Exelon Generation®

**Mark D. Flaherty**
Plant Manager

Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657

410 495 5205 Office
410 495 5444 Fax
443 534 5476 Mobile
www.exeloncorp.com

mark.flaherty@exeloncorp.com

10 CFR 50.36(a)(2)
and 72.44(d)(3)

June 29, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
NRC Docket Nos. 50-317 and 50-318

Calvert Cliffs Nuclear Power Plant
Independent Spent Fuel Storage Installation, License No. SNM-2505
NRC Docket No. 72-8

Subject: Annual Radioactive Effluent Release Report

References:
1. Calvert Cliffs Unit Nos. 1 and 2 Technical Specification 5.6.3
2. Calvert Cliffs ISFSI Technical Specification 6.3

As required by References 1 and 2, the Annual Radioactive Effluent Release Report is enclosed. Meteorological data is kept in an onsite file and is available upon request. The Offsite Dose Calculation Manual, Revision 9 is also enclosed.

There are no regulatory commitments contained in this correspondence.

Should you have questions regarding this matter, please contact Mr. Larry D. Smith at (410) 495-5219.

Respectfully,

Mark D. Flaherty
Plant Manager

MDF/PSF/bjm

IE48
NMSS/26
NRR/NMSS

Enclosures: (1) Annual Radioactive Effluent Release Report for Calvert Cliffs Nuclear Power Plant and Independent Spent Fuel Storage Installation-2015
(2) Offsite Dose Calculation Manual, Revision 9

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR
Director, NMSS
J. Folkwein, ANI

# ENCLOSURE (1)

# Annual Radioactive Effluent Release Report for Calvert Cliffs Nuclear Power Plant and Independent Spent Fuel Storage Installation-2015

**This report covers the period January 1, 2015 to December 31, 2015 for the Calvert Cliffs Nuclear Power Plant**

**This report covers the period June 1, 2015 to May 31, 2016 for the Independent Spent Fuel Storage Installation**

**Calvert Cliffs Nuclear Power Plant**
**June 29, 2016**

**ENCLOSURE (1)**

**CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION RADIOACTIVE EFFLUENT RELEASE ANNUAL REPORT - 2015**

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, 2015 to December 31, 2015 for Calvert Cliffs Nuclear Power Plant.

This report covers the period June 1, 2015 to May 31, 2016 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 whole body or greater than 3000 mrem/year to the skin (Offsite Dose Calculation Manual (ODCM) Rev. 00900, 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.

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 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. Monthly composites of the main vent particulate filters are analyzed for gross alpha. Quarterly composites are analyzed for Sr-89 and Sr-90. All of the above parameters are calculated according to the methodology specified in the ODCM. Additionally, two quarterly composites are analyzed for Fe-55; the Fe-55 analysis is not required by the ODCM, but is driven by site procedure.

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. 2015 Offsite Dose Due to Carbon-14

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

a. C-14 released to the atmosphere: 10.38 Curies of C-14 from Unit 1 and 9.45 curies from Unit 2.
b. Release was consistent throughout the year.
c. Carbon-14 release values were estimated using the methodology included in the
Electric Power Research Institute (EPRI) Technical Report 1021106, using the 2014 Calvert Cliffs Nuclear Power Plant assumed parameters of normalized Carbon-14 production rate of 3.822 Ci/GWt-yr, a gaseous release fraction of 0.98, a Carbon-14 carbon dioxide fraction of 0.30, a reactor power rating of 2737 MWt for Unit 1 and 2737 MWt for Unit 2, and equivalent full power operation of 362.02 days for Unit 1 and 329.67 days for Unit 2.
d. Meteorological dispersion factor (X/Q) at the nearest residence and garden location at 1.1 miles in the southwest meteorological sector and to the hypothetical maximally exposed member of the public (child) is 3.86E-7 $sec/m^3$.
e. Pathways considered were inhalation and leafy vegetation ingestion.

