEASUREMENTS	3-2
3.6	QUALITY CONTROL	3-2
3.7	REFERENCES FOR ANALYTICAL PROCEDURES	3-2

TROJAN NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT

TABLE OF CONTENTS

Section	Title	Page
4.0	RESULTS AND DISCUSSION	4-1
4.1	SAMPLES FROM THE TERRESTRIAL ENVIRONMENT	4-1
	4.1.1 Air Particulates	4-1
	4.1.2 Well Water	4-1
	4.1.3 Ambient Radiation Levels	4-1
4.2	SAMPLES FROM THE AQUATIC ENVIRONMENT	4-2
	4.2.1 Drinking Water Samples	4-2
	4.2.2 Shoreline Soil	4-2
4.3	SUMMARY OF RESULTS	4-3
5.0	COMMENTS ON AND TERMS USED IN DATA TABLES	5-1

TROJAN NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT

LIST OF TABLES

Number	Title
2-1	Sampling Locations and Frequency by Type
3-1	Program Analyses and Reported Detection Levels
3-2	1996 EPA and DOE Interlaboratory Comparison Program Results
3-3	1996 Quality Control Analyses Summary
4-1	Average Gross Beta Concentrations for Air Particulates
4-2	Average Ambient Gamma Radiation Levels
4-3	Average Gross Beta Concentrations for Drinking Water from Columbia River
4-4	Radiological Environmental Monitoring Program Summary
5-1	Gross Beta in Air Particulate Filters
5-2	Summary - Gross Beta in Air Samples
5-3	Gamma Emitters: Concentrations in Air Particulate Filters
5-4	Radioactivity in Well Water
5-5	Ambient Gamma Radiation Levels
5-6	Radioactivity in Drinking Water
5-7	Radioactivity in Shoreline Soil

TROJAN NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT

LIST OF FIGURES

Number

Title

2-1 Sampling Locations

ABSTRACT

This report presents the data obtained through the analyses of environmental samples collected through the Portland General Electric Trojan Nuclear Plant Radiological Environmental Monitoring Program for the period January 1, 1996, through December 31, 1996.

Most of the radionuclide analyses on the environmental samples resulted in non-detectable values for radionuclides that could be released from the Trojan Nuclear Plant. In no case did radioactivity that could be attributed to the Trojan Nuclear Plant exceed the Reporting Levels of the Offsite Dose Calculation Manual for Trojan.

1.0 INTRODUCTION

The Trojan Nuclear Plant, a 1130 megawatt-electric pressurized water reactor, first achieved criticality on December 15, 1975. On January 27, 1993, Portland General Electric decided to permanently shut down the Trojan Nuclear Plant. This report presents the analytical data from the Radiological Environmental Monitoring Program with appropriate interpretation for 1996.

The analytical contractor during this period has been Thermo NUtech, Albuquerque, New Mexico. In comparing data obtained during this period with those from previous periods, care should be taken to ensure that differences in procedures among the contractors are considered.

Information concerning the Radiological Environmental Monitoring Program prior to this period may be found in earlier reports.

2.0 SAMPLING AND PROGRAM PROCEDURES

2.1 SAMPLING LOCATIONS

Fifteen (15) sampling locations were used in the Radiological Environmental Monitoring Program from January 1, 1996, through December 31, 1996. These sampling locations are shown in Figure 2-1. Table 2-1 includes a listing of the sites, their distance from Trojan, and the type and frequency of sample collection.

During 1994 a review of the environmental sample results from 1977 through 1993 was conducted. In general, the review confirmed that radioactivity attributable to Trojan Nuclear Plant during power operations was not detected in the environmental samples. Therefore, since the production of radioactivity had ceased when the reactor was permanently shut down, and from that point forward, the radioactivity in both liquid and gaseous effluents continued to decrease, it was evident that the environmental sampling requirements could be reduced. Therefore, revisions to the Radiological Environmental Monitoring Program were submitted to the Oregon Department of Energy (ODOE) on September 22, 1994, for approval. The revisions to the program were approved on December 12, 1994.

2.2 SAMPLING PROCEDURES

2.2.1 AIR PARTICULATE

Air particulate sampling was performed weekly. The samples were gathered with a low-volume air sampling device which is designed to draw a constant flow rate regardless of the pressure drop across the filter. The sampling devices were set to maintain one cfm. The sample pump, metering devices, and timer were in a weatherproof housing. The filter was located in a sample housing that is connected to an air inlet about one meter above the ground. Glass fiber filters were used to collect particulate matter.

The glass fiber filter was removed from the air sampler and placed in a two-inch plastic petri dish. Air flow readings and other data required to compute the levels of radioactivity were recorded and submitted to the analysis laboratory along with the samples.

2.2.2 AMBIENT RADIATION MEASUREMENTS USING TLDs

Thermoluminescent dosimeters (TLDs) were placed for field exposure and collected on a quarterly frequency. The TLDs were placed about 1 meter above ground level in plastic containers. The time of collection, the exposure period, and any abnormal conditions such as moisture in the holders, damage done by animals, etc., were recorded when the TLDs were retrieved. Care was taken to minimize exposure to the TLDs between collection and delivery to the laboratory. Trip TLDs were carried with the field TLDs during transport to and from the field.

2.2.3 WELL WATER

Well water was collected quarterly from the tap that leads off the pump. The line was purged for about five minutes prior to collection. Sixty milliliters were drawn from the one-gallon sample for tritium analysis. The remainder of the sample was put in a one-gallon polyethylene bottle and acidified with concentrated HCl. The bottles were securely sealed and labeled, and collection data forms were prepared specifying site, date collected, volume, and sample type.

2.2.4 DRINKING WATER

Four-week composite samples of municipal drinking water were collected for Rainier (Sample Location 8) and St. Helens (Sample Location 9) at their respective intake structures on the Columbia River. Rainier is downstream of the Trojan Nuclear Plant while St. Helens is upstream. At each location, a compositing sampler took a sample every two hours and aliquots of this four-week composite were sent for analysis. From these aliquots, 60 milliliters are sent for tritium analysis and two one-gallon polyethylene bottles are acidified with concentrated HCl and sent for the other analyses. The bottles were securely sealed and labeled, and collection data forms were prepared specifying site, date collected, volume, and sample type.

2.2.5 SHORELINE SOIL

Shoreline soil samples of about one quart in volume were taken twice a year. The samples were taken from a one square foot area at a depth of between one and four inches. Vegetation and large rocks were removed from the sample before it was placed in a plastic container. The containers were securely sealed and labeled. The sample site identification number, date collected, and volume obtained were recorded on the collection data forms.

