

**ENCLOSURE (1)**

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**CALVERT CLIFFS NUCLEAR POWER PLANT  
EFFLUENT AND WASTE DISPOSAL  
2007 ANNUAL REPORT**

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Facility - Calvert Cliffs Nuclear Power Plant

Licensee – Calvert Cliffs Nuclear Power Plant, Inc.

**I. REGULATORY LIMITS**

**A. Fission and Activation Gases**

1. The instantaneous release rate of noble gases in gaseous effluents shall not result in a site boundary dose rate greater than 500 mRem/year to the whole body or greater than 3000 mRem/year to the skin [Offsite Dose Calculation Manual (ODCM) 3.11.2.1].
2. Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce gaseous emissions when the calculated gamma-air dose due to gaseous effluents exceeds 1.20 mRad or the calculated beta-air dose due to gaseous effluents exceeds 2.4 mRad at the site boundary in a 92 day period (ODCM 3.11.2.4).
3. The air dose at the site boundary due to noble gases released in gaseous effluents shall not exceed (ODCM 3.11.2.2):
  - 10 mRad/qtr, gamma-air
  - 20 mRad/qtr, beta-air
  - 20 mRad/year, gamma-air
  - 40 mRad/year, beta-air
4. All of the above parameters are calculated according to the methodology specified in the ODCM.

**B. Iodines and Particulates with Half Lives Greater than Eight Days**

1. The instantaneous release rate of iodines and particulates in gaseous effluents shall not result in a site boundary dose-rate in excess of 1500 mRem/year to any organ (ODCM 3.11.2.1).
2. The Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous effluents when calculated doses exceed 1.8 mRem to any organ in a 92 day period at or beyond the site boundary (ODCM 3.11.2.4).
3. The dose to a member of the public at or beyond the site boundary from iodine-131 and particulates with half lives greater than eight days in gaseous effluents shall not exceed (ODCM 3.11.2.3):
  - 15 mRem/qtr, any organ
  - 30 mRem/year, any organ
  - less than 0.1% of the above limits as a result of burning contaminated oil.
4. All of the above parameters are calculated according to the methodology specified in the ODCM.

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C. Liquid Effluents

1. The concentrations of radionuclides in liquid effluents from the plant shall not exceed the values specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for unrestricted areas (ODCM 3.11.1.1).
2. The liquid radwaste treatment system shall be used to reduce the concentration of radionuclides in liquid effluents from the plant when the calculated dose to unrestricted areas exceeds 0.36 mRem to the whole body, or 1.20 mRem to any organ in a 92 day period (ODCM 3.11.1.3).
3. The dose to a member of the public in unrestricted areas shall not exceed (ODCM 3.11.1.2):
  - 3 mRem/qtr, total body
  - 10 mRem/qtr, any organ
  - 6 mRem/year, total body
  - 20 mRem/year, any organ
4. All of the liquid dose parameters are calculated according to the methodology specified in the ODCM.

**II. MAXIMUM PERMISSIBLE CONCENTRATIONS**

A. Fission and Activation Gases

Prior to the batch release of gaseous effluents, a sample of the source is collected and analyzed by gamma spectroscopy for the principal gamma emitting radionuclides. The identified radionuclide concentrations are evaluated and an acceptable release rate is determined to ensure that the dose rate limits of ODCM 3.11.2.1 are not exceeded.

B. Iodines and Particulates with Half Lives Greater than Eight Days

Compliance with the dose rate limitations for iodines and particulates is demonstrated by analysis of the charcoal and particulate samples of the station main vents. The charcoal samples are analyzed by gamma spectroscopy for quantification of radioiodine. The particulate samples are analyzed by gamma spectroscopy for quantification of particulate radioactive material. All of the above parameters are calculated according to the methodology specified in the ODCM.

C. Liquid Effluents

The Maximum Permissible Concentrations (MPCs) used for radioactive materials released in liquid effluents are in accordance with ODCM 3.11.1.1 and the values from 10 CFR Part 20, Appendix B, Table II, Column 2 including applicable table notes. In all cases, the more restrictive (lower) MPC found for each radionuclide is used regardless of solubility.

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**III. TECHNICAL SPECIFICATION REPORTING REQUIREMENTS**

A. Calvert Cliffs Nuclear Power Plant (CCNPP), Technical Specification 5.6.3

1. 2007 Dose Assessment Summary

	Actual Value	Percent of ODCM limit	ODCM Limit
Liquid Waste:			
Maximum Annual Organ Dose (mRem) <sup>1</sup>	0.0031	0.02%	20
Maximum Whole Body Dose (mRem)	0.0012	0.02%	6
Gaseous Waste:			
Noble Gases:			
Maximum Quarterly Gamma Air Dose (mRad)	0.007	0.07%	10
Maximum Quarterly Beta Air Dose (mRad)	0.004	0.18%	20
Iodines and Particulates:			
Maximum Annual Organ Dose (mRem) <sup>2</sup>	0.13	0.45%	30

<sup>1</sup> The controlling pathway was the fish and shellfish pathway with adult as the controlling age group and the GI-LLI representing the organ with the highest calculated dose during the calendar year of 2007.

