UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

MAR 30 1992

Report Nos : 50-338/92-05 and 50-339/92-05

Licensee: Virginia Electric and Power Company
Glen Allen, Virginia 23060

Docket Nos.: 50-338 and 50-339 License Nos.: NPF-4 and NPF-7

Facility Name: North Anna 1 and 2

Inspection Conducted: February 24-28, 1992

Inspector: D A Seymour 3.20.92
D. A. Seymour Date Signed

Approved by: T R Decker 3-20-92
T. R. Decker, Chief Date Signed
Radiological Effluents and Chemistry Section
Radiological Protection and Emergency Preparedness Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope:

This was a routine, unannounced inspection in the areas of dose assessment, the Semi-Annual Effluent Reports, and confirmatory measurements.

Results:

Unresolved Item 50-338/90-18-03: Gas Stripper Inoperability and Potential for Unmonitored Release; was closed (Paragraph 2).

The licensee was in agreement with accepted NRC values for the samples analyzed as part of a confirmatory measurements inspection. A review of the Quality Assurance Program for the gamma spectrometers indicated that detector operability was satisfactory (Paragraph 3).

The effluent releases and resultant doses were within Technical Specifications; 10 CFR 20, Appendix B; and 10 CFR 50, Appendix I limits. The doses to the public due to effluents ranged from less than one percent to eighteen percent of the applicable limits. The doses were similar to the doses reported for 1990 (Paragraph 4).

The licensee displayed proper health physics techniques, and were thorough and competent in the investigation of a shoe contamination received by the inspector prior to this inspection (Paragraph 5).

The equations listed in the licensee's ODCM, as amended, could be used to generate the dose factors used to calculate offsite doses due to liquid effluents (Paragraph 6).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

J. B. Breeden, Supervisor, Radiological Analysis
*E. W. Dreyer, Supervisor, Radiation Protection
*G. E. Kane, Station Manager
*P. A. Kemp, Supervisor, Licensing
*J. H. Leberstein, Licensing Engineer
*J. P. Smith, Manager, Quality Assurance
*A. H. Stafford, Superintendent of Radiation Protection
*J. A. Stall, Assistant Station Manager
*F. L. Thomlassen, Corporate Radiation Protection

Other licensee employees contacted during this inspection included engineers, technicians, and administrative personnel.

Nuclear Regulatory Commission

*R. D. Haag, Senior Resident Inspector, Summer Power Station

*Attended exit interview

2. Licensee Action on Previously Identified Items (84750)

(Closed) Unresolved Item 50-338/90-18-03: Gas Stripper Inoperability and Potential for Unmonitored Release.

The inspector reviewed the licensee's resolution of this item. The gas strippers purpose was to remove entrained and dissolved gases from reactor coolant during letdown. The stripped liquid would then be stored in the Boron Recovery Tanks (BRT), and the stripped radioactive gas would be routed to the Waste Gas Decay Tanks (WGDT). This issue involved the use of the Gas Strippers without the use of steam to aid in the stripping process. This meant that the entrained gases may remain with the liquid being routed to the BRTs. In the BRTs the gas would diffuse out of the liquid, and would be swept into the process vent system (a monitored release point).

The North Anna Updated Final Safety Analysis Report (UFSAR), states in section 11.2.[illegible].2 "All of the noble gases are stripped prior to entering the boron recovery tank and are not available for release from the boron recovery tanks." During this inspection, the inspector reviewed the licensee's 10 CFR 50.59 safety evaluation of the gas stripper not being operated as described in the UFSAR. The licensee concluded that the operation of the Boron Recovery System without steam aiding the gas stripping operation did

not constitute an unreviewed safety question. The licensee determined that the consequences of a BRT rupture would be bounded by a rupture of the WGDT; and that the possibility for an accident or malfunction of a different type had not been created.

The inspector reviewed studies performed by the licensee indicating that a large portion of the radioactive gases from the RC letdown were removed from the liquid and routed to the WGDTs without the aid of the steam stripping. In addition, the inspector reviewed offsite gamma air doses and beta air doses for 1990 and 1991, and determined that these reported doses were less than 2 percent of the limits specified in 10 CFR 50, Appendix I for an operating nuclear power plant (10 millirad gamma, 20 millirad beta, per unit). Thus the releases met the criterion "As low as is Reasonably Achievable," specified in 10 CFR 50, Appendix I.

