Calvert Cliffs Nuclear Power Plant

1650 Calvert Cliffs Parkway
Lusby, Maryland 20657

CENG
a joint venture of
Constellation Energy · EDF

CALVERT CLIFFS
NUCLEAR POWER PLANT

July 9, 2013

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant; Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Independent Spent Fuel Storage Installation, Docket No. 72-8
Annual Radioactive Effluent Release Report

REFERENCES: (a) Calvert Cliffs Unit Nos. 1 and 2 Technical Specification 5.6.3
(b) Calvert Cliffs Independent Spent Fuel Storage Installation Technical Specification 6.3

As required by References (a) and (b), Enclosure (1) is provided. Meteorological data is kept in an onsite file and is available upon request.

This letter contains no regulatory commitments.

Should you have questions regarding this matter, please contact Mr. Douglas E. Lauver at (410) 495-5219.

Very truly yours,

Douglas E. Lauver
Director – Licensing

DEL/PSF/bjd

Enclosure: (1) Annual Radioactive Effluent Release Report for Calvert Cliffs Nuclear Power Plant and Independent Spent Fuel Storage Installation

IE48
NMSS26
NRR
NMSS

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ENCLOSURE (1)

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT FOR

CALVERT CLIFFS NUCLEAR POWER PLANT AND

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

This report covers the period January 1, 2012 to December 31, 2012 for Calvert Cliffs Nuclear Power Plant.

This report covers the period June 1, 2012 to May 31, 2013 for the Independent Spent Fuel Storage Installation.

Calvert Cliffs Nuclear Power Plant, LLC
July 9, 2013

ENCLOSURE (1)

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT FOR CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION

Facility - Calvert Cliffs Nuclear Power Plant and Independent Spent Fuel Storage Installation

Licensee – Calvert Cliffs Nuclear Power Plant, LLC

This report covers the period January 1, 2012 to December 31, 2012 for Calvert Cliffs Nuclear Power Plant.

This report covers the period June 1, 2012 to May 31, 2013 for the Independent Spent Fuel Storage Installation.

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 total body or greater than 3000 mrem/year to the skin (Offsite Dose Calculation Manual (ODCM) Rev. 0802, 3.11.2.1).

2. Gaseous Radwaste Processing 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 with half life greater than 8 days 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 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.

C. Liquid Effluents

1. The concentration of radioactive material released in liquid effluents to unrestricted areas from the plant shall not exceed the values specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases (ODCM 3.11.1.1).

2. The liquid radwaste processing 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 total 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. 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. Iodine-131 and Particulates with Half Lives Greater than Eight Days

Compliance with the dose rate limitations for iodine-131 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.

III. TECHNICAL SPECIFICATION REPORTING REQUIREMENTS

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

1. 2012 Offsite Dose Due to Carbon-14

Carbon-14 releases from Calvert Cliffs were estimated using the EPRI TR-1021106 methodology, and the Carbon-14 Source Term Calculator using specific reactor core data and reactor coolant chemistry to estimate the products of the activation reactions. Carbon-14 released to the atmosphere is estimated at 6.4 curies from Unit 1 and 7.61 curies from Unit 2. Unit 2 C-14 curies released are higher than Unit 1 due to a higher Total Effective Full Power Days (EFPD) during the 2012 calendar year.

Dose due to Carbon-14 in gaseous effluents was calculated using the following conditions:

a. Release was consistent throughout the year.

b. 10% of the C-14 was in the chemical form of CO2, which is the only dose contributor. The bulk of C-14 was in the chemical form of methane (CH4) which would exhibit high upward velocity due to its low density relative to air. In addition CH4 does not have an uptake pathway for humans.

c. Meteorological dispersion factor, (X/Q), at the site boundary to the hypothetical maximally exposed member of the public is 2.08E-07 sec/m^3.

d. Dose calculations and dose factors are from Regulatory Guide 1.109 methodology.

e. Pathways considered were inhalation and vegetation ingestion.

f. Critical receptor is child at the site boundary in the SE direction.

