

VIRGINIA ELECTRIC AND POWER COMPANY  
RICHMOND, VIRGINIA 23261

April 14, 2005

United States Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, D. C. 20555

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Gentlemen:

**VIRGINIA ELECTRIC AND POWER COMPANY**  
**NORTH ANNA POWER STATION UNITS 1 AND 2 AND**  
**INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)**  
**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

The enclosed, Annual Radioactive Effluent Release Report for the reporting period January 1, 2004, through December 31, 2004, is provided in accordance with 10 CFR 50.36a, North Anna Units 1 and 2 Technical Specification 5.6.3, and 10 CFR 72.44(d)(3), relative to North Anna Independent Spent Fuel Storage Installation Technical Specification 5.5.2.c.

If you have any questions or require additional information, please contact Page Kemp at (540) 894-2295.

Very truly yours,



J. M. Davis  
Site Vice President

Enclosure

Commitments made in this letter: None

IE48

cc: U. S. Nuclear Regulatory Commission  
Region II  
Atlanta Federal Center  
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Director, Nuclear Material Safety and Safeguards  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Mr. J. T. Reece  
NRC Senior Resident Inspector  
North Anna Power Station

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
**FOR THE**  
**NORTH ANNA POWER STATION**  
**JANUARY 01, 2004 TO DECEMBER 31, 2004**

**I N D E X**

<b><u>Section No.</u></b>	<b><u>Subject</u></b>	<b><u>Page</u></b>
1	EXECUTIVE SUMMARY.....	1 - 2
2	PURPOSE AND SCOPE.....	2
3	DISCUSSION.....	3 - 4
4	SUPPLEMENTAL INFORMATION.....	4
Attachment 1	- Effluent Release Data.....	5
Attachment 2	- Annual and Quarterly Doses.....	6
Attachment 3	- Revisions to Offsite Dose Calculation Manual (ODCM).....	7
Attachment 4	- Major Changes to Radioactive Liquid, Gaseous, and Solid Waste Treatment Systems.....	8
Attachment 5	- Inoperability of Radioactive Liquid and Gaseous Effluent Monitoring Instrumentation.....	9
Attachment 6	- Unplanned Releases.....	10
Attachment 7	- Lower Limits of Detection (LLD) for Effluent Sample Analysis.....	11 - 12

## 1.0 EXECUTIVE SUMMARY

The Annual Radioactive Effluent Release Report describes the radioactive effluent control program conducted at the North Anna Power Station and Independent Spent Fuel Storage Installation (ISFSI) during the 2004 calendar year. This document summarizes the quantities of radioactive liquid and gaseous effluents and solid waste released from the North Anna Power Station and ISFSI in accordance with R.G. 1.21 during the period January 1 through December 31, 2004, and includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents. There were no releases from the ISFSI during 2004.

There were no unplanned releases, either liquid or gaseous, meeting the reporting criteria of section 6.7.2.a.3 of the Offsite Dose Calculation Manual during this reporting period.

Based on the 2004 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:

- a. The total body dose due to liquid effluents was  $3.23\text{E-}1$  mrem, which is  $5.39\text{E+}0\%$  of the dose limit and the critical organ dose due to liquid effluents was  $4.31\text{E-}1$  mrem, which is  $2.15\text{E+}0\%$  of the dose limit.
- b. The air dose due to noble gases was  $8.51\text{E-}4$  mrad gamma, which is  $4.26\text{E-}3\%$  of the annual gamma dose limit, and  $3.24\text{E-}3$  mrad beta, which is  $8.10\text{E-}3\%$  of the annual beta dose limit.
- c. The critical organ dose for I-131, I-133, H-3, and Particulates with half-lives greater than 8 days was  $1.17\text{E-}2$  mrem, which is  $3.89\text{E-}2\%$  of the annual dose limit.

There was no major change to radioactive liquid and solid waste treatment systems during this reporting period. Changes to the gaseous waste treatment system are explained in Attachment 4.

There was 1 revision to the Offsite Dose Calculation Manual during this reporting period. Attachment 3 provides the changes to VPAP-2103N.

## 1.0 EXECUTIVE SUMMARY (cont.)

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, 2, and ISFSI 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 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 for Table 1 and 2 and on an annual basis on Table 3. 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, 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 FSAR updates.

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 the 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  $2.0E-4$   $\mu\text{Ci/ml}$ .

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 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 a child. The total body dose was determined for this individual. The critical organ was determined to be the child liver.

As shown in Attachment 6 there were no unplanned gaseous or unplanned liquid releases meeting the requirements of 6.7.2.a.3 of the ODCM.

### **3.0 DISCUSSION (cont.)**

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. No changes were made.

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 stations 14, 15, 16, 21, 23 and 26, as applicable, were not collected for the months of January, February, March, April, October, November and December 2004 due to seasonal unavailability. All other milk and vegetation samples were obtained and analyzed as required during the time period covered by this report.

**ATTACHMENT 1**  
**EFFLUENT RELEASE DATA**  
**(01/04 - 12/04)**

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, except that in accordance with Step 6.7.2.a.1 of the ODCM liquid and gaseous data is summarized on a quarterly basis and solid waste is summarized on an annual basis.

**TABLE 1A**  
**NORTH ANNA POWER STATION**  
**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
**SUMMATION OF ALL GASEOUS EFFLUENT RELEASES FOR (01/04 - 12/04)**

	UNITS	1 ST QUARTER	2 ND QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. <u>Fission and Activation Gases:</u></b>				
1. Total Release	Curies	9.95E-01	1.58E+01	1.80E+1
2. Average Release Rate For Period	μCi/sec	1.27E-01	2.01E+00	
<b>B. <u>Iodines:</u></b>				
1. Total Iodine-131 Release	Curies	N/D	1.72E-04	2.80E+1
2. Average Release Rate For Period	μCi/sec	N/D	2.19E-05	
<b>C. <u>Particulate (T<sub>1/2</sub> &gt; 8 days):</u></b>				
1. Total Particulate (T <sub>1/2</sub> > 8 days) Release	Curies	3.50E-07	1.89E-05	2.80E+1
2. Average Release Rate For Period	μCi/sec	4.45E-08	2.40E-06	
3. Gross Alpha Radioactivity Release	Curies	6.16E-07	3.44E-07	
<b>D. <u>Tritium:</u></b>				
1. Total Release	Curies	4.46E+00	2.29E+01	3.10E+1
2. Average Release Rate For Period	μCi/sec	5.67E-01	2.92E+00	
<b>E. <u>Percentage Of Technical Specification Limits</u></b>				
1. Total Body Dose Rate	%	1.21E-05	5.15E-04	
2. Skin Dose Rate	%	4.28E-06	2.70E-04	
3. Critical Organ Dose Rate	%	3.01E-04	2.20E-03	







**TABLE 2A**  
**NORTH ANNA POWER STATION**  
**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
**LIQUID EFFLUENT - SUMMATION OF ALL RELEASES FOR (01/04 - 12/04)**

	UNITS	1 ST QUARTER	2 ND QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. <u>Fission and Activation Products:</u></b>				
1. Total Release (not including tritium, noble gas, and gross alpha).	Curies	2.71E-02	7.18E-02	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	8.36E-11	1.31E-10	
3. Percent of applicable limit (T.S.)	%	6.70E-05	1.11E-04	
<b>B. <u>Tritium:</u></b>				
1. Total release activity.	Curies	4.06E+02	3.10E+02	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	1.25E-06	5.65E-07	
3. Percent of applicable limit (T.S.)	%	1.25E-02	5.65E-03	
<b>C. <u>Dissolved and Entrained Gases:</u></b>				
1. Total release activity.	Curies	N/D	2.51E-04	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	N/D	4.57E-13	
3. Percent of applicable limit (T.S.)	%	N/D	2.29E-07	
<b>D. <u>Gross Alpha Radioactivity:</u></b>				
1. Total release activity.	Curies	N/D	N/D	2.00E+01
<b>E. <u>Volume of waste released: prior to dilution).</u></b>				
	Liters	1.31E+08	1.62E+08	3.00E+00
<b>F. <u>Total volume of dilution water used during the period.</u></b>				
	Liters	3.24E+11	5.49E+11	3.00E+00

**TABLE 2A**  
**NORTH ANNA POWER STATION**  
**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
**LIQUID EFFLUENT - SUMMATION OF ALL RELEASES FOR (01/04 - 12/04)**

	UNITS	3 RD QUARTER	4 TH QUARTER	ESTIMATED TOTAL PERCENT ERROR (%)
<b>A. <u>Fission and Activation Products:</u></b>				
1. Total Release (not including tritium, noble gas, and gross alpha).	Curies	5.96E-02	5.42E-02	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	8.37E-11	1.57E-11	
3. Percent of applicable limit (T.S.)	%	8.04E-05	3.15E-05	
<b>B. <u>Tritium:</u></b>				
1. Total release activity.	Curies	3.26E+02	7.29E+01	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	4.58E-07	2.11E-08	
3. Percent of applicable limit (T.S.)	%	4.58E-03	2.11E-04	
<b>C. <u>Dissolved and Entrained Gases:</u></b>				
1. Total release activity.	Curies	N/D	4.00E-04	2.00E+01
2. Average diluted concentration during the period.	μCi/ml	N/D	1.16E-13	
3. Percent of applicable limit (T.S.)	%	N/D	5.79E-08	
<b>D. <u>Gross Alpha Radioactivity:</u></b>				
1. Total release activity.	Curies	N/D	N/D	2.00E+01
<b>E. <u>Volume of waste released: prior to dilution).</u></b>				
	Liters	1.11E+08	1.39E+08	3.00E+00
<b>F. <u>Total volume of dilution water used during the period.</u></b>				
	Liters	7.12E+11	3.46E+12	3.00E+00



**TABLE 3**  
**NORTH ANNA POWER STATION**  
**RADIOACTIVE EFFLUENT RELEASE REPORT**  
**SUMMATION OF SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS**  
**FOR 01-01-04 THROUGH 12-31-04**

**3. Solid Waste Disposition**

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
3	Truck	Barnwell, SC
6	Truck	Oak Ridge, TN (Duratek)

**B. Irradiated Fuel Shipments (Disposition)**

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
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No shipments of Irradiated Nuclear Fuel were made in 2003.

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\* (2) shipments containing resins were shipped to a licensed waste processor for processing.

\*\* (5) shipments containing contaminated equipment, dry compressible waste / incinerable waste were shipped to a licensed waste processor for processing and/or volume reduction.

\*\*\* (1) shipment containing oil was shipped to a licensed waste processor for disposal.

**ATTACHMENT 2**  
**ANNUAL AND QUARTERLY DOSES**  
**(01/04 - 12/04)**

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 as required by ODCM Section 6.7.2.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
<b>Total Body Dose (mrem)</b>	1.09E-1	9.75E-2	9.08E-2	2.61E-2	3.23E-1
<b>Critical Organ Dose (mrem)</b>	1.45E-1	1.30E-1	1.21E-1	3.47E-2	4.31E-1

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
<b>Noble Gas Gamma Dose (mrad)</b>	1.75E-5	7.57E-4	7.40E-5	2.20E-6	8.51E-4
<b>Noble Gas Beta Dose (mrad)</b>	4.07E-5	2.84E-3	3.52E-4	1.15E-5	3.24E-3
<b>Critical Organ Dose for I-131, I-133, H-3, Particulates with T<sub>1/2</sub> &gt; 8 days (mrem)</b>	2.13E-4	9.14E-3	1.53E-3	7.82E-4	1.17E-2

**ATTACHMENT 3**

**REVISIONS TO OFFSITE DOSE CALCULATION MANUAL**

**(ODCM)**

**(01/04 - 12/04)**

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.

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There was one revision made to the ODCM in 2004.

Revision 8, which was effective 05/12/2004, corrected the distances from Unit 1 containment of certain environmental sample locations.



# Station Administrative Procedure

**Title: Offsite Dose Calculation Manual (North Anna)**

**Process / Program Owner: Manager Radiological Protection (North Anna)**

**Procedure Number  
VPAP-2103N**

**Revision Number  
8**

**Effective Date  
On File**

## Revision Summary

*Effective Date  
5/12/2004*

Revised Environmental Sampling Locations (Attachment 10) to update sample media distance from Unit 1 and remarks column.

### Details:

- Revised Environmental Sampling Locations (Attachment 10) to update sample media distance from Unit 1 and remarks column:
- Revised environmental TLDs distance for Good Hope Church, Biology Lab, Route 700 SW, and Route 208.
- Revised surface water distance for Waste Heat Treatment Facility (WHTF).
- Revised ground water distance for Biology Lab.
- Revised aquatic sediment distance for WHTF.
- Revised shoreline soil distance for Lake Anna.
- Revised fish distance for WHTF.
- Removed "Control" from Bumpass Post Office and Mineral, VA remarks column.

North Anna Radiological Protection is required to submit each revision of this procedure to the Management Safety Review Committee (MSRC) Coordinator.

