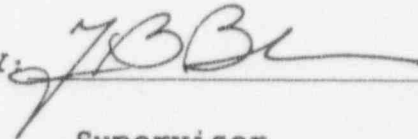


ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

NORTH ANNA POWER STATION

(JANUARY 01, 1996 TO DECEMBER 31, 1996)

PREPARED BY:



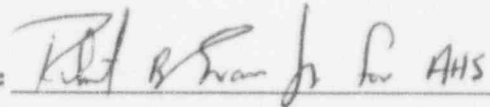
Supervisor  
Radiological Analysis  
And Material Control

REVIEWED BY:



Supervisor  
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APPROVED BY:



Superintendent  
Radiological Protection

## F O R W A R D

This report is submitted as required by Appendix A to Operating License Nos. NPF-4 and NPF-7, Technical Specifications for North Anna Power Station, Units 1 and 2, Virginia Electric and Power Company, Docket Nos. 50-338, 50-339, Section 6.9.1.9.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

FOR THE

NORTH ANNA POWER STATION

JANUARY 01, 1996 TO DECEMBER 31, 1996

I N D E X

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## 1.0 EXECUTIVE SUMMARY

The Annual Radiological Effluent Release Report describes the radiological effluent control program conducted at the North Anna Power station during the 1996 calendar year. This document summarizes the quantities of radioactive liquid and gaseous effluents and solid waste released from the North Anna Power Station in accordance with R.G. 1.21 during the period January 1 through December 31, 1996, and includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents.

There was one unplanned gaseous effluent release which met the reporting criteria in the Offsite Dose Calculation Manual during this reporting period.

Based on the 1996 effluent release data, 10 CFR 50, Appendix I dose calculations were performed in accordance with the Offsite Dose Calculation Manual. The results of these pathway dose calculations indicate the following:

1. The total body dose due to liquid effluents was  $3.38\text{E-}01$  mrem, which is 5.63% of the dose limit and the critical organ (liver) dose due to liquid effluents was  $3.57\text{E-}01$  mrem, which is 1.8% of the dose limit.
2. The air dose due to noble gases was  $5.73\text{E-}03$  mrad gamma, which is 0.03% of the annual gamma dose limit, and  $3.36\text{E-}03$  mrad beta, which is 0.008% of the annual beta dose limit.

## 1.0 EXECUTIVE SUMMARY (cont.)

3. The critical organ dose for I-131, I-133, H-3, and Particulates with half-lives greater than 8 days was  $6.61\text{E-}03$  mrem, which is 0.02% of the annual dose limit.

There was (1) one major change to radioactive liquid, gaseous, and solid waste treatment systems during this reporting period. This was installation of a high capacity blowdown proportional sampler for each unit. A brief description of this system is provided in Attachment 4.

There were changes to the Offsite Dose Calculation Manual, VPAP-2103, during this reporting period which were implemented in PN-1 and PN-2 on January 3, 1996 and May 16, 1996 respectively. Attachment 3 provides the changes to VPAP-2103.

Based on the levels of radioactivity observed during this reporting period and the dose calculations performed, the operations of the North Anna Nuclear Power Station Units 1 and 2 have resulted in negligible dose consequences to the maximum exposed member of the public in unrestricted areas.

## 2.0 PURPOSE AND SCOPE

The Radioactive Effluent Release Report includes, in Attachment 1, a summary of the quantities of radioactive liquid and gaseous effluents and solid waste as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of

## 2.0 PURPOSE AND SCOPE (cont.)

Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants", Revision 1, June 1974, with data summarized on a quarterly basis following the format of Tables 1, 2 and 3 of Appendix B thereof. The report submitted before May 1st of each year includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents released from the site during the previous calendar year. The report also includes a list of unplanned releases during the reporting period, in Attachment 6.

As required by Technical Specification 6.15, changes to the Offsite Dose Calculation Manual (ODCM) for the time period covered by this report are included in Attachment 3.

Major changes to radioactive liquid, gaseous and solid waste treatment systems are reported in Attachment 4, as required by the ODCM, section 6.7.2.a.4. Information to support the reason(s) for the change(s) and a summary of the 10 CFR 50.59 evaluation are included. In lieu of reporting major changes in this report, major changes to the radioactive waste treatment systems may be submitted as part of the annual FSAR update.

As required by the ODCM, sections 6.2.2.b.2 and 6.3.2.b.3, a list and explanation for the inoperability of radioactive liquid and/or gaseous effluent monitoring instrumentation is provided in Attachment 5 of this report.

### 3.0 DISCUSSION

The basis for the calculation of the percent of technical specification for the critical organ in Table 1A of Attachment 1 is the ODCM, section 6.3.1, which requires that the dose rate for iodine-131 & iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days shall be less than or equal to 1500 mrem/yr to the critical organ at or beyond the site boundary. The critical organ is the child's thyroid via the inhalation pathway.

The basis for the calculation of percent of technical specification for the total body and skin in Table 1A of Attachment 1 is the ODCM, section 6.3.1, which requires that the dose rate for noble gases to areas at or beyond site boundary shall be less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin.

The basis for the calculation of the percent of technical specification in Table 2A in Attachment 1 is the ODCM, section 6.2.1, which states that the concentrations of radioactive material released in liquid effluents to unrestricted areas shall be limited to 10 times the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to  $2.0\text{E}-4$  microcuries/ml.

Percent of technical specification calculations are based on the total gaseous or liquid effluents released for that respective quarter.