2. 2015 Dose Assessment Summary

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Liquid Effluent Dose Limit, Total Body** | 3 mrem | 3 mrem | 3 mrem | 3 mrem | 6 mrem |
| Total Body Dose | 1.05E-02 | 9.54E-03 | 2.58E-04 | 7.50E-04 | 2.11E-02 |
| % of Limit | 3.50E-01 | 3.18E-01 | 8.60E-03 | 2.50E-02 | 3.52E-01 |
| **Liquid Effluent Dose Limit, Any Organ** | 10 mrem | 10 mrem | 10 mrem | 10 mrem | 20 mrem |
| Organ Dose | 1.57E-02 | 1.42E-02 | 2.75E-04 | 1.28E-03 | 3.15E-02[1] |
| % of Limit | 1.57E-01 | 1.42E-01 | 2.75E-03 | 1.28E-02 | 1.58E-01 |
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 1.97E-04 | 2.35E-05 | 2.08E-05 | 3.26E-05 | 2.74E-04 |
| % of Limit | 1.97E-03 | 2.35E-04 | 2.08E-04 | 3.26E-04 | 1.37E-03 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 7.67E-04 | 2.77E-05 | 1.65E-04 | 5.03E-05 | 1.01E-03 |
| % of Limit | 3.84E-03 | 1.39E-04 | 8.25E-04 | 2.52E-04 | 2.53E-03 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 8.12E-04 | 4.09E-04 | 2.90E-04 | 1.89E-04 | 1.30E-03[2] |
| % of Limit | 5.41E-03 | 2.73E-03 | 1.93E-03 | 1.26E-03 | 4.33E-03 |
| Total Body Dose | 2.33E-04 | 3.09E-04 | 2.90E-04 | 1.89E-04 | 1.01E-03 |
| Skin Dose (due to NG) | | | | | 8.04E-04 |
| C-14 Total Body/Organ | mrem | | | | |
| Bone Dose | 5.41E-03 | 6.25E-03 | 6.48E-03 | 6.31E-03 | 2.44E-02 |
| Total Body Dose | 1.06E-03 | 1.22E-03 | 1.27E-03 | 1.23E-03 | 4.78E-03 |

[1] The controlling liquid pathway was the fish and shellfish pathway with adult as the controlling age group and the liver representing the organ with the highest calculated annual dose during the calendar year of 2015.

[2] The controlling gaseous pathway was the infant-thyroid pathway representing the organ with the highest calculated dose during the calendar year of 2015. There is currently no milk pathway.

3. 40 CFR 190 Total Dose Compliance

Based upon the calendar year 2015 and the ODCM calculations, the maximum exposed individual would receive 0.23% of the allowable dose. During the calendar year 2015, 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.

**EPA 40CFR190 Individual in the Unrestricted Area**

| | Whole Body | Thyroid | Any Other Organ |
|---|---|---|---|
| **Dose Limit** | 25 mrem | 75 mrem | 25 mrem |
| Liquid | 2.11E-02 | 1.17E-03 | 3.15E-02 |
| Gas | 1.01E-03 | 1.30E-03 | 1.01E-03 |
| C-14 | 4.78E-03 | | 2.45E-02 |
| **Dose** | 2.69E-02 | 2.47E-03 | 5.70E-02 |
| **% of Limit** | 1.08E-01 | 3.29E-03 | 2.28E-01 |

Child bone dose was used for Any Other Organ due to C-14

4. Solid Waste Report Requirements

During 2015, 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 of this report provides a detailed breakdown of the waste shipments for 2015 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 PCP was not revised in 2015. Revision 00900 of ODCM was approved in 2015. A summary of the changes and the entire ODCM is submitted to the NRC along with this report.

B. Radioactive Effluent Monitoring Instrumentation

1. During 2015, Waste Gas RMS monitor, 0-RE-2191, exceeded the 30 days inoperable time period allowed in ODCM section 3.3.3.9. The monitor was declared inoperable on 7/12/13, and has remained inoperable since that time. A plant modification is being prepared to correct the operability issues associated with this monitor.