<sup>2</sup> The controlling pathway was the child-thyroid pathway representing the organ with the highest calculated dose during the calendar year of 2007. There is currently no milk pathway.

2. 40 CFR 190 Total Dose Compliance

Based upon the calendar year 2007 and the ODCM calculations, the maximum exposed individual would receive 0.5% of the allowable dose. During the calendar year 2007, there were no on-site sources of direct radiation that would have contributed to a significant or measurable off-site dose. The direct radiation contribution is measured by both on-site and off-site thermoluminescent dosimeters (TLDs). The results of these measurements did not indicate any statistical increase in the off-site radiation doses attributable to on-site sources. Therefore, no increase in the calculated offsite dose is attributed to the direct exposure from on-site sources. A more detailed evaluation may be found in the Annual Radiological Environmental Operating Report.

3. Solid Waste Report Requirements

During 2007, the types of radioactive solid waste shipped from Calvert Cliffs were dry compressible waste, spent resins, irradiated components, and cartridge filters which were shipped in either High Integrity Containers (HICs) within NRC approved casks, Sea/Land containers, or steel boxes. Appendix A provides a detailed breakdown of the waste shipments for 2007 per Technical Specification 5.6.3. At CCNPP, methods of waste and materials segregation are used to reduce the volume of solid waste shipped offsite for processing, volume reduction, and burial.

4. Offsite Dose Calculation Manual (ODCM) and Process Control Program (PCP) Changes

The ODCM was not revised during calendar year 2007. The PCP was not revised in 2007.

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**B. Radioactive Effluent Monitoring Instrumentation**

In 2007, the minimum channels operable requirement for the Unit-1 steam generator blowdown radiation monitor was not satisfied for greater than 30 days. Per ODCM 3.3.3.10, Radioactive Liquid Effluents, Action b:

*“with less than the minimum number of radioactive liquid effluent monitoring instrumentation channels operable, take the action shown in Table 3.3-13. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.”*

There are two radiation monitors on the Unit-1 steam generator blowdown line: 1-RE-4014 and 1-RE-4095. The ODCM requires that one channel remain operable. Contrary to the ODCM requirements, both 1-RE-4014 and 1-RE-4095 were inoperable from 1-Jan-2007 through 10-Aug-2007 at 16:45. The provisions of Action 29 (ODCM Table 3.3-13) were implemented. Those actions required:

*“with the number of channels operable less than required by the minimum channels operable requirement, effluent releases via this pathway may continue provided grab samples are analyzed for gross radioactivity (beta or gamma) at the lower limit of detection defined in Table 4.11-1 at least every 48 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcuries/gram dose equivalent I-131.”*

Chemistry sampling was discontinued when one steam generator blowdown radiation monitor (1-RI-4095) was returned to service on 10-Aug-2007. 1-RE-4014 remained out of service for all calendar year 2007. The Unit-1 radiation monitors were out of service due to an unavailability of spare parts.

**C. Independent Spent Fuel Storage Installation (ISFSI), ISFSI Technical Specification 6.1**

Four (4) casks of spent fuel were transferred to the ISFSI during 2007. No quantity of radionuclides was released to the environment during the ISFSI operation in 2007. Additional information regarding the ISFSI radiological environmental monitoring program is included in the Annual Radiological Environmental Operation Report.

**IV. AVERAGE ENERGY**

Not Applicable.

**V. MEASUREMENTS AND APPROXIMATIONS AND TOTAL RADIOACTIVITY**

**A. Fission and Activation Gases**

**1. Batch Releases**

Prior to each batch release of gas from a pressurized waste gas decay tank or containment, a sample is collected and analyzed by gamma spectroscopy using a germanium detector for the principal gamma emitting noble gas radionuclides. The total activity released is based on the pressure/volume relationship (gas laws). The Plant Vent Stack Radiation Monitor typically monitors containment releases, and the

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values from the radiation monitor may be used to assist in the calculation of activity discharged from containment during venting.

2. Continuous Releases

A gas sample is collected at least weekly from the main vents and analyzed by gamma spectroscopy using a germanium detector for the principal gamma emitting noble gas radionuclides. The total activity released for the week is based on the total sample activity decay corrected to the sample time multiplied by the main vent flow for the week. The Plant Vent Stack Radiation Monitor continuously measures routine plant vent stack releases, per design, and the values from the radiation monitor may be used to assist in the calculation of activity discharged in routine plant vent stack discharges.

Prior to and after each containment purge, a gas sample is collected and analyzed by gamma spectroscopy using a germanium detector to determine the concentration of principal gamma emitting noble gas radionuclides inside containment. The total activity released is based on containment volume and purge rate. Alternatively, total activity released during a containment purge is based on continuous radiation monitor responses, grab samples, and purge fan flow rate.