The annual and quarterly doses, as reported in Attachment 2, were calculated according to the methodology presented in the ODCM. The beta

### 3.0 DISCUSSION (cont.)

and gamma air doses due to noble gases released from the site were calculated at site boundary. The maximum exposed member of the public from the releases of airborne iodine-131 & iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days, is defined as an infant, exposed through the grass-cow-milk pathway, with the critical organ being the thyroid gland. The maximum exposed member of the public from radioactive materials in liquid effluents in unrestricted areas is defined as an adult, exposed by either the invertebrate or fish pathway, with the critical organ being the liver. The total body dose was also determined for this individual.

Presented in Attachment 6 is a list of unplanned gaseous and liquid releases meeting the requirements of 6.7.2.a.3 of the ODCM.

The typical Lower Limit of Detection (LLD) capabilities of the radioactive effluent analysis instrumentation are presented in Attachment 7. These LLD values are based upon conservative conditions (i.e., minimum sample volume and maximum delay time prior to analysis). Actual LLD values may be lower. If a radioisotope was not detected when effluent samples were analyzed, then the activity of that radioisotope was reported as Not Detectable (N/D) on Attachment 1 of this report. If an analysis for an isotope was not performed, then the activity was reported as Not Applicable (N/A).



#### 4.0 SUPPLEMENTAL INFORMATION

As required by the ODCM, section 6.6.2, evaluation of the Land Use Census is made to determine if new location(s) have been identified for the radiological environmental monitoring program pursuant to the ODCM. Evaluation of the Land Use Census conducted in 1996 identified no change in sample locations for the radiological environmental monitoring program.

Section 6.6.1.b.4 of the ODCM requires identification of the cause(s) for the unavailability of milk or leafy vegetation samples, and the identification of new locations for obtaining replacement samples. Milk samples, as required by the ODCM, section 6.6.1, were available during the time period covered by this report. The leafy vegetation samples for vegetation station 14, 15, 16, 21 and 23 were not collected for the months of January, February, March, November and December 1996 due to seasonal unavailability. All other samples were obtained and analyzed as required during the time period covered by this report.

ATTACHMENT 1  
EFFLUENT RELEASE DATA  
(01/96 - 12/96)

This attachment includes a summary of the quantities of radioactive liquid and gaseous effluents and solid waste, as outlined in Regulatory Guide 1.21, Appendix B.

ATTACHMENT 2  
ANNUAL AND QUARTERLY DOSES  
(01/96 - 12/96)

An assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents released from the site for each calendar quarter for the calendar year of this report, along with an annual total of each effluent pathway will be made pursuant to the ODCM Section 6.7.2.

Liquid Effluents:

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Total Body Dose (mrem)	8.52E-2	7.65E-2	1.39E-1	3.66E-2	3.38E-1
Critical Organ Dose (mrem)	9.65E-2	8.12E-2	1.41E-1	3.77E-2	3.57E-1

Gaseous Effluents:

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Noble Gas Gamma Dose (mrad)	4.23E-4	5.31E-3	5.28E-6	1.48E-6	5.73E-3
Noble Gas Beta Dose (mrad)	1.44E-3	1.89E-3	1.90E-5	3.90E-6	3.36E-3
Critical Organ Dose for I-131, I-133, H-3, Particulates with T½ > 8 days (mrem)	4.07E-3	1.28E-4	1.82E-3	5.89E-4	6.61E-3

ATTACHMENT 3

REVISIONS TO OFFSITE DOSE CALCULATION MANUAL

(ODCM)

(01/96 - 12/96)

As required by Technical Specification 6.15, revisions to the ODCM, effective for the time period covered by this report, are summarized in this attachment.

---

There are two procedure changes to Revision 7 implemented during the period January 1 through December 31, 1996. Included in this attachment are the revision summaries and associated page changes to the ODCM corresponding to North Anna's procedure changes.

The changes which relate to North Anna Power Station are the following:

- 1). 7-PN1: Made corrections to the Interlaboratory Comparison Program. Deleted need for NRC approval of Program. Deleted reference to the Environmental Protection Agency's Environmental Radioactivity Laboratory Intercomparison Studies Program. Also corrected title of Quality Control Manual.
- 2). 7-PN2: Upgraded procedure for Steam Generator High Capacity Blowdown System.

ATTACHMENT 4

MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS, AND SOLID  
WASTE TREATMENT SYSTEMS

(01/96 - 12/96)

As required by the ODCM, Section 6.7.2.a.4, major changes to radioactive liquid, gaseous and solid waste treatment systems for the time period covered by this report are synopsized in this attachment. Supporting information as to the reason(s) for the change(s) and a summary of the 10 CFR 50.59 evaluations are included, as applicable.

---

There were no major changes to radioactive liquid, gaseous, and solid waste treatment systems for 1996.

ATTACHMENT 5

INOPERABILITY OF RADIOACTIVE LIQUID AND GASEOUS

EFFLUENT MONITORING INSTRUMENTATION

(01/96 - 12/96)

As required by the ODCM, Sections 6.2.2.b.2 and 6.3.2.b.3, a list and explanation for extended inoperability of radioactive liquid and/or gaseous effluent monitoring instrumentation is provided in this attachment.

---

There was one Liquid Effluent Radiation Monitor which was out of service for more than 30 days. 1-RM-SW-108 the Radiation Monitor for the Service Water system was out of service from 10/31/96 through 12/31/96. This radiation monitor is required as per the Offsite Dose Calculation Manual for effluent releases from the Service Water system.