Maximum dose values due to C-14 in gaseous effluents in 2012

Organ	Age	mrem/yr
RG-1.109 Bone	Child	3.12E-02
RG-1.109 T. Body / Other	Child	6.19E-03

2. 2012 Dose Assessment Summary

	Actual Value	Percent of ODCM limit	ODCM Limit
Liquid Waste:			
Maximum Annual Organ Dose (mrem) [1]	0.001	0.005%	20
Maximum Annual Total Body Dose (mrem)	0.001	0.014%	6
Gaseous Waste:			
Noble Gases:			
Maximum Quarterly Gamma Air Dose (mrad)	0.0007	0.007%	10
Maximum Quarterly Beta Air Dose (mrad)	0.009	0.05%	20
Iodines and Particulates:			
Maximum Annual Organ Dose (mrem) [2]	0.06	0.19%	30

[1] The controlling pathway was the fish and shellfish pathway with adult as the controlling age group and the Liver representing the organ with the highest calculated dose during the calendar year of 2012.

[2] The controlling pathway was the infant-Thyroid pathway representing the organ with the highest calculated dose during the calendar year of 2012. There is currently no milk pathway.

3. 40 CFR 190 and 10 CFR 72.104 Total Dose Compliance

Based upon the calendar year 2012 and the ODCM calculations, the maximum exposed individual would receive 0.06% of the allowable dose. During the calendar year 2012, 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.

4. Solid Waste Report Requirements

During 2012, the types of radioactive solid waste shipped from Calvert Cliffs were dry compressible waste, spent resins, 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 2012 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.

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

The ODCM and PCP were not revised in 2012.

B. Radioactive Effluent Monitoring Instrumentation

1. The Gaseous Radwaste Processing System Radiation Monitor 0-RE-2191 was taken out of service on 11/27/2012 at 0300 hours during the performance of Surveillance STP M-567-0. At 2100 hours on the same day, the Radiation Monitor was declared Out of Service due to a broken connection pin. The two spare detectors in the warehouse would not provide the required response from the transfer calibration sources. The lead time for the replacement detector was 12-16 weeks, which required the channel to be out of service for greater than 30 days.

2. The Unit 1 Steam Generator Blowdown Radiation Monitor 1-RE-4014 remained inoperable for the entire year due to sample cooler issues. However, during the reporting period, the Unit 1 Steam Generator Blowdown Radiation Monitor 1-RE-4095 was operational.

Required compensatory actions were performed in accordance with the ODCM for above item 1 as there was no redundant Radiation Monitor.

C. Independent Spent Fuel Storage Installation (ISFSI), ISFSI Technical Specification 6.3

Three (3) Dry Shielded Canisters (DSCs) of spent fuel were transferred to the ISFSI during the period June 1, 2012 to May 31, 2013. No quantity of radionuclides was released to the environment during the ISFSI operation this period. 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 values from the radiation monitor may be used to assist in the calculation of activity discharged from containment during venting. Carbon-14 is estimated per section III.A.1.

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. 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.

During 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. Total activity released during a containment purge is based on continuous radiation monitor responses, grab samples, and purge fan flow rate.

Carbon-14 is estimated per section III.A.1.

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 release methodology discussed in section V.B.2.

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 and particulate 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, Iron-55 is analyzed twice per year.

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, 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. An additional composite sample is also withdrawn from each release to prepare quarterly samples for iron-55, nickel-63, strontium-89, and strontium-90 analyses.

Batch discharges of secondary (normally uncontaminated) waste streams are also monitored for radioactivity. No activity is normally detected in these secondary waste streams (excluding tritium).

There were no major changes to the liquid radwaste processing system in calendar year 2012. A new radwaste discharge pipe was installed above ground during the Unit 1 Refueling Outage and the two original discharge lines were removed from services. This change in piping configuration does not adversely impact dose to the public.

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 once per week. These results are multiplied by the actual quantity of blowdown to determine the total activity released. The weekly sample is also used to prepare monthly composites for tritium analysis.

During the monitoring for primary-to-secondary leakage low levels of tritium have been detected in the Turbine Building sumps. This water is sampled and analyzed for principal gamma emitting radionuclides weekly and composited. The composite sample is analyzed at least monthly for tritium. 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.

During the reporting period there was no radioactive liquid spill/leak to the ground.

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 (see Tables below). Sample size and/or count times are adjusted to achieve analytical sensitivities better than the environmental LLDs for gamma emitters (listed in ODCM Table 4.12-1). Established LLD limits for tritium are approximately 350 pCi/l.