TABLE 2-1

Sheet 1 of 2

SAMPLING LOCATIONS AND FREQUENCY BY TYPE

Sample Location	Radial		Sample				
	Distance (meters)	Direction	TLD	Air Particulate	Well Water	Surface Water	Shore Soil
1 - Trojan North Building	300	WNW	Q				
2 - NW Fenceline	210	NW	Q				
3 - N Fenceline	191	N	Q				
4 - Switchyard	191	WSW	Q				
5 - Training Building	354	SW	Q				
6 - Park Entrance	354	SSW	Q				
7 - South End Cooling Tower	327	SE	Q				
8 - Rainier	6,115	NW	Q			MC	
9 - St. Helens (Municipal Water Supply)	16,898	SSE	Q			MC	
10- Columbia River	116,510*	E					S/A
11- Prescott Water Supply	1,287	NNW			Q		
12- Meteorology Tower	805	S		W			
13- N Site Boundary at Columbia River	161	NNW	Q	W			
14- S Site Boundary	1,332	S	Q				

TABLE 2-1

Sheet 2 of 2

SAMPLING LOCATIONS AND FREQUENCY BY TYPE

Sample Location	Radial		Sample				
	Distance (meters)	Direction	TLD	Air Particulate	Well Water	Surface Water	Shore Soil
15- E Fenceline	93	E	Q				

LEGEND:

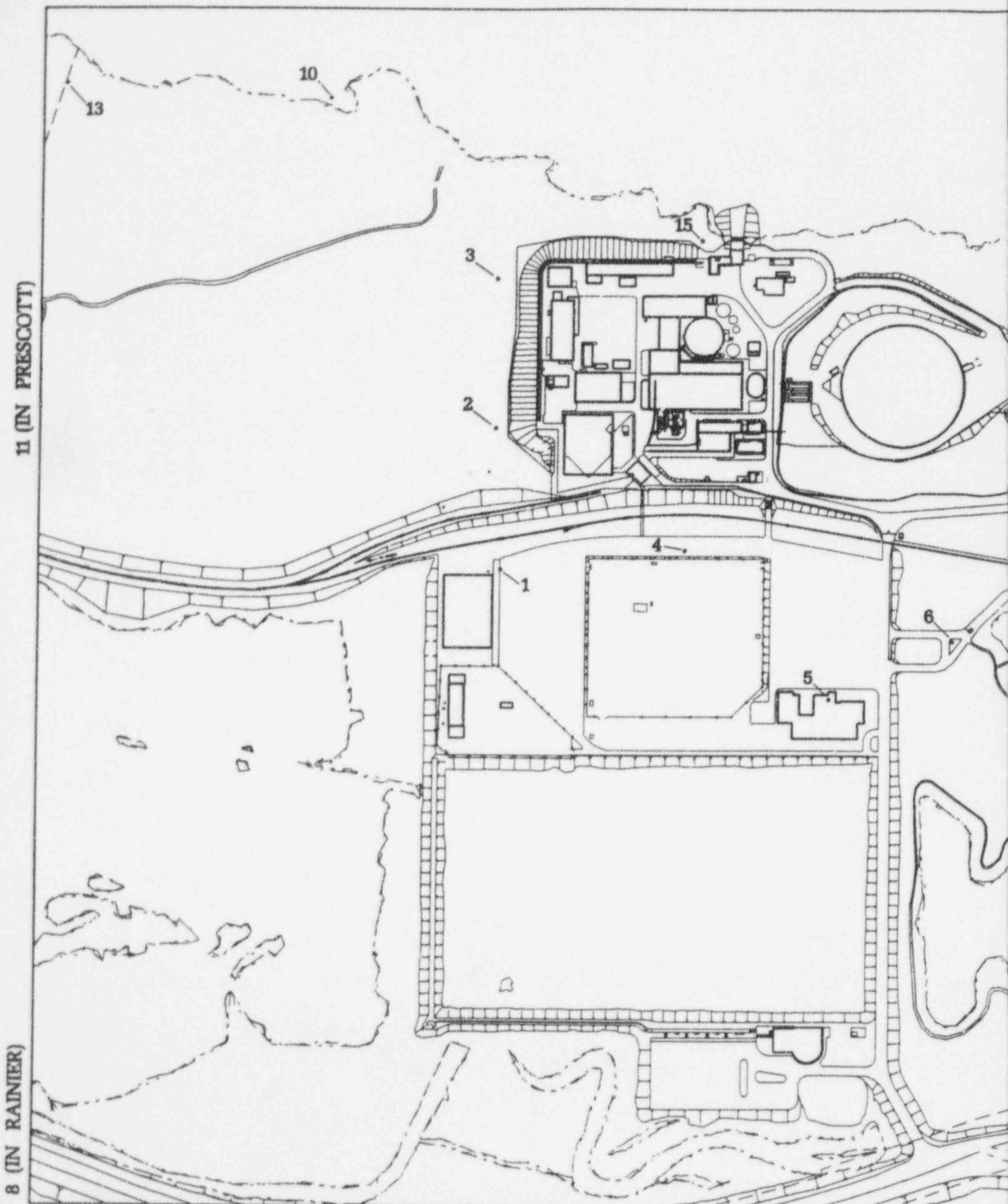
W - Weekly.

MC - Monthly Composite.

Q - Quarterly.

S/A- Semi-Annually.

* - Columbia River Distance refers to meters measured from mouth.