The radiation monitor was out of service due to repairs of the Service Water system. The system was taken out of service for pipe weld repairs as per DCP 94-010. The initial system draining was monitored via 12 hour grab samples as per the Offsite Dose Calculation Manual Attachment #2. No other effluent releases have occurred for the period.

The radiation monitor will be returned to service as soon as the system is returned to service.

ATTACHMENT 6

UNPLANNED RELEASES

(01/96 - 12/96)

As required by the ODCM, Section 6.7.2.a.3, a list of unplanned releases, from the site to unrestricted areas, of radioactive material in gaseous and liquid effluents occurring during the reporting period, is made in this attachment.

---

One unplanned release met a criterion of the ODCM, Section 6.7.2.a.3. This release was from the "C" Boron Recovery Tank vent during filling operations of the tank. The release was discovered during an HP self-assessment to determine if the Boron Recovery Tank vents were an unmonitored release pathway. Since the occurrence, a miscellaneous release permit is prepared weekly by the Health Physics Department, and sampling is conducted once each shift when filling. These releases are now accounted for under batch releases and average about 20  $\mu\text{Ci}$  of noble gas and 200  $\mu\text{Ci}$  of tritium per week. This contributes about  $10 \text{ E-}10$  mrem to the total body and  $2 \text{ E-}9$  mrem per week from noble gases and about  $7 \text{ E-}8$  mrem per week to the critical organ from tritium. The data for the unplanned release is summarized below:

<u>Nuclide</u>	<u><math>\mu\text{Ci}</math> Released</u>	<u>Critical Organ Dose Rate</u>	<u>% Tech. Spec.</u>
H-3	4.78E+0	9.22E-7 mrem/yr	6.15E-8

ATTACHMENT 7  
 LOWER LIMITS OF DETECTION FOR EFFLUENT SAMPLE ANALYSIS  
 (01/96 - 12/96)

Gaseous Effluents:

Radioisotope	Required L.L.D. ( $\mu\text{Ci/ml}$ )	Typical L.L.D. ( $\mu\text{Ci/ml}$ )
Krypton - 87	1.00E-4	4.40E-8 - 3.98E-7
Krypton - 88	1.00E-4	7.09E-8 - 5.70E-7
Xenon - 133	1.00E-4	4.48E-8 - 3.56E-7
Xenon - 133m	1.00E-4	1.51E-7 - 1.38E-6
Xenon - 135	1.00E-4	1.79E-8 - 1.50E-7
Xenon - 135m	1.00E-4	6.84E-8 - 5.83E-7
Xenon - 138	1.00E-4	1.64E-7 - 1.96E-6
Iodine - 131	1.00E-12	5.52E-14 - 7.59E-14
Iodine - 133	1.00E-10	6.03E-14 - 7.15E-14
Manganese - 54	1.00E-11	3.64E-14 - 5.32E-14
Cobalt - 58	1.00E-11	4.05E-14 - 5.21E-14
Iron - 59	1.00E-11	7.84E-14 - 1.01E-13
Cobalt - 60	1.00E-11	5.40E-14 - 1.52E-13
Zinc - 65	1.00E-11	9.09E-14 - 1.19E-13
Strontium - 89	1.00E-11	4.00E-15 - 5.00E-15
Strontium - 90	1.00E-11	7.00E-16 - 1.00E-15
Molybdenum - 99	1.00E-11	2.72E-13 - 3.47E-13
Cesium - 134	1.00E-11	4.90E-14 - 1.61E-13
Cesium - 137	1.00E-11	4.64E-14 - 5.77E-14
Cerium - 141	1.00E-11	4.54E-14 - 6.79E-14
Cerium - 144	1.00E-11	2.04E-13 - 3.22E-13
Gross Alpha	1.00E-11	6.90E-15 - 1.20E-14
Tritium	1.00E-6	1.12E-7 - 1.37E-7



ATTACHMENT 7  
 LOWER LIMITS OF DETECTION FOR EFFLUENT SAMPLE ANALYSIS  
 (01/96 - 12/96)

Liquid Effluents:

Radioisotope	Required L.L.D. ( $\mu\text{Ci/ml}$ )	Typical L.L.D. ( $\mu\text{Ci/ml}$ )
Krypton - 87	1.00E-5	5.93E-8 - 7.29E-8
Krypton - 88	1.00E-5	9.38E-8 - 1.16E-7
Xenon - 133	1.00E-5	6.08E-8 - 8.83E-8
Xenon - 133m	1.00E-5	2.04E-7 - 2.69E-7
Xenon - 135	1.00E-5	2.65E-8 - 3.14E-8
Xenon - 135m	1.00E-5	8.92E-8 - 1.19E-7
Xenon - 138	1.00E-5	2.17E-7 - 3.41E-7
Iodine - 131	1.00E-6	2.63E-8 - 3.43E-8
Manganese - 54	5.00E-7	2.45E-8 - 3.39E-8
Iron - 55	1.00E-6	9.70E-9 - 8.00E-7
Cobalt - 58	5.00E-7	2.61E-8 - 3.31E-8
Iron - 59	5.00E-7	5.04E-8 - 5.86E-8
Cobalt - 60	5.00E-7	2.86E-8 - 8.43E-8
Zinc - 65	5.00E-7	5.81E-8 - 6.83E-8
Strontium - 89	5.00E-8	3.00E-8 - 5.00E-8
Strontium - 90	5.00E-8	5.00E-9 - 1.00E-8
Molybdenum - 99	5.00E-7	1.82E-7 - 2.31E-7
Cesium - 134	5.00E-7	3.40E-8 - 1.00E-7
Cesium - 137	5.00E-7	3.32E-8 - 3.84E-8
Cerium - 141	5.00E-7	4.07E-8 - 5.47E-8
Cerium - 144	5.00E-7	1.81E-7 - 2.63E-7
Gross Alpha	1.00E-7	2.15E-8 - 3.72E-8
Tritium	1.00E-5	2.78E-6 - 3.32E-6