A monthly composite sample is collected from the main vents and analyzed by liquid scintillation for tritium. The total tritium release for the month is based on the sample analysis and the main vent flow.

B. Iodine and Particulates

1. Batch Releases

The total activities of radioiodines and particulates released from pressurized waste gas decay tanks, containment purges, and containment vents are accounted for by the continuous samplers on the main vent.

2. Continuous Releases

During the release of gas from the main vents, samples of iodines and particulates are collected using a charcoal and particulate filter, respectively. The filters are removed weekly (or more often) and are analyzed by gamma spectroscopy using a germanium detector for significant gamma emitting radionuclides. The total activity released for the week is based on the total sample activity decay corrected to the midpoint of the sample period multiplied by the main vent flow for the week. A plate-out correction factor is applied to the results to account for the amount of iodine lost in the sample lines prior to sample collection. The weekly particulate filters are then combined to form monthly and quarterly composites for the gross alpha and strontium-89 and strontium-90 analyses.

Fuel failures in 2007 continued to cause iodine releases to be elevated relative to historical average values. Analyses on main vent filters indicated the presence of gross alpha activity in 2007. Alpha activity was detected in June and July on Unit 1, and was also detected in March and April on Unit 2. Although these values were reported, it is strongly suspected these results are related to naturally occurring radon, thoron, and their progeny. In future years, alpha spectroscopy may be used on

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samples indicating positive gross alpha activity to distinguish naturally occurring radioactive material from plant related radioactive material.

C. Liquid Effluents

1. Batch Releases

Prior to the release of liquid from a waste tank, a sample is collected and analyzed by gamma spectroscopy for the principal gamma emitting radionuclides. To demonstrate compliance with the concentration requirements addressed in Section I.C.1 above, the measured radionuclide concentrations are compared with the allowable MPCs; dilution in the discharge conduit is considered, and an allowable release rate is verified.

The total activity released in each batch is determined by multiplying the volume released by the concentration of each radionuclide. The actual volume released is based on the difference in tank levels prior to and after the release. A proportional composite sample is also withdrawn from each release, and this is used to prepare monthly tritium and gross alpha, iron-55, nickel-63, strontium-89, and strontium-90 samples for analysis are prepared quarterly for offsite analysis.

Batch discharges of secondary (normally uncontaminated) waste streams are also monitored for radioactivity. No activity is normally detected in these secondary waste streams. In the fourth quarter of 2007, the composite sample indicated the presence of Fe-55 activity at  $8.1E-7$  uCi/ml. No other activity (tritium, gamma, Ni-63, Sr-89, or Sr-90) was detected in this composite sample. A re-sample of the fourth quarters composite was sent for re-analysis in the first quarter of 2008 and results for Fe-55 were less than detectable activity  $< 3.1E-7$  uCi/ml.

There were no major changes to the liquid radwaste system in calendar year 2007.

2. Continuous Releases

To account for activity from continuous releases, a sample is collected and analyzed by gamma spectroscopy for the principal gamma emitting radionuclides. The measured radionuclide concentrations are compared with the allowable MPC concentrations in the discharge conduit, and an allowable release rate is verified.

When steam generator blowdown is discharged to the circulating water conduits, it is sampled and gamma isotopic analysis is performed at a minimum of three times per week and these samples are used in turn to prepare a weekly blowdown composite sample based on each day's blowdown. These results are multiplied by the actual quantity of blowdown to determine the total activity released. The weekly composite is also used to prepare monthly composites for tritium analysis.

During periods of primary-to-secondary leakage, the secondary system becomes contaminated and subsequently contaminates the turbine building sumps. The low-level activity water (predominantly tritium) contained in the turbine building sumps is discharged to the circulating water conduits. This water is sampled weekly and composited. The composite sample is analyzed at least monthly for tritium and

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principal gamma emitting radionuclides. The results are multiplied by the actual quantity of liquid released to determine the total activity released.

D. Estimation of Total Error

Total error for all releases was estimated using, as a minimum, the random counting error associated with typical releases. In addition to this random error, the following systematic errors were also examined:

1. Liquid
  - a. Error in volume of liquid released prior to dilution during batch releases.
  - b. Error in volume of liquid released via steam generator blowdown.
  - c. Error in amount of dilution water used during the reporting period.
2. Gases
  - a. Error in main vent release flow.
  - b. Error in sample flow rate.
  - c. Error in containment purge release flow.
  - d. Error in gas decay tank pressure.

Where errors could be estimated they are usually considered additive.

E. Reporting and Recordkeeping for Decommissioning

In accordance with 10 CFR 50.75.g, each licensee shall keep records of information important to the safe and effective decommissioning of the facility in an identified location until the license is terminated by the Commission. If records of relevant information are kept for other purposes, reference to these records and their locations may be used. Information the Commission considers important to decommissioning consists of records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. These records may be limited to instances when significant contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records must include any known information on identification of involved nuclides, quantities, forms, and concentrations.