TROJAN NUCLEAR

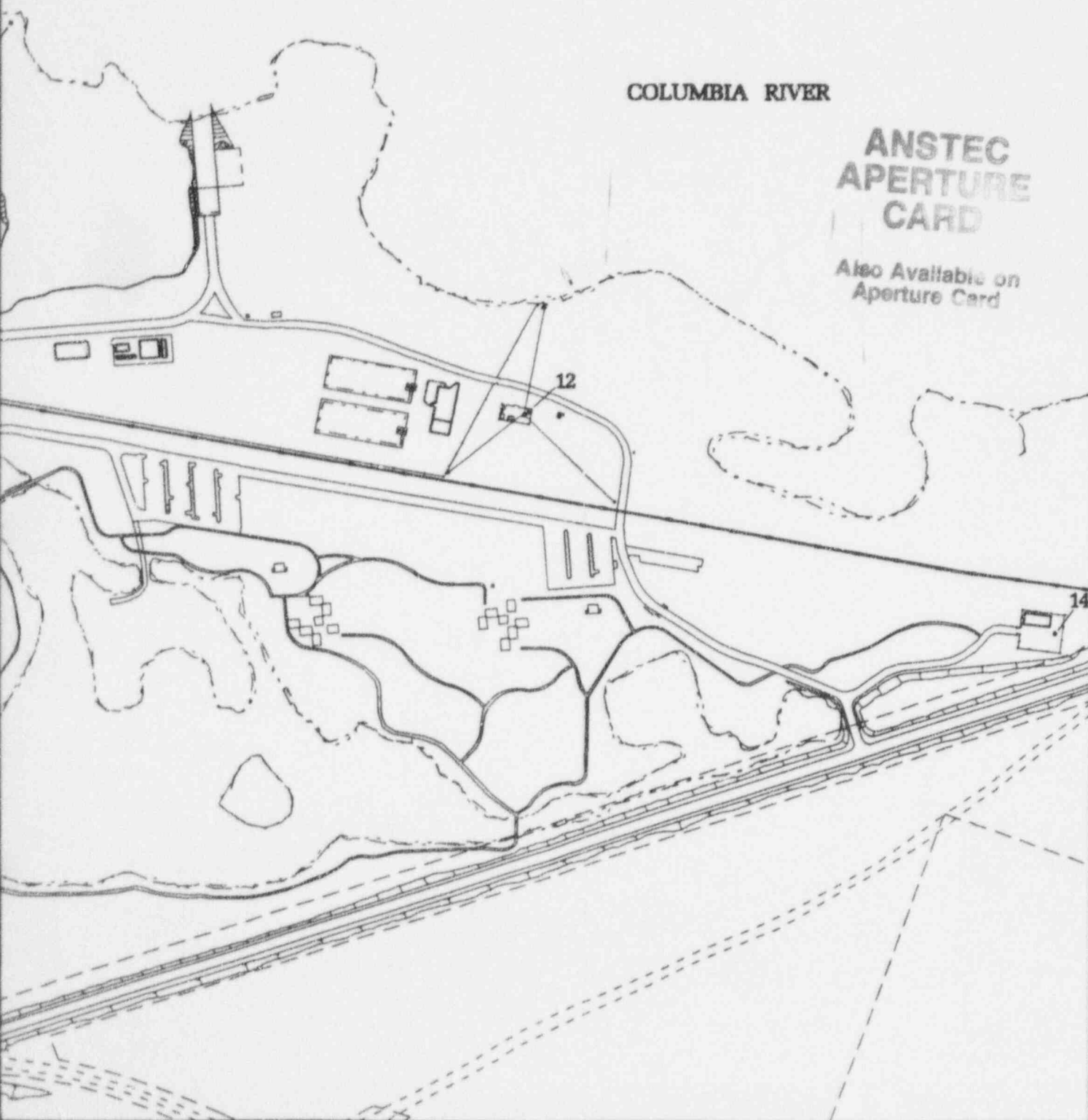
FIGURE 2-1 SAMPLING



COLUMBIA RIVER

ANSTEC
APERTURE
CARD

Also Available on
Aperture Card



9 (IN ST. HELENS)

PLANT

LOCATIONS

9704240194 - 01

3.0 ANALYTICAL PROCEDURES AND COUNTING METHODS

Samples are analyzed for the various radioactive components by standard radiochemical methods. These methods are equal to, and in most cases, identical with, those of the U. S. Department of Energy [Health and Safety Laboratory (HASL) Procedures Manual, HASL-300, see references, Section 3.7], or those of the U. S. Environmental Protection Agency (EPA).

Analyses of individual sample types, general methods, and routine analytical sensitivities are discussed below. The analytical program and sensitivity requirements are given in Table 3-1.

3.1 ANALYTICAL DETECTION LIMITS AND UNCERTAINTY

In environmental radiological analyses the dominant known uncertainty is usually the sample count rate. This uncertainty is calculated by standard methods (HASL-300), and is reported at the 95 percent confidence level (2σ). The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that will yield a net indication, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a real signal. Analytical data for samples for which concentrations are less than or equal to the LLD are preceded by the symbol "<" unless otherwise specified.

3.2 AIR PARTICULATES

Gross beta concentrations are measured with low background, window-type (0.85 mg/cm^2 in thickness), proportional counting systems. The LLD for gross beta measurements is less than or equal to 0.01 pCi/m^3 assuming a collected air volume of $285 \text{ m}^3/\text{week}$.

Gamma isotopic analyses are performed with germanium detectors. The LLD requirements for gamma scans are given in Table 3-1.

3.3 DRINKING AND WELL WATER

Gross beta analysis of water samples is performed by evaporation of a measured aliquot of the sample, digestion, plancheting of the processed sample and radiometric assay by the low-background beta counters mentioned in Section 3.2, with an LLD of 1 pCi/liter . Tritium analysis is performed on water samples to the required LLD of 1000 pCi/liter by liquid scintillation counting. Gamma isotopic analysis is performed using germanium detectors. The LLD requirements for gamma scans are given in Table 3-1.

3.4 SHORELINE SOIL

Samples are oven-dried and results reported based on dry weight. Gamma emitters are measured with germanium detectors. The LLD requirements for gamma scan are given in Table 3-1.

3.5 AMBIENT RADIATION MEASUREMENTS

Quarterly ambient gamma radiation measurements were made using TLDs supplied by a vendor. Each environmental dosimeter is composed of two $\text{CaF}_2\text{:Dy}$ (TLD-200) elements and two LiF:Mg,Ti (TLD-100) elements, all of which are 0.035 inches thick. The $\text{CaF}_2\text{:Dy}$ elements are shielded by 80 mg/cm^2 ABS plastic, 0.010 inches of tantalum and 0.002 inches of lead. The LiF:Mg,Ti elements are shielded by 80 mg/cm^2 ABS plastic only.

Environmental dosimeters retrieved from the field are sent to the vendor for processing on a quarterly basis.

3.6 QUALITY CONTROL

A large number of the analyses performed by the analysis laboratory are for quality control purposes. The analysis laboratory participates in Environmental Protection Agency (EPA) and Department of Energy (DOE) interlaboratory comparison programs for environmental measurements. Reports of quality control analyses are presented monthly to PGE.

Results of EPA and DOE interlaboratory comparisons for 1996 are given in Table 3-2. In those cases where the laboratory failed the performance evaluation study, the laboratory performs an investigation to determine the cause and corrective action as required. Table 3-3 summarizes the spiked sample results for the year 1996.