Groundwater samples were collected from nine on-site piezometer tubes in 2012. A piezometer tube is a shallow monitoring well which allows access to groundwater at a depth of approximately 40 feet beneath the site. Number 19 Piezometer Tube was added to the program in 2010, 3 additional wells were installed in December of 2010 and were included in 2012 monitoring. Of the piezometer tubes sampled, only #11 Piezometer Tube showed any plant related activity. This activity was previously identified and evaluated in December of 2005. The activity consists of tritium originating from normal radwaste discharges and was previously reported in the Annual Radioactive Effluent Release Reports. The tritium contamination is contained on site. No drinking water has been affected; the groundwater at this location does not impact any drinking water pathway. The 2012 analyses results for tritium and gamma emitters are shown in the following tables.

Concentration of Tritium in Groundwater (Results in units of pCi/L +/- 2σ)

Sample Date	Piezometer Tube #s								
	11	12	13	15	18	19	20	21	22
01/20/2012	*	*	*	*	*	*	*	*	*
06/19/2012	*	*	*	*	*	*	*	*	*
09/11/2012	ND	ND	ND	ND	ND	ND	*	*	*
09/24/2012	388 +/- 185	*	*	*	*	*	ND	ND	ND
12/2/2012	*	*	*	*	ND	ND	*	*	*
12/5/2012	ND	ND	ND	ND	*	*	ND	ND	ND

* Less than Minimum Detectable Activity (<MDA)
ND = No Data – Quarterly sample obtained as required.

Gross Concentration of Gamma Emitters in Groundwater (Results in units of pCi/L +/- 2σ)

Sample Date	Piezometer Tube #s								
	11	12	13	15	18	19	20	21	22
01/20/2012	*	*	*	*	*	*	*	*	*
06/19/2012	*	*	*	*	*	*	*	*	*
09/11/2012	ND	ND	ND	ND	ND	ND	*	*	*
09/24/2012	*	*	*	*	*	*	ND	ND	ND
12/2/2012	*	*	*	*	ND	*	*	*	*
12/5/2012	ND	ND	ND	ND	*	ND	ND	ND	ND

* All Non-Natural Gamma Emitters <MDA
ND = No Data – Quarterly sample obtained as required.

VI. BATCH RELEASES

	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
A. Liquid				
1. Number of batch releases	13	12	13	13
2. Total time period for batch releases (min)	2.86E+04 (1)	5.49E+03	6.10E+03	5.74E+03
3. Maximum time period for a batch release (min)	2.30E+04 (1)	9.52E+02	7.24E+02	7.00E+02
4. Average time period for batch releases (min)	2.20E+03	4.57E+02	4.69E+02	4.41E+02
5. Minimum time period for a batch release (min)	5.00E+00	2.70E+01	2.30E+01	2.50E+01
6. Average stream flow during periods of effluent into a flowing stream (liters/min of dilution water)	4.45E+06	4.57E+06	4.59E+06	4.60E+06

	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
B. Gaseous				
1. Number of batch releases	18	24	22	19
2. Total time period for batch releases (min)	6.00E+04 (2)	8.86E+03	8.07E+03	6.93E+03
3. Maximum time period for a batch release (min)	5.18E+04 (2)	5.54E+02	5.50E+02	6.32E+02
4. Average time period for batch release (min)	3.33E+03	3.69E+02	3.67E+02	3.65E+02
5. Minimum time period for a batch release (min)	4.50E+01	1.83E+02	1.34E+02	8.50E+01

(1) Liquid 1st Quarter Total time and Maximum time durations are higher than the other quarters due to Steam Generator Drain and Fill during the 2012 Refueling Outage

(2) Gaseous 1st Quarter Total time and Maximum time durations are higher than the other quarters due to Containment Purge during the 2012 Refueling Outage

VII. ABNORMAL RELEASES

	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
A. Liquid				
1. Number of releases	- 0 -	- 0 -	- 0 -	- 0 -
2. Total activity released (Curies)	- 0 -	- 0 -	- 0 -	- 0 -
B. Gaseous				
1. Number of releases	- 1 -	- 0 -	- 0 -	- 0 -
2. Total activity releases (Curies)	1.74E-04 (1)	- 0 -	- 0 -	- 0 -

(1) This release occurred from the Refueling Water Tank (RWT) vent during the 2012 Refueling Outage in order to "re-use" and minimize Liquid Radwaste generated. The activity released is minimized by procedurally limiting concentrations of liquids transferred to the RWT.