TABLE 1A  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
SUMMATION OF ALL GASEOUS EFFLUENT RELEASES FOR (01/96 - 12/96)

Page 1 of 2

	UNITS	1ST QUARTER	2ND QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. Fission and Activation Gases:</b>				
1. Total Release.	Curies	1.51E+1	2.19E+0	1.80E+1
2. Average Release Rate for Period	μCi/sec	1.91E-6	2.78E-7	
<b>B. Iodines:</b>				
1. Total Iodine-131 Release.	Curies	8.03E-5	N/D	2.80E+1
2. Average Release Rate for Period	μCi/sec	1.02E-11	N/D	
<b>C. Particulates (T% &gt; 8 days):</b>				
1. Total Particulate (T% > 8 days) Release	Curies	3.02E-4	8.35E-7	2.80E+1
2. Average Release Rate for Period	μCi/sec	3.85E-11	1.06E-7	
3. Gross Alpha Radioactivity Release	Curies	1.40E-6	2.41E-6	
<b>D. Tritium:</b>				
1. Total Release	Curies	7.10E+0	2.44E+0	3.10E+1
2. Average Release Rate for Period	μCi/sec	9.03E-7	3.10E-7	
<b>E. Percentage of Technical Specification Limits</b>				
1. Total Body Dose Rate	%	2.88E-4	4.07E-3	
2. Skin Dose Rate	%	1.38E-4	9.91E-4	
3. Critical Organ Dose Rate	%	7.13E-4	2.00E-4	

TABLE 1A  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
SUMMATION OF ALL GASEOUS EFFLUENT RELEASES FOR (01/96 - 12/96)

Page 2 of 2

	UNITS	3rd QUARTER	4th QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. Fission and Activation Gases:</b>				
1. Total Release.	Curies	2.50E-1	6.73E-2	1.80E+1
2. Average Release Rate for Period	μCi/sec	3.27E-8	8.47E-9	
<b>B. Iodines:</b>				
1. Total Iodine-131 Release.	Curies	2.09E-5	N/D	2.80E+1
2. Average Release Rate for Period	μCi/sec	2.63E-12	N/D	
<b>C. Particulates (T% &gt; 8 days):</b>				
1. Total Particulate (T% > 8 days) Release	Curies	1.57E-5	4.93E-6	2.80E+1
2. Average Release Rate for Period	μCi/sec	1.96E-12	6.20E-13	
3. Gross Alpha Radioactivity Release	Curies	3.49E-6	1.04E-6	
<b>D. Tritium:</b>				
1. Total Release	Curies	1.59E+1	1.10E+1	3.10E+1
2. Average Release Rate for Period	μCi/sec	2.00E-6	1.39E-6	
<b>E. Percentage of Technical Specification Limits</b>				
1. Total Body Dose Rate	%	3.53E-6	1.00E-6	
2. Skin Dose Rate	%	1.76E-6	3.76E-7	
3. Critical Organ Dose Rate	%	1.39E-3	9.29E-4	

TABLE 1B  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
MIXED MODE GASEOUS EFFLUENT RELEASES FOR 01/96 - 12/96

Page 1 of 4

NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		1st QUARTER	2nd QUARTER	1st QUARTER	2nd QUARTER
Fission & Activation Gases:					
Krypton - 85	Ci	1.46E+0	N/D	1.48E+0	2.42E-1
Krypton - 85m	Ci	N/D	N/D	N/D	N/D
Krypton - 87	Ci	N/D	N/D	7.44E-4	N/D
Krypton - 88	Ci	N/D	N/D	N/D	N/D
Xenon - 131m	Ci	N/D	N/D	1.23E-1	N/D
Xenon - 133	Ci	6.26E-1	N/D	8.31E+0	N/D
Xenon - 133m	Ci	N/D	N/D	1.22E-1	N/D
Xenon - 135	Ci	N/D	N/D	3.23E-1	N/D
Xenon - 135m	Ci	N/D	N/D	N/D	N/D
Xenon - 138	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Argon - 41	Ci	6.57E-2	4.93E-3	N/D	N/D
Total for Period					
	Ci	2.15E+0	4.93E-3	1.04E+1	2.42E-1
Iodines:					
Iodine - 131	Ci	1.25E-7	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Iodine - 135	Ci	N/D	N/D	N/D	N/D
Total for Period					
	Ci	1.25E-7	N/D	N/D	N/D
Particulates:					
Manganese - 54	Ci	N/D	N/D	N/D	N/D
Iron - 55	Ci	N/A	N/A	N/A	N/A
Cobalt - 58	Ci	N/D	1.90E-8	N/D	N/D
Iron - 59	Ci	N/D	N/D	N/D	N/D
Cobalt - 60	Ci	N/D	1.95E-7	N/D	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Strontium - 89	Ci	N/D	N/D	N/D	N/D
Strontium - 90	Ci	N/D	N/D	N/D	N/D
Cesium - 134	Ci	N/D	3.25E-8	N/D	N/D
Cesium - 136	Ci	N/D	N/D	N/D	N/D
Cesium - 137	Ci	7.55E-8	5.88E-7	N/D	N/D