3.7 REFERENCES FOR ANALYTICAL PROCEDURES

1. American Public Health Association, American Water Works Association and Water Pollution Control Federation (1971): Standard Methods for the Examination of Water and Wastewater. Thirteenth edition, pp 583-632; 12th edition, pp 325-352. APHA, 1740 Broadway, New York, NY 10019.
2. Department of Health, Education and Welfare, Public Health Service: Radioassay Procedures for Environmental Samples. National Center for Radiological Health (1967), Sec. 1, pp 36-115.
3. Atomic Energy Commission: Regulatory Guide 4.3 (September 1973).

4. Health and Safety Laboratory, Atomic Energy Commission: HASL Procedures Manual (now known as EML of the Department of Energy). HASL, 376 Hudson Street, New York, NY 10014.
5. National Environmental Research Center, Environmental Protection Agency; Handbook of Radiochemical Analytical Methods. Program Element 1HA 325. Office of Research and Development, Las Vegas, NV 89114.

TABLE 3-1

PROGRAM ANALYSES AND REPORTED DETECTION LEVELS

<u>Program Analysis</u>	<u>Reported Detection Limits (LLD)^[a]</u>
Air Particulate-gross beta	0.01 pCi/m ³
Air Particulate-gamma scan	0.05 pCi/m ³ Cs-134 0.06 pCi/m ³ Cs-137
Water-gross beta	1 pCi/liter
Water-tritium	1000 pCi/liter
Water-gamma scan	15 pCi/liter Mn-54 15 pCi/liter Co-58 15 pCi/liter Co-60 30 pCi/liter Zn-65 30 pCi/liter Zr-95 15 pCi/liter Nb-95 15 pCi/liter Cs-134 18 pCi/liter Cs-137
Shoreline Soil-gamma scan (dry)	0.15 pCi/g Cs-134 0.18 pCi/g Cs-137
Direct Radiation	0.04 mR/day or less

^[a]Reported detection level or LLD is defined in Section 3.1

TABLE 3-2

Sheet 1 of 2

1996 EPA AND DOE INTERLABORATORY COMPARISON PROGRAM RESULTS

Sample Type	Analysis	Study Date	EPA Value pCi/l	TNU/A Value pCi/l	Deviation (known)	
Water	Beta	January 96	7.0 ± 5.0	9.3 ± 0.1	0.79	Pass
Water	H-3	March 96	22002 ± 2200	19797 ± 146	-1.74	Pass
Water	Beta	April 96	167 ± 25	160 ± 1	-0.51	Pass
Water	Co-60	April 96	31.0 ± 5.0	32.0 ± 0.0	0.35	Pass
Water	Cs-134	April 96	46.0 ± 5.0	48.0 ± 1.0	0.69	Pass
Water	Cs-137	April 96	50.0 ± 5.0	51.3 ± 0.3	0.46	Pass
Water	Co-60	June 96	99.0 ± 5.0	89.3 ± 3.1	-3.35	Fail ¹
Water	Zn-65	June 96	300 ± 30	292 ± 7.0	-0.46	Pass
Water	Cs-134	June 96	79.0 ± 5.0	77.7 ± 2.1	-0.46	Pass
Water	Cs-137	June 96	197 ± 10	195 ± 2.0	-0.35	Pass
Water	Ba-133	June 96	745 ± 75	635 ± 1	-2.54	Pass
Water	Beta	July 96	44.8 ± 5.0	36.0 ± 2.1	-3.06	Fail ²
Water	H-3	August 96	10879 ± 1088	9573 ± 199	-2.08	Pass
Water	Beta	October 96	34.6 ± 5.0	29.4 ± 2.1	-1.81	Pass
Water	Beta	October 96	111.8 ± 16.8	107.5 ± 0.4	-0.44	Pass
Water	Co-60	October 96	15.0 ± 5.0	14.0 ± 1.0	-0.35	Pass
Water	Cs-134	October 96	20.0 ± 5.0	20.3 ± 0.6	0.12	Pass
Water	Cs-137	October 96	30.0 ± 5.0	30.0 ± 0.0	0.00	Pass
Water	Co-60	November 96	44.0 ± 5.0	41.7 ± 3.2	-0.81	Pass
Water	Zn-65	November 96	35.0 ± 5.0	38.0 ± 1.7	1.04	Pass
Water	Cs-134	November 96	11.0 ± 5.0	12.7 ± 0.6	0.58	Pass
Water	Cs-137	November 96	19.0 ± 5.0	19.7 ± 1.5	0.23	Pass
Water	Ba-133	November 96	64.0 ± 6.0	65.0 ± 1.0	0.29	Pass

¹ Assignable cause of problem: possible counting system bias. Corrective action: recount sample on all detectors. Results: passed performance evaluation. Subsequent performance evaluations for Co-60 in water samples were acceptable.

² Assignable cause of problem: poor precision of method. Corrective action: recount sample. Results: passed performance evaluation. Subsequent performance evaluation for gross beta in water samples were acceptable.

TABLE 3-2

Sheet 2 of 2

1996 EPA AND DOE INTERLABORATORY COMPARISON PROGRAM RESULTS

Sample Type	Analysis	Study Date	DOE Value pCi/Filter	TNU/A Value pCi/filter	Ratio	
Filter	Ce-144	April 96	900.0 \pm 89.2	694.6 \pm 24.3	0.77	Pass
Filter	Co-57	April 96	240.5 \pm 24.3	198.4 \pm 6.4	0.82	Pass
Filter	Co-60	April 96	797.3 \pm 78.6	718.9 \pm 22.4	0.90	Pass
Filter	Cs-134	April 96	397.3 \pm 39.5	373.0 \pm 11.8	0.94	Pass
Filter	Cs-137	April 96	179.5 \pm 18.9	162.7 \pm 9.7	0.91	Pass
Filter	Mn-54	April 96	93.0 \pm 10.3	75.4 \pm 5.1	0.81	Pass
Filter	Ru-106	April 96	313.5 \pm 38.9	308.1 \pm 30.5	0.98	Pass
Filter	Sb-125	April 96	264.3 \pm 27.8	261.1 \pm 12.8	0.99	Pass
Filter	Beta	April 96	47.8 \pm 4.1	41.6 \pm 3.2	0.87	Pass
Filter	Co-57	October 96	400.0 \pm 22.0	459.5 \pm 13.9	1.15	Pass
Filter	Co-60	October 96	233.5 \pm 11.6	264.1 \pm 9.6	1.13	Pass
Filter	Cs-134	October 96	291.9 \pm 10.6	337.8 \pm 10.9	1.16	Pass
Filter	Cs-137	October 96	230.3 \pm 9.9	257.0 \pm 9.1	1.12	Pass
Filter	Mn-54	October 96	171.6 \pm 7.3	205.1 \pm 8.0	1.20	Pass
Filter	Ru-106	October 96	291.9 \pm 30.8	335.1 \pm 35.9	1.15	Pass
Filter	Sb-125	October 96	291.9 \pm 14.6	135.1 \pm 10.0	0.46	Fail ³
Filter	Beta	October 96	13.5 \pm 1.4	16.0 \pm 2.4	1.19	Pass