APPENDIX A

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

A.	FISSION AND ACTIVATION GASES	UNITS	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	EST. TOTAL ERROR, %
	1. Total Release (11)	Ci	7.63E+01 (11)	1.42E+01	1.47E+01	6.89E+00	±1.20E+01
	2. Average release rate for period	µCi/sec	9.67E+00 (11)	1.80E+00	1.87E+00	8.74E-01	
	3. Percent of ODCM limit (1)	%	1.52E-04	1.71E-04	3.74E-05	1.52E-05	
	4. Percent of ODCM limit (2)	%	2.97E-04	1.17E-04	7.51E-05	4.18E-05	
	5. Percent of ODCM limit (3)	%	5.08E-03	4.80E-03	1.37E-03	4.63E-04	
	6. Percent of ODCM limit (4)	%	1.70E-02	4.94E-03	5.58E-03	5.74E-03	
	7. Percent of ODCM limit (5)	%	2.81E-03	9.62E-03	8.92E-03	4.33E-03	
	8. Percent of ODCM limit (6)	%	9.18E-03	1.33E-02	1.78E-02	1.96E-02	
B.	**IODINES**						
	1. Total Iodine – 131	Ci	1.88E-03(11)	4.48E-05	4.17E-05	(10)	±6.50E+00
	2. Average release rate for period	µCi/sec	2.39E-04	5.68E-06	5.28E-06	(10)	
	3. Percent of ODCM limit (7)	%	4.32E-04	1.80E-04	2.83E-04	(10)	
	4. Percent of ODCM limit (8)	%	3.28E-01	9.74E-03	2.47E-02	(10)	
	5. Percent of ODCM limit (9)	%	1.65E-01	1.69E-01	1.73E-01	(10)	
C.	**PARTICULATES**						
	1. Particulates with half lives greater than 8 days	Ci	(10)	1.42E-06	2.33E-06	2.34E-06	±1.20E+01
	2. Average release rate for period	µCi/sec	(10)	1.80E-07	2.96E-07	2.97E-07	
	3. Percent of ODCM limit (7)	%	(10)	1.80E-04	2.83E-04	2.67E-04	
	4. Percent of ODCM limit (8)	%	(10)	9.74E-03	2.47E-02	1.32E-02	
	5. Percent of ODCM limit (9)	%	(10)	1.69E-01	1.73E-01	1.73E-01	±2.50E+01
D.	**GROSS ALPHA RADIOACTIVITY**						
	1. Gross alpha radioactivity	Ci	4.80E-07	6.60E-07	8.83E-07	1.94E-06	±2.50E+01
	2. Average release rate for period	µCi/sec	6.09E-08	8.38E-07	1.12E-07	2.46E-07	
E.	**TRITIUM**						
	1. Total Release	Ci	9.32E-01	2.10E+00	3.03E+00	1.72E+00	±1.32E+01
	2. Average release rate for period	µCi/sec	1.18E-01	2.67E-01	3.84E-01	2.18E-01	

APPENDIX A

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

NOTES TO TABLE 1A

(1) Percent of I.A.1 total 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 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 lower limit of detection (LLD) requirements of ODCM Surveillance Requirement 4.11.2.1.2.

(11) Gaseous releases are higher than normal due to Containment Purge during the Refueling Outage