**Approvals on File**

**TABLE OF CONTENTS (continued)**

Section	Page
6.4.6 Radioactive Liquid and Gaseous Release Controls	32
<b>6.5 Total Dose Limit to Public From Uranium Fuel Cycle Sources</b>	<b>34</b>
<b>6.6 Radiological Environmental Monitoring</b>	<b>34</b>
6.6.1 Monitoring Program	34
6.6.2 Land Use Census	36
6.6.3 Interlaboratory Comparison Program	37
<b>6.7 Reporting Requirements</b>	<b>38</b>
6.7.1 Annual Radiological Environmental Operating Report	38
6.7.2 Annual Radioactive Effluent Release Report	39
6.7.3 Annual Meteorological Data	41
6.7.4 Changes to the ODCM	42
<b>7.0 RECORDS</b>	<b>43</b>

**TABLE OF CONTENTS (continued)**

Section		Page
<b>ATTACHMENTS</b>		
<b>1</b>	<b>Radioactive Liquid Effluent Monitoring Instrumentation</b>	<b>44</b>
<b>2</b>	<b>Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements</b>	<b>46</b>
<b>3</b>	<b>Radioactive Liquid Waste Sampling and Analysis Program</b>	<b>48</b>
<b>4</b>	<b>Radioactive Gaseous Waste Sampling and Analysis Program</b>	<b>51</b>
<b>5</b>	<b>Gaseous Effluent Dose Factors</b>	<b>55</b>
<b>6</b>	<b>Radioactive Gaseous Effluent Monitoring Instrumentation</b>	<b>58</b>
<b>7</b>	<b>Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements</b>	<b>61</b>
<b>8</b>	<b>Critical Organ Dose Factors</b>	<b>64</b>
<b>9</b>	<b>Radiological Environmental Monitoring Program</b>	<b>65</b>
<b>10</b>	<b>Environmental Sampling Locations</b>	<b>70</b>
<b>11</b>	<b>Detection Capabilities for Environmental Sample Analysis</b>	<b>74</b>
<b>12</b>	<b>Reporting Levels for Radioactivity Concentrations in Environmental Samples</b>	<b>76</b>
<b>13</b>	<b>Meteorological, Liquid, and Gaseous Pathway Analysis</b>	<b>77</b>

## 1.0 PURPOSE

The Offsite Dose Calculation Manual (ODCM) establishes requirements for the Radioactive Effluent and Radiological Environmental Monitoring Programs. Methodology and parameters are provided to calculate offsite doses resulting from radioactive gaseous and liquid effluents, to calculate gaseous and liquid effluent monitoring alarm / trip setpoints, and to conduct the Environmental Monitoring Program. Requirements are established for the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by Station Technical Specifications. Calculation of offsite doses due to radioactive liquid and gaseous effluents are performed to assure that:

- Concentration of radioactive liquid effluents to the unrestricted area will be limited to ten times the effluent concentration values of 10 CFR 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases and  $2E-4$   $\mu\text{Ci/ml}$  for dissolved or entrained noble gases.
- Exposure to the maximum exposed member of the public in the unrestricted area from radioactive liquid effluents will not result in doses greater than the liquid dose limits of 10 CFR 50, Appendix I
- Dose rate at and beyond the site boundary from radioactive gaseous effluents will be limited to:
  - Noble gases – less than or equal to a dose rate of 500 mrem/yr to the total body and less than or equal to a dose rate of 3000 mrem/yr to the skin
  - $I^{131}$ ,  $I^{133}$ , and  $H^3$ , and all radionuclides in particulate form with half-lives greater than 8 days – less than or equal to a dose rate of 1500 mrem/yr to any organ
- Exposure from radioactive gaseous effluents to the maximum exposed member of the public in the unrestricted area will not result in doses greater than the gaseous dose limits of 10 CFR 50, Appendix I, and
- Exposure to a real individual will not exceed 40 CFR 190 dose limits

## 2.0 SCOPE

This procedure applies to the Radioactive Effluent and Environmental Monitoring Programs at North Anna Power Station.

- 3.1.19 Environmental Measurements Laboratory, DOE HASL 300 Manual
- 3.1.20 NRC Generic Letter 89-01, Implementation of Programmatic Controls for Radiological Effluent Technical Specifications (RETS) in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program
- 3.1.21 North Anna UFSAR
- 3.1.22 Nuclear Reactor Environmental Radiation Monitoring Quality Control Manual, IWL-0032-361
- 3.1.23 VPAP-2802, Notifications and Reports
- 3.1.24 North Anna Circulating Water System Modifications
  - a. DC-85-37-1 Unit 1
  - b. DC-85-38-2 Unit 2
- 3.1.25 Plant Issue (Deviation) N-1994-1137, Improper Placement of Emergency TLDs

## **3.2 Commitment Documents**

- 3.2.1 Quality Assurance Audit Report Number C 90-22, Management Safety Review Committee, Observation 03C, January 17, 1991
- 3.2.2 Quality Assurance Audit Report Number 91-03, Observation 08N
- 3.2.3 Quality Assurance Audit Report Number 92-03, Observation 02N
- 3.2.4 Quality Assurance Audit Report Number 92-03, Observation 04NS (Item 2)
- 3.2.5 Plant Issue (Deviation) N-1997-0926, Annual Radiological Effluent Release Report

## **4.0 DEFINITIONS**

### **4.1 Channel Calibration**

A channel calibration shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The channel calibration shall encompass all devices in the channel required for channel operability. The channel calibration may be performed by means of any series of sequential, overlapping, or total channel steps.

### **4.2 Channel Check**

A qualitative assessment, by observation, of channel behavior during operation. This assessment includes, where possible, comparison of the channel indication and status with other indications or status derived from independent instrumentation channels measuring the same parameter.

#### 4.3 Channel Operational Test

A Channel Operational Test (COT) shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY. The COT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for channel OPERABILITY such that setpoints are within the necessary range and accuracy. The COT may be performed by means of any series of sequential, overlapping, or total channel steps.

#### 4.4 Critical Organ

That organ, which has been determined to be the maximum exposed organ based on an effluent pathway analysis, thereby ensuring the dose and dose rate limitations to any organ will not be exceeded. Dose calculations to the critical organ will be evaluated in accordance with Technical Specifications 5.5.4 dose rate limits specified for any organ to verify these limits have not been exceeded.

#### 4.5 Dose Equivalent I-131

That concentration of  $I^{131}$  ( $\mu\text{Ci}/\text{cc}$ ) that alone would produce the same thyroid dose as the quantity and isotopic mixture of  $I^{131}$ ,  $I^{132}$ ,  $I^{133}$ ,  $I^{134}$ , and  $I^{135}$  actually present. Thyroid dose conversion factors for this calculation are listed in Table III of TID-14844, Calculation of Distance Factors for Power and Test Reactor Sites. Thyroid dose conversion factors from NRC Regulatory Guide 1.109, Revision 1, may be used.

**4.10 Members of the Public**

Individuals who, by virtue of their occupational status, have no formal association with the Station. This category includes non-employees of Dominion who are permitted to use portions of the site for recreational, occupational, or other purposes not associated with Station functions. This category does not include non-employees such as vending machine servicemen or postal workers who, as part of their formal job function, occasionally enter an area that is controlled by Dominion to protect individuals from exposure to radiation and radioactive materials.

**4.11 Operable - Operability**

A system, subsystem, train, component, or device is operable or has operability when it is capable of performing its specified functions and all necessary, attendant instrumentation, controls, normal and emergency electrical power sources, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its functions are also capable of performing their related support functions.

**4.12 Purge - Purging**

Controlled discharge of air or gas from a confinement to maintain temperature, pressure, humidity, concentration, or other operating condition, so that replacement air or gas is required to purify the confinement.

**4.13 Rated Thermal Power**

Total reactor core heat transfer rate to reactor coolant (i.e., North Anna – 2893 MWt).

**4.14 Site Boundary**

The line beyond which Dominion does not own, lease, or otherwise control the land.

**4.15 Source Check**

A qualitative assessment of channel response when a channel sensor is exposed to radiation. This applies to installed radiation monitoring systems.

**4.16 Special Report**

A report to NRC to comply with Subsections 6.2, 6.3, or 6.5 of this procedure. Also refer to VPAP-2802, Notifications and Reports.

**4.17 Thermal Power**

Total reactor core heat transfer rate to the reactor coolant.

**4.18 Unrestricted Area**

Any area at or beyond the site boundary, access to which is neither limited nor controlled by Dominion for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the site boundary used for residential quarters or for industrial, commercial, institutional and/or recreational purposes.

**4.19 Ventilation Exhaust Treatment System**

A system that reduces gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and High Efficiency Particulate Air (HEPA) filters to remove iodines and particulates from a gaseous exhaust stream prior to release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not Ventilation Exhaust Treatment System components.

**5.0 RESPONSIBILITIES****5.1 Manager Radiological Protection**

The Manager Radiological Protection is responsible for:

- 5.1.1 Establishing and maintaining procedures for surveying, sampling, and monitoring radioactive effluents and the environment.
- 5.1.2 Surveying, sampling, and analyzing plant effluents and environmental monitoring, and documenting these activities.
- 5.1.3 Analyzing plant effluent trends and recommending actions to correct adverse trends.
- 5.1.4 Preparing Effluent and Environmental Monitoring Program records.

**5.2 Manager Nuclear Operations**

The Manager Nuclear Operations is responsible for requesting samples, analyses, and authorization to release effluents.

- c. Daily concentrations of radioactive materials in liquid waste released to unrestricted areas shall meet the following:

$$\frac{\text{Volume of Waste Discharged} + \text{Volume of Dilution Water}}{\text{Volume of Waste Discharged} \times \sum_i \frac{\mu\text{Ci/ml}_i}{\text{ACW}_i}} \geq 1 \quad (1)$$

where:

$\mu\text{Ci/ml}_i$  = the concentration of nuclide  $i$  in the liquid effluent discharge

$\text{ACW}_i$  = ten times the effluent concentration value in unrestricted areas of nuclide  $i$ , expressed as  $\mu\text{Ci/ml}$  from 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than noble gases, and  $2\text{E-}4 \mu\text{Ci/ml}$  for dissolved or entrained noble gases

## 6.2.2 Liquid Monitoring Instrumentation

### a. Radioactive Liquid Effluent Monitoring Instrumentation

Radioactive liquid effluent monitoring instrumentation channels shown on Radioactive Liquid Effluent Monitoring Instrumentation (Attachment 1) shall be operable with their alarm / trip setpoints set to ensure that 6.2.1.a. limits are not exceeded.

1. Alarm / trip setpoints of these channels shall be determined and adjusted in accordance with 6.2.2.d., Setpoint Calculation.
2. If a radioactive liquid effluent monitoring instrumentation channel alarm / trip setpoint is less conservative than required by 6.2.2.a., perform one of the following:
  - Promptly suspend release of radioactive liquid effluents monitored by the affected channel
  - Declare the channel inoperable
  - Change the setpoint to an acceptable, conservative value

**b. Radioactive Liquid Effluent Monitoring Instrumentation Operability**

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated operable by performing a Channel Check, Source Check, Channel Calibration, and Channel Operational Test at the frequencies shown in Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements (Attachment 2).

1. If the number of operable channels is less than the minimum required by the tables in Radioactive Liquid Effluent Monitoring Instrumentation (Attachment 1) perform the action shown in those tables.
2. Attempt to return the instruments to operable status within 30 days. If unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

**c. Applicable Monitors**

Liquid effluent monitors for which alarm / trip setpoints shall be determined are:

Release Point	Instrument Number
Liquid Radwaste Effluent Line	1-LW-RM-111
Service Water System Effluent Line	1-SW-RM-108
Condenser Circulating Water Line	1-SW-RM-130 2-SW-RM-230
Steam Generator High Capacity Blowdown Line	1-SS-RM-125 2-SS-RM-225

**d. Setpoint Calculation**

**NOTE:** This methodology does not preclude use of more conservative setpoints.

1. Maximum setpoint values shall be calculated by:

$$S = \frac{CF_D}{F_E} \quad (2)$$

where:

S = the setpoint, in  $\mu\text{Ci/ml}$ , of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution

C = the effluent concentration limit for the monitor used to implement 10 CFR 20 for the Station, in  $\mu\text{Ci/ml}$

$F_E$  = maximum design pathway effluent flow rate

$F_D$  = dilution water flow rate calculated as:

$$D = F_E + (218,000 \text{ gpm} \times \text{number of circ. pumps in service})$$

2. Each of the condenser circulating water channels (e.g., SW-130, SW-230) monitors the effluent (service water, including component cooling service water, circulating water, and liquid radwaste) in the circulating water discharge tunnel beyond the last point of possible radioactive material addition. No dilution is assumed for this pathway. Therefore, Equation (2) becomes:

$$S = C \quad (3)$$

The setpoint for Station monitors used to implement 10 CFR 20 for the site becomes the effluent concentration limit.

3. In addition, for added conservatism, setpoints shall be calculated for the liquid radwaste effluent line LW-111 and the Service Water System effluent line SW-108.

**b. Action**

If the calculated dose from release of radioactive materials in liquid effluents exceeds any of the above limits, prepare and submit to the NRC, within 30 days, a special report in accordance with VPAP-2802, Notifications and Reports, that identifies causes for exceeding limits and defines corrective actions taken to reduce releases of radioactive materials in liquid effluents to ensure that subsequent releases will be in compliance with the above limits.