The inspector also determined that the licensee was in the process of amending their UFSAR to reflect current operating conditions of the Boron Recovery System. These changes were targeted to be completed by August 31, 1992.

3. Confirmatory Measurements (84750)

10 CFR 20.201(b) requires the licensee to perform surveys as necessary to evaluate the extent of radiation hazards.

The licensee uses their measurements of effluent streams to assess doses to the public resulting from the operation of the plant. In order for the licensee to assess the doses to the public accurately, it is imperative that the measurements of the different effluent streams be representative and accurate.

Pursuant to these requirements, the inspector evaluated the licensee's analytical capabilities to make accurate radioactivity measurements. During this inspection, samples of reactor coolant and selected liquid and gaseous process streams were collected and the resultant sample matrices were analyzed for radionuclide concentrations using the licensee's counting laboratory and the NRC Region II mobile laboratory gamma spectroscopy system. The purpose of these comparative measurements was to verify the licensee's capability to measure quantities of radionuclides accurately in various plant systems.

Analyses were conducted using the licensee's three intrinsic germanium gamma spectroscopy systems. Sample types and counting geometries included the following:

a. reactor coolant (Unit 2 cold leg): 50-milliliter bottle;
b. liquid waste (High Level Waste Tank B): 1250 milliliter marinelli;
c. gaseous waste (waste gas decay tank): one liter marinelli counted as a single unit;
d. airborne particulate (steam generator air sample, Unit 1); particulate filter;
e. a spiked charcoal cartridge (provided by the NRC).

A comparison of licensee and NRC results are listed in Attachment 1, Table 1 with the acceptance criteria listed in Attachment 2. The results were in agreement for all sample streams analyzed.

As part of the confirmatory measurements inspection, the inspector also reviewed the licensee's Quality Assurance Program for their gamma spectrometers. This review was performed to ensure compliance with selected and applicable portions of Regulatory Guide 4.15, Quality Assurance for Radiochemistry Monitoring Programs (normal operations) - Effluent Streams and the Environment, Rev. 1, February 1978. the following observations were made:

1). Energy calibrations and full-width half max (resolution) determinations were performed daily. The values obtained were recorded and trended on control charts with predetermined limits in order to determine detector stability and operability. The warning limits were set at two standard deviations and the control limits were set at three standard deviations.

2). A one hour background count was performed weekly to verify lower limits of detection.

3). A ten minute daily background count was performed to verify that the detectors had not become contaminated.

The inspector also briefly reviewed the last calibration package for one of the detectors. The inspector also reviewed the results of the licensee's quarterly cross-check program. Based on this review, the inspector concluded that overall operability of the detectors was satisfactory.

No violations or deviations were identified.

4. Semi-Annual Effluent Report (84750)

Technical Specification 6.9.1.9 requires the submittal of routine Radioactive Effluent Release Reports covering the operation of the units during the previous six months of

operation. These reports summarize the amounts of liquid and gaseous effluents released from the site and assess the dose to offsite populations from these effluents.

Pursuant to these requirements, a summary of the effluent releases for 1989, 1990, and 1991 are presented below. The licensee reported that there were no unplanned releases in 1990, as defined in 10 CFR 50.73. There were no instances of radiation monitor inoperability of greater than 30 days.

A summary of the effluent releases and associated calculated annual radiation doses to the public for 1989, 1990 and 1991 are presented in Attachment 3 and 4 respectively. The doses to the public due to these effluents ranged from less than one percent to eighteen percent of the applicable limits. The doses were similar to the doses reported for 1990.

In conclusion, the effluent releases and resultant doses were within Technical Specifications; 10 CFR 20, Appendix B; and 10 CFR 50, Appendix I limits.

No violations or deviations were identified.