2. The Steam Generator Blowdown Effluent Radiation Monitor, 1-RE-4095, was declared inoperable on 7/7/15 and exceeded the 30 days allowed in ODCM section

3.3.3.9. It remained out of service for the rest of 2015. 2-RE-4014 is credited by the ODCM as an equivalent monitor. With 2-RE-4014 in service, no compensatory actions were required. Repairs to 1-RE-4095 were scheduled through the work control process.

On 11/17/15, the calibration for Liquid Waste Discharge Radiation monitor, 0-RE-2201, was identified as past due by approximately 12 months. The calibration was completed on 11/18/15.

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

Four casks of spent fuel were transferred to the ISFSI during the reporting period. No quantity of radionuclides was released to the environment during the ISFSI operation in 2015. 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 and the Wide Range Gas Monitor typically monitor 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 using methodology from EPRI Technical Report 1021106, as described in 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.

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.

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.

Carbon-14 is estimated using methodology from EPRI Technical Report 1021106, as described in 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 lost in the sample lines prior to sample collection. The weekly particulate filters are then combined to form monthly composites for gross alpha analysis. The weekly particulate filters are also combined to form quarterly composites for strontium-89 and strontium-90 analyses. Two quarterly composites per year are analyzed for Iron-55; the Iron-55 analysis is not required by the ODCM, but is driven by site procedure.

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 before and after the release. A proportional composite sample is also withdrawn from each release. These composite samples are used for monthly tritium and gross alpha analyses. The composite samples are also used for Iron-55, Nickel-63, Strontium-89, and Strontium-90 analyses that are performed quarterly by an offsite laboratory.

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

Changes were made to the liquid radwaste system in calendar year 2015. An ultra-filtration treatment system was replaced with a system that uses mechanical filtration and demineralization.

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. Meteorological Data

A summary of required meteorological data is included in the Annual Radiological Environmental Operating Report and is not included in this report.

F. 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 (see Tables below). Sample size and/or count times are adjusted to achieve analytical sensitivities lower than the environmental LLDs for gamma emitters (listed in ODCM Table 4.12-1). The established LLD limit for tritium is 200 pCi/l for tritium.

Groundwater samples were collected from seventeen on-site piezometer tubes throughout 2015. 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 piezometer tubes sampled, only #11 and # 19 Piezometer Tubes showed any plant related activity. The activity at #11 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 activity at #19 was detected in the third quarter 2015 and was not detected in the following quarter. The value was very low and near the detection level. The 2015 analysis result for tritium and gamma are shown in the following tables.

## VI. ERRATA

A. Corrections to 2010 – 2013 ARERR

1. Attachment B includes the correction to ARERR for calendar years 2010 through 2013 to more accurately account for main vent flow.

B. Correction to 2014 ARERR

1. Attachment C includes the correction to the 2014 ARERR that incorrectly stated that no effluent radiation monitors were inoperable in 2014 past the 30 day period allowed by the ODCM.

2. Attachment C also includes corrections to the 2014 ARERR for Carbon-14 data that was incorrectly reported due to an error in the calculation of curies released and the resultant dose.