## Page 2 of 4

NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		1st QUARTER	2nd QUARTER	1st QUARTER	2nd QUARTER
Particulates: (cont.)					
Barium- Lanthanum - 140	ci	N/D	N/D	N/D	N/D
Cerium - 141	ci	N/D	N/D	N/D	N/D
Cerium - 144	ci	N/D	N/D	N/D	N/D
Ruthenium -103	ci	3.58E-9	N/D	N/D	N/D
Other (Specify)					
Thulium - 170	ci	2.48E-7	N/D	N/D	N/D
Molybdenum - 99 (T½ < 8 days)	ci	N/D	N/D	N/D	N/D
Total for Period (T½ > 8 days)	ci	3.27E-7	8.35E-7	N/D	N/D
Total for Period (T½ < 8 days)	ci	N/D	N/D	N/D	N/D
Total for Period	ci	3.27E-7	8.35E-7	N/D	N/D
GROSS ALPHA:	ci	7.98E-10	9.63E-10	N/A	N/A
TRITIUM:	ci	3.06E-1	2.34E-1	7.30E-4	3.51E-4

TABLE 1B

NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
MIXED MODE GASEOUS EFFLUENT RELEASES FOR 01/96 - 12/96

Page 3 of 4

CONTINUOUS MODE			BATCH MODE		
NUCLIDES RELEASED	UNITS	3rd QUARTER	4th QUARTER	3rd QUARTER	4th QUARTER
Fission & Activation Gases:					
Krypton - 85	Ci	N/D	N/D	5.40E-2	N/D
Krypton - 85m	Ci	N/D	N/D	N/D	N/D
Krypton - 87	Ci	N/D	N/D	N/D	N/D
Krypton - 88	Ci	N/D	N/D	N/D	N/D
Xenon - 131m	Ci	N/D	N/D	1.54E-4	N/D
Xenon - 133	Ci	9.30E-2	N/D	8.71E-2	6.32E-2
Xenon - 133m	Ci	N/D	N/D	1.43E-3	N/D
Xenon - 135	Ci	N/D	N/D	1.08E-4	N/D
Xenon - 135m	Ci	N/D	N/D	N/D	N/D
Xenon - 138	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Argon - 41	Ci	N/D	N/D	N/D	N/D
Total for Period	Ci	9.30E-2	N/D	1.43E-1	6.32E-2
Iodines:					
Iodine - 131	Ci	N/D	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Iodine - 135	Ci	N/D	N/D	N/D	N/D
Total for Period	Ci	N/D	N/D	N/D	N/D
Particulates:					
Manganese - 54	Ci	N/D	N/D	N/D	N/D
Cobalt - 58	Ci	N/D	N/D	N/D	N/D
Iron - 59	Ci	N/D	N/D	N/D	N/D
Cobalt - 60	Ci	N/D	1.29E-8	N/D	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Strontium - 85	Ci	N/D	N/D	N/D	N/D
Strontium - 89	Ci	N/D	N/D	N/A	N/A
Strontium - 90	Ci	N/D	N/D	N/A	N/A
Cesium - 134	Ci	N/D	N/D	N/D	N/D
Cesium - 136	Ci	N/D	N/D	N/D	N/D
Cesium - 137	Ci	1.27E-7	3.75E-8	N/D	N/D

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NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		3rd QUARTER	4th QUARTER	3rd QUARTER	4th QUARTER
Particulates: (cont.)					
Barium-Lanthanum - 140	Ci	N/D	N/D	N/D	N/D
Cerium - 141	Ci	N/D	N/D	N/D	N/D
Cerium - 144	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Molybdenum - 99 (TX < 8 days)	Ci	N/D	N/D	N/D	N/D
Total for Period (TX > 8 days)	Ci	1.27E-7	5.04E-8	N/D	N/D
Total for Period (TX < 8 days)	Ci	N/D	N/D	N/D	N/D
Total for Period	Ci	1.27E-7	5.04E-8	N/D	N/D
GROSS ALPHA:	Ci	9.01E-10	5.32E-10	N/A	N/A
TRITIUM:	Ci	4.52E-1	5.38E-1	1.59E-2	1.12E-3