To assist in the decommissioning, and to provide early and advance detection of any unmonitored releases of radioactive material from the site, groundwater is routinely sampled. These groundwater samples are analyzed for gamma and tritium activity. Sample size and/or count times are adjusted to achieve analytical sensitivities better than the environmental lower limit of detections (LLDs) for gamma emitters (listed in ODCM Table 4.12-1), and approximately 350 pCi/l for tritium.

Groundwater samples were collected from five piezometer tubes in 2007. A piezometer tube is a shallow monitoring well which allows access to groundwater at a depth of approximately 40 feet beneath the site. Of the five piezometer tubes sampled in 2007 none showed any plant-related activity. The 2007 tritium analysis results are reproduced on the following table.



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**Groundwater Monitoring Sample Results**

Sample location	Date	Tritium Concentration	
		microcuries/milliliter	picocuries/liter
11 Piezometer	2/9/2007	Not Detected, < 3.32E-7	Not Detected, < 332
12 Piezometer	2/9/2007	Not Detected, < 3.32E-7	Not Detected, < 332
13 Piezometer	2/9/2007	Not Detected, < 3.32E-7	Not Detected, < 332
15 Piezometer	2/9/2007	Not Detected, < 3.32E-7	Not Detected, < 332
18 Piezometer	2/9/2007	Not Detected, < 3.32E-7	Not Detected, < 332
11 Piezometer	5/16/2007	Not Detected, < 3.39E-7	Not Detected, < 339
12 Piezometer	5/16/2007	Not Detected, < 3.39E-7	Not Detected, < 339
13 Piezometer	5/16/2007	Not Detected, < 3.39E-7	Not Detected, < 339
15 Piezometer	5/16/2007	Not Detected, < 3.39E-7	Not Detected, < 339
18 Piezometer	5/16/2007	Not Detected, < 3.39E-7	Not Detected, < 339
11 Piezometer	9/13/2007	Not Detected, < 3.58E-7	Not Detected, < 358
12 Piezometer	9/13/2007	Not Detected, < 3.58E-7	Not Detected, < 358
13 Piezometer	9/13/2007	Not Detected, < 3.58E-7	Not Detected, < 358
15 Piezometer	9/13/2007	Not Detected, < 3.58E-7	Not Detected, < 358
18 Piezometer	9/13/2007	Not Detected, < 3.58E-7	Not Detected, < 358
11 Piezometer	12/9/2007	Not Detected, < 3.62E-7	Not Detected, < 362
12 Piezometer	12/9/2007	Not Detected, < 3.62E-7	Not Detected, < 362
13 Piezometer	12/9/2007	Not Detected, < 3.62E-7	Not Detected, < 362
15 Piezometer	12/9/2007	Not Detected, < 3.62E-7	Not Detected, < 362
18 Piezometer	12/9/2007	Not Detected, < 3.62E-7	Not Detected, < 362

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**VI. BATCH RELEASES**

	<u>2007</u>			
	<u>1ST QUARTER</u>	<u>2ND QUARTER</u>	<u>3RD QUARTER</u>	<u>4TH QUARTER</u>
<b>A. <u>Liquid</u></b>				
1. Number of batch releases	1.40E+01	1.20E+01	1.10E+01	7.00E+00
2. Total time period for batch releases (min)	6.02E+03	5.10E+03	3.61E+03	4.29E+03
3. Maximum time period for a batch release (min)	6.42E+02	6.07E+02	6.00E+02	6.75E+02
4. Average time period for batch releases (min)	4.30E+02	4.25E+02	3.28E+02	6.12E+02
5. Minimum time period for a batch release (min)	2.70E+01	2.90E+01	5.00E+00	5.65E+02
6. Average stream flow during periods of effluent into a flowing stream (liters/min of dilution water)	4.51E+06	4.23E+06	4.20E+06	4.62E+06
<b>B. <u>Gaseous</u></b>				
1. Number of batch releases	7.00E+00	1.00E+00	1.00E+00	2.00E+00
2. Total time period for batch releases (min)	4.32E+03	1.59E+03	1.82E+02	2.83E+02
3. Maximum time period for a batch release (min)	2.16E+03	1.59E+03	1.82E+02	1.51E+02
4. Average time period for batch release (min)	6.18E+02	1.59E+03	1.82E+02	1.42E+02
5. Minimum time period for a batch release (min)	1.10E+02	1.59E+03	1.82E+02	1.32E+02

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**VII. ABNORMAL RELEASES**

	<u>2007</u>			
	<u>1ST</u> <u>QUARTER</u>	<u>2ND</u> <u>QUARTER</u>	<u>3RD</u> <u>QUARTER</u>	<u>4TH</u> <u>QUARTER</u>
<b>A. <u>Liquid</u></b>				
1. Number of releases	- 0 -	- 1 -	- 1 -	- 0 -
2. Total activity released (Curies)	- 0 -	- 6.63E-6 -	- 1.68E-6 -	- 0 -
<b>B. <u>Gaseous</u></b>				
1. Number of releases	- 0 -	- 0 -	- 0 -	- 0 -
2. Total activity releases (Curies)	- 0 -	- 0 -	- 0 -	- 0 -