Sample Type	Analysis	Study Date	DOE Value pCi/g	TNU/A Value pCi/g	Ratio	
Soil	Cs-137	April 96	9.7 \pm 0.3	11.2 \pm 0.4	1.15	Pass
Soil	K-40	April 96	12.6 \pm 0.8	11.9 \pm 1.3	0.94	Pass
Soil	Cs-137	October 96	41.9 \pm 0.6	39.2 \pm 1.2	0.94	Pass
Soil	K-40	October 96	8.1 \pm 0.7	8.2 \pm 0.8	1.01	Pass

3

Assignable cause of problem: loss of Sb-125 by volatilization during dissolution. Corrective action: add 0.1g of potassium chloride to sample prior to addition of HNO₃ and HCl. Monitor sample heat.

TABLE 3-3

1996 QUALITY CONTROL ANALYSES SUMMARY

The table below summarizes results of samples run for process quality control purposes during the subject year. These listings are in addition to such measurements as detector backgrounds, check source values, radiometric-gravimetric comparisons, system calibrations, etc. Detailed listings of each measurement are maintained at the analysis laboratory and are available for inspection if required.

Spiked Samples

Nuclide Analyzed	Number of Determs.	Within 2 Sigma of Known	Between 2-3 Sigma of Known
Alpha	62	57	5
Beta	81	76	5
H-3	37	36	1
Sr-90	8	8	0
Tc-99	12	10	2
Cs-137	81	81	0
Po-210	1	1	0
Ra-226	31	28	3
Ra-228	12	11	1
Th-228	49	41	8
Th-230	49	44	5
Th-232	49	45	4
U-234	33	33	0
U-235	33	29	4
U-238	33	29	4
Pu-238	7	6	1
Pu-239	20	17	3
Am-241	3	3	0
Uranium	69	69	0

4.0 RESULTS AND DISCUSSION

4.1 SAMPLES FROM THE TERRESTRIAL ENVIRONMENT

4.1.1 AIR PARTICULATES

The gross beta air particulate data obtained during 1996 were comparable to the data obtained during the years of 1982, 1983, 1984, 1985, 1986 (except May 1986), 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, and the preoperational period. Gross beta concentrations for air particulates for sampling periods in 1996 remained generally at low levels.

Average concentrations with their average standard deviations for the years 1996 and before are presented in Table 4-1 for both onsite and offsite locations. Due to revisions of the Radiological Environmental Monitoring Program, air samples were only collected at onsite locations during 1996.

In October 1980, the People's Republic of China tested a nuclear device in the atmosphere. For this reason, the increased average concentrations in 1981 were due to increased fallout levels from the October 1980 Chinese test and not from operation of the Trojan Nuclear Plant. The larger average standard deviation for the 1986 data was due to the increased gross beta activity for May 1986 resulting from the Chernobyl reactor accident near Kiev, Ukraine.

For 1996, the measurement of gamma emitting radionuclides in quarterly composites of air particulate filters resulted in no detectable activity.

Data for these air monitoring samples are listed in Chapter 5, Tables 5-1, 5-2, and 5-3.

4.1.2 WELL WATER

Well water samples were collected on a quarterly basis. Tritium levels were below the sensitivity requirements of the program. Gamma emitting radionuclides were not detected in well water samples. The data are presented in Chapter 5, Table 5-4.

4.1.3 AMBIENT RADIATION LEVELS

Gamma radiation levels (mR/day) for dosimeter measurements at locations in the environs around the Trojan Nuclear Plant are shown in Chapter 5, Table 5-5.

The elevated radiation levels from Location 15 were due to radioactivity contained in the refueling water storage tank (RWST) and radioactive materials stored in outside areas of the

Restricted Area during 1996. The dosimeter at this location is on the Industrial Area fence, which is immediately adjacent to Trojan's Restricted Area boundary. The elevated radiation levels were limited to a section of the East Industrial Area fence. This area is on a bluff that overlooks the Restricted Area and is also in direct line of sight with the RWST.

All of the other dosimeter measurements obtained within the Controlled Area showed no increase in ambient radiation levels. Therefore, the measurements from Location 15 were not included in the determination of the onsite mean ambient radiation level used for comparison with the mean ambient radiation level for the control locations. However, the increase in the radiation levels was evaluated by performing a dose assessment for a member of the public present in the area adjacent to the East Industrial Area fence. This dose assessment has been included in Trojan's Annual Radiological Effluent Release Report for 1996.

The mean and standard deviation for the Trojan onsite measurements was 0.09 ± 0.02 mR/day. This is less than, but not significantly different from, the mean and standard deviation of 0.11 ± 0.02 mR/day for the control locations.

4.2 SAMPLES FROM THE AQUATIC ENVIRONMENT

4.2.1 DRINKING WATER SAMPLES

Composited drinking water samples were collected from municipal water supply locations on the Columbia River that are downstream (Sample Location 8) and upstream (Sample Location 9) of the Trojan site. The samples were analyzed monthly for gross beta activity, tritium, and gamma emitters. The data are presented in Chapter 5, Table 5-6.

No radioactivity attributable to operation of the Trojan Nuclear Plant was detected in any of the water samples.

Table 4-3 presents the annual average of the gross beta activity for the two water sample sites from 1980 through 1996. These samples were not collected prior to 1980. The annual average values do not differ significantly over the years.

4.2.2 SHORELINE SOIL

Shoreline soil samples were collected from a location on the bank of the Columbia River near the Trojan site. Analyses were performed for gamma emitters. The data are presented in Chapter 5, Table 5-7. None of the shoreline soil samples showed detectable levels of gamma emitters.

4.3 SUMMARY OF RESULTS

Table 4-4 presents a summary of the radioactivity analysis results for each medium or pathway sampled during 1996 for the Radiological Environmental Monitoring Program. The format of Table 4-4 is that which is required by ODCM Control 5.1.1.