TABLE 1C

## NORTH ANNA POWER STATION

## ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

GROUND LEVEL GASEOUS EFFLUENT RELEASES FOR 01/96 - 12/96

Page 1 of 4

NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		1st QUARTER	2nd QUARTER	1st QUARTER	2nd QUARTER
Fission & Activation Gases:					
Krypton - 85	Ci	N/D	N/D	1.14E-1	N/D
Krypton - 85m	Ci	N/D	N/D	N/D	N/D
Krypton - 87	Ci	N/D	N/D	N/D	N/D
Krypton - 88	Ci	N/D	N/D	N/D	N/D
Xenon - 131m	Ci	N/D	N/D	2.16E-2	N/D
Xenon - 133	Ci	N/D	N/D	2.34E+0	N/D
Xenon - 133m	Ci	N/D	N/D	1.68E-2	N/D
Xenon - 135	Ci	N/D	N/D	8.91E-3	N/D
Xenon - 135m	Ci	N/D	N/D	N/D	N/D
Xenon - 138	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Argon - 41	Ci	N/D	1.94E+0	N/D	N/D
Total for Period					
	Ci	N/D	1.94E+0	2.51E+0	N/D
Iodines:					
Iodine - 131	Ci	8.02E-5	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Iodine - 135	Ci	N/D	N/D	N/D	N/D
Total for Period					
	Ci	8.02E-5	N/D	N/D	N/D
Particulates:					
Mangarese - 54	Ci	2.24E-5	N/D	1.22E-8	N/D
Iron - 55	Ci	N/A	N/A	N/A	N/A
Cobalt - 58	Ci	1.31E-5	N/D	4.24E-8	N/D
Iron - 59	Ci	N/D	N/D	N/D	N/D
Cobalt - 60	Ci	3.20E-5	N/D	6.14E-8	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Strontium - 89	Ci	N/D	N/D	N/D	N/D
Strontium - 90	Ci	N/D	N/D	N/D	N/D



TABLE 1C		
NORTH ANNA POWER STATION		
ANNUAL RADIOACTIVE EFFLUENT RELEASE	REPORT	
LEVEL GASEOUS EFFLUENT RELEASES	FOR 01/96	- 12/96
GROUND		

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TABLE 1C

NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
GROUND LEVEL GASEOUS EFFLUENT RELEASES FOR 01/96 - 12/96

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NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		3rd QUARTER	4th QUARTER	3rd QUARTER	4th QUARTER
Fission & Activation Gases:					
Krypton - 85	Ci	N/D	N/D	N/D	N/D
Krypton - 85m	Ci	N/D	N/D	N/D	N/D
Krypton - 87	Ci	N/D	N/D	N/D	N/D
Krypton - 88	Ci	N/D	N/D	N/D	N/D
Xenon - 131m	Ci	N/D	N/D	N/D	N/D
Xenon - 133	Ci	N/D	N/D	2.30E-2	3.96E-3
Xenon - 133m	Ci	N/D	N/D	2.18E-4	N/D
Xenon - 135	Ci	N/D	N/D	6.90E-4	1.22E-4
Xenon - 135m	Ci	N/D	N/D	N/D	N/D
Xenon - 138	Ci	N/D	N/D	N/D	N/D
Other (Specify)	Ci	N/D	N/D	N/D	N/D
Argon - 41	Ci	N/D	N/D	N/D	5.60E-5
Total for Period	Ci	N/D	N/D	2.39E-2	4.14E-3
Iodines:					
Iodine - 131	Ci	2.09E-5	N/D	N/D	N/D
Iodine - 132	Ci	4.32E-5	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Iodine - 135	Ci	N/D	N/D	N/D	N/D
Total for Period	Ci	6.41E-5	N/D	N/D	N/D
Particulates:					
Manganese - 54	Ci	N/D	N/D	N/D	N/D
Iron - 55	Ci	N/A	N/A	N/A	N/A
Cobalt - 58	Ci	1.32E-5	2.30E-6	N/D	2.19E-6
Iron - 59	Ci	N/D	N/D	N/D	N/D
Cobalt - 60	Ci	N/D	N/D	2.26E-7	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Niobium - 95	Ci	N/D	N/D	N/D	N/D
Zirconium - 95	Ci	N/D	N/D	N/D	N/D
Strontium - 89	Ci	N/D	N/D	N/D	N/D
Strontium - 90	Ci	N/D	N/D	N/D	N/D

NORTH ANNA POWER STATION

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

GROUND LEVEL GASEOUS EFFLUENT RELEASES FOR 01/96 - 12/96

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TABLE 2A

NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES FOR (01/96 - 12/96)

Page 1 of 2

	UNITS	1st QUARTER	2nd QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. Fission and Activation Products:</b>				
1. Total release (not including tritium, noble gas, and gross alpha).	Curies	1.35E-1	2.37E-1	2.00E+1
2. Average diluted concentration during the period.	$\mu\text{Ci/ml}$	3.77E-10	3.37E-10	
3. Percent of applicable limit (T.S.)	%	3.40E-4	2.95E-4	
<b>B. Tritium:</b>				
1. Total release activity.	Curies	2.37E+2	2.56E+2	2.00E+1
2. Average diluted concentration during the period.	$\mu\text{Ci/ml}$	6.62E-7	3.64E-7	
3. Percent of applicable limit (T.S.)	%	6.63E-3	3.63E-3	
<b>C. Dissolved and Entrained Gases:</b>				
1. Total release activity.	Curies	1.42E-4	7.24E-4	2.00E+1
2. Average diluted concentration during the period.	$\mu\text{Ci/ml}$	3.97E-13	1.03E-12	
3. Percent of applicable limit (T.S.)	%	1.98E-7	5.13E-7	
<b>D. Gross Alpha Radioactivity:</b>				
1. Total release activity.	Curies	N/D	N/D	2.00E+1
<b>E. Volume of waste released: (prior to dilution).</b>				
	Liters	2.78E+7	9.05E+7	3.00E+0
<b>F. Total volume of dilution water used during the period.</b>				
	Liters	3.58E+11	7.04E+11	3.00E+0

TABLE 2A  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES FOR (01/96 - 12/96)