**c. Dose Contribution Calculations**

Dose contribution shall be calculated for all radionuclides identified in liquid effluents released to unrestricted areas based on:

$$D = \sum_i Q_i \times B_i \quad (6)$$

Where:

Subscripts =  $i$ , refers to individual radionuclide

$D$  = the cumulative dose commitment to the total body or critical organ from the liquid effluents for the period  $t$ , in mrem

$B_i$  = Dose Commitment Factors (mrem/Ci) for each age group of interest. Values for  $B_i$  are provided in code file for North Anna Power Station liquid pathway critical organ calculations

$Q_i$  = Total released activity for the considered period and the  $i$ th nuclide

$$Q_i = t \times C_i \times \text{Waste Flow} \quad (7)$$

Where:

$t$  = the period for which  $C_i$  and  $F$  are averaged for all liquid releases, in hours

$C_i$  = the average concentration of radionuclide,  $i$ , in undiluted liquid effluent during the period,  $t$ , from any liquid releases, in  $\mu\text{Ci/ml}$

2. Estimate  $R_1$ , the ratio of the estimated volume of liquid effluent releases in the present 31-day period to the volume released in the previous 31-day period.
3. Estimate  $F_1$ , the ratio of the estimated liquid effluent radioactivity concentration in the present 31-day period to liquid effluent concentration in the previous 31-day period ( $\mu\text{Ci/ml}$ ).
4. Determine  $PD_{\text{TB}}$ , the projected total body dose in a 31-day period.

$$PD_{\text{TB}} = D_{\text{TB}}(R_1 F_1) \quad (8)$$

#### d. Projected Critical Organ Dose Calculation

1. Determine  $D_o$ , the critical organ dose from liquid effluents in the previous 31-day period, per Equation (6).
2. Estimate  $R_1$  as in 6.2.4.c.2.
3. Estimate  $F_1$  as in 6.2.4.c.3.
4. Determine  $PD_o$  = projected critical organ dose in a 31-day period.

$$PD_o = D_o(R_1 F_1) \quad (9)$$

#### 6.2.5 Liquid Sampling

Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis requirements in Radioactive Liquid Waste Sampling and Analysis Program (Attachment 3).

### 6.3 Gaseous Radioactive Waste Effluents

#### 6.3.1 Gaseous Effluent Dose Rate Limitation

##### a. Requirement

Dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to:

1. The dose rate limit for noble gases shall be  $\leq 500$  mrem/year to the total body and  $\leq 3000$  mrem/year to the skin.

2. The dose rate limit for  $I^{131}$ ,  $I^{133}$ , for tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days shall be  $\leq 1500$  mrem/year to the critical organ.

**b. Action**

1. If dose rates exceed 6.3.1.a. limits, promptly decrease the release rate to within the above limits.
2. Dose rates due to noble gases in gaseous effluents shall be determined, continuously, to be within 6.3.1.a. limits.
3. Dose rates due to  $I^{131}$ ,  $I^{133}$ , tritium, and all radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents shall be determined to be within the above limits by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified on Radioactive Gaseous Waste Sampling and Analysis Program (Attachment 4).

c. **Calculations of Gaseous Effluent Dose Rates**

1. The dose rate limit for noble gases shall be determined to be within the limit by limiting the release rate to the lesser of:

$$\sum_i [K_{i_{vv}} \dot{Q}_{i_{vv}} + K_{i_{pv}} \dot{Q}_{i_{pv}}] \leq 500 \text{mrem/yr to the total body} \quad (10)$$

OR

$$\sum_i [(L_{i_{vv}} + 1.1M_{i_{vv}}) \dot{Q}_{i_{vv}} + (L_{i_{pv}} + 1.1M_{i_{pv}}) \dot{Q}_{i_{pv}}] \leq 3000 \text{mrem/yr to the skin} \quad (11)$$

where:

- Subscripts = vv, refers to vent releases from the building ventilation vent  
pv, refers to the vent releases from the process vent;  
i, refers to individual radionuclide
- $K_{i_{vv}}, K_{i_{pv}}$  = The total body dose factor for ventilation vents or process vent release due to gamma emissions for each identified noble gas radionuclide i, in mrem/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)
- $L_{i_{vv}}, L_{i_{pv}}$  = The skin dose factor for ventilation vents or process vent release due to beta emissions for each identified noble gas radionuclide i, in mrem/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)
- $M_{i_{vv}}, M_{i_{pv}}$  = The air dose factor for ventilation vents or process vent release due to gamma emissions for each identified noble gas radionuclide, i, in mrad/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)
- $\dot{Q}_{i_{vv}}, \dot{Q}_{i_{pv}}$  = The release rate for ventilation vents or process vent of noble gas radionuclide i, in gaseous effluents in Curie/sec (per site)
- 1.1 = The unit conversion factor that converts air dose to skin dose, in mrem/mrad

2. The dose rate limit for  $I^{131}$ ,  $I^{133}$ , tritium, and for all radionuclides in particulate form with half-lives greater than 8 days, shall be determined to be within the limit by restricting the release rate to:

$$\sum_i [P_{ivv} \dot{Q}_{ivv} + P_{ipv} \dot{Q}_{ipv}] \leq 1500 \text{mrem/yr to the critical organ} \quad (12)$$

where:

- $P_{ivv}, P_{ipv}$  = The critical organ dose factor for ventilation vents or process vent for  $I^{131}$ ,  $I^{133}$ ,  $H^3$ , and all radionuclides in particulate form with half-lives greater than 8 days, for the inhalation pathway, in mrem/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)
- $\dot{Q}_{ivv}, \dot{Q}_{ipv}$  = The release rate for ventilation vents or process vent of  $I^{131}$ ,  $I^{133}$ ,  $H^3$ , and all radionuclides  $i$ , in particulate form with half-lives greater than 8 days, in gaseous effluents in Curie/sec (per site)

3. All gaseous releases, not through the process vent, are considered ground level and shall be included in the determination of  $\dot{Q}_{ivv}$ .

### 6.3.2 Gaseous Monitoring Instrumentation

#### a. Requirement

1. The radioactive gaseous effluent monitoring instrumentation channels shown in Radioactive Gaseous Effluent Monitoring Instrumentation (Attachment 6) shall be operable with alarm / trip setpoints set to ensure that 6.3.1.a. noble gas limits are not exceeded. Alarm / trip setpoints of these channels shall be determined and adjusted in accordance with 6.3.2.d.
2. Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated operable by Channel Checks, Source Checks, Channel Calibrations, and Channel Operational Tests at the frequencies shown in Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements (Attachment 7).

**b. Action**

1. If a radioactive gaseous effluent monitoring instrumentation channel alarm / trip setpoint is less conservative than required by 6.3.2.a.1, promptly:
  - Suspend the release of radioactive gaseous effluents monitored by the affected channel **and** declare the channel inoperable

or

  - Change the setpoint so it is acceptably conservative
2. If the number of operable channels is less than the minimum required by tables in Radioactive Gaseous Effluent Monitoring Instrumentation (Attachment 6) take the action shown in those tables.
3. Return instruments to operable status within 30 days. If unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

**c. Applicable Monitors**

Radioactive gaseous effluent monitors for which alarm / trip setpoints shall be determined are:

Release Point	Instrument Number
Process Vent	1-GW-RM-178-1
Condenser Air Ejector	1-SV-RM-121 2-SV-RM-221
Ventilation Vent A	1-VG-RM-179-1
Ventilation Vent B	1-VG-RM-180-1

**d. Setpoint Calculations**

1. Setpoint calculations for each monitor listed in 6.3.2.c. shall maintain this relationship:

$$D \geq D_{pv} + D_{cae} + D_{vv} \quad (13)$$

where:

- $D$  = Step 6.3.1.a. dose limits that implement 10 CFR 20 for the Station, mrem/yr
- $D_{pv}$  = The noble gas site boundary dose rate from process vent gaseous effluent releases, mrem/yr
- $D_{cae}$  = The noble gas site boundary dose rate from condenser air ejector gaseous effluent releases, mrem/yr
- $D_{vv}$  = The noble gas site boundary dose rate from summation of Ventilation Vent A plus B gaseous effluent releases, mrem/yr

2. Setpoint values shall be determined by:

$$C_m = \frac{R_m \times 2.12 \text{ E-03}}{F_m} \quad (14)$$

where:

- $m$  = The release pathway, process vent (pv), ventilation vent (vv) condenser air ejector (cae)
- $C_m$  = The effluent concentration limit implementing 6.3.1.a. for the Station,  $\mu\text{Ci/ml}$
- $R_m$  = The release rate limit for pathway  $m$  determined from methodology in 6.3.1.c., using  $\text{Xe}^{133}$  as nuclide to be released,  $\mu\text{Ci/sec}$
- $2.12\text{E-03}$  = CFM per ml/sec
- $F_m$  = The maximum flow rate for pathway  $m$ , CFM

**NOTE:** According to NUREG-0133, the radioactive effluent radiation monitor alarm / trip setpoints should be based on the radioactive noble gases. It is not practicable to apply instantaneous alarm / trip setpoints to integrating monitors sensitive to radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases.

### 6.3.3 Noble Gas Effluent Air Dose Limit

#### a. Requirement

1. The air dose in unrestricted areas due to noble gases released in gaseous effluents from each unit at or beyond the site boundary shall be limited to:
  - During any calendar quarter:  $\leq 5$  mrad for gamma radiation and  $\leq 10$  mrad for beta radiation
  - During any calendar year:  $\leq 10$  mrad for gamma radiation and  $\leq 20$  mrad for beta radiation
2. Cumulative dose contributions for noble gases for the current calendar quarter and current calendar year shall be determined in accordance with 6.3.3.c. at least once per 31 days.

#### b. Action

If the calculated air dose from radioactive noble gases in gaseous effluents exceeds any of the above limits, prepare and submit to the NRC, within 30 days, a special report in accordance with VPAP-2802, Notifications and Reports, that identifies the causes for exceeding the limits and defines corrective actions that have been taken to reduce releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the limits in 6.3.3.a.

**c. Noble Gas Effluent Air Dose Calculation**

Gaseous releases, not through the process vent, are considered ground level and shall be included in the determination of  $\bar{Q}_{ivv}$ .

The air dose to areas at or beyond the site boundary due to noble gases shall be determined by the following:

For gamma radiation:

$$D_g = 3.17E-08 \sum_i [M_{ivv} \bar{Q}_{ivv} + M_{ipv} \bar{Q}_{ipv}] \quad (15)$$

For beta radiation:

$$D_b = 3.17E-08 \sum_i [N_{ivv} \bar{Q}_{ivv} + N_{ipv} \bar{Q}_{ipv}] \quad (16)$$

Where:

- Subscripts = vv, refers to vent releases from the building ventilation vents, including air ejectors  
 pv, refers to the vent releases from the process vent  
 i, refers to individual radionuclide
- $D_g$  = the air dose for gamma radiation, in mrad  
 $D_b$  = the air dose for beta radiation, in mrad  
 $M_{ivv}, M_{ipv}$  = the air dose factors for ventilation vents or process vent release due to gamma emissions for each identified noble gas radionuclide i, in mrad/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)  
 $N_{ivv}, N_{ipv}$  = the air dose factor for ventilation vents or process vent release due to beta emissions for each identified noble gas radionuclide i, in mrad/yr per Curie/sec. Factors are listed in Gaseous Effluent Dose Factors (Attachment 5)  
 $\bar{Q}_{ivv}, \bar{Q}_{ipv}$  = the release for ventilation vents or process vent of noble gas radionuclide i, in gaseous effluents for 31 days, quarter, or year as appropriate in Curies (per site)  
 3.17 E-08 = the inverse of the number of seconds in a year

**6.3.4 I-131, 133, H-3 & Radionuclides In Particulate Form Effluent Dose Limit****a. Requirement**

1. Methods shall be implemented to ensure that the dose to any organ of a member of the public from I<sup>131</sup>, I<sup>133</sup>, tritium, and all radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents released from the site to unrestricted areas from each reactor unit shall be:
  - During any calendar quarter:  $\leq 7.5$  mrem to the critical organ
  - During any calendar year:  $\leq 15$  mrem to the critical organ
2. Cumulative dose contributions to a member of the public from I<sup>131</sup>, I<sup>133</sup>, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents released to unrestricted areas for the current calendar quarter and current calendar year shall be determined at least once per 31 days in accordance with 6.3.4.c.

**b. Action**

If the calculated dose from the release of I<sup>131</sup>, I<sup>133</sup>, tritium, and radionuclides in particulate form, with half-lives greater than 8 days, in gaseous effluents exceeds any of the above limits, prepare and submit to the NRC within 30 days, a special report in accordance with VPAP-2802, Notifications and Reports, that contains the:

1. Causes for exceeding limits.
2. Corrective actions taken to reduce releases.
3. Proposed corrective actions to be taken to assure that subsequent releases will be in compliance with limits stated in 6.3.4.a.

**c. Dose Calculations**

Gaseous releases, not through the process vent, are considered ground level and shall be included in the determination of  $\tilde{Q}_{ivv}$ . Historical data pertaining to the volumes and radioactive concentrations of gaseous effluents released in connection to specific Station functions, such as containment purges, shall be used in the estimates as appropriate.

1. The dose to the maximum exposed member of the public, attributable to gaseous effluents at and beyond the site boundary, that contain  $I^{131}$ ,  $I^{133}$ , tritium, and particulate-form radionuclides with half-lives greater than 8 days, shall be determined by:

$$D_r = 3.17E-08 \sum_i [RM_{ivv} \tilde{Q}_{ivv} + RM_{ipv} \tilde{Q}_{ipv}] \quad (17)$$

Where:

Subscripts = vv, refers to vent releases from the building ventilation vents;  
pv, refers to the vent releases from the process vent

$D_r$  = the dose to the critical organ of the maximum exposed member of the public, in mrem

$RM_{ivv}$ ,  $RM_{ipv}$  = the cow-milk dose factor for ventilation vents or process vent release due to  $I^{131}$ ,  $I^{133}$ , tritium, and from all particulate-form radionuclides with half-lives greater than 8 days, in mrem/yr per Curie/sec. Factors are listed in Critical Organ Dose Factors (Attachment 8)

$\tilde{Q}_{ivv}$ ,  $\tilde{Q}_{ipv}$  = the release for ventilation vents or process vent of  $I^{131}$ ,  $I^{133}$ , tritium, and from all particulate-form radionuclides with half-lives greater than 8 days, in Curies

3.17 E-08 = the inverse of the number of seconds in a year

### 6.3.5 Gaseous Radwaste Treatment

Historical data pertaining to the volumes and radioactive concentrations of gaseous effluents released in connection with specific Station functions, such as containment purges, shall be used to calculate projected doses, as appropriate.