A review of Table 4-4 shows that none of the radioactivity measurements, averaged over a quarter year period, were larger than the Reporting Levels defined by ODCM Control 3.3.1.

Air particulate samples were collected from two onsite locations during 1996. Location 13 is at the North site boundary and Location 12 is South of the plant at the meteorology tower. The gross beta annual mean concentrations of 0.021 ± 0.008 pCi/m³ for Location 13 and 0.019 ± 0.008 pCi/m³ for Location 12 were both less than, but not significantly different from, the five year (1990-1994) mean concentration of 0.025 ± 0.014 pCi/m³ for the control location.

For the ambient radiation measurements, the mean value for the control locations was not significantly different than the mean values for the Trojan onsite locations.

For the radioactivity measurements in drinking water, the annual mean for the gross beta determination was higher (though not significantly) for the upstream or control location (St. Helens) than it was for the downstream location (Rainier).

As is shown by Table 4-4, there is no indication that the operations of the Trojan Nuclear Plant had a radiological impact on the environs around the Plant.

TABLE 4-1

AVERAGE GROSS BETA CONCENTRATIONS
FOR AIR PARTICULATES
(10^{-2} pCi/m³)

<u>Year</u>	<u>Trojan Site</u>	<u>Oregon</u>	<u>Washington</u>
Preop	2±2	2±2	3±2
1976	2±6	3±8	2±4
1977	3±4	4±4	5±2
1978	2±2	2±1	2±1
1979	1±1	1±1	1±1
1980	3±4	3±4	2±4
1981	11±2	11±4	11±1
1982	2±5	2±7	2±6
1983	2±2	2±2	2±2
1984	2±2	2±2	2±2
1985	2±2	2±1	2±1
1986	3±7	3±6	3±7
1987	1±1	1±1	1±1
1988	1±1	1±1	1±1
1989	2±2	2±2	2±2
1990	2±1	2±1	2±1
1991	2±1	2±1	2±1
1992	2±1	2±1	2±1
1993	3±2	3±2	3±2
1994	3±2	3±1	3±1
1995	2±1	*	*
1996	2±1	*	*

* Due to revisions of the Radiological Environmental Monitoring Program, air samples are no longer collected at offsite locations.

TABLE 4-2

AVERAGE AMBIENT GAMMA RADIATION LEVELS
mR/Day

<u>Year</u>	<u>Trojan Site</u>	<u>Oregon</u>	<u>Washington</u>
1976	0.13	0.14	0.13
1977	0.13	0.15	0.14
1978	0.11	0.13	0.13
1979	0.11±0.02	0.14±0.02	0.13±0.03
1980	0.11±0.02	0.14±0.02	0.12±0.01
1981	0.11±0.03	0.14±0.02	0.12±0.02
1982	0.14±0.03	0.16±0.02	0.15±0.02
1983	0.12±0.02	0.14±0.02	0.13±0.01
1984	0.12±0.03	0.13±0.02	0.12±0.02
1985	0.12±0.03	0.14±0.02	0.12±0.02
1986	0.12±0.03	0.14±0.03	0.12±0.02
1987	0.13±0.03	0.15±0.03	0.12±0.02
1988	0.12±0.02	0.14±0.02	0.12±0.02
1989	0.11±0.02	0.14±0.02	0.12±0.02
1990	0.11±0.02	0.13±0.03	0.11±0.02
1991	0.11±0.02	0.13±0.02	0.13±0.02
1992	0.10±0.03	0.13±0.03	0.12±0.02
1993	0.10±0.03	0.12±0.03	0.10±0.03
1994	0.19±0.03	0.22±0.03	0.20±0.03
1995	0.08±0.02	0.11±0.01	*
1996	0.09±0.02	0.11±0.02	*

* Due to revisions of the Radiological Environmental Monitoring Program, ambient gamma radiation levels are no longer measured in the state of Washington.

TABLE 4-3

AVERAGE GROSS BETA CONCENTRATIONS
FOR DRINKING WATER FROM COLUMBIA RIVER
(Units: pCi/l)

<u>Year</u>	No. 8 -Rainier (Downstream)	No. 9 - St. Helens (Upstream)
1980	2±2	2±1
1981	2±1	3±1
1982	3±2	4±2
1983	3±2	4±2
1984	3±2	4±2
1985	3±2	4±1
1986	3±2	3±2
1987	3±2	4±1
1988	4±2	6±3
1989	3±2	4±2
1990	2±3	5±3
1991	3±3	1±2
1992	2±1	3±1
1993	2±1	3±1
1994	2±1	3±1
1995	2±0.4	3±1
1996	2±0.4	3±1

TABLE 4-4

Sheet 2 of 2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Trojan Nuclear Plant, Columbia County, Oregon, Docket 50-344, Reporting Period: January 1-December 31, 1996

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean(f) ^[a] Range	Location with Highest Annual Mean		Control Locations	
				Name, Distance, and Direction	Mean(f) ^[a] Range	Mean(f) ^[a] Range	Number of Reportable Events
Ambient Radiation (mR/day)	γ -exposure-43	0.04	0.09(35/35) 0.05-0.16	6 - Park Entrance - 354 Meters SSW	0.10(4/4) 0.09-0.12	0.11(8/8) 0.09-0.15	N/A ^[b]
Drinking Water (pCi/liter)	Gross β -26	1	1.5(7/13) 1.0-2.0	8 - Rainier 3.8 mi - NW	1.5(7/13) 1.0-2.0	3.4(13/13) 2.8-4.7	N/A ^[b]
	Tritium-26	1000	<LLD	-	<LLD	<LLD	0
	γ -scan-26	Table 3-1	<LLD	-	<LLD	<LLD	0
Shoreline Soil (pCi/g - dry)	γ -scan-2	Table 3-1	<LLD	-	<LLD	N/A ^[b]	N/A ^[b]

^[a]Mean and range based upon detectable measurements only. The fraction of detectable measurements at specified locations is indicated in parentheses (f).

^[b]N/A - Not applicable.

^[c]Based on measurements taken at a control location in Portland, Oregon, from 1990 through 1994.