## Concentration of Tritium in Groundwater
## (Results in units of pCi/L)

| Sample Date | Piezometer Tube | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | 12 | 13 | 15 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 02/25/2015 | ND | ND | ND | ND | ND | ND | # | # | # | ND | ND | ND | ND | ND | ND | ND | ND |
| 02/28/2015 | ND | # | # | # | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 03/02/2015 | 708+/-149 | ND | ND | ND | # | # | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 03/24/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | # | ND | # | # | # | # | ND |
| 03/25/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | ND | ND | ND | ND | # |
| | | | | | | | | | | | | | | | | | |
| 06/06/2015 | ND | ND | # | # | # | # | # | # | # | ND | ND | ND | ND | # | ND | ND | ND |
| 06/20/2015 | 1370+/-xxx | ND | ND | ND | ND | ND | ND | ND | ND | # | ND | ND | # | ND | # | ND | ND |
| 06/22/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | # | ND | ND | ND | # | # |
| 06/29/2015 | ND | # | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | | | | | | | | | | | | | |
| 07/25/2015 | ND | ND | ND | ND | ND | ND | # | # | # | ND | ND | ND | ND | ND | ND | ND | ND |
| 08/22/2015 | 2100+/-224 | # | # | # | # | # | ND | ND | ND | ND | ND | # | ND | ND | ND | ND | ND |
| 09/19/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | # | # | # | # | # | # | # |
| 09/28/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | | | | | | | | | | | | | |
| 11/07/2015 | ND | ND | ND | # | # | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11/09/2015 | ND | ND | ND | ND | ND | 147+/-96 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11/15/2015 | 1570+/-222 | # | # | ND | ND | ND | # | # | # | ND | ND | ND | # | # | # | ND | ND |
| 12/12/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | # | ND | ND | ND | # | # |
| 12/31/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | # | ND | ND | ND | ND | ND | ND | ND |

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

## Gross Concentration of Gamma Emitters
## (Results in units of pCi/L)

| Sample Date | Piezometer Tube | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | 12 | 13 | 15 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 02/25/2015 | ND | ND | ND | ND | ND | ND | * | * | * | ND | ND | ND | ND | ND | ND | ND | ND |
| 02/28/2015 | ND | * | * | * | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 03/02/2015 | * | ND | ND | ND | * | * | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 03/24/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | * | ND | * | * | * | * | ND |
| 03/25/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | ND | ND | ND | ND | * |
| | | | | | | | | | | | | | | | | | |
| 06/06/2015 | ND | ND | * | * | * | * | * | * | * | ND | ND | ND | ND | * | ND | ND | ND |
| 06/20/2015 | * | ND | ND | ND | ND | ND | ND | ND | ND | * | ND | ND | * | ND | * | ND | ND |
| 06/22/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | * | ND | ND | ND | * | * |
| 06/29/2015 | ND | * | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | | | | | | | | | | | | | |
| 07/25/2015 | ND | ND | ND | ND | ND | ND | * | * | * | ND | ND | ND | ND | ND | ND | ND | ND |
| 08/22/2015 | * | * | * | * | * | * | ND | ND | ND | ND | ND | * | ND | ND | ND | ND | ND |
| 09/19/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | * | * | * | * | * | * | * |
| 09/28/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | | | | | | | | | | | | | | | | | |
| 11/07/2015 | ND | ND | ND | * | * | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11/09/2015 | ND | ND | ND | ND | ND | * | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11/15/2015 | * | * | * | ND | ND | ND | * | * | * | ND | ND | ND | * | * | * | ND | ND |
| 12/12/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | * | ND | ND | ND | * | * |
| 12/31/2015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | * | ND | ND | ND | ND | ND | ND | ND |

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

## VII. BATCH RELEASES

| A. Liquid (1) | 2015 1ST QUARTER | 2015 2ND QUARTER | 2015 3RD QUARTER | 2015 4TH QUARTER |
|---|---|---|---|---|
| 1. Number of batch releases | 11 | 8 | 7 | 8 |
| 2. Total time period for batch releases (min) | 6.59E+03 | 4.42E+03 | 4.31E+03 | 4.74E+03 |
| 3. Maximum time period for a batch release (min) | 7.76E+02 | 7.25E+02 | 7.66E+02 | 7.01E+02 |
| 4. Average time period for batch release (min) | 5.99E+02 | 5.53E+02 | 6.16E+02 | 5.92E+02 |
| 5. Minimum time period for a batch release (min) | 5.23E+02 | 1.15E+02 | 5.60E+02 | 2.97E+02 |
| 6. Average stream flow during periods of effluent into a flowing stream (liters/min of dilution water) | 4.12E+06 | 4.45E+06 | 4.61E+06 | 4.60E+06 |

(1) This table excludes batch releases from the Waste Neutralizing Tanks and the Condenser Hotwells. While releases from these sources are sampled, documented, permitted, and accounted for in the Dose Assessment Tables, Table 2A, and 2B of this report, they are not significant contributors to radioactive effluent and are therefore not included in this table.