#### a. Requirement

1. The Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce radioactive material in gaseous waste before its discharge, when projected gaseous effluent air doses due to gaseous effluent releases, from each unit to areas at and beyond the site boundary, would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation, averaged over 31 days.
2. The Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous waste before its discharge, when the projected doses due to gaseous effluent releases, from each unit to areas at and beyond the site boundary, would exceed 0.3 mrem to the critical organ, averaged over 31 days.
3. Doses due to gaseous releases from the site shall be projected at least once per 31 days, based on the calculations in 6.3.5.c.

#### b. Action

If gaseous waste that exceeds the limits in 6.3.5.a. is discharged without treatment, prepare and submit to the NRC within 30 days, a special report in accordance with VPAP-2802, Notifications and Reports, that includes:

1. An explanation why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability.
2. Actions taken to restore the inoperable equipment to operable status.
3. Summary description of actions taken to prevent recurrence.

#### c. Projected Gamma Dose

1. Determine  $D_g$ , the 31-day gamma air dose for the previous 31-day period, per Equation (15).
2. Estimate  $R_g$ , the ratio of the estimated volume of gaseous effluent in the current 31-day period to the volume released during the previous 31-day period.

3. Estimate  $F_g$ , the ratio of the estimated noble gas effluent activity in the current 31-day period to the noble gas effluent activity during the previous 31-day period ( $\mu\text{Ci/ml}$ ).
4. Determine  $PD_g$ , the projected 31-day gamma air dose.

$$PD_g = D_g(R_g \times F_g) \quad (18)$$

**d. Projected Beta Dose**

1. Determine  $D_b$ , the 31-day beta air dose in the previous 31 days, per Equation (16).
2. Estimate  $R_g$  and  $F_g$  as in 6.3.5.c.2. and 6.3.5.c.3.
3. Determine  $PD_b$ , the projected 31-day beta air dose.

$$PD_b = D_b(R_g \times F_g) \quad (19)$$

**e. Projected Maximum Exposed Member of the Public Dose**

1. Determine  $D_{\max}$ , the 31-day maximum exposed member of the public dose in the previous 31-day period, per Equation (14), where  $D_r = D_{\max}$ .
2. Estimate  $F_i$ , the ratio of the estimated activity from  $I^{131}$ ,  $I^{133}$ , radioactive materials in particulate form with half-lives greater than 8 days, and tritium in the current 31-day period to the activity of  $I^{131}$ ,  $I^{133}$ , radioactive materials in particulate form with half-lives greater than 8 days, and tritium in the previous 31-day period ( $\mu\text{Ci/ml}$ ).
3. Determine  $PD_{\max}$ , the projected 31-day maximum exposed member of the public dose.

$$PD_{\max} = D_{\max}(R_g \times F_i) \quad (20)$$

**6.4.3 Waste Gas Decay Tank (WGDT) Release Permit**

Operations shall obtain RP authorization before initiating WGDT releases.

**6.4.4 Reactor Containment Release Permits**

Operations shall obtain authorization from RP before initiating containment purges or containment hogging. Reactor Containment Release Permits shall be valid from start of purge / hog until:

- Routine termination
- Terminated for cause by RP
- Receipt of Radiation Monitoring System (RMS) Containment Gas Monitor high alarm

**6.4.5 Miscellaneous Gaseous Release Permit**

Operations shall obtain RP authorization before initiating releases of noble gases that may not be accounted for by routine sampling, or any planned release not being routed through the Process Vent or Ventilation Vents (e.g., steam driven auxiliary feedwater pump testing if primary to secondary leakage exists).

**6.4.6 Radioactive Liquid and Gaseous Release Controls**

- a. Operations shall notify RP of pending releases and request RP to initiate the appropriate release permit. Operations shall provide the necessary information to complete the required release permit.
- b. A representative sample shall be obtained of the source to be released.
  1. Operations shall provide RP with liquid samples and sample information (e.g., time of sample) for samples obtained outside the Primary Sample Room, except Clarifier Proportional Tank and Clarifier Grab Samples.
  2. Chemistry shall provide RP with liquid samples and sample information for samples obtained from inside the Primary Sample Room.
  3. RP shall obtain gaseous samples.
- c. RP shall perform required sample analyses.

- d. RP shall calculate and record the following information on a release permit:
- Maximum authorized release rate
  - Maximum authorized release rate in percentage of limits specified by the ODCM
  - Applicable conditions or controls pertaining to the release
- e. RP shall notify the Shift Supervisor if it is determined that a release may not be within the effluent dose limits.
- f. Upon receipt of a release permit from RP, Operations shall:
1. Verify the correct source is authorized for release.
  2. Note maximum authorized release rate.
  3. Note percent of Technical Specifications limits the release represents.
  4. Note and ensure compliance with any indicated controls or conditions applicable to the release.
- g. When commencing release, Operations shall provide RP with required information. As appropriate, required information shall include:
- Date and time release was started
  - Starting tank / sump level
  - Beginning pressure
  - Release flow rate
  - Dilution water flow rate
- h. Upon terminating the release, Operations shall return the permit to RP and provide information necessary for completion of permit. As appropriate, required information shall include:
- Date and time release was stopped
  - Tank / sump ending level
  - Release flow rate just prior to termination
  - Ending pressure
  - Volume released

2. Samples shall be collected from specific locations specified in Environmental Sampling Locations (Attachment 10). [**Commitment 3.2.2**]
3. Samples shall be analyzed in accordance with:
  - Radiological Environmental Monitoring Program (Attachment 9) requirements
  - Detection capabilities required by Detection Capabilities for Environmental Sample Analysis (Attachment 11)
  - Guidance of the Radiological Assessment Branch Technical Position on Environmental Monitoring dated November, 1979, Revision No. 1

**b. Action**

1. If the Radiological Environmental Monitoring Program is not being conducted as required in 6.6.1.a., report the situation in accordance with VPAP-2802, Notifications and Reports, by preparing and submitting to the NRC, in the Annual Radiological Environmental Operating Report required by Technical Specifications 5.6.2, a description of the reasons for not conducting the program as required, and the plan for precluding recurrence.
2. If, when averaged over any calendar quarter, radioactivity exceeds the reporting levels of Reporting Levels for Radioactivity Concentrations in Environmental Samples (Attachment 12) prepare and submit to the NRC within 30 days, a special report in accordance with VPAP-2802, Notifications and Reports, that:
  - Identifies the causes for exceeding the limits, and
  - Defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a member of the public is less than the calendar year limits of 6.2.3, 6.3.3, and 6.3.4

When more than one of the radionuclides listed in Reporting Levels for Radioactivity Concentrations in Environmental Samples (Attachment 12) are detected in the sampling medium, the report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \dots \geq 1.0 \quad (21)$$

2. In lieu of the garden census, broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two different direction sectors with the highest predicted ground deposition (D/Qs). Specifications for broad leaf vegetation sampling in Radiological Environmental Monitoring Program (Attachment 9) shall be followed, including analysis of control samples.

**b. Action**

1. If a land use census identifies locations that yield a calculated dose or dose commitment greater than the values currently being calculated in 6.3.4.a.2, identify the new locations in the next Annual Radioactive Effluent Release Report in accordance with VPAP-2802, Notifications and Reports.
2. If a land use census identifies locations that yield a calculated dose or dose commitment (via the same exposure pathway) 25 percent greater than at a location from which samples are currently being obtained, add the new locations to the Radiological Environmental Monitoring Program within 30 days. Sampling locations, excluding the control station location, that have the lowest calculated dose or dose commitments (via the same exposure pathway) may be deleted from the monitoring program. Identify new locations in the next Annual Radioactive Effluent Release Report and include in the report revised figures and tables reflecting the new locations in accordance with VPAP-2802, Notifications and Reports. [**Commitment 3.2.4**]

**6.6.3 Interlaboratory Comparison Program**

**a. Requirement**

Radioactive materials (which contain nuclides produced at the Station), supplied as part of an Interlaboratory Comparison Program, shall be analyzed.

**b. Action**

- Analyses shall be performed at least semiannually as follows:

Program	Cross-Check of
Milk	I <sup>131</sup> , Gamma, Sr <sup>89</sup> and Sr <sup>90</sup>
Water	Gross Beta, Gamma, I <sup>131</sup> , H <sup>3</sup> (Tritium), Sr <sup>89</sup> and Sr <sup>90</sup> (blind - any combinations of above radionuclides)
Air Filter	Gross Beta, Gamma, Sr <sup>90</sup>

- If analyses are not performed as required by 6.6.3.b., report in the Annual Radiological Environmental Operating Report in accordance with VPAP-2802, Notifications and Reports, the corrective actions taken to prevent recurrence.

**c. Results**

Results shall be reported in the Annual Radiological Environmental Monitoring Report in accordance with VPAP-2802, Notifications and Reports.

**6.7 Reporting Requirements****6.7.1 Annual Radiological Environmental Operating Report**

Routine Radiological Environmental Operating Reports covering the operation of the units during the previous calendar year shall be submitted prior to May 1 of each year. A single submittal may be made for the Station. Radiological Environmental Operating Reports shall include:

- Summaries, interpretations, and analysis of trends of results of radiological environmental surveillance activities for the report period, including:
  - A comparison (as appropriate) with preoperational studies, operational controls, and previous environmental surveillance reports
  - An assessment of the observed impacts of the plant operation on the environment
  - Results of land use census per 6.6.2

- b. Results of analysis of radiological environmental samples and of environmental radiation measurements taken per 6.6.1, Monitoring Program. Results shall be summarized and tabulated in the format of the table in the Radiological Assessment Branch Technical Position on Environmental Monitoring.
  - 1. If some individual results are not available for inclusion with the report, the report shall be submitted, noting and explaining reasons for missing results.
  - 2. Missing data shall be submitted in a supplementary report as soon as possible.
- c. A summary description of the radiological environmental monitoring program.
- d. At least two legible maps covering sampling locations, keyed to a table giving distances and directions from the centerline of one reactor. One map shall cover stations near the site boundary; a second shall include more distant stations.
- e. Results of Station participation in the Interlaboratory Comparison Program, per 6.6.3.
- f. Discussion of deviations from the Station's environmental sampling schedule per Radiological Environmental Monitoring Program (Attachment 9).
- g. Discussion of analyses in which the lower limit of detection (LLD) required by Detection Capabilities for Environmental Sample Analysis (Attachment 11) was not achievable.

#### 6.7.2 Annual Radioactive Effluent Release Report

##### a. Requirement - Station

Radioactive Effluent Release Reports covering operation of the units during the previous 12 months of operation shall be submitted before May 1 of each year. A single submittal may be made for the Station and should combine those sections that are common to both units. Radioactive Effluent Release Reports shall include:

- 1. A summary of quantities of radioactive liquid and gaseous effluents and solid waste released. Data shall be summarized on a quarterly basis following the format of Regulatory Guide 1.21, Appendix B, for liquid and gaseous effluents. Data shall be summarized on an annual basis following the format of Regulatory Guide 1.21, Appendix B, for solid waste. **[Commitment 3.2.5]**

2. An assessment of radiation doses to the maximum exposed members of the public due to the radioactive liquid and gaseous effluents released from the Station during the previous calendar year. This assessment shall be in accordance with 6.7.2.b.
3. A list and description of unplanned releases from the site to unrestricted areas, during the reporting period, which meet the following criteria:
  - Unplanned releases that exceeded the limits in 6.2.1 and 6.3.1
  - Unplanned releases which require a Plant Issue (Deviation) and involve the discharge of contents of the wrong Waste Gas Decay Tank or the wrong liquid radwaste release tank
  - Unplanned releases from large leaks due to unexpected valve or pipe failures that result in a quantity of release such that a 10 CFR 50.72, Immediate Notification Requirements for Operating Nuclear Power Reactors or 10 CFR 50.73, Licensee Event Report System, report is required
  - Unplanned releases as determined by Radiation Protection Supervision, which may or may not require a Plant Issue (Deviation)
4. Major changes to radioactive liquid, gaseous, and solid waste treatment systems during the reporting period.
5. Changes to VPAP-2103N, Offsite Dose Calculation Manual (North Anna) (See 6.7.4).
6. A listing of new locations for dose calculations or environmental monitoring identified by the land use census (See 6.6.2).

**b. Dose Assessment**

1. Radiation dose to individuals due to radioactive liquid and gaseous effluents from the Station during the previous calendar year shall either be calculated in accordance with this procedure or in accordance with Regulatory Guide 1.109. Population doses shall not be included in dose assessments.

- b. Meteorological data shall be retained in a file on site and shall be made available to NRC upon request.

#### 6.7.4 Changes to the ODCM

Changes to the ODCM shall be:

- a. Reviewed and approved by SNSOC and Site Vice President before implementation.
- b. Documented. Records of reviews shall be retained as Station records.

Documentation shall include:

1. Sufficient information to support changes, together with appropriate analyses or evaluations justifying changes.
  2. A determination that a change will not adversely impact the accuracy or reliability of effluent doses or setpoint calculations, and will maintain the level of radioactive effluent control required by:
    - 10 CFR 20 Subpart D
    - 40 CFR 190
    - 10 CFR 50.36a
    - 10 CFR 50, Appendix I
- c. Submitted to NRC in the form of a complete, legible copy of the entire ODCM as a part of, or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month / year) the change was implemented.
- d. Submitted to the Management Safety Review Committee (MSRC) Coordinator.  
**[Commitment 3.2.1]**
- e. Submitted to NRC in accordance with VPAP-2802, Notifications and Reports.