TABLE 4-4

Sheet 1 of 2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Trojan Nuclear Plant, Columbia County, Oregon, Docket 50-344, Reporting Period: January 1-December 31, 1996

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean(f) ^[a] Range	Location with Highest Annual Mean		Control Locations	
				Name, Distance, and Direction	Mean(f) ^[a] Range	Mean(f) ^[a] Range	Number of Reportable Events
Air Particulates (pCi/m ³)	Gross β -102	0.01	0.020(102/102) 0.007-0.058	13 - Trojan North Site Boundary - 161 Meters NNW	0.021(50/50) 0.007-0.058	0.025(256/256) ^[c] 0.007-0.107	N/A ^[b]
	γ -scan-24	Table 3-1	<LLD	-	<LLD	<LLD ^[c]	0
Well Water (pCi/liter)	Tritium-4	1000	<LLD	-	<LLD	N/A ^[b]	0
	γ -scan-4	Table 3-1	<LLD	-	<LLD	N/A ^[b]	0

^[a]Mean and range based upon detectable measurements only. The fraction of detectable measurements at specified locations is indicated in parentheses (f).

^[b]N/A - Not applicable.

^[c]Based on measurements taken at a control location in Portland, Oregon, from 1990 through 1994.

5.0 COMMENTS ON AND TERMS USED IN DATA TABLES

Dry Weight	A reporting unit used for shoreline soil in which the amount of sample is taken to be the weight of the sample after removal of moisture by drying in an oven at about 110°C for about 15 hours.
pCi/m ³	A reporting unit used with air particulate data which refers to the radioactivity content expressed in picocuries per unit volume of air expressed in cubic meters passed through the glass fiber filter. Note that the volumes are not corrected to standard conditions.
Gamma Emitters or Gamma Isotopic	Samples were analyzed by high resolution germanium gamma spectrometry. The resulting spectrum is analyzed by a computer program which scans about 50 to 2000 KeV and lists the energy peaks of any nuclides present in concentrations exceeding the sensitivity limits set for that particular experiment.
Error Terms	Figures following "±" are error terms based on counting uncertainties at the 2σ (95 percent confidence) level unless otherwise specified. Values preceded by the "<" symbol were below the stated concentration as defined by the notation associated with Table 4.3-1 of Trojan's Offsite Dose Calculation Manual.

TABLE 5-1

Sheet 1 of 2

GROSS BETA IN AIR PARTICULATE FILTERS
(Weekly Collections)

Location 12			Location 12		
Collection Date	Volume (m ³)	Gross B (pCi/m ³)	Collection Date	Volume (m ³)	Gross B (pCi/m ³)
1/2/96	295	0.040±0.003	7/2/96	280	0.015±0.002
1/09/96	285	0.014±0.002	7/9/96	285	0.013±0.002
1/16/96	280	0.017±0.002	7/16/96	280	0.018±0.002
1/23/96	290	0.014±0.002	7/23/96	285	0.012±0.002
1/30/96	275	0.017±0.002	7/30/96	285	0.019±0.002
2/6/96	290	0.049±0.003	8/6/96	285	0.011±0.002
2/13/96	*	*	8/13/96	290	0.021±0.002
2/20/96	205	0.038±0.003	8/20/96	285	0.013±0.002
2/27/96	285	0.015±0.002	8/27/96	275	0.021±0.002
3/5/96	290	0.025±0.002	9/3/96	290	0.025±0.002
3/12/96	285	0.018±0.002	9/9/96	240	0.020±0.002
3/19/96	285	0.015±0.002	9/17/96	330	0.017±0.002
3/26/96	290	0.022±0.002	9/24/96	285	0.018±0.002
4/2/96	280	0.022±0.002	10/1/96	285	0.022±0.002
4/9/96	280	0.024±0.002	10/8/96	285	0.027±0.002
4/16/96	280	0.013±0.002	10/15/96	295	0.020±0.002
4/23/96	290	0.008±0.002	10/22/96	275	0.015±0.002
4/30/96	290	0.017±0.002	10/29/96	285	0.015±0.002
5/7/96	280	0.014±0.002	11/5/96	290	0.030±0.002
5/14/96	265	0.023±0.002	11/12/96	280	0.026±0.002
5/21/96	285	0.013±0.002	11/19/96	285	0.016±0.002
5/28/96	290	0.015±0.002	11/26/96	280	0.021±0.002
6/4/96	280	0.018±0.002	12/3/96	285	0.009±0.002
6/11/96	285	0.017±0.002	12/10/96	285	0.009±0.002
6/18/96	295	0.014±0.002	12/17/96	280	0.018±0.002
6/25/96	285	0.015±0.002	12/24/96	280	0.014±0.002
			12/31/96	280	0.019±0.002

* No sample available; air sampling equipment was submerged due to flooding of the Columbia River.

TABLE 5-1

Sheet 2 of 2

GROSS BETA IN AIR PARTICULATE FILTERS
(Weekly Collections)

Location 13			Location 13		
Collection Date	Volume (m ³)	Gross β (pCi/m ³)	Collection Date	Volume (m ³)	Gross β (pCi/m ³)
1/2/96	295	0.036 \pm 0.003	7/2/96	280	0.016 \pm 0.002
1/9/96	285	0.018 \pm 0.002	7/9/96	285	0.015 \pm 0.002
1/16/96	280	0.021 \pm 0.002	7/16/96	280	0.017 \pm 0.002
1/23/96	290	0.017 \pm 0.002	7/23/96	285	0.014 \pm 0.002
1/30/96	280	0.015 \pm 0.002	7/30/96	285	0.021 \pm 0.002
2/6/96	290	0.058 \pm 0.003	8/6/96	285	0.015 \pm 0.002
2/13/96	285	0.024 \pm 0.002	8/13/96	290	0.017 \pm 0.002
2/20/96	285	0.041 \pm 0.003	8/20/96	285	0.019 \pm 0.002
2/27/96	280	0.016 \pm 0.002	8/27/96	275	0.019 \pm 0.002
3/5/96	290	0.030 \pm 0.002	9/3/96	290	0.025 \pm 0.002
3/12/96	285	0.019 \pm 0.002	9/9/96	240	0.020 \pm 0.002
3/19/96	285	0.018 \pm 0.002	9/17/96	330	0.018 \pm 0.002
3/26/96	290	0.025 \pm 0.002	9/24/96	285	0.025 \pm 0.002
4/2/96	280	0.025 \pm 0.002	10/1/96	275	0.025 \pm 0.002
4/9/96	280	0.022 \pm 0.002	10/8/96	275	0.027 \pm 0.002
4/16/96	285	0.010 \pm 0.002	10/15/96	175	0.030 \pm 0.003
4/23/96	290	0.007 \pm 0.002	10/22/96	280	0.015 \pm 0.002
4/30/96	290	0.015 \pm 0.002	10/29/96	285	0.015 \pm 0.002
5/7/96	280	0.016 \pm 0.002	11/5/96	290	0.029 \pm 0.002
5/14/96	285	0.028 \pm 0.002	11/12/96	280	0.025 \pm 0.002
5/21/96	280	0.018 \pm 0.002	11/19/96	285	0.013 \pm 0.002
5/28/96	290	0.012 \pm 0.002	11/26/96	255	0.022 \pm 0.002
6/4/96	280	0.015 \pm 0.002	12/3/96	**	**
6/11/96	285	0.016 \pm 0.002	12/10/96	**	**
6/18/96	*	*	12/17/96	280	0.021 \pm 0.002
6/25/96	250	0.018 \pm 0.002	12/24/96	280	0.017 \pm 0.002
			12/31/96	280	0.020 \pm 0.002

* No sample available; lost power to automatic sampling equipment.