5. Shoe Contamination

During this inspection, the inspector identified fixed contamination on her shoe using a GM frisker upon exiting the mobile laboratory. An investigation by the licensee indicated that this contamination (approximately 0.4 nanocuries U-238/U-235, 2-3 percent enriched) probably originated from another licensed facility, most likely a fuel manufacturing plant. The contamination was not identified by the site's portal or hand and foot monitors because of the deposition of the contamination on top of the shoe, and because of the low gamma energy of the contaminant. The licensee performed surveys of the mobile laboratory and of the inspector's rental car and did not detect any fixed or removable contamination and/or elevated background levels. No overexposures or internal intakes were identified as a result of this contamination. The shoe was disposed of by the licensee as radioactive waste. The licensee was not required to file a report with the NRC.

The inspector concluded that the licensee displayed proper health physics techniques, and were thorough and competent in the investigation of this incident. The inspector appreciated the support and cooperation received in dealing with this incident.

6. Dose Assessment (84750)

The Offsite Dose Calculation Manual establishes the requirements for the Radioactive Effluent and Radiological Environmental Monitoring Programs. This manual includes the methods and parameters for the calculation of offsite doses resulting from radioactive gaseous and liquid effluents. These calculations are performed to verify that the concentrations of effluents to the unrestricted area, and the resultant doses at the site boundary or to the maximum exposed member of the public, will not exceed the applicable regulatory limits.

Inspection Report 50-338, 339/91-13 detailed the results of a previous inspection in this area. The licensee's assessment of radiation doses to the maximum exposed member of the public due to gaseous effluents for all four quarters of 1990 were verified. This included the noble gas gamma dose, the noble gas beta dose, and the critical organ dose for iodine-131, tritium, and particulates with a half life greater than eight days. Excellent agreement was achieved between the licensee's reported doses, and the doses calculated by the NRC computer program.

Because of the complexity of the calculations, and the complexity of calculating the recirculation of Lake Anna due to its relatively small volume, the inspector was not able to verify the doses due to liquid effluents reported in the 1990 Semiannual Report by using the NRC computer modules.

During the current inspection the inspector verified the licensee's ingestion dose factors, used to calculate doses due to liquid effluents. These factors, and the equations used to generate them, were listed in the ODCM. This verification was performed by hand calculations of the dose factors using these equations; as well as the use of a computer spreadsheet. The inspector was aided in this task by a NRC contractor (by telephone).

These calculations identified that two of the equations listed in the ODCM were not correct. Two other minor discrepancies were also noted. When these errors were corrected, the licensee's and the NRC's values for these dose factors were in agreement. However, it should be recognized that the dose factors used by the licensee in their computerized dose calculation program were not in error. The licensee verbally committed to amend the documentation supporting their dose calculations so that it would be correct and consistent with their computerized methods.

In conclusion, the inspector determined that the equations listed in the licensee's ODCM, when amended, could be used to generate the dose factors used calculate offsite doses due to liquid effluents.

No violations or deviations were identified.

7. Exit Interview

The inspection scope and results were summarized on February 28, 1992 with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results as listed in the summary. Unresolved Item 50-338/90-18-03: Gas Stripper Inoperability and Potential for Unmonitored Release; was closed. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

8. Acronyms and Initialisms

BRT	- Boron Recovery Tank
CFR	- Code of Federal Regulation
mRad	- millirad
mRem	- millirem
No.	- number
NRC	- Nuclear Regulatory Commission
ODCM	- Offsite Dose Calculation Manual
RC	- Reactor Coolant
TS	- Technical Specification
UFSAR	- Updated Final Safety Analysis Report
WGDT	- Waste Gas Decay Tank