Page 2 of 2

	UNITS	3rd QUARTER	4th QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. Fission and Activation Products:</b>				
1. Total release (not including tritium, noble gas, and gross alpha).	Curies	1.62E-1	1.26E-1	2.00E+1
2. Average diluted concentration during the period.	µCi/ml	2.09E-10	1.68E-10	
3. Percent of applicable limit (T.S.)	%	1.15E-4	1.64E-4	
<b>B. Tritium:</b>				
1. Total release activity.	Curies	5.05E+2	1.24E+2	2.00E+1
2. Average diluted concentration during the period.	µCi/ml	6.51E-7	1.66E-7	
3. Percent of applicable limit (T.S.)	%	6.49E-3	1.66E-3	
<b>C. Dissolved and Entrained Gases:</b>				
1. Total release activity.	Curies	5.12E-5	N/D	2.00E+1
2. Average diluted concentration during the period.	µCi/ml	6.60E-14	N/D	
3. Percent of applicable limit (T.S.)	%	3.29E-8	N/A	
<b>D. Gross Alpha Radioactivity:</b>				
1. Total release activity.	Curies	N/D	N/D	2.00E+1
E. Volume of waste released: (prior to dilution).	Liters	1.37E+8	1.43E+8	3.00E+0
F. Total volume of dilution water used during the period.	Liters	7.76E+11	7.49E+11	3.00E+0

TABLE 2B  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
LIQUID EFFLUENT RELEASES FOR 01/96 - 12/96

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NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		1st QUARTER	2nd QUARTER	1st QUARTER	2nd QUARTER
Fission & Activation Products:					
Manganese - 54	Ci	4.18E-4	2.05E-3	N/D	N/D
Iron - 55	Ci	2.51E-2	1.08E-1	N/D	N/D
Cobalt - 58	Ci	1.29E-2	3.07E-2	N/D	N/D
Cobalt - 60	Ci	1.60E-2	3.80E-2	1.13E-4	N/D
Strontium - 89	Ci	N/D	N/D	N/D	N/D
Strontium - 90	Ci	N/D	N/D	N/D	N/D
Niobium - 95	Ci	1.05E-4	1.22E-3	N/D	N/D
Ruthenium - 106	Ci	N/D	2.30E-4	N/D	N/D
Silver - 110m	Ci	1.31E-2	2.26E-2	N/D	N/D
Iodine - 131	Ci	N/D	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Cesium - 134	Ci	N/D	N/D	N/D	N/D
Cesium - 136	Ci	N/D	N/D	N/D	N/D
Cesium - 137	Ci	1.36E-3	4.31E-4	N/D	N/D
Barium-Lanthanum - 140	Ci	N/D	N/D	N/D	N/D
Cerium - 141	Ci	N/D	N/D	N/D	N/D
Antimony - 124	Ci	2.25E-3	N/D	N/D	N/D
Antimony - 125	Ci	5.88E-2	1.66E-2	N/D	N/D
Technetium - 99m	Ci	N/D	N/D	N/D	N/D
Molybdenum - 99	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Chromium - 51	Ci	4.54E-3	9.63E-3	N/D	N/D
Iron - 59	Ci	6.33E-4	5.31E-3	N/D	N/D
Zirconium - 95	Ci	N/D	5.68E-4	N/D	N/D
Indium-113m (T½ < 8 days)	Ci	N/D	4.47E-4	N/D	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Rhodium - 106 (T½ < 8 days)	Ci	N/D	2.30E-4	N/D	N/D
Tellurium - 129	Ci	N/D	N/D	N/D	N/D
Tellurium - 129m	Ci	N/D	N/D	N/D	N/D
Tin-113	Ci	N/D	4.47E-4	N/D	N/D
Cobalt - 57	Ci	N/D	2.06E-4	N/D	N/D
Total for Period		1.35E-1	2.37E-1	1.13E-4	N/D

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TABLE 2B  
NORTH ANNA POWER STATION  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
LIQUID EFFLUENT RELEASES FOR 01/96 - 12/96

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NUCLIDES RELEASED	UNITS	CONTINUOUS MODE		BATCH MODE	
		3rd QUARTER	4th QUARTER	3rd QUARTER	4th QUARTER
Fission & Activation Products:					
Manganese - 54	Ci	2.89E-4	2.71E-4	N/D	1.90E-7
Iron - 55	Ci	8.98E-2	2.48E-2	N/D	1.50E-6
Cobalt - 58	Ci	4.16E-2	5.06E-2	N/D	1.19E-5
Cobalt - 60	Ci	1.34E-2	1.36E-2	N/D	6.71E-6
Strontium - 89	Ci	N/D	N/D	N/D	N/D
Strontium - 90	Ci	N/D	N/D	N/D	N/D
Niobium - 95	Ci	4.53E-4	1.06E-7	N/D	2.51E-7
Ruthenium - 106	Ci	N/D	N/D	N/D	N/D
Silver - 110m	Ci	4.61E-3	2.64E-2	N/D	N/D
Iodine - 131	Ci	N/D	N/D	N/D	N/D
Iodine - 133	Ci	N/D	N/D	N/D	N/D
Cesium - 134	Ci	N/D	N/D	N/D	4.38E-6
Cesium - 137	Ci	2.21E-4	1.67E-4	N/D	9.91E-6
Barium-Lanthanum - 140	Ci	N/D	N/D	N/D	N/D
Cerium - 141	Ci	N/D	N/D	N/D	N/D
Antimony - 125	Ci	8.10E-3	1.03E-2	N/D	7.92E-6
Antimony - 124	Ci	1.08E-3	1.85E-4	N/D	N/D
Technetium - 99m	Ci	N/D	N/D	N/D	N/D
Molybdenum - 99	Ci	N/D	N/D	N/D	N/D
Other (Specify)					
Chromium - 51	Ci	1.77E-3	N/D	N/D	1.52E-6
Iron - 59	Ci	4.43E-4	1.40E-4	N/D	N/D
Zirconium - 95	Ci	2.03E-4	N/D	N/D	N/D
Indium - 113m (TK < 8 days)	Ci	N/D	N/D	N/D	N/D
Zinc - 65	Ci	N/D	N/D	N/D	N/D
Rhodium - 106 (TK < 8 days)	Ci	N/D	N/D	N/D	N/D
Cobalt - 57	Ci	N/D	N/D	N/D	N/D
Antimony - 122 (TK < 8 days)	Ci	2.53E-5	N/D	N/D	N/D
Ruthenium - 103	Ci	N/D	N/D	N/D	N/D
Tin - 113	Ci	N/D	N/D	N/D	N/D
Iodine - 132	Ci	4.41E-5	N/D	N/D	N/D
Tellurium - 132	Ci	6.63E-5	N/D	N/D	N/D
Antimony - 126	Ci	3.96E-5	N/D	N/D	N/D
Total for Period	Ci	1.62E-1	1.26E-1	N/D	4.43E-5