**B. Gaseous**

| | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
|---|---|---|---|---|
| 1. Number of batch releases | 23 | 24 | 19 | 15 |
| 2. Total time period for batch releases (min) | 1.48E+04 | 8.13E+03 | 6.97E+03 | 6.20E+03 |
| 3. Maximum time period for a batch release (min) | 6.00E+03 | 5.36E+02 | 4.64E+02 | 9.13E+02 |
| 4. Average time period for batch release (min) | 6.43E+02 | 3.39E+02 | 3.67E+02 | 4.14E+02 |
| 5. Minimum time period for a batch release (min) | 5.30E+01 | 5.00E+00 | 2.35E+2 | 1.73E+02 |

## VIII. ABNORMAL RELEASES

| | 2015 | | | |
|---|---|---|---|---|
| | 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 | - 0 - | - 0 - | 1 | - 0 - |
| 2. Total activity releases (Curies) | - 0 - | - 0 - | 9.80E-01 | - 0 - |

# APPENDIX A

## CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION EFFLUENT AND WASTE DISPOSAL 2015 ANNUAL REPORT

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

| | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| **A. FISSION AND ACTIVATION GASES** | | | | | | |
| 1. Total Release | Ci | 8.42E+00 | 1.80E-01 | 1.19E+00 | 6.28E-01 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 1.08E+00 | 2.29E-02 | 1.50E-01 | 7.90E-02 | |
| 3. Percent of ODCM limit (1) | % | 1.97E-03 | 2.35E-04 | 2.08E-04 | 3.26E-04 | |
| 4. Percent of ODCM limit (2) | % | 3.84E-03 | 1.39E-04 | 8.25E-04 | 2.52E-04 | |
| **B. IODINES** | | | | | | |
| 1. Total Iodine - 131 | Ci | 5.33E-03 | 5.10E-04 | 0.00E+00 | 3.91E-05 | ±6.50E+00 |
| 2. Average release rate for period | µCi/sec | 6.85E-04 | 6.49E-05 | 0.00E+00 | 4.92E-06 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **C. PARTICULATES** | | | | | | |
| 1. Particulates with half lives greater than 8 days | Ci | <LLD | <LLD | <LLD | <LLD | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | <LLD | <LLD | <LLD | <LLD | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 2.52E+00 | 3.49E+00 | 3.26E+00 | 2.14E+00 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 3.24E-01 | 4.43E-01 | 4.11E-01 | 2.686E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | 9.25E-08 | 2.13E-06 | 9.25E-07 | 1.19E-06 | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | 1.19E-08 | 2.71E-07 | 1.16E-07 | 1.50E-07 | |
| **F. Carbon-14** | | | | | | |
| 1. Total Release | Ci | 4.37E+00 | 5.07E+00 | 5.26E+00 | 5.12E+00 | N/A |
| 2. Average release rate for period | µCi/sec | 5.62E-01 | 6.45E-01 | 6.62E-01 | 6.44E-01 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)

(2) Percent of quarterly beta-air dose limit (20 mRad)

(3) Iodine, Tritium, Carbon-14, and Particulates are treated as a group. % limit can be found in Section III.A.2