**7.0 RECORDS**

**7.1** The following individual and packaged documents and copies of any related correspondence completed as a result of the performance or implementation of this procedure are records. They shall be transmitted to Records Management in accordance with VPAP-1701, Records Management. Prior to transmittal, the sender shall assure that:

- Each record is packaged when applicable.
- QA program requirements have been fulfilled for Quality Assurance records.
- Each record is legible, completely filled out, and adequately identifiable to the item or activity involved.
- Each record is stamped, initialed, signed, or otherwise authenticated and dated, as required by this procedure.

**7.1.1 Individual Records**

None

**7.1.2 Record Packages**

- Records of changes to the ODCM in accordance with 6.7.4
- Records of meteorological data in accordance with 6.7.3
- Records of sampling and analyses
- Records of radioactive materials and other effluents released to the environment
- Records of preventive maintenance, surveillances, and calibrations

**7.2** The following documents completed as a result of the implementation of this procedure are **not** Quality Assurance records and are not required to be transmitted to Records Management.

None



**ATTACHMENT 1**

(Page 2 of 2)

**Radioactive Liquid Effluent Monitoring Instrumentation**

- ACTION 1:** If the number of operable channels is less than required, effluent releases via this pathway may continue if, at least once within 12 hours, grab samples are collected and analyzed for gross radioactivity (beta and gamma) at an LLD of at least  $1 \times 10^{-7}$   $\mu\text{Ci/g}$  or an isotopic radioactivity at an LLD of at least  $5 \times 10^{-7}$   $\mu\text{Ci/g}$ .
- ACTION 2:** If the number of operable channels is less than required, effluent releases via this pathway may continue if the flow rate is estimated at least once per 4 hours during actual releases. Design capacity performance curves generated in situ may be used to estimate flow.
- ACTION 3:** If the number of operable channels is less than required, liquid additions to this tank may continue if the tank liquid level is estimated during all liquid additions to the tank.
- ACTION 4:** If the number of operable channels is less than required, make repairs as soon as possible. Effluent releases via this pathway may continue provided that, at least once per 12 hours, grab samples from the discharge canal are collected and analyzed for principal gamma emitters as defined in Radioactive Liquid Waste Sampling and Analysis Program (Attachment 3).
- NOTE 1:** Tanks included in this requirement are those outdoor tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents, and do not have overflows and surrounding area drains connected to the liquid radwaste treatment system.
- NOTE 2:** This is a shared system between Unit 1 and Unit 2.
- NOTE 3:** The capability for obtaining grab samples at least every 12 hours must exist. Grab samples shall commence if there is indication of radioactivity in the Service Water System or an indication from other radiation monitors in the Service Water System of an increase in radioactivity.

## ATTACHMENT 2

(Page 1 of 2)

## Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements

Channel Description	Channel Check	Source Check	Channel Calibration	Channel Operational Test
<b>1. Liquid Radwaste Effluent</b>				
(a) 1-LW-RM-111, Liquid Radwaste Effluent Monitor	D	D	R	Q (NOTE 1)
(b) 1-LW-FT-104, Liquid Radwaste Effluent Total Flow Measuring Device	D (NOTE 3)	N/A	R	Q
(c) 1-LW-TK-20, Liquid Waste Effluent Sample Vessel	D (NOTE 9)	N/A	N/A	N/A
(d) 1-LW-1130, Liquid Waste Effluent Proportional Sample Valve	D (NOTE 9)	N/A	N/A	N/A
(e) 1-SW-RM-108, Service Water System Effluent Monitor	D	M	R	Q (NOTE 2)
(f) 1-SW-RM-130, Unit 1 Circulating Water System Effluent Line Monitor	D	M	R	Q (NOTE 2)
(g) 2-SW-RM-230, Unit 2 Circulating Water System Effluent Line Monitor	D	M	R	Q (NOTE 2)
<b>2. Tank Level Indicating Device (NOTE 6)</b>				
(a) Refueling Water Storage Tanks				
Unit 1 1-QS-LT-100A, 1-QS-LT-100B 1-QS-LT-100C, 1-QS-LT-100D	D (NOTE 4)	N/A	R	Q (NOTE 7)
Unit 2 2-QS-LT-200A, 2-QS-LT-200B 2-QS-LT-200C, 2-QS-LT-200D	D (NOTE 4)	N/A	R	Q (NOTE 7)
(b) Casing Cooling Storage Tanks				
Unit 1 1-RS-LT-103A, 1-RS-LT-103B	D (NOTE 4)	N/A	R	Q (NOTE 7)
Unit 2 2-RS-LT-203A, 2-RS-LT-203B	D (NOTE 4)	N/A	R	Q (NOTE 7)
(c) PG Water Storage Tanks (NOTE 5)				
1-BR-LT-116A (1-PG-TK-1A)	D (NOTE 4)	N/A	R	Q (NOTE 8)
1-BR-LT-116B (1-PG-TK-1B)	D (NOTE 4)	N/A	R	Q (NOTE 8)
(d) Boron Recovery Test Tanks (NOTE 5)				
1-BR-LT-112A (1-BR-TK-2A)	D (NOTE 4)	N/A	R	Q (NOTE 8)
1-BR-LT-112B (1-BR-TK-2B)	D (NOTE 4)	N/A	R	Q (NOTE 8)
<b>3. Steam Generator (SG) High Capacity Blowdown</b>				
(a) SG High Capacity Blowdown Radiation Monitor				
Unit 1 1-SS-RM-125	D (NOTE 12)	D (NOTE 12)	R	Q (NOTE 11)
Unit 2 2-SS-RM-225				R (NOTE 10)
(b) SG High Capacity Blowdown Flash Tank Outlet Flow Rate				
Unit 1 1-BD-FT-105	D (NOTE 13)	N/A	R	N/A
Unit 2 2-BD-FT-205				
(c) SG High Capacity Blowdown Proportional Sampling System Collection Tank				
Unit 1 1-BD-TK-4	D (NOTE 9)	N/A	N/A	N/A
Unit 2 2-BD-TK-4				

## ATTACHMENT 3

(Page 1 of 3)

## Radioactive Liquid Waste Sampling and Analysis Program

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) ( $\mu\text{Ci/ml}$ ), (Note 1)
Batch Releases (Notes 2 and 7)	P (Each Batch)	P (Each Batch)	Principle Gamma Emitters (Note 3)	$5 \times 10^{-7}$
			$\text{I}^{131}$	$1 \times 10^{-6}$
	P (One Batch/M)	M	Dissolved and Entrained Gases (Gamma Emitters)	$1 \times 10^{-5}$ (Note 8)
	P (Each Batch)	M Composite (Note 4)	$\text{H}^3$	$1 \times 10^{-5}$
			Gross Alpha	$1 \times 10^{-7}$
	P (Each Batch)	Q Composite (Note 4)	$\text{Sr}^{89}$ and $\text{Sr}^{90}$	$5 \times 10^{-8}$
$\text{Fe}^{55}$			$1 \times 10^{-6}$	
Continuous Releases (Note 5)	Continuous (Note 6)	W Composite (Note 6)	Principal Gamma Emitters (Note 6)	$5 \times 10^{-7}$
			$\text{I}^{131}$	$1 \times 10^{-6}$
	M	Grab Sample	Dissolved and Entrained Gases (Gamma Emitters)	$1 \times 10^{-5}$ (Note 8)
	Continuous (Note 6)	M Composite (Note 6)	$\text{H}^3$	$1 \times 10^{-5}$
			Gross Alpha	$1 \times 10^{-7}$
	Continuous (Note 6)	Q Composite (Note 6)	$\text{Sr}^{89}$ and $\text{Sr}^{90}$	$5 \times 10^{-8}$
$\text{Fe}^{55}$			$1 \times 10^{-6}$	

**ATTACHMENT 3**

(Page 3 of 3)

**Radioactive Liquid Waste Sampling and Analysis Program**

- NOTE 3: The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn<sup>54</sup>, Fe<sup>59</sup>, Co<sup>58</sup>, Co<sup>60</sup>, Zn<sup>65</sup>, Mo<sup>99</sup>, Cs<sup>134</sup>, Cs<sup>137</sup>, Ce<sup>141</sup>, and Ce<sup>144</sup>. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, at levels exceeding the LLD, together with the above nuclides, shall also be identified and reported.
- NOTE 4: A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and for which the method of sampling employed results in a specimen that is representative of the liquids released.
- NOTE 5: A continuous release is the discharge of liquid wastes of a non-discrete volume, e.g., from a volume of a system that has an input flow during the continuous release.
- NOTE 6: To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent releases.
- NOTE 7: Whenever the secondary coolant activity exceeds  $10^{-5}$   $\mu\text{Ci/ml}$ , the turbine building sump pumps shall be placed in manual operation and samples shall be taken and analyzed prior to release. Secondary coolant activity samples shall be collected and analyzed on a weekly basis. These samples are analyzed for gross activity or gamma isotopic activity within 24 hours.
- NOTE 8: The gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, Xe-135m and Xe-138. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, at levels exceeding the LLD, together with the above nuclides shall also be identified and reported.

## ATTACHMENT 4

(Page 2 of 4)

**Radioactive Gaseous Waste Sampling and Analysis Program**

NOTE 1: For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 s_b}{E \cdot V \cdot 2.22E+06 \cdot Y \cdot e^{-(\lambda\Delta t)}} \quad (11-1)$$

Where:

- LLD = the “a priori” (before the fact) Lower Limit of Detection as defined above (as microcuries per unit mass or volume) (See 4.9)
- $s_b$  = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute, cpm)
- E = the counting efficiency (as counts per disintegration)
- V = the sample size (in units of mass or volume)
- 2.22E+06 = the number of disintegrations per minute (dpm) per microcurie
- Y = the fractional radiochemical yield (when applicable)
- $\lambda$  = the radioactive decay constant for the particular radionuclide
- $\Delta t$  = the elapsed time between the midpoint of sample collection and time of counting

Typical values of E, V, Y and  $\Delta t$  should be used in the calculation.

The LLD is an “a priori” (before the fact) limit representing the capability of a measurement system and not as “posteriori” (after the fact) limit for a particular measurement.

**ATTACHMENT 4**

(Page 3 of 4)

**Radioactive Gaseous Waste Sampling and Analysis Program**

- NOTE 2: The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr<sup>87</sup>, Kr<sup>88</sup>, Xe<sup>133</sup>, Xe<sup>133m</sup>, Xe<sup>135</sup>, Xe<sup>135m</sup>, and Xe<sup>138</sup> for gaseous emissions and Mn<sup>54</sup>, Fe<sup>59</sup>, Co<sup>58</sup>, Co<sup>60</sup>, Zn<sup>65</sup>, Mo<sup>99</sup>, Cs<sup>134</sup>, Cs<sup>137</sup>, Ce<sup>141</sup> and Ce<sup>144</sup> for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, at levels exceeding the LLD, together with the above nuclides, shall also be identified and reported.
- NOTE 3: Sampling and analysis shall also be performed following shutdown, start-up, and whenever a thermal power change exceeding 15 percent of the rated thermal power occurs within any one-hour period, if:
- Analysis shows that the dose equivalent I<sup>131</sup> concentration in the primary coolant is greater than 1.0 µCi/gm; and
  - The noble gas activity monitor shows that effluent activity has increased by more than a factor of 3.
- NOTE 4: The ratio of the sample flow rate to the sampled stream flow rate shall be known for the period covered by each dose or dose rate calculation made in accordance with 6.3.1, 6.3.3, and 6.3.4.
- NOTE 5: Samples shall be changed at least once per seven days and analyses shall be completed within 48 hours after changing (or after removal from sampler). Sampling shall also be performed at least once per 24 hours for at least seven days following each shutdown, start-up or thermal power change exceeding 15 percent of rated thermal power in one hour and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement applies if:
- Analysis shows that the dose equivalent I<sup>131</sup> concentration in the primary coolant is greater than 1.0 µCi/gm and;
  - Noble gas monitor shows that effluent activity has increased more than a factor of 3.

**ATTACHMENT 4**

(Page 4 of 4)

**Radioactive Gaseous Waste Sampling and Analysis Program**

- NOTE 6: Whenever the secondary coolant activity exceeds  $10^{-5}$   $\mu\text{Ci/ml}$ , Condenser Air Ejector and Steam Generator Blowdown Vent samples shall be obtained and analyzed weekly. Secondary coolant activity samples shall be collected and analyzed on a weekly basis. These samples are analyzed for gross activity or gamma isotopic activity within 24 hours.
- NOTE 7: The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides:  $\text{Kr}^{87}$ ,  $\text{Kr}^{88}$ ,  $\text{Xe}^{133}$ ,  $\text{Xe}^{133\text{m}}$ ,  $\text{Xe}^{135}$ ,  $\text{Xe}^{135\text{m}}$ , and  $\text{Xe}^{138}$  for gaseous emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, at levels exceeding the LLD together with the above nuclides, shall also be identified and reported.
- NOTE 8: If the secondary coolant activity level in any Steam Generator supplying steam to the Hogger exceeds  $1.0\text{E-}5$   $\mu\text{Ci/ml}$ , Steam Generator samples shall be obtained and analyzed prior to release.