APPENDIX A

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
1. FISSION AND ACTIVATION GASES									
Argon -41	Ci	1.01E-01	4.86E-01	(2)	(2)	2.18E-02	2.89E-02	3.00E-02	2.60E-02
Krypton -85	Ci	5.04E+01	(2)	(2)	(2)	8.77E+00	1.16E+01	8.87E+00	6.10E+00
Krypton -85m	Ci	(2)	(2)	(2)	(2)	(2)	(2)	1.26E-05	(2)
Krypton -87	Ci	(2)	(2)	(2)	(2)	(2)	(2)	(2)	8.07E-05
Krypton -88	Ci	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Xenon -131m	Ci	(2)	(2)	4.32E+00	(2)	2.49E-03	6.83E-02	1.72E-02	1.23E-03
Xenon -133	Ci	1.61E+01	1.68E-01	9.50E-01	6.23E-01	1.06E-01	1.24E+00	4.43E-01	1.40E-01
Xenon -133m	Ci	(2)	(2)	(2)	(2)	(2)	1.40E-04	6.04E-05	1.70E-04
Xenon -135	Ci	7.74E-01	6.52E-01	8.83E-02	(2)	3.35E-04	3.56E-04	3.70E-04	1.43E-04
Xenon -135m	Ci	(2)	(2)	(2)	(2)	(2)	5.95E-04	(2)	3.85-04
Xenon -138	Ci	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Total for Period	Ci	6.74E+01	1.31E+00	5.35E+00	6.23E-01	8.90E+00	1.29E+01	9.36E+00	6.27E+00
2. IODINES									
Iodine -131	Ci	1.71E-03	4.48E-05	4.17E-05	(2)	1.74E-04	(1)	(1)	(1)
Iodine -132	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Iodine -133	Ci	4.95E-04	1.73E-04	1.33E-04	1.15E-04	(1)	(1)	(1)	(1)
Iodine -135	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Total for Period	Ci	2.20E-03	2.17E-04	1.75E-04	1.15E-04	1.74E-04	(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
3. PARTICULATES (half life > 8 days)									
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	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
		CONTINUOUS MODE				BATCH MODE			
	UNITS	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
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)	1.42E-06	2.33E-06	2.34E-06	(1)	(1)	(1)	(1)
Cerium 141	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Cerium 144	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)
Total For Period	Ci	(2)	1.42E-06	2.33E-06	2.34E-06	(1)	(1)	(1)	(1)
4. GROSS ALPHA RADIOACTIVITY									
	Ci	4.80E-07	6.60E-07	8.83E-07	1.94E-06	(1)	(1)	(1)	(1)

APPENDIX A

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.

APPENDIX A

TABLE 2A - REG GUIDE 1.21
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

		UNITS	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	EST. TOTAL ERROR, %
A.	**FISSION AND ACTIVATION PRODUCTS**						
	1. Total Release (not including tritium, gases, alpha)	Ci	1.43E-04	3.14E-04	4.26E-04	2.60E-03	±1.03E+01
	2. Average diluted conc. during period	µCi/ml	5.45E-14	1.41E-13	1.70E-13	1.04E-12	
	3. Percent of ODCM limit (1)	%	1.50E-03	2.53E-03	5.85E-03	3.89E-03	
	4. Percent of ODCM limit (2)	%	1.47E-03	1.57E-03	3.57E-03	6.44E-03	
	5. Percent of ODCM limit (3)	%	4.70E-03	7.78E-03	1.36E-02	1.12E-02	
	6. Percent of ODCM limit (4)	%	4.69E-03	4.87E-03	8.67E-03	2.03E-02	
B.	**TRITIUM**						
	1. Total Release	Ci	2.30E+02	1.24E+02	4.43E+02	3.31E+02	±1.03E+01
	2. Average diluted conc. during period	µCi/ml	8.75E-08	5.58E-08	1.77E-07	1.33E-07	
		UNITS	**1ST QUARTER**	**2ND QUARTER**	**3RD QUARTER**	**4TH QUARTER**	**EST. TOTAL ERROR, %**
	3. Percent of applicable limit (5)	%	2.92E-03	1.86E-03	5.90E-03	4.43E-03	
C.	**DISSOLVED AND ENTRAINED GASES**						
	1. Total Release	Ci	1.50E-02(8)	3.47E-06	1.05E-03	1.69E-03	±1.03E+01
	2. Average diluted conc. during period	µCi/ml	6.15E-12	1.56E-15	4.20E-13	6.77E-13	
D.	**GROSS ALPHA RADIOACTIVITY**						
	1. Total Release	Ci	(6)	(6)	(6)	(6)	N/A
	2. Average diluted conc. during period	µCi/ml	(6)	(6)	(6)	(6)	
E.	**VOLUME OF WASTE RELEASED** (prior to dilution)						
	1. Volume processed thru radwaste system	liters	9.66E+07	6.73E+07	8.96E+07	1.09E+08	±1.30E+00
F.	**VOLUME OF DILUTION DURING PERIOD (7)**	liters	2.63E+12	2.22E+12	2.51E+12	2.49E+12	±1.64E+01

APPENDIX A

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 Total Body Dose Limit (3 mrem)
(4) Percent of I.C.3 Yearly Total Body Dose Limit (6 mrem)
(5) Limit used is 3×10^{-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.
(8) Liquid releases are higher than normal during Refueling Outage due to noble gases released from failed fuel.