On 1-May-2007 at 14:00, a leak was discovered on a waste neutralizing tank (WNT). The leak rate was estimated to be 2.3 gallons per minute and it continued for approximately 5 hours until the leak was contained. The liquid spilled to a gravel area where it contacted the soil. The liquid flowed across the surface of the ground and entered a concrete culvert which emptied to the Chesapeake Bay. At the time of the leak, the WNT contained tritium at a concentration of 2.50E-6 uCi/ml (2,500 pCi/l). After the event, a liquid radioactive waste release permit (Permit #70050) was prepared. The total activity discharged from the WNT was estimated to be 0.00000663 Ci. A majority of this material drained into the concrete culvert and was discharged to the Chesapeake Bay. The soil and gravel that was wetted was remediated by excavating soil and gravel from the area. After remediation, a soil sample was collected from the hole (i.e., the excavated area). A tritium analysis was conducted on this soil sample. No tritium was detected in the soil sample. The Chesapeake Bay is not a drinking water pathway. This spill totaled 0.00000663 Ci of tritium. By comparison, 827 curies of tritium were discharged in liquid radwaste to the Chesapeake Bay in 2007. The dose resulting from the WNT leak was less than 0.1 mR.

On 1-Aug-2007 at 06:05, water was discovered dripping from the corner of a Sea Land Container. Total leakage was estimated to be 50 gallons. The liquid spilled to the soil. Water from the Sea Land Container was sampled and analyzed for tritium and gamma activity. At the time of the leak, the Sea Land Container contained tritium at a concentration of 8.84E-6 uCi/ml (8,840 pCi/l), Cs-137 at a concentration of 1.42E-8 uCi/ml (14.2 pCi/l), and Co-60 at 3.04E-8 uCi/ml (30.4 pCi/l). After the fact, a liquid radioactive waste release permit (Permit #70049) was prepared. The total activity discharged from the Sea Land Container was estimated to be 5.75 E-6 Ci Co-60, 2.69E-2.69E-8 Ci Cs-137, and 1.67E-6 Ci of H-3. The soil was remediated by excavating soil from the area. After remediation, a soil sample was collected from the hole (i.e., the excavated area). A tritium analysis was conducted on this soil sample. No tritium was detected in the soil sample. None of the radioactive material left the owner controlled area. The contamination was remediated and as a result, there was no dose to the public.

**APPENDIX A**  
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**TABLE 1A - REG GUIDE 1.21**  
**GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES**

<b>A. FISSION AND ACTIVATION GASES</b>	<b>UNITS</b>	<b>1ST QUARTER</b>	<b>2ND QUARTER</b>	<b>3RD QUARTER</b>	<b>4TH QUARTER</b>	<b>EST. TOTAL ERROR, %</b>
1. Total Release	Ci	3.69E+02	5.96E+01	9.02E+01	1.11E+02	±1.20E+01
2. Average release rate for period	µCi/sec	4.75E+01	7.58E+00	1.13E+01	1.40E+01	
3. Percent of Tech. Spec. limit (1)	%	5.10E-03	1.41E-03	1.77E-03	2.08E-03	
4. Percent of Tech. Spec. limit (2)	%	3.43E-03	5.50E-04	7.91E-04	1.03E-03	
5. Percent of Tech. Spec. limit (3)	%	7.37E-02	2.02E-02	2.59E-02	3.03E-02	
6. Percent of Tech. Spec. limit (4)	%	3.69E-02	1.01E-02	1.30E-02	1.51E-02	
7. Percent of Tech. Spec. limit (5)	%	1.76E-01	2.46E-02	3.84E-02	5.00E-02	
8. Percent of Tech. Spec. limit (6)	%	8.81E-02	1.23E-02	1.92E-02	2.50E-02	
<b>B. IODINES</b>						
1. Total Iodine - 131	Ci	3.67E-03	5.09E-04	3.99E-04	1.80E-04	±6.50E+00
2. Average release rate for period	µCi/sec	4.72E-04	6.47E-05	5.02E-05	2.26E-05	
3. Percent of Tech. Spec. limit (7)	%	1.12E-03	1.54E-04	1.19E-04	5.38E-05	
4. Percent of Tech. Spec. limit (8)	%	2.76E-02	3.83E-03	3.00E-03	1.35E-03	
5. Percent of Tech. Spec. limit (9)	%	1.38E-02	1.92E-03	1.50E-03	6.77E-04	
<b>C. PARTICULATES</b>						
1. Particulates with half lives greater than 8 days	Ci	4.71E-06	4.03E-07	(10)	(10)	±1.20E+01
2. Average release rate for period	µCi/sec	6.05E-07	5.12E-08	(10)	(10)	
3. Percent of Tech. Spec. limit (7)	%	1.03E-05	1.03E-05	(10)	(10)	
4. Percent of Tech. Spec. limit (8)	%	2.36E-04	2.02E-05	(10)	(10)	
5. Percent of Tech. Spec. limit (9)	%	1.18E-04	1.01E-05	(10)	(10)	
6. Gross alpha radioactivity	Ci	1.55E-07	1.28E-06	7.67E-07	(10)	±2.50E+01
<b>D. TRITIUM</b>						
1. Total Release	Ci	3.12E-01	5.74E-01	4.47E+00	5.98E-01	±1.32E+01
2. Average release rate for period	µCi/sec	4.02E-02	7.30E-02	5.63E-01	7.52E-02	