## TABLE 1B - 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 | <LLD | <LLD | <LLD | <LLD | 2.89E-02 | 3.58E-02 | 2.98E-02 | 2.74E-02 |
| Krypton-85 | Ci | 1.82E+00 | <LLD | 9.80E-01 | <LLD | 2.06E-01 | 1.42E-01 | 1.79E-01 | <LLD |
| Krypton-85m | Ci | <LLD | <LLD | <LLD | <LLD | 2.53E-05 | <LLD | <LLD | <LLD |
| Krypton-87 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Krypton-88 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Xenon-131m | Ci | 3.16E-02 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Xenon-133 | Ci | 6.09E+00 | <LLD | <LLD | 5.99E-01 | 6.19E-02 | 2.34E-03 | 1.61E-03 | 1.12E-03 |
| Xenon-133m | Ci | 1.37E-02 | <LLD | <LLD | <LLD | 4.33E-04 | <LLD | <LLD | <LLD |
| Xenon-135 | Ci | 1.77E-01 | <LLD | <LLD | <LLD | 1.88E-03 | <LLD | <LLD | <LLD |
| Xenon-135m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Xenon-138 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Total for Period | Ci | 8.12E+00 | <LLD | 9.80E-01 | 5.99E-01 | 2.99E-01 | 1.80E-01 | 2.10E-01 | 2.85E-02 |
| **2. IODINES** | | | | | | | | | |
| Iodine-131 | Ci | 2.70E-05 | 1.25E-05 | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iodine-132 | Ci | 4.68E-03 | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iodine-133 | Ci | 6.25E-04 | 4.98E-04 | <LLD | 3.91E-05 | (1) | (1) | (1) | (1) |
| Iodine-135 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for Period | Ci | 5.33E-03 | 5.10E-04 | <LLD | 3.91E-05 | (1) | (1) | (1) | (1) |
| **3. PARTICULATES (half life > 8 days)** | | | | | | | | | |
| Manganese-54 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iron-55 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iron-59 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cobalt-58 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cobalt-60 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Zinc-65 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Strontium-89 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Strontium-90 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Molybdenum-99 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium-134 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium-137 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |

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

| | | | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| | Cerium-141 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cerium-144 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Total for period | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| **4.** | **GROSS ALPHA RADIOACTIVITY** | | | | | | | | | |
| | Gross Alpha | Ci | 9.25E-08 | 2.129E-06 | 9.25E-07 | 1.19E-06 | <LLD | <LLD | <LLD | <LLD |
| **5.** | **TRITIUM** | | | | | | | | | |
| | Tritium | Ci | 2.52E+00 | 3.46E+00 | 3.26E+00 | 2.14E+00 | <LLD | 2.11E-02 | <LLD | <LLD |
| **6.** | **Carbon-14[2]** | | | | | | | | | |
| | Carbon-14 | Ci | 4.37E+00 | 5.07E+00 | 5.26E+00 | 5.12E+00 | N/A | N/A | N/A | N/A |

**NOTES TO TABLE 1B**

(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) Carbon-14 is estimated using the methodology from EPRI Technical Report 1021106, as described in section III.A.1.

**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 | 3.03E-01 | 3.33E-01 | 2.34E-03 | 1.58E-02 | ±1.03E+01 |
| 2. Average diluted concentration during period | µCi/ml | 8.91E-11 | 9.36E-11 | 6.02E-13 | 4.26E-12 | |
| 3. Percent of ODCM limit (1) | % | 1.57E-01 | 1.42E-01 | 2.75E-03 | 1.28E-02 | |
| 4. Percent of ODCM limit (2) | % | 3.50E-01 | 3.18E-01 | 8.60E-03 | 2.50E-02 | |
| **B. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 2.18E+02 | 2.76E+02 | 2.27E+02 | 4.06E+02 | ±1.03E+01 |
| 2. Average diluted concentration during period | µCi/ml | 6.41E-08 | 7.77E-08 | 5.83E-08 | 1.10E-07 | |
| 3. Percent of applicable limit (3) | % | 2.14E-03 | 2.59E-03 | 1.94E-03 | 3.67E-03 | |
| **C. DISSOLVED AND ENTRAINED GASES** | | | | | | |
| 1. Total Release | Ci | 1.63E-03 | 1.78E-04 | 1.08E-04 | 1.01E-03 | ±1.03E+01 |
| 2. Average diluted concentration during period | µCi/ml | 4.80E-13 | 5.00E-14 | 2.78E-14 | 2.74E-13 | |
| **D. GROSS ALPHA RADIOACTIVITY** | | | | | | |
| 1. Total Release | Ci | <LLD | <LLD | <LLD | <LLD | N/A |
| **E. VOLUME OF WASTE RELEASED** (prior to dilution) | | | | | | |
| 1. Volume of waste released | liters | 1.02E+08 | 8.36E+07 | 9.18E+07 | 1.06E+08 | ±1.30E+00 |
| **F. VOLUME OF DILUTION WATER USED DURING PERIOD (4)** | liters | 1.09E+12 | 1.18E+12 | 1.22E+12 | 1.22E+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 Quarterly Whole Body Dose Limit (3 mrem)
(3) Limit used is 3 x 10-3 µCi/ml
(4) Includes dilution water used during continuous discharges.
(5) Liquid releases are higher than normal during refueling outages due to noble gases released from failed fuel