ATTACHMENT 1
TABLE 1

NORTH ANNA - 2/26/92

NRC-LICENSEE SAMPLE COMPARISON EVALUATION

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Reactor	#1	Cs-58	4.75E-3	(4.31±0.42)E-3	10	1.10	Agreement
Coolant		Cs-134	2.31E-3	(1.57±0.23)E-3	7	1.47	Agreement
		Cs-137	2.48E-3	(2.18±0.29)E-3	8	1.14	Agreement
		Cs-138	1.45E-1	(1.48±0.06)E-1	25	0.98	Agreement
		I-131	8.25E-3	(6.69±0.62)E-3	11	1.23	Agreement
		I-132	3.51E-2	(3.91±0.22)E-2	18	0.90	Agreement
		I-133	2.29E-2	(2.17±0.13)E-2	17	06	Agreement
		I-134	5.60E-2	(5.87±0.24)E-2	24	0.95	Agreement
		I-135	3.64E-2	(3.05±0.21)E-2	15	1.19	Agreement
		Mn-54	6.25E-3	(5.45±0.43)E-3	13	1.15	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Reactor	#2	Cs-58	4.41E-3	(4.31±0.42)E-3	10	1.02	Agreement
Coolant		Cs-134	1.83E-3	(1.57±0.23)E-3	7	1.16	Agreement
		Cs-137	2.16E-3	(2.18±0.29)E-3	8	0.99	Agreement
		Cs-138	1.43E-1	(1.48±0.06)E-1	25	0.97	Agreement
		I-131	7.12E-3	(6.69±0.62)E-3	11	1.06	Agreement
		I-132	3.62E-2	(3.91±0.22)E-2	18	0.92	Agreement
		I-133	2.28E-2	(2.17±0.13)E-2	17	1.05	Agreement
		I-134	5.81E-2	(5.87±0.24)E-2	24	0.99	Agreement
		I-135	3.78E-2	(3.05±0.21)E-2	15	1.23	Agreement
		Mn-54	5.83E-3	(5.45±0.43)E-3	13	1.07	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Reactor	#3	Cs-58	4.39E-3	(4.31±0.42)E-3	10	1.02	Agreement
Coolant		Cs-134	2.05E-3	(1.57±0.23)E-3	7	1.31	Agreement
		Cs-137	2.23E-3	(2.18±0.29)E-3	8	1.02	Agreement
		Cs-138	1.51E-1	(1.48±0.06)E-1	25	1.02	Agreement
		I-131	8.36E-3	(6.69±0.62)E-3	11	1.25	Agreement
		I-132	3.59E-2	(3.91±0.22)E-2	18	0.92	Agreement
		I-133	2.20E-2	(2.17±0.13)E-2	17	1.01	Agreement
		I-134	6.00E-2	(5.87±0.24)E-2	24	1.02	Agreement
		I-135	3.90E-2	(3.05±0.21)E-2	15	1.28	Agreement
		Mn-54	5.37E-3	(5.45±0.43)E-3	13	0.99	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Liquid	#1	Co-57	1.83E-6	(1.41±0.40)E-6	4	1.30	Agreement
Waste		Co-58	2.80E-4	(2.65±0.09)E-4	29	1.06	Agreement
		Co-60	8.05E-4	(7.57±0.24)E-4	32	1.06	Agreement
		Cs-134	4.76E-5	(4.47±0.23)E-5	19	1.06	Agreement
		Cs-137	1.10E-4	(1.15±0.05)E-4	23	0.96	Agreement
		Mn-54	4.66E-5	(3.97±0.16)E-5	25	1.17	Agreement
		Nb-95	1.10E-5	(1.09±0.09)E-5	12	1.01	Agreement
		Sb-125	8.04E-5	(7.12±0.38)E-5	19	1.13	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Liquid Waste	#2	Co-57	1.26E-6	(1.41±0.40)E-6	4	0.89	Agreement
		Co-58	2.79E-4	(2.65±0.09)E-4	29	1.05	Agreement
		Co-60	8.41E-4	(7.57±0.24)E-4	32	1.11	Agreement
		Cs-134	4.82E-5	(4.47±0.23)E-5	19	1.08	Agreement
		Cs-137	1.13E-4	(1.15±0.05)E-4	23	0.98	Agreement
		Mn-54	5.07E-5	(3.97±0.16)E-5	25	1.28	Agreement
		Nb-95	1.24E-5	(1.09±0.09)E-5	12	1.14	Agreement
		Sb-125	9.30E-5	(7.12±0.38)E-5	19	1.31	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Liquid Waste	#3	Co-57	1.51E-6	(1.41±0.40)E-6	4	1.07	Agreement