** No sample available; maintenance performed on power supply.

TABLE 5-2

SUMMARY - GROSS BETA IN AIR SAMPLES

	<u>pCi/m³</u>		
	<u>Mean + 1σ</u>	<u>Maximum</u>	<u>Minimum</u>
Trojan Onsite Stations			
Location 12	0.019±0.008	0.049	0.008
Location 13	0.021±0.008	0.058	0.007

TABLE 5-3

GAMMA EMITTERS: CONCENTRATIONS IN AIR PARTICULATE FILTERS
(Monthly Composites)

Collection Dates	(pCi/m ³)	
	Location 12	Location 13
12/26/95-1/30/96	<LLD	<LLD
1/30/96-2/27/96	<LLD	<LLD
2/27/96-3/26/96	<LLD	<LLD
3/26/96-4/30/96	<LLD	<LLD
4/30/96-5/28/96	<LLD	<LLD
5/28/96-6/25/96	<LLD	<LLD
6/25/96-7/30/96	<LLD	<LLD
7/30/96-8/27/96	<LLD	<LLD
8/27/96-9/24/96	<LLD	<LLD
9/24/96-10/29/96	<LLD	<LLD
10/29/96-11/26/96	<LLD	<LLD
11/26/96-12/31/96	<LLD	<LLD

LLD: 0.05 pCi/m³ Cs-134
0.06 pCi/m³ Cs-137

TABLE 5-4

RADIOACTIVITY IN WELL WATER

<u>Collection Date</u>	<u>pCi/l</u>	
	<u>Location 11</u>	
	<u>Tritium</u>	<u>Gamma Emitters</u>
3/12/96	< 1000	< LLD
6/18/96	< 1000	< LLD
9/9/96	< 1000	< LLD
12/12/96	< 1000	< LLD

LLD: 15 pCi/l Mn-54, Co-58, Co-60, Nb-95, Cs-134
18 pCi/l Cs-137
30 pCi/l Zn-65, Zr-95
1000 pCi/l H-3

TABLE 5-5

AMBIENT GAMMA RADIATION LEVELS

mR/Day

Location	First Quarter 12/27/95-3/28/96	Second Quarter 3/28/96-6/27/96	Third Quarter 6/27/96-9/26/96	Fourth Quarter 9/26/96-12/26/96
1	0.10	0.12	0.08	0.09
2	0.09	0.05	0.07	0.07
3	0.16	0.08	0.07	0.07
4	0.10	0.08	0.07	0.09
5	0.12	0.09	0.09	0.10
6	0.12	0.09	0.10	0.10
7	0.07	0.07	0.09	0.07
8	0.12	0.09	0.09	0.10
9	0.15	0.12	0.09	0.10
13	0.10	0.07	*	0.11
14	0.10	0.08	0.08	0.09
15	0.20	0.16	0.21	0.19

* Dosimeter lost in field

TABLE 5-6

RADIOACTIVITY IN DRINKING WATER
(Samples Split with State of Oregon)

Location 8 - Rainier Municipal Water Supply				Location 9 - St. Helens Municipal Water Supply			
pCi/l				pCi/l			
Collection Dates	Gross Beta	Tritium	Gamma Emitters	Collection Dates	Gross Beta	Tritium	Gamma Emitters
12/19/95-1/16/96	1.1±0.7	<1000	<LLD	12/19/95-1/16/96	3.5±0.9	<1000	<LLD
1/16/96-2/13/96	<1.0	<1000	<LLD	1/16/96-2/13/96	3.3±0.9	<1000	<LLD
2/13/96-3/12/96	1.2±0.8	<1000	<LLD	2/13/96-3/12/96	3.2±0.9	<1000	<LLD
3/12/96-4/9/96	<1.0	<1000	<LLD	3/12/96-4/9/96	3.2±0.7	<1000	<LLD
4/9/96-5/7/96	<1.2	<1000	<LLD	4/9/96-5/7/96	3.4±0.9	<1000	<LLD
5/7/96-6/4/96	<1.0	<1000	<LLD	5/7/96-6/4/96	3.6±1.0	<1000	<LLD
6/4/96-7/2/96	1.5±0.8	<1000	<LLD	6/4/96-7/2/96	3.7±1.0	<1000	<LLD
7/2/96-7/30/96	2.0±0.8	<1000	<LLD	7/2/96-7/30/96	3.0±0.9	<1000	<LLD
7/30/96-8/27/96	<1.2	<1000	<LLD	7/30/96-8/27/96	4.7±1.1	<1000	<LLD
8/27/96-9/24/96	1.8±0.8	<1000	<LLD	8/27/96-9/24/96	2.9±1.0	<1000	<LLD
9/24/96-10/22/96	<1.2	<1000	<LLD	9/24/96-10/22/96	3.4±0.9	<1000	<LLD
10/22/96-11/19/96	1.7±0.8	<1000	<LLD	10/22/96-11/19/96	2.8±0.9	<1000	<LLD
11/19/96-12/17/96	1.0±0.7	<1000	<LLD	11/19/96-12/17/96	2.9±0.9	<1000	<LLD

LLD: 15 pCi/l Mn-54, Co-58, Co-60, Nb-95, Cs-134
18 pCi/l Cs-137
30 pCi/l Zn-65, Zr-95
1000 pCi/l H-3

TABLE 5-7

RADIOACTIVITY IN SHORELINE SOIL
(Semiannual Collections)

pCi/g (dry)

<u>Location 10</u>	
Collection	Gamma
<u>Date</u>	<u>Emitters</u>
3/12/96	<LLD
9/9/96 ^[a]	<LLD

^[a] Split sample with the State of Oregon.

LLD: 0.15 pCi/g Cs-134
0.18 pCi/g Cs-137