APPENDIX A

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)	(1)	(1)	(1)	(1)
Manganese - 54	Ci	(1)	(1)	(1)	(1)	2.32E-07	(1)	3.92E-06	2.90E-06
Iron – 55	Ci	(2)	(2)	(2)	(2)	(1)	(1)	(1)	1.11E-03
Cobalt – 57	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cobalt – 58	Ci	(1)	(1)	(1)	(1)	2.91E-05	4.61E-05	2.40E-05	2.87E-05
Iron – 59	Ci	(1)	(1)	(1)	(1)	(1)	1.45E-06	(1)	(1)
Cobalt – 60	Ci	(1)	(1)	(1)	(1)	2.03E-05	1.23E-04	4.41E-05	3.74E-04
Nickel-63	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	7.22E-04
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 – 91	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)	(1)	(1)	1.29E-06
Zirconium - 95	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(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)	(1)	(1)
Tin – 113	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tin – 117m	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Antimony - 122	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Antimony - 124	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

APPENDIX A

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
Antimony - 125	Ci	(1)	(1)	(1)	(1)	4.43E-07	(1)	2.71E-06	9.84E-05
Tellurium – 125m	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tellurium - 132	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Iodine - 131	Ci	(1)	(1)	(1)	(1)	2.96E-07	(1)	(1)	1.08E-06
Iodine - 132	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Iodine – 133	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Iodine – 135	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cesium – 134	Ci	(1)	(1)	(1)	(1)	4.29E-07	2.86E-06	5.21E-05	1.71E-05
Cesium – 136	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Cesium – 137	Ci	(1)	(1)	(1)	(1)	9.24E-05	1.41E-04	2.99E-04	2.37E-04
Barium – 140	Ci	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lanthanum - 140	Ci	(1)	(1)	(1)	(1)	1.05E-07	(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)	1.60E-04	3.14E-04	4.26E-04	3.02E-03
Tritium	Ci	9.81E-02	6.47E-02	1.01E-01	6.29E-02	2.30E+02	1.24E+02	4.43E+02	3.31E+02
Krypton – 85	Ci	(1)	(1)	(1)	(1)	2.99E-03	(1)	(1)	(1)
Xenon - 131m	Ci	(1)	(1)	(1)	(1)	4.12E-04	(1)	(1)	(1)
Xenon – 133	Ci	(1)	(1)	(1)	(1)	1.15E-02	3.47E-06	1.03E-03	1.69E-03
Xenon – 133m	Ci	(1)	(1)	(1)	(1)	9.91E-05	(1)	(1)	(1)
Xenon – 135	Ci	(1)	(1)	(1)	(1)	1.84E-05	(1)	2.65E-05	(1)
Total For Period	Ci	(1)	(1)	(1)	(1)	1.50E-02	3.47E-06	1.05E-03	1.69E-03

APPENDIX A

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.

APPENDIX A

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

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

1. Type of Waste		Units	12-Month Period	Est. Total Error %
a)	**Spent resins, Filters**	m^3 Ci	9.63E+00 4.83E+02	25%
b)	Dry compressible waste, contaminated equipment, etc.	m^3 Ci	1.74E+03 2.51E+00	25%
c)	Irradiated components, control rods, etc.	m^3 Ci	0.00E-00 0.00E+00	N/A
d)	Other (cartridge filters, misc. dry compressible, Oil)	m^3 **Ci**	3.51E+01 3.36E+00	25%
e)	Solidification agent or absorbent	m^3	N/A	N/A

Volume shipped represents waste generated prior to offsite volume reduction.

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

a)
Fe-55	9.6%
Co-60	4.2%
Ni-63	57.3%
Cs-134	8.1%
Cs-137	18.8%

b)
Fe-55	41.0%
Co-58	14.7%
Co-60	9.5%
Ni-63	28.0%
Cs-134	1.1%

c) N/A

d)
Cr-51	5.9%
Mn-54	1.0%
Fe-55	19.1%
Co-58	25.9%
Co-60	14.7%
Ni-63	29.7%

3. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
46	Motor Surface Transit	Studsvik Processing Facility Memphis, TN
5	Motor Surface Transit	Studsvik Processing Facility Erwin, TN
2	Motor Surface Transit	Perma-Fix Northwest Richland, Richland, WA
2	Motor Surface Transit	Energy Solutions Oak Ridge, TN

B. IRRADIATED FUEL SHIPMENTS (DISPOSITION) N/A