		Co-58	2.78E-4	(2.65±0.09)E-4	29	1.05	Agreement
		Co-60	8.36E-4	(7.57±0.24)E-4	32	1.10	Agreement
		Cs-134	4.58E-5	(4.47±0.23)E-5	19	1.02	Agreement
		Cs-137	1.12E-4	(1.15±0.05)E-4	23	0.97	Agreement
		Mn-54	4.95E-5	(3.97±0.16)E-5	25	1.25	Agreement
		Nb-95	1.11E-5	(1.09±0.09)E-5	12	1.02	Agreement
		Sb-125	9.28E-5	(7.12±0.38)E-5	19	1.30	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Gaseous Waste	#1	Kr-85	8.62E-2	(9.52±1.17)E-2	8	0.91	Agreement
		Xe-131M	6.06E-2	(4.80±0.32)E-2	15	1.26	Agreement
		Xe-133	1.75E-0	(2.08±0.06)E-0	35	0.84	Agreement
		Xe-133M	6.21E-3	(3.99±0.32)E-3	12	1.56	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Gaseous	#2	Kr-85	8.75E-2	(9.52±1.17)E-2	8	0.92	Agreement
Waste		Xe-131M	5.15E-2	(4.80±0.32)E-2	15	1.07	Agreement
		Xe-133	1.90E-0	(2.08±0.06)E-0	35	0.91	Agreement
		Xe-133M	6.36E-3	(3.99±0.32)E-3	12	1.59	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Gaseous	#3	Kr-85	7.14E-2	(9.52±1.17)E-2	8	0.75	Agreement
Waste		Xe-131M	6.58E-2	(4.80±0.32)E-2	15	1.37	Agreement
		Xe-133	1.70E-0	(2.08±0.06)E-0	35	0.82	Agreement
		Xe-133M	6.60E-3	(3.99±0.32)E-3	12	1.65	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Airborne	#1	Co-57	3.46E-4	(3.19±0.50)E-4	6	1.08	Agreement
Particulate		Co-58	5.13E-2	(4.79±0.16)E-2	30	1.07	Agreement
		Co-60	6.57E-2	(6.51±0.22)E-2	30	1.01	Agreement
		Mn-54	1.90E-3	(2.20±0.19)E-3	12	0.86	Agreement
		Nb-95	6.02E-3	(5.40±0.30)E-3	18	1.11	Agreement
		Zr-95	3.37E-3	(2.80±0.32)E-3	9	1.20	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Airborne	#2	Co-57	1.82E-4	(3.19±0.50)E-4	6	0.57	Agreement
Particulate		Co-58	4.97E-2	(4.79±0.16)E-2	30	1.04	Agreement
		Co-60	6.62E-2	(6.51±0.22)E-2	30	1.02	Agreement
		Mn-54	2.16E-3	(2.20±0.19)E-3	12	0.98	Agreement
		Nb-95	5.64E-3	(5.40±0.30)E-3	18	1.04	Agreement
		Zr-95	3.22E-3	(2.80±0.32)E-3	9	1.15	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Airborne	#3	Co-57	2.38E-4	(3.19±0.50)E-4	6	0.75	Agreement
Particulate		Co-58	4.86E-2	(4.79±0.16)E-2	30	1.01	Agreement
		Co-60	6.37E-2	(6.51±0.22)E-2	30	0.98	Agreement
		Mn-54	2.00E-3	(2.20±0.19)E-3	12	0.91	Agreement
		Nb-95	5.32E-3	(5.40±0.30)E-3	18	0.99	Agreement
		Zr-95	3.77E-3	(2.80±0.32)E-3	9	1.35	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Charcoal	#1	Cd-109	4.49E-1	(4.76±0.13)E-1	37	0.94	Agreement
Cartridge		Co-57	7.27E-3	(7.31±0.24)E-3	30	0.99	Agreement
(NRC Spike)		Co-60	4.70E-2	(4.60±0.[illegible]E-2	29	1.02	Agreement
		Cs-137	4.98E-2	(4.63±0.20)E-2	23	1.08	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Charcoal	#2	Cd-109	4.450E-1	(4.76±0.13)E-1	37	0.95	Agreement
Cartridge		Co-57	7.99E-3	(7.31±0.24)E-3	30	1.09	Agreement
(NRC Spike)		Co-60	5.02E-2	(4.60±0.16)E-2	29	1.09	Agreement
		Cs-137	4.81E-2	(4.63±0.20)E-2	23	1.04	Agreement