**ATTACHMENT 5**

(Page 1 of 3)

**Gaseous Effluent Dose Factors**

(Gamma and Beta Dose Factors)

 $\chi/Q = 9.3E-06 \text{ sec/m}^3$  at 1416 meters SE Direction**Dose Factors for Ventilation Vent**

Noble Gas Radionuclide	$K_{jvv}$ Total Body <u>mrem/yr</u> Curie/sec	$L_{jvv}$ Skin <u>mrem/yr</u> Curie/sec	$M_{jvv}$ Gamma Air <u>mrad/yr</u> Curie/sec	$N_{jvv}$ Beta Air <u>mrad/yr</u> Curie/sec
Kr-85m	1.09E+04	1.36E+04	1.14E+04	1.83E+04
Kr-85	1.50E+02	1.25E+04	1.60E+02	1.81E+04
Kr-87	5.51E+04	9.05E+04	5.74E+04	9.58E+04
Kr-88	1.37E+05	2.20E+04	1.41E+05	2.72E+04
Kr-89	1.54E+05	9.39E+04	1.61E+05	9.86E+04
Xe-131m	8.51E+02	4.43E+03	1.45E+03	1.03E+04
Xe-133m	2.33E+03	9.24E+03	3.04E+03	1.38E+04
Xe-133	2.73E+03	2.85E+03	3.28E+03	9.77E+03
Xe-135m	2.90E+04	6.61E+03	3.12E+04	6.87E+03
Xe-135	1.68E+04	1.73E+04	1.79E+04	2.29E+04
Xe-137	1.32E+04	1.13E+05	1.40E+04	1.18E+05
Xe-138	8.21E+04	3.84E+04	8.57E+04	4.42E+04
Ar-41	8.22E+04	2.50E+04	8.65E+04	3.05E+04

## ATTACHMENT 5

(Page 2 of 3)

## Gaseous Effluent Dose Factors

(Gamma and Beta Dose Factors)

 $\chi/Q = 1.2E-06 \text{ sec/m}^3$  at 1513 meters S Direction

## Dose Factors for Process Vent

Noble Gas Radionuclide	$K_{ipv}$ Total Body <u>mrem/yr</u> Curie/sec	$L_{ipv}$ Skin <u>mrem/yr</u> Curie/sec	$M_{ipv}$ Gamma Air <u>mrad/yr</u> Curie/sec	$N_{ipv}$ Beta Air <u>mrad/yr</u> Curie/sec
Kr-85m	1.40E+03	1.75E+03	1.48E+03	2.36E+03
Kr-85	1.93E+01	1.61E+03	2.06E+01	2.34E+03
Kr-87	7.10E+03	1.17E+04	7.40E+03	1.24E+04
Kr-88	1.76E+04	2.84E+03	1.82E+04	3.52E+03
Kr-89	1.99E+04	1.21E+04	2.08E+04	1.27E+04
Xe-131m	1.10E+02	5.71E+02	1.87E+02	1.33E+03
Xe-133m	3.01E+02	1.19E+03	3.92E+02	1.78E+03
Xe-133	3.53E+02	3.67E+02	4.24E+02	1.26E+03
Xe-135m	3.74E+03	8.53E+02	4.03E+03	8.87E+02
Xe-135	2.17E+03	2.23E+03	2.30E+03	2.95E+03
Xe-137	1.70E+03	1.46E+04	1.81E+03	1.52E+04
Xe-138	1.06E+04	4.96E+03	1.11E+04	5.70E+03
Ar-41	1.06E+04	3.23E+03	1.12E+04	3.94E+03

## ATTACHMENT 6

(Page 1 of 3)

## Radioactive Gaseous Effluent Monitoring Instrumentation

INSTRUMENT	MINIMUM OPERABLE CHANNELS	ACTION
<b>1. PROCESS VENT SYSTEM</b> (a) Noble Gas Activity Monitor 1-GW-RM-178-1 (b) Iodine Sampler 1-GW-RM-178-1 Process Vent Continuous HP Sampler (c) Particulate Sampler 1-GW-RM-178-1 Process Vent Continuous HP Sampler (d) Total Flow Monitor 1-GW-FT-108 (e) Sampler Flow Rate Measuring Device MGPI Flow Rate Measuring Device HP Sampler Rotameter	1 (NOTE 3)  1 (NOTE 3)  1 (NOTE 3)  1  1 (NOTE 3)	2, 4         2, 5         2, 5         1         1
<b>2. CONDENSER AIR EJECTOR SYSTEM</b> (a) Gross Activity Monitor Unit 1 1-SV-RM-121 Unit 2 2-SV-RM-221 (b) Flow Rate Measuring Device Unit 1 1-SV-FI-100A 1-SV-FI-101A 1-SV-FI-100B 1-SV-FI-101B Unit 2 2-SV-FI-200A 2-SV-FI-201A 2-SV-FI-200B 2-SV-FI-201B	1          1 (NOTE 1)          1 (NOTE 2)	3          1          1

**ATTACHMENT 6**

(Page 3 of 3)

**Radioactive Gaseous Effluent Monitoring Instrumentation**

- ACTION 1:** If the number of operable channels is less than required, effluent releases, via this path, may continue if the flow rate is estimated at least once per four hours.
- ACTION 2:** If the number of operable channels is less than required, effluent releases, via this path, may continue if grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity or gamma isotopic activity within 24 hours.
- ACTION 3:** If the number of operable channels is less than required, effluent releases via this path may continue if grab samples are obtained in accordance with TRM TR 3.4.5 and these samples are analyzed for gross activity or gamma isotopic activity within eight hours.
- ACTION 4:** If the number of operable channels is less than required, the contents of the Waste Gas Decay Tanks may be released to the environment provided that prior to initiation of the release:
- a. At least two independent samples of the tank's contents are analyzed, and:
  - b. At least two technically qualified members of the Station staff independently verify the release rate calculations and discharge valve lineup.
- ACTION 5:** If the number of operable channels is less than required, effluent releases from the Waste Gas Decay Tank may continue provided samples are continuously collected with auxiliary sampling equipment as required in Radioactive Gaseous Waste Sampling and Analysis Program (Attachment 4).
- NOTE 1:** A channel shall consist of:
- a. The flow instrument installed in the ejector through which the discharge is routed; either Train A (1-SV-FI-100A, 101A), or Train B (1-SV-FI-100B, 101B) or both.
  - b. Flow instruments 101A and 101B provide low range measurement. Flow instruments 100A and 100B provide high range measurement.
- NOTE 2:** A channel shall consist of:
- a. The flow instrument installed in the ejector through which the discharge is routed; either Train A (2-SV-FI-200A, 201A), or Train B (2-SV-FI-200B, 201B) or both.
  - b. Flow instruments 201A and 201B provide low range measurement. Flow instruments 200A and 200B provide high range measurement.
- NOTE 3:** A channel shall consist of a MGPI monitor; and a MGPI or HP particulate and iodine sampler, and its associated sampler flow rate measuring device or rotameter.

**ATTACHMENT 7**

(Page 1 of 3)

**Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements**

CHANNEL DESCRIPTION	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	Channel Operational Test
<b>1. PROCESS VENT SYSTEM</b>				
(a) Noble Gas Activity Monitor 1-GW-RM-178-1	D	M (NOTE 5)	R	Q (NOTE 1)
(b) Iodine Sampler 1-GW-RM-178-1 Process Vent Continuous HP Sampler	W D (NOTE 3)	N/A N/A	N/A N/A	N/A N/A
(c) Particulate Sampler 1-GW-RM-178-1 Process Vent Continuous HP Sampler	W D (NOTE 3)	N/A N/A	N/A N/A	N/A N/A
(d) Total Flow Monitor 1-GW-FT-108	D	N/A	R	Q
(e) Sampler Flow Rate Measuring Device MGPI Flow Rate Measuring Device HP Sampler Rotameter	D (NOTE 3) D (NOTE 3)	N/A N/A	R SA	N/A N/A
<b>2. CONDENSER AIR EJECTOR SYSTEM</b>				
(a) Noble Gas Activity Monitor Unit 1 1-SV-RM-121 Unit 2 2-SV-RM-221	D	M	R	Q (NOTE 1)
(b) Flow Rate Measuring Device Unit 1 1-SV-FI-100A 1-SV-FI-101A 1-SV-FI-100B 1-SV-FI-101B Unit 2 2-SV-FI-200A 2-SV-FI-201A 2-SV-FI-200B 2-SV-FI-201B	D D	N/A N/A	R R	N/A N/A

**ATTACHMENT 7**

(Page 3 of 3)

**Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements**

NOTE 1: The Channel Operational Test shall demonstrate:

- a. Automatic actuation of the valves in this pathway and Control Room alarm annunciation occur if the instrument indicates measured levels above the alarm / trip setpoint.
- b. Alarm annunciation occurs if the instrument controls not set in "operate" mode.

NOTE 2: The Channel Operational Test shall demonstrate:

- a. Control Room alarm annunciation occurs if the instrument indicates measured levels are above the alarm / trip setpoint.
- b. Alarm annunciation occurs if the instrument controls not set in "operate" mode.

NOTE 3: Channel Checks shall consist of verifying indication of flow during periods of release. Channel Checks shall be made at least once per 24 hours on days on which continuous, periodic, or batch releases are made. Verification need only to be done to verify operability of one train, either MGPI or HP Sampler.

NOTE 4: The Channel Operational Test shall demonstrate that:

- a. Control Room alarm annunciation occurs if the instrument indicates measured levels are above alarm / trip setpoint.
- b. The Instrument mode selection control automatically resets to "operate" mode when released.

NOTE 5: Monitors 1-GW-RM-178-1, 1-VG-RM-179-1, and 1-VG-RM-180-1 perform periodic source checks automatically.



## ATTACHMENT 9

(Page 3 of 5)

## Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Number of Sample and Sample Location (NOTE 2)	Collection Frequency	Type and Frequency of Analysis
4. INGESTION			
a) Milk (NOTE 7)	<p>a) Samples from milking animals in 3 locations within 5 km that have the highest potential. If there are none, then 1 sample from milking animals in each of 3 areas between 5 to 8 km where doses are calculated to be greater than 1 mrem per yr (NOTE 6)</p> <p>b) 1 sample from milking animals at a control location (15-30 km in the least prevalent wind direction)</p>	Monthly at all times	Gamma isotopic (NOTE 5) and I <sup>131</sup> analysis monthly
b) Fish and Invertebrates	<p>a) 1 sample of commercially and recreationally important species (bass, sunfish, catfish) in vicinity of plant discharge area</p> <p>b) 1 sample of same species in areas not influenced by plant discharge</p>	Semiannually	Gamma isotopic on edible portions
c) Food Products	<p>a) Samples of an edible broad leaf vegetation grown nearest each of two different offsite locations of highest predicted historical annual average ground level D/Q if milk sampling is not performed</p> <p>b) 1 sample of broad leaf vegetation grown 15-30 km in the least prevalent wind direction if milk sampling is not performed</p>	Monthly if available, or at harvest	Gamma isotopic (NOTE 5) and I <sup>131</sup> analysis

**ATTACHMENT 9**

(Page 4 of 5)

**Radiological Environmental Monitoring Program**

- NOTE 1: The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. Local site characteristics must be examined to determine if pathways not covered by this table may significantly contribute to an individual's dose and be included in the sampling program.
- NOTE 2: For each and every sample location in Environmental Sampling Locations (Attachment 10), specific parameters of distance and direction sector from the centerline of the reactor, and additional description where pertinent, shall be provided in Attachment 10. Refer to Radiological Assessment Branch Technical Positions and to NUREG-0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plant. Deviations are permitted from the required sampling schedule if specimens are unattainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unattainable due to sampling equipment malfunction, every effort shall be made to complete corrective action before the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to 6.7.1. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances, suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. In lieu of a Licensee Event Report and pursuant to 6.7.2, identify the cause of the unavailability of samples for that pathway and identify the new locations for obtaining replacement samples in the next Annual Radioactive Effluent Release Report, and include revised figures and tables from the ODCM reflecting the new locations in the report.

**ATTACHMENT 9**

(Page 5 of 5)

**Radiological Environmental Monitoring Program**

- NOTE 3: One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The 36 stations are not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations, e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.
- NOTE 4: Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.
- NOTE 5: Gamma isotopic analysis is the identification and quantification of gamma-emitting radionuclides that may be attributable to effluents from the facility.
- NOTE 6: The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.
- NOTE 7: If milk sampling cannot be performed, use item 4.c (Page 3 of 5, Radiological Environmental Monitoring Program (Attachment 9)).