TABLE 3  
NORTH ANNA POWER STATION  
RADIOACTIVE EFFLUENT RELEASE REPORT  
SUMMATION OF SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS  
FOR 01-01-96 THROUGH 12-31-96

Page 1 of 2

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (NOT IRRADIATED FUEL)

1.	Type of Waste	Unit	12-Month Period	Estimated Total Percent Error (%)
a.	Spent resins, sludges, filters, filter sludge, evaporator bottoms, etc.	m <sup>3</sup> Ci	4.53E+1* 7.27E+2	2.50E+1 2.50E+1
b.	Dry compressible waste, contaminated equipment, etc.	m <sup>3</sup> Ci	1.53E+2** 6.04E+0	2.50E+1 2.50E+1
c.	Irradiated components, control rods, etc.	m <sup>3</sup> Ci	2.96E-3 2.13E+0	2.50E+1 2.50E+1
d.	Other (describe) Waste oil/solvent/glycol/grease	m <sup>3</sup> Ci	6.03E+0*** 5.25E-2	2.50E+1 2.50E+1

2. Estimate of major nuclide composition (by type of waste)

a.	Ni-63	35.6%	2.59E+2	2.50E+1
	Co-60	27.03%	1.96E+2	2.50E+1
	Cs-137	4.62%	3.36E+1	2.50E+1
	Fe-55	20.88%	1.52E+2	2.50E+1
	Cs-134	1.91%	1.39E+1	2.50E+1
	Co-58	5.35%	3.89E+1	2.50E+1
	Mn-54	2.58%	1.87E+1	2.50E+1
b.	Mn-54	1.53%	9.15E-2	2.50E+1
	Co-58	12.08%	7.23E-1	2.50E+1
	Fe-55	60.70%	3.59E+0	2.50E+1
	Co-60	7.59%	4.54E-1	2.50E+1
	Ni-63	3.90%	2.33E-1	2.50E+1
	Zr-95	3.15%	1.88E-1	2.50E+1
	Nb-95	4.77%	2.85E-1	2.50E+1
	Cs-137	1.35%	8.05E-2	2.50E+1
	Cr-51	4.15%	2.48E-1	2.50E+1
c.	Mn-54	6.91%	1.47E-1	2.50E+1
	Fe-55	78.85%	1.68E+0	2.50E+1
	Co-58	1.18%	2.51E-2	2.50E+1
	Co-60	10.70%	2.28E-1	2.50E+1
	Ni-63	1.07%	2.27E-2	2.50E+1

NORTH ANNA POWER STATION  
RADIOACTIVE EFFLUENT RELEASE REPORT  
SUMMATION OF SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS  
FOR 01-01-96 THROUGH 12-31-96

Page 2 of 2

2. Estimate of major nuclide  
composition (by type of  
waste) (cont.)

	Unit	12-Month Period	Estimated Total Percent Error (%)
d. Cs-137	9.71%	5.09E-3	2.50E+1
Co-60	2.90%	1.52E-3	2.50E+1
Ni-63	38.29%	2.06E-2	2.50E+1
Fe-55	32.44%	1.70E-2	2.50E+1
Sr-90	14.05%	7.36E-3	2.50E+1
Ag-110m	1.62%	8.49E-4	2.50E+1

3. Solid Waste Disposition

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
10	Truck	Barnwell, SC
5	Truck	Oak Ridge, TN (SEG)

B. Irradiated Fuel Shipments (Disposition)

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
N/A	N/A	N/A

- \* 1 shipment of resin sludge was shipped from North Anna to a Licensed Waste Processor for volume reduction. Therefore, the volume listed for this type is not representative of actual volume buried. The total volume buried for this reporting period was 34.5 m<sup>3</sup>.
- \*\* 4 shipments of dry compressible waste/contaminated equipment were shipped from North Anna to Licensed Waste Processors for volume reduction. Therefore, the volume listed for this type is not representative of the actual volume buried. The total volume buried for this reporting period was 21.11 m<sup>3</sup>.
- \*\*\* 1 shipment of waste oil and 1 shipment of snubber fluid, solvent, glycol and grease were shipped from North Anna to a Licensed Waste Processor for incineration. Therefore, the volume listed for this type is not representative of the actual volume buried. The total volume buried for this reporting period was 0.00 m<sup>3</sup>.