Sample	Detector	Isotope	Concentration (uCi/unit) Licensee	NRC	Resolution	Licensee/NRC	Comparison
Charcoal	#3	Cd-109	4.16E-1	(4.76±0.13)E-1	37	0.87	Agreement
Cartridge		Co-57	7.41E-3	(7.31±0.24)E-3	30	1.01	Agreement
(NRC Spike)		Co-60	4.47E-2	(4.60±0.16)E-2	29	0.97	Agreement
		Cs-137	4.64E-2	(4.63±0.20)E-2	23	1.00	Agreement

ATTACHMENT 2

CRITERIA FOR COMPARISONS OF ANALYTICAL MEASUREMENTS

This attachment provides criteria for the comparison of results of analytical radioactivity measurements. These criteria are based on empirical relationships which combine prior experience in comparing radioactivity analyses, the measurement of the statistically random process of radioactive emission, and the accuracy needs of this program.

In these criteria, the "Comparison Ratio Limits"[1] denoting agreement or disagreement between licensee and NRC results are variable. This variability is a function of the ratio of the NRC's analytical value relative to its associated statistical and analytical uncertainty, referred to in this program as "Resolution"[2].

For comparison purposes, a ratio between the licensee's analytical value and the NRC's analytical value is computed for each radionuclide present in a given sample. The computed ratios are then evaluated for agreement or disagreement based on "Resolution." The corresponding values for "Resolution" and the "Comparison Ratio Limits" are listed in the Table below. Ratio values which are either above or below the "Comparison Ratio Limits" are considered to be in disagreement, while ratio values within or encompassed by the "Comparison Ratio Limits" are considered to be in agreement.

TABLE

NRC Confirmatory Measurements Acceptance Criteria
Resolution vs. Comparison Ratio Limits

Resolution	Comparison Ratio Limits for Agreement
<4	0.4 - 2.5
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

[1]Comparison Ratio = $\frac{\text{Licensee Value}}{\text{NRC Reference Value}}$

[2]Resolution = $\frac{\text{NRC Reference Value}}{\text{Associated Uncertainty}}$

ATTACHMENT 3

North Anna Units 1 and 2 Radioactive Effluent Summary

	1989	1990	1991
No. of Unplanned Releases			
a. Liquid	0	0	0
b. Gas	0	0	0
Activity Released (Curies)			
a. Gaseous			
1. Fission and Activation Gases	1.44E+03	9.53E+02	2.24E+03
2. Iodines	3.76E-03	6.31E-03	2.55E-03
3. Particulates	5.68E-04	5.95E-04	1.46E-04
4. Tritium	1.22E+02	3.10E+01	4.90E+01
b. Liquid			
1. Fission and Activation Gases	1.17E+00	6.74E-01	3.20E-01
2. Tritium	1.40E+03	1.67E+03	1.16E+03
3. Gross Alpha	<LLD	<LLD	2.18E-04
c. Volume of Liquid Wastes Released Prior to Dilution (liters)	2.75E+08	3.62E+08	3.17E+08

ATTACHMENT 4

North Anna Units 1 and 2 Annual Doses

Annual Dose Totals	1989	1990	1991
a. Liquid Effluents			
1. Total Body (mRem)	3.08E+00	6.33E-	5.27-01
2. Critical Organ (mRem)	4.18E+00	7.08E-01	6.26-01
b. Gaseous Effluents			
1. Noble Gas Gamma (mRad)	1.01E-01	4.96E-02	1.51-01
2. Noble Gas Beta (mRad)	2.26E-01	1.16E-01	3.38-01
3. Critical Organ (mRem)	1.80E-01	2.92E-01	1.19-01