## ATTACHMENT 10

(Page 2 of 4)

## Environmental Sampling Locations

## Distance and Direction From Unit No. 1

Sample Media	Location	Station No.	Distance (Miles)	Direction	Collection Frequency	Remarks
Environmental TLDs	Biology Lab	SE-13/45	0.64	SE	Quarterly	On-Site
	Route 701 (Dam Entrance)	SE-14/46	5.88	SE	Quarterly	
	"Aspen Hills"	SSE-15/47	0.93	SSE	Quarterly	Site Boundary
	Elk Creek	SSE-16/48	2.33	SSE	Quarterly	
	NAPS Access Road	S-17/49	0.47	S	Quarterly	On-Site
	Elk Creek Church	S-18/50	1.55	S	Quarterly	
	NAPS Access Road	SSW-19/51	0.42	SSW	Quarterly	On-Site
	Route 618	SSW-20/52	5.30	SSW	Quarterly	
	500KV Tower	SW-21/53	0.60	SW	Quarterly	On-Site
	Route 700	SW-22/54	3.96	SW	Quarterly	
	NAPS Radio Tower	WSW-23/55	0.38	WSW	Quarterly	On-Site
	Route 700	WSW-24/56	1.00	WSW	Quarterly	Site Boundary
	South Gate of Switchyard	W-25/57	0.32	W	Quarterly	On-Site
	Route 685	W-26/58	1.55	W	Quarterly	
	End of Route 685	WNW-27/59	1.00	WNW	Quarterly	Site Boundary
	Route 685	WNW-28/60	1.40	WNW	Quarterly	
	Laydown Area North Gate	NW-29/61	0.45	NW	Quarterly	On-Site
	Lake Anna Campground	NW-30/62	2.54	NW	Quarterly	
	#1/#2 Intake	NNW-31/63	0.07	NNW	Quarterly	On-Site
	Route 208	NNW-32/64	2.21	NNW	Quarterly	
Bumpass Post Office	C-1/2	7.30	SSE	Quarterly		
Orange, VA	C-3/4	22.00	NW	Quarterly	Control	
Mineral, VA	C-5/6	7.10	WSW	Quarterly		
Louisa, VA	C-7/8	11.54	WSW	Quarterly	Control	

## ATTACHMENT 10

(Page 4 of 4)

## Environmental Sampling Locations

## Distance and Direction From Unit No. 1

Sample Media	Location	Station No.	Distance (Miles)	Direction	Collection Frequency	Remarks
Soil (continued)	Fredericks Hall	02	5.30	SSW	Once per 3 yrs	
	Mineral, VA	03	7.10	WSW	Once per 3 yrs	
	Wares Crossroads	04	5.10	WNW	Once per 3 yrs	
	Route 752	05	4.20	NNE	Once per 3 yrs	
	Sturgeon's Creek Marina	05A	2.04	N	Once per 3 yrs	
	Levy, VA	06	4.70	ESE	Once per 3 yrs	
	Bumpass, VA	07	7.30	SSE	Once per 3 yrs	
	End of Route 685	21	1.00	WNW	Once per 3 yrs	Site Boundary
	Route 700	22	1.00	WSW	Once per 3 yrs	Site Boundary
	"Aspen Hills"	23	0.93	SSE	Once per 3 yrs	Site Boundary
Orange, VA	24	22.00	NW	Once per 3 yrs	Control	
Milk	Holladay Dairy (R.C. Goodwin)	12	8.30	NW	Monthly	
	Terrell's Dairy (Frederick's Hall)	13	5.60	SSE	Monthly	
Fish	Waste Heat Treatment Facility (Second Cooling Lagoon)	08	3.37	SSE	Semi-Annually	
	Lake Orange	25	16.50	NW	Semi-Annually	Control
Food Products (Edible broadleaf vegetation <sup>a</sup> )	Bel Aire Plantation	14	varies	NE	Monthly if available, or at harvest	
	Route 614	15	varies	SE		
	Route 629 / 522	16	varies	NW		Control
	Historic Ln	26	varies	S		
	"Aspen Hills" Area	23	varies	SSE		

a. If edible broadleaf vegetation is unavailable, non-edible vegetation of similar leaf characteristics may be substituted.

## ATTACHMENT 11

(Page 1 of 2)

## Detection Capabilities for Environmental Sample Analysis

## LOWER LIMIT OF DETECTION (LLD)

Analysis (NOTE 2)	Water (pCi/l)	Airborne Particulate or Gases (pCi/m <sup>3</sup> )	Fish (pCi/kg) (wet)	Milk (pCi/l)	Food Products (pCi/kg) (wet)	Sediment (pCi/kg) (dry)
Gross beta	4	0.01				
H-3	2,000					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	(NOTE 3) 1	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

NOTE 1: Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

NOTE 2: This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

NOTE 3: LLD for the ground (drinking) water samples. The LLD for the surface (non-drinking) water samples is 10 pCi/l.

## ATTACHMENT 11

(Page 2 of 2)

**Detection Capabilities for Environmental Sample Analysis****LOWER LIMIT OF DETECTION (LLD) (NOTE 3)**

NOTE 3: For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 s_b}{E \cdot V \cdot 2.22E+06 \cdot Y \cdot e^{-(\lambda \Delta t)}} \quad (25-1)$$

Where:

- LLD = the “a priori” (before the fact) Lower Limit of Detection as defined above (as microcuries per unit mass or volume) (See 4.9)
- $s_b$  = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute, cpm)
- E = the counting efficiency (as counts per disintegration)
- V = the sample size (in units of mass or volume)
- 2.22E+06 = the number of disintegrations per minute (dpm) per microcurie
- Y = the fractional radiochemical yield (when applicable)
- $\lambda$  = the radioactive decay constant for the particular radionuclide
- $\Delta t$  = the elapsed time between sample collection (or end of the sample collection period) and time of counting (for environmental samples, not plant effluent samples)

Typical values of E, V, Y and  $\Delta t$  should be used in the calculation.

The LLD is an “a priori” (before the fact) limit representing the capability of a measurement system and not a “posteriori” (after the fact) limit for a particular measurement.

## ATTACHMENT 12

(Page 1 of 1)

## Reporting Levels for Radioactivity Concentrations in Environmental Samples

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m <sup>3</sup> )	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	(NOTE 1) 20,000				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

NOTE 1: For drinking water samples

**ATTACHMENT 13**

(Page 1 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis****1.0 METEOROLOGICAL ANALYSIS****1.1 Purpose**

The purpose of the meteorological analysis was to determine the annual average  $X/Q$  and  $D/Q$  values at critical locations around the Station for ventilation vent (ground level) and process vent (mixed mode) releases. The annual average  $X/Q$  and  $D/Q$  values were used to perform a dose pathway analysis to determine both the maximum exposed individual at site boundary and member of the public. The  $X/Q$  and  $D/Q$  values resulting in the maximum exposures were incorporated into the dose factors in Gaseous Effluent Dose Factors (Attachment 5) and Critical Organ Dose Factors (Attachment 8).

**1.2 Meteorological Data, Parameters, and Methodology**

Onsite meteorological data for the period January 1, 1981, through December 31, 1981, were used in calculations. These data included wind speed, wind direction, and differential temperature for the purpose of determining joint frequency distributions for those releases characterized as ground level (e.g., ventilation vent), and those characterized as mixed mode (i.e., process vent). The portions of release characterized as ground level were based on  $\Delta T_{158.9\text{ft}-28.2\text{ft}}$  and 28.2 foot wind data, and the portions characterized as mixed mode were based on  $\Delta T_{158.9\text{ft}-28.2\text{ft}}$  and 158.9 ft wind data.

$X/Q$ 's and  $D/Q$ 's were calculated using the NRC computer code "XOQDOQ - Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," September, 1977. The code is based upon a straight line airflow model implementing the assumptions outlined in Section C (excluding C1a and C1b) of Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

The open terrain adjustment factors were applied to the  $X/Q$  values as recommended in Regulatory Guide 1.111. The site region is characterized by gently rolling terrain so open terrain correction factors were considered appropriate. The ground level ventilation vent release calculations included a building wake correction based on a 1516 m<sup>2</sup> containment minimum cross-sectional area.

**ATTACHMENT 13**

(Page 2 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

The effective release height used in mixed mode release calculations was based on a process vent release height of 157.5 ft, and plume rise due to momentum for a vent diameter of 3 in. with plume exit velocity of 100 ft/sec. Ventilation vent, and vent releases other than from the process vent, are considered ground level as specified in Regulatory Guide 1.111 for release points less than the height of adjacent solid structures. Terrain elevations were obtained from North Anna Power Station Units 1 and 2, Virginia Electric and Power Company Final Safety Analysis Report Table 11C.2-8.

$X/Q$  and  $D/Q$  values were calculated for the nearest site boundary, resident, milk cow, and vegetable garden by sector for process vent and ventilation vent releases at distances specified from North Anna Power Station Annual Environmental Survey Data for 1981.  $X/Q$  values were also calculated for the nearest lake shoreline by sector for the process vent and ventilation vent releases.

According to the definition for short term in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Stations," October, 1978, some gaseous releases may fit this category, primarily waste gas decay tank releases and containment purges. However, these releases are considered long term for dose calculations as past releases were both random in time of day and duration as evidenced by reviewing past release reports. Therefore, the use of annual average concentrations is appropriate according to NUREG-0133.

The  $X/Q$  and  $D/Q$  values calculated from 1981 meteorological data are comparable to the values presented in the North Anna Power Station UFSAR.

**1.3 Results**

The  $X/Q$  value that resulted in the maximum total body, skin and inhalation exposure for ventilation vent releases was  $9.3E-06 \text{ sec/m}^3$  at a site boundary location 1416 meters SE sector. For process vent releases, the site boundary  $X/Q$  value was  $1.2E-06 \text{ sec/m}^3$  at a location 1513 meters S sector. The shoreline  $X/Q$  value that resulted in the maximum inhalation exposure for ventilation vent releases was  $1.0E-04 \text{ sec/m}^3$  at a location 274 meters NNE sector. The shoreline  $X/Q$  value for process vent was  $2.7E-06 \text{ sec/m}^3$  at a location 274 meters NNE sector.

**ATTACHMENT 13**

(Page 3 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

Pathway analysis indicated that the maximum exposure from I-131, I<sup>133</sup>, and from all radionuclides in particulate form with half-lives greater than 8 days was through the grass-cow-milk pathway. The D/Q value from ventilation vent releases resulting in the maximum exposure was 2.4E-09 per m<sup>2</sup> at a location 3250 meters N sector. For process vent releases, the D/Q value was 1.1E-09 per m<sup>2</sup> at a location 3250 meters N sector. For tritium, the X/Q value from ventilation vent releases resulting in the maximum exposure for the milk pathway was 7.2E-07 sec/m<sup>3</sup>, and 3.9E-07 sec/m<sup>3</sup> for process vent releases at a location 3250 meters N sector.

**2.0 LIQUID PATHWAY ANALYSIS****2.1 Purpose**

The purpose of the liquid pathway analysis was to determine the maximum exposed member of the public in unrestricted areas as a result of radioactive liquid effluent releases. The analysis includes a determination of most restrictive liquid pathway, most restrictive age group, and critical organ. This analysis is required for Subsection 6.2.

**2.2 Data, Parameters, and Methodology**

Initially, radioactive liquid effluent release data for the years 1979, 1980, and 1981 were compiled from the North Anna Power Station semi-annual effluent release reports. The data for each year, along with appropriate site specific parameters and default selected parameters, were entered into the NRC computer code LADTAP as described in NUREG-0133.

Re-concentration of effluents using the small lake connected to larger water body model was selected with the appropriate parameters determined from Table 3.5.3.5, Design Data for Reservoir and Waste Heat Treatment Facility from Virginia Electric and Power Company, Applicant's Environmental Report Supplement, North Anna Power Station, Units 1 and 2, March 15, 1972. Dilution factors for aquatic foods, shoreline, and drinking water were set to one. Transit time calculations were based on average flow rates. All other parameters were defaults selected by the LADTAP computer code.

**ATTACHMENT 13**

(Page 4 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

Beginning in 1997, the activity by nuclide released in the previous year is entered into the North Anna Power Station liquid pathway critical organ calculations spreadsheet, which calculates the most limiting age group total body and critical organ. This Process is repeated annually.

**2.3 Results**

Initially, the fish pathway resulted in the largest dose. The critical organ each year was the liver, and the adult and teenage age groups received the same organ dose. However, since the adult total body dose was greater than the teen total body dose for each year, the adult was selected as the most restrictive age group. Beginning in 1997, the most limiting age group for both total body and critical organ is calculated from the spreadsheet for North Anna Power Station liquid pathway critical organ calculations.

**3.0 GASEOUS PATHWAY ANALYSIS****3.1 Purpose**

A gaseous effluent pathway analysis was performed to determine the location that would result in the maximum doses due to noble gases for use in demonstrating compliance with 6.3.1.a. and 6.3.3.a. The analysis also included a determination of the critical pathway, location of maximum exposed member of the public, and the critical organ for the maximum dose due to  $I^{131}$ ,  $I^{133}$ , tritium, and for all radionuclides in particulate form with half-lives greater than 8 days for use in demonstrating compliance with requirements in 6.3.4.a.1. In addition, the analysis included a determination of the critical pathway, maximum age group, and sector location of an exposed individual through the inhalation pathway from  $I^{131}$ ,  $I^{133}$ , tritium, and particulates with half-lives greater than 8 days to demonstrate compliance with 6.3.1.a..

**ATTACHMENT 13**

(Page 5 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis****3.2 Data, Parameters, and Methodology**

Annual average  $\chi/Q$  values were calculated, as described in Section 1 of this attachment, for the nearest site boundary in each directional sector and at other critical locations beyond the site boundary. The largest  $\chi/Q$  value was determined to be  $9.3E-06 \text{ sec/m}^3$  at site boundary for ventilation vent releases at a location 1416 meters SE direction, and  $1.2E-06 \text{ sec/m}^3$  at site boundary for process vent releases at a location 1513 meters S direction. The maximum doses to total body and skin, and air doses for gamma and beta radiation due to noble gases, would be at these site boundary locations. The doses from both release points are summed in calculations to calculate total maximum dose.

Step 6.3.1.a.2 dose limits apply specifically to the inhalation pathway. Therefore, the locations and  $\chi/Q$  values determined for maximum noble gas doses can be used to determine the maximum dose from  $I^{131}$ ,  $I^{133}$ , tritium, and for all radionuclides in particulate form with half-lives greater than 8 days for the inhalation pathway.

The NRC computer code GASPAR, "Evaluation of Atmospheric Releases," Revised 8/19/77, was run using 1979, 1980 and 1981 North Anna Power Station Gaseous Effluent Release Report data. Doses from  $I^{131}$ ,  $I^{133}$ , tritium, and particulates for the inhalation pathway were calculated using the  $9.3E-06 \text{ sec/m}^3$  site boundary  $\chi/Q$ . Except for the source term data and the  $\chi/Q$  value, computer code default parameters were used. Results for each year indicated that the critical age group was the child and the critical organ was the thyroid for the inhalation pathway.