## 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 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Sodium – 24 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Chromium - 51 | Ci | <LLD | <LLD | <LLD | <LLD | 7.05E-04 | <LLD | <LLD | 1.04E-04 |
| Manganese - 54 | Ci | <LLD | <LLD | <LLD | <LLD | 1.38E-04 | 3.95E-04 | <LLD | <LLD |
| Iron – 55 | Ci | (2) | (2) | (2) | (2) | <LLD | 1.29E-03 | <LLD | 4.57E-03 |
| Cobalt – 57 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | 9.43E-05 | <LLD | <LLD |
| Cobalt – 58 | Ci | <LLD | <LLD | <LLD | <LLD | 8.34E-03 | 3.44E-02 | 2.68E-04 | 7.96E-04 |
| Iron – 59 | Ci | <LLD | <LLD | <LLD | <LLD | 1.53E-04 | <LLD | <LLD | <LLD |
| Cobalt – 60 | Ci | <LLD | <LLD | <LLD | <LLD | 9.69E-04 | 4.00E-03 | 2.16E-04 | 1.26E-03 |
| Nickel-63 | Ci | <LLD | <LLD | <LLD | <LLD | 1.98E-03 | 1.40E-02 | 4.33E-04 | 1.05E-03 |
| Zinc – 65 | Ci | <LLD | <LLD | <LLD | <LLD | 2.22E-04 | 3.52E-04 | <LLD | <LLD |
| Strontium - 89 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Strontium - 90 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Strontium – 91 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Strontium - 92 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Niobium - 95 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | 2.33E-05 |
| Zirconium - 95 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | 4.09E-05 |
| Niobium - 97 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Zirconium - 97 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Molybdenum - 99 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Technetium - 99m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Ruthenium - 103 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Rhodium - 105 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Ruthenium - 105 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Silver - 110m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Tin – 113 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Tin – 117m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Antimony - 122 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Antimony - 124 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | 2.08E-04 | <LLD | <LLD |
| Antimony - 125 | Ci | <LLD | <LLD | <LLD | <LLD | 5.50E-04 | 3.12E-03 | 7.58E-04 | 2.08E-03 |
| Tellurium – 125m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |

## 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 |
| Tellurium - 132 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Iodine - 131 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Iodine - 132 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Iodine – 133 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Iodine – 135 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Cesium – 134 | Ci | <LLD | <LLD | <LLD | <LLD | 2.37E-02 | 2.21E-02 | 3.17E-05 | 4.02E-04 |
| Cesium – 136 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Cesium – 137 | Ci | <LLD | <LLD | <LLD | <LLD | 2.66E-01 | 2.53E-01 | 6.36E-04 | 5.43E-03 |
| Barium – 140 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Lanthanum - 140 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Cerium – 144 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Europium – 154 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Europium – 155 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Tungsten – 187 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Total For Period (I;P) | Ci | <LLD | <LLD | <LLD | <LLD | 3.03E-01 | 3.33E-01 | 2.34E-03 | 1.58E-02 |
| Krypton – 85 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | 1.01E-02 | <LLD |
| Xenon - 131m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Xenon – 133 | Ci | <LLD | <LLD | <LLD | <LLD | 1.63E-03 | 1.78E-04 | 1.08E-04 | 1.01E-03 |
| Xenon – 133m | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Xenon – 135 | Ci | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD |
| Total For Period (NG) | Ci | <LLD | <LLD | <LLD | <LLD | 1.63E-03 | 1.78E-04 | 1.08E-04 | 1.01E-03 |
| Tritium | Ci | 7.76E-02 | 1.32E-01 | 1.84E-01 | 1.21E-01 | 2.18E+02 | 2.76E+02 | 2.27E+02 | 4.06E+02 |
| Total For Period (Tritium) | Ci | 7.76E-02 | 1.32E-01 | 1.84E-01 | 1.21E-01 | 2.18E+02 | 2.76E+02 | 2.27E+02 | 4.06E+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.