**APPENDIX A**  
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**TABLE 1A - REG GUIDE 1.21**  
**GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES**

**NOTES TO TABLE 1A**

- (1) Percent of I.A.1 whole body dose rate limit (500 mRem/year)
- (2) Percent of I.A.1 skin dose rate limit (3000 mRem/year)
- (3) Percent of I.A.3 quarterly gamma-air dose limit (10 mRad)
- (4) Percent of I.A.3 yearly gamma-air dose limit (20 mRad)
- (5) Percent of I.A.3 quarterly beta-air dose limit (20 mRad)
- (6) Percent of I.A.3 yearly beta-air dose limit (40 mRad)
- (7) Percent of I.B.1 organ dose rate limit (1500 mRem/year)
- (8) Percent of I.B.3 quarterly organ dose limit (15 mRem)
- (9) Percent of I.B.3 yearly organ dose limit (30 mRem)
- (10) Less than minimum detectable activity which meets the LLD requirements of ODCM Surveillance Requirement 4.11.2.1.2.

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TABLE 1C - REG GUIDE 1.21  
GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

	UNITS	CONTINUOUS MODE				BATCH MODE			
		1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
<b>1. FISSION AND ACTIVATION GASES</b>									
Argon	-41	Ci (2)	(2)	(2)	(2)	3.85E-04	1.13E-03	(2)	(2)
Krypton	-85	Ci 4.94E+01	6.96E-01	(2)	(2)	6.53E+01	(2)	8.77E+00	1.90E+01
Krypton	-85m	Ci 7.11E-03	1.80E-04	(2)	(2)	6.91E-04	(2)	(2)	(2)
Krypton	-87	Ci (2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Krypton	-88	Ci 4.85E-03	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Xenon	-131m	Ci 3.84E+00	(2)	(2)	(2)	2.71E-01	(2)	(2)	(2)
Xenon	-133	Ci 2.38E+02	5.37E+01	7.61E+01	8.57E+01	1.85E+00	1.50E-04	(2)	1.69E-03
Xenon	-133m	Ci 1.33E+00	2.34E-03	(2)	(2)	1.90E-02	(2)	(2)	(2)
Xenon	-135	Ci 9.28E+00	5.23E+00	5.27E+00	6.68E+00	3.13E-02	(2)	(2)	(2)
Xenon	-135m	Ci (2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Xenon	-138	Ci (2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Total for Period		Ci 3.02E+02	5.96E+01	8.14E+01	9.24E+01	6.75E+01	1.28E-03	8.77E+00	1.90E+01
<b>2. HALOGENS</b>									
Iodine	-131	Ci 3.67E-03	5.09E-04	3.99E-04	1.80E-04	3.15E-07	(1)	(1)	(1)
Iodine	-132	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Iodine	-133	Ci 1.32E-04	8.11E-05	9.65E-04	5.39E-04	(1)	(1)	(1)	(1)
Iodine	-135	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Total for Period		Ci 3.80E-03	5.90E-04	1.36E-03	7.19E-04	3.15E-07	(1)	(1)	(1)
<b>3. PARTICULATES (half life &gt; 8 days)</b>									
Manganese	-54	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Iron	-55	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Iron	-59	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cobalt	-58	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cobalt	-60	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Zinc	-65	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Strontium	-89	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Strontium	-90	Ci 4.71E-06	4.03E-07	(2)	(2)	(1)	(1)	(1)	(1)
Molybdenum	-99	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cesium	-134	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cesium	-137	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cerium	-141	Ci (2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)

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**TABLE 1C - REG GUIDE 1.21  
 GASEOUS EFFLUENTS - GROUND LEVEL RELEASES**

	UNITS	CONTINUOUS MODE				BATCH MODE			
		1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
Cerium -144	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Gross Alpha	Ci	1.55E-07	1.28E-06	7.67E-07	(2)	(1)	(1)	(1)	(1)
Total For Period	Ci	4.71E-06	4.03E-07	(2)	(2)	(1)	(1)	(1)	(1)

**NOTES TO TABLE 1C**

- (1) Iodines and particulates in batch releases are accounted for with the main vent continuous samplers when the release is made through the plant main vent.
- (2) Less than minimum detectable activity which meets the LLD requirements of ODCM Surveillance Requirement 4.11.2.1.2.