The gamma and beta dose factors  $K_{ivv}$ ,  $L_{ivv}$ ,  $M_{ivv}$ , and  $N_{ivv}$  in Gaseous Effluent Dose Factors (Attachment 5) were obtained by performing a units conversion of the appropriate dose factors from Table B-1, Regulatory Guide 1.109, Rev. 1, to  $\text{mrem/yr per Ci/m}^3$  or  $\text{mrad/yr per Ci/m}^3$ , and multiplying by the ventilation vent site boundary  $\chi/Q$  value of  $9.3E-06 \text{ sec/m}^3$ . The same approach was used in calculating the gamma and beta dose factors  $K_{ipv}$ ,  $L_{ipv}$ ,  $M_{ipv}$ , and  $N_{ipv}$  in Gaseous Effluent Dose Factors (Attachment 5) using the process vent site boundary  $\chi/Q$  value of  $1.2E-06 \text{ sec/m}^3$ .

**ATTACHMENT 13**

(Page 6 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

The inhalation pathway dose factors  $P_{ivv}$  and  $P_{ipv}$  in Gaseous Effluent Dose Factors (Attachment 5) were calculated using the following equation:

$$P_i = K'(BR) DFA_i(\chi/Q) \text{ (mrem/yr per Curie/sec)} \quad (29-1)$$

where:

- $K'$  = a constant of unit conversion,  $1E+12$  pCi/Ci
- $BR$  = the breathing rate of the child age group,  $3700 \text{ m}^3/\text{yr}$ , from Table E-5, Regulatory Guide 1.109, Rev.1
- $DFA_i$  = the thyroid organ inhalation dose factor for child age group for the  $i$ th radionuclide, in mrem/pCi, from Table E-9, Regulatory Guide 1.109, Rev. 1
- $\chi/Q$  = the ventilation vent site boundary  $\chi/Q$ ,  $9.3E-06 \text{ sec/m}^3$ , or the process vent site boundary  $\chi/Q$ ,  $1.2E-06 \text{ sec/m}^3$ , as appropriate

Step 6.3.4.a., requires that the dose to the maximum exposed member of the public from  $I^{131}$ ,  $I^{133}$ , tritium, and from all radionuclides in particulate form with half-lives greater than 8 days be less than or equal to the specified limits. Dose calculations were performed for an exposed member of the public within site boundary unrestricted areas, and to an exposed member of the public beyond site boundary at locations identified in the North Anna Power Station Annual Environmental Survey Data for 1981.

It was determined that the member of the public within site boundary would be using Lake Anna for recreational purposes a maximum of 2232 hours per year. It is assumed that this member of the public would be located the entire 2232 hours at the lake shoreline with the largest annual  $\chi/Q$  of  $1.0E-04$  at a location 274 meters NNE sector. The NRC computer code GASPAR was run to calculate the inhalation dose to this individual. The GASPAR results were corrected for the fractional year the member of the public would be using the lake.

## ATTACHMENT 13

(Page 7 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

Using the NRC computer code GASPAR and annual average  $X/Q$  and  $D/Q$  values obtained as described in Section 1 of this attachment, the member of the public receiving the largest dose beyond site boundary was determined to be located 3250 meters N sector. The critical pathway was the grass-cow-milk, the maximum age group was the infant, and the critical organ the thyroid. For each year 1979, 1980, and 1981 the dose to the infant from the grass-cow-milk pathway was greater than the dose to the member of the public within site boundary. Therefore, the maximum exposed member of the public was determined to be the infant, exposed through the grass-cow-milk pathway, critical organ thyroid, at a location 3250 meters N sector.

Pathway analysis results indicate that existing pathways, including ground and inhalation, within five miles of North Anna Power Station, yield  $R_i$  dose factors less than those determined for the cow-milk pathway. Although the cow-milk pathway does not exist within five miles of the Station, NUREG-0133 requires the use of cow-milk  $R_i$  dose factors since these values result in the most limiting doses. There is no requirement to include the other pathways.

**[Commitment 3.2.3]**

The  $RM_{iVV}$  and  $RM_{iPV}$  dose factors, except for tritium, in Critical Organ Dose Factors (Attachment 8) were calculated by multiplying the appropriate  $D/Q$  value with the following equation:

$$RM_i = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_m(r) (DFL_i) \left[ \frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_r} \quad (29-2)$$

where:

- $K'$  = a constant of unit conversion,  $1E+12$  pCi/Ci
- $Q_F$  = cow's consumption rate, 50, in Kg/day (wet weight)
- $U_{ap}$  = infant milk consumption rate, 330 liters/yr
- $Y_p$  = agricultural productivity by unit area of pasture feed grass,  $0.7$  Kg/m<sup>2</sup>
- $Y_s$  = agricultural productivity by unit area of stored feed,  $2.0$ , in Kg/m<sup>2</sup>
- $F_m$  = stable element transfer coefficients, from Table E-1, Regulatory Guide 1.109, Rev. 1

## ATTACHMENT 13

(Page 8 of 8)

**Meteorological, Liquid, and Gaseous Pathway Analysis**

- $r$  = fraction of deposited activity retained on cow's feed grass, 1.0 for radioiodine, and 0.2 for particulates
- $DFL_i$  = thyroid ingestion dose factor for the  $i$ th radionuclide for the infant, in mrem/pCi, from Table E-14, Regulatory Guide 1.109, Rev. 1
- $\lambda_i$  = decay constant for the  $i$ th radionuclide, in  $\text{sec}^{-1}$ , from Table of Isotopes, Lederer, Hollander, and Perlman, sixth Edition
- $\lambda_w$  = decay constant for removal of activity of leaf and plant surfaces by weathering,  $5.73\text{E-}07 \text{ sec}^{-1}$  (corresponding to a 14 day half-life)
- $t_f$  = transport time from pasture to cow, to milk, to receptor,  $1.73\text{E+}05$ , in seconds
- $t_h$  = transport time from pasture, to harvest, to cow, to milk, to receptor,  $7.78\text{E+}06$ , in seconds
- $f_p$  = fraction of year that cow is on pasture, 0.58 (dimensionless), 7 months per year from NUREG-0597
- $f_s$  = fraction of cow feed that is pasture grass while cow is on pasture, 1.0, dimensionless

Parameters used in the above equation were obtained from NUREG-0133 and Regulatory Guide 1.109, Rev.1

Since the concentration of tritium in milk is based on the airborne concentration rather than the deposition, the following equation is used:

$$RM_{H^3} = K'K''F_m Q_F U_{ap} (DFL_{H^3}) [0.75(0.5/H)] \chi/Q \quad (29-3)$$

where:

- $K''$  = a constant of unit conversion  $1\text{E+}03 \text{ gm/kg}$
- $H$  = absolute humidity of the atmosphere,  $8.0, \text{ gm/m}^3$
- $0.75$  = the fraction of total feed that is water
- $0.5$  = the ratio of the specific activity of the feed grass to the atmospheric water
- $\chi/Q$  = the annual average concentration at a location 3250 meters N sector,  $7.2\text{E-}07 \text{ sec/m}^3$  for ventilation vent releases, and  $3.9\text{E-}07 \text{ sec/m}^3$  for the process vent releases

Other parameters have been previously defined.

**ATTACHMENT 4**  
**MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS, AND SOLID**  
**WASTE TREATMENT SYSTEMS**  
**(01/04 - 12/04)**

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 synopsised 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.

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There was one major change to radioactive liquid, gaseous, and solid waste treatment systems for 2004. As part of DCP-99-006, 1-VG-104, 1-VG-113, and associated high range monitors, 1-RM-VG-174 and 1-RM-VG-175, were removed from VVA and VVB respectively. Safety evaluation 01-SE-MOD-02 was prepared and approved for DCP-99-006.

A review has been made of the methodologies used in this DCP, of the implementation of the DCP and of the changes that this implementation will have upon the UFSAR. In each case, the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report will not be increased. Also, the probability or malfunction of a different type than any evaluated previously in the safety analysis report will not be created, nor will the margin of safety as defined in the basis for any technical specification be reduced.

**ATTACHMENT 5**  
**INOPERABILITY OF RADIOACTIVE LIQUID AND GASEOUS**  
**EFFLUENT MONITORING INSTRUMENTATION**  
**(01/04 - 12/04)**

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.

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1-RM-SW-130 was out-of-service from 08 September 2004 until 12 October 2004. The cause of this condition was due to electrical failure. The high voltage lead had become detached from its lug leading to spiking of the radiation monitor. Grab samples were taken as required by VPAP-2103N, Offsite Dose Calculation Manual, during periods of radioactive discharge via this pathway.

1-BR-LT-112B, level transmitter for "B" Boron Recovery Test Tank was out-of-service from 05 August 2004 through 31 December 2004 due to failure of the transmitter. The transmitter is obsolete and an evaluation is being performed on a replacement transmitter to determine if it meets all applicable requirements. Upon completion of a satisfactory evaluation the failed transmitter will be replaced. There were neither additions to nor discharges from the tank during this period.

**ATTACHMENT 6**

**UNPLANNED RELEASES**

**(01/04 - 12/04)**

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.

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There were no unplanned gaseous or unplanned liquid releases during 2004.

**ATTACHMENT 7**  
**LOWER LIMITS OF DETECTION FOR EFFLUENT SAMPLE ANALYSIS**  
**(01/04 - 12/04)**

**Gaseous Effluents:**

<b>Radioisotope</b>	<b>Required L.L.D. (<math>\mu\text{Ci/ml}</math>)</b>	<b>Typical L.L.D. (<math>\mu\text{Ci/ml}</math>)</b>	
Krypton - 87	1.00E-4	2.00E-8	- 4.50E-8
Krypton - 88	1.00E-4	5.00E-8	- 8.00E-8
Xenon - 133	1.00E-4	3.00E-8	- 7.00E-8
Xenon - 133m	1.00E-4	7.50E-8	- 1.5 0E-7
Xenon - 135	1.00E-4	9.00E-9	- 2.00E-8
Xenon - 135m	1.00E-4	8.20E-8	- 1.40E-7
Xenon - 138	1.00E-4	1.50E-7	- 4.00E-7
Iodine - 131	1.00E-12	4.50E-14	- 9.00E-14
Iodine - 133	1.00E-10	4.00E-13	- 1.00E-12
Manganese - 54	1.00E-11	2.80E-14	- 5.10E-14
Cobalt - 58	1.00E-11	3.20E-14	- 5.30E-14
Iron - 59	1.00E-11	6.75E-14	- 1.25E-13
Cobalt - 60	1.00E-11	4.00E-14	- 8.50E-14
Zinc - 65	1.00E-11	7.00E-14	- 1.40E-13
Strontium - 89	1.00E-11	2.90E-14	- 6.00E-14
Strontium - 90	1.00E-11	4.00E-15	- 2.25E-14
Molybdenum - 99	1.00E-11	4.00E-13	- 7.00E-13
Cesium - 134	1.00E-11	9.50E-15	- 3.00E-14
Cesium - 137	1.00E-11	4.00E-14	- 5.50E-14
Cerium - 141	1.00E-11	5.00E-14	- 1.00E-13
Cerium - 144	1.00E-11	1.00E-13	- 5.00E-13
Gross Alpha	1.00E-11	4.00E-15	- 6.50E-15
Tritium	1.00E-6	3.00E-9	- 7.30E-9

**ATTACHMENT 7**  
**LOWER LIMITS OF DETECTION FOR EFFLUENT SAMPLE ANALYSIS**  
**(01/04 - 12/04)**

**Liquid Effluents:**

<b>Radioisotope</b>	<b>Required L.L.D. (<math>\mu</math>Ci/ml)</b>	<b>Typical L.L.D. (<math>\mu</math>Ci/ml)</b>		
Krypton - 87	1.00E-5	2.00E-8	-	8.00E-8
Krypton - 88	1.00E-5	5.00E-8	-	1.50E-7
Xenon - 133	1.00E-5	2.30E-8	-	7.50E-8
Xenon - 133m	1.00E-5	8.58E-8	-	3.00E-7
Xenon - 135	1.00E-5	5.00E-9	-	1.25E-8
Xenon - 135m	1.00E-5	5.00E-8	-	3.00E-7
Xenon - 138	1.00E-5	7.00E-8	-	6.00E-7
Iodine - 131	1.00E-6	2.00E-8	-	6.25E-8
Manganese - 54	5.00E-7	1.00E-8	-	2.30E-8
Iron - 55	1.00E-6	1.50E-7	-	4.40E-7
Cobalt - 58	5.00E-7	1.50E-8	-	6.00E-8
Iron - 59	5.00E-7	2.00E-8	-	4.00E-8
Cobalt - 60	5.00E-7	1.50E-8	-	5.70E-8
Zinc - 65	5.00E-7	2.50E-8	-	4.00E-8
Strontium - 89	5.00E-8	3.40E-8	-	4.50E-8
Strontium - 90	5.00E-8	2.00E-8	-	4.70E-8
Molybdenum - 99	5.00E-7	3.50E-8	-	5.50E-8
Cesium - 134	5.00E-7	9.90E-8	-	2.00E-7
Cesium - 137	5.00E-7	2.20E-8	-	6.00E-8
Cerium - 141	5.00E-7	5.00E-8	-	9.00E-8
Cerium - 144	5.00E-7	1.20E-7	-	4.00E-7
Gross Alpha	1.00E-7	2.00E-8	-	6.60E-8
Tritium	1.00E-5	2.75E-6	-	3.25E-6