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TABLE 2A - REG GUIDE 1.21 LIQUID EFFLUENTS - SUMMARY OF ALL RELEASES						
	UNITS	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	EST. TOTAL ERROR, %
<b>A. FISSION AND ACTIVATION PRODUCTS</b>						
1. Total Release (not including tritium, gases, alpha)	Ci	9.14E-03	1.68E-02	1.34E-03	2.41E-03	±1.03E+01
2. Average diluted concentration during period	µCi/ml	3.39E-10	7.57E-10	8.34E-11	1.22E-10	
3. Percent of Tech. Spec. limit (1)	%	7.41E-03	1.37E-02	5.73E-03	5.18E-03	
4. Percent of Tech. Spec. limit (2)	%	3.71E-03	6.85E-03	2.87E-03	2.59E-03	
5. Percent of Tech. Spec. limit (3)	%	1.43E-02	5.57E-03	7.97E-03	1.06E-02	
6. Percent of Tech. Spec. limit (4)	%	7.15E-03	2.79E-03	3.99E-03	5.30E-03	
<b>B. TRITIUM</b>						
1. Total Release	Ci	2.94E+02	9.31E+01	1.91E+02	2.50E+02	±1.03E+01
2. Average diluted concentration during period	µCi/ml	1.26E-06	3.30E-07	2.32E-07	3.02E-07	
3. Percent of applicable limit (5)	%	4.21E-02	1.10E-02	7.72E-03	1.01E-02	
<b>C. DISSOLVED AND ENTRAINED GASES</b>						
1. Total Release	Ci	3.60E-01	1.24E-02	4.14E-03	3.81E-02	±1.03E+01
2. Average diluted concentration during period	µCi/ml	1.34E-08	5.62E-10	2.58E-10	1.92E-09	
<b>D. GROSS ALPHA RADIOACTIVITY</b>						
1. Total Release	Ci	(6)	(6)	(6)	(6)	N/A
<b>E. VOLUME OF WASTE RELEASED (prior to dilution)</b>						
1. Volume processed through radwaste system	liters	2.50E+06	1.97E+06	1.58E+06	1.68E+06	±1.30E+00
2. Volume low activity from secondary system	liters	1.58E+07	1.72E+07	5.01E+07	4.43E+07	±1.30E+00
<b>F. VOLUME OF DILUTION WATER USED DURING PERIOD (7)</b>						
	liters	9.54E+11	1.18E+12	1.20E+12	1.20E+12	±1.64E+01

NOTES TO TABLE 2A

- (1) Percent of I.C.3 Quarterly Organ Dose Limit (10 mRem) to maximum exposed organ
- (2) Percent of I.C.3 Yearly Organ Dose Limit (20 mRem) to maximum exposed organ
- (3) Percent of I.C.3 Quarterly Whole Body Dose Limit (3 mRem)
- (4) Percent of I.C.3 Yearly Whole Body Dose Limit (6 mRem)
- (5) Limit used is  $3 \times 10^{-3}$  µCi/ml
- (6) Less than minimum detectable activity which meets the LLD requirements of ODCM Surveillance Requirement 4.11.1.1.1.
- (7) Includes dilution water used during continuous discharges.



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**TABLE 2B - REG GUIDE 1.21  
LIQUID EFFLUENTS**

NUCLIDES RELEASED	Units	CONTINUOUS MODE				BATCH MODE			
		1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
Beryllium - 7	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Sodium - 24	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Chromium - 51	Ci	(1)	(1)	(1)	(1)	3.06E-04	(1)	(1)	(1)
Manganese - 54	Ci	(1)	(1)	(1)	(1)	3.52E-05	2.53E-05	2.95E-05	(1)
Iron - 55	Ci	(2)	(2)	(2)	(2)	2.98E-03	1.67E-03	5.90E-04	2.06E-03
Cobalt - 57	Ci	(1)	(1)	(1)	(1)	(1)	2.24E-06	(1)	(1)
Cobalt - 58	Ci	(1)	(1)	(1)	(1)	5.96E-04	6.83E-04	3.27E-04	2.74E-04
Iron - 59	Ci	(1)	(1)	(1)	(1)	(1)	1.54E-05	(1)	(1)
Cobalt - 60	Ci	(1)	(1)	(1)	(1)	2.58E-04	1.12E-04	1.63E-04	6.96E-05
Nickel-63	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc - 65	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Strontium - 89	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Strontium - 90	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Strontium - 92	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Niobium - 95	Ci	(1)	(1)	(1)	(1)	1.43E-05	1.31E-04	3.99E-05	(1)
Zirconium - 95	Ci	(1)	(1)	(1)	(1)	4.61E-06	8.84E-05	1.86E-05	(1)
Niobium - 97	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zirconium - 97	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Molybdenum - 99	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Technetium - 99m	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ruthenium - 103	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Rhodium - 105	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ruthenium - 105	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Silver - 110m	Ci	(1)	(1)	(1)	(1)	(1)	1.13E-04	(1)	(1)
Tin - 113	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tin - 117m	Ci	(1)	(1)	(1)	(1)	(1)	8.09E-05	(1)	(1)
Antimony - 122	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Antimony - 124	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Antimony - 125	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tellurium - 125m	Ci	(1)	(1)	(1)	(1)	4.31E-03	1.35E-02	(1)	(1)
Tellurium - 132	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Iodine - 131	Ci	(1)	(1)	(1)	(1)	4.66E-04	8.28E-06	3.20E-05	(1)

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**TABLE 2B - REG GUIDE 1.21**  
**LIQUID EFFLUENTS**

NUCLIDES RELEASED	Units	CONTINUOUS MODE				BATCH MODE			
		1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
Iodine - 132	Ci	(1)	(1)	(1)	(1)	1.61E-05	(1)	(1)	(1)
Iodine - 133	Ci	(1)	(1)	(1)	(1)	(1)	(1)	3.52E-06	(1)
Iodine - 135	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cesium - 134	Ci	(1)	(1)	(1)	(1)	2.29E-04	2.35E-05	5.32E-05	(1)
Cesium - 136	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cesium - 137	Ci	(1)	(1)	(1)	(1)	2.40E-04	3.67E-05	8.06E-05	(1)
Barium - 140	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lanthanum - 140	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cerium - 144	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Europium - 154	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Europium - 155	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tungsten - 187	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Total For Period	Ci	(1)	(1)	(1)	(1)	9.15E-03	1.68E-02	1.34E-03	2.41E-03
Krypton - 85	Ci	(1)	(1)	(1)	(1)	2.08E-02	5.13E-03		2.47E-03
Xenon - 131m	Ci	(1)	(1)	(1)	(1)	7.93E-03	4.58E-04		8.69E-04
Xenon - 133	Ci	(1)	(1)	(1)	(1)	3.30E-01	6.86E-03	4.14E-03	3.47E-02
Xenon - 133m	Ci	(1)	(1)	(1)	(1)	7.62E-04			
Xenon - 135	Ci	(1)	(1)	(1)	(1)	2.04E-05			
Total For Period	Ci	(1)	(1)	(1)	(1)	3.60E-01	1.24E-02	4.14E-03	3.81E-02

**NOTES TO TABLE 2B**

- (1) Less than minimum detectable activity which meets the LLD requirements of ODCM Surveillance Requirement 4.11.1.1.1.
- (2) Continuous mode effluents are not analyzed for Fe-55.

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**TABLE 3A**  
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**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

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

<b>1. Type of Waste</b>	<b>Units</b>	<b>12-Month Period</b>	<b>Est. Total Error %</b>
a) Spent resins, Filters	m <sup>3</sup> Ci	1.87E+01 7.37E+02	25%
b) Dry compressible waste, contaminated equipment, etc.	m <sup>3</sup> Ci	1.28E+03 2.43E+00	25%
c) Irradiated components, control rods, etc.	m <sup>3</sup> Ci	4.54E-04 2.46E+04	25%
d) Other (cartridge filters, misc. dry compressible, Oil)	m <sup>3</sup> Ci	4.36E+01 2.23E+01	25%

Volume shipped represents waste generated prior to offsite volume reduction.

**2. Estimate of Major Nuclides (By Type of Waste - Only nuclides >1 % are reported)**

a)	Fe-55	8.16E+00%
	Co-58	1.94E+00%
	Co-60	3.36E+00%
	Ni-63	3.44E+01%
	Cs-134	2.06E+01%
	Cs-137	2.92E+01%
b)	H-3	2.70E+00%
	Cr-51	7.05E+00%
	Mn-54	1.68E+00%
	Fe-55	2.25E+01%
	Co-58	2.01E+01%
	Co-60	4.87E+00%
	Ni-63	1.78E+01%
	Zr-95	2.65E+00%
	Nb-95	4.37E+00%
	I-131	6.28E+00%
	Cs-134	3.08E+00%
	Cs-137	3.98E+00%
c)	Co-58	1.27E+00%
	Co-60	3.50E+01%
	Fe-55	5.14E+01%
	Mn-54	4.23E+00%
	Ni-63	3.64E+00%
	Sn-119m	2.03E+00%
	Zr-95	1.86E+00%

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d)	Cr-51	9.36E+00%
	Mn-54	2.85E+00%
	Fe-55	1.07E+01%
	Co-58	3.21E+01%
	Co-60	1.16E+01%
	Ni-63	1.31E+01%
	Zr-95	5.50E+00%
	Nb-95	1.14E+01%

**3. Solid Waste Disposition**

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
1	Water Vessel	Studsvik/ RACE, Inc Memphis, TN
2	Motor Surface Transit	Energy Solutions Oak Ridge, TN
2	Motor Surface Transit	Energy Solutions Barnwell, SC
9	Motor Surface Transit	Studsvik, Inc Erwin, TN
39	Motor Surface Transit	Studsvik/ RACE, Inc Memphis, TN

**B. IRRADIATED FUEL SHIPMENTS (DISPOSITION) N/A**