## TABLE 3A
## 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 | $m^3$<br>Ci | 5.38E+00<br>1.47E+01 | 25% |
| b) Dry compressible waste, contaminated equipment, etc. | $m^3$<br>Ci | 4.90E+02<br>5.11E-01 | 25% |
| c) Irradiated components, control rods, etc. | $m^3$<br>Ci | 0.00E+00<br>0.00E+00 | N/A |
| d) Other (cartridge filters, misc. dry compressible, Oil) | $m^3$<br>Ci | 3.40E+00<br>1.12E-02 | 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 >1 % are reported)

| Spent Resins, Filters | |
|---|---|
| Nuclide | Abundance (%) |
| Mn-54 | 4.94 |
| Fe-55 | 5.71 |
| Co-58 | 1.61 |
| Co-60 | 44.95 |
| Ni-63 | 5.29 |
| Cs-134 | 10.54 |
| Cs-137 | 24.84 |

| Dry Active Waste | |
|---|---|
| Nuclide | Abundance (%) |
| H-3 | 1.37 |
| C-14 | 13.99 |
| Fe-55 | 15.45 |
| Co-58 | 12.09 |
| Co-60 | 18.28 |
| Ni-63 | 16.86 |
| Zr-95 | 5.31 |
| Nb-95 | 9.83 |
| Cs-137 | 2.87 |
| Pu-241 | 1.34 |

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

| Irradiated Components | |
|---|---|
| Nuclide | Abundance (%) |
| N/A | |

| Other Waste | |
|---|---|
| Nuclide | Abundance (%) |
| H-3 | 1.34 |
| C-14 | 13.68 |
| Fe-55 | 15.20 |
| Co-58 | 12.72 |
| Co-60 | 17.93 |
| Ni-63 | 16.49 |
| Zr-95 | 5.62 |
| Nb-95 | 10.33 |
| Cs-137 | 2.81 |
| Pu-241 | 1.31 |

**3. Solid Waste Disposition**

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| | | |
| 13 | Motor Surface Transit (Hittman) | Energy Solutions (Duratek) Oak Ridge, TN |
| 1 | Motor Surface Transit (Hittman) | Energy Solutions Clive, UT |
| 1 | Motor Surface Transit (Hittman) | Waste Control Specialists LLC Andrews, TX |

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

## APPENDIX B

## ERRATA/CORRECTIONS TO 2010 THROUGH 2013 ARERRs

## CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION EFFLUENT AND WASTE DISPOSAL 2015 ANNUAL REPORT

From April 2010 to February 2015 the Calvert Cliffs Unit 1 Main Vent stack flow rate was over estimated intermittently throughout the 5 year period. When performing Gaseous Waste permits for continuous releases, the procedure/software uses a default nominal flow rate of 119,339 scfm for the Unit 1 Main Vent. This is the value listed in Attachment 7 of the Calvert Cliff Offsite Dose Calculation Manual (ODCM).

The ODCM also lists +/- 10% criteria in which a technical evaluation should be performed if the flowrate is outside the 10% criteria during the maintenance test. Throughout the 5 year period, maintenance surveillance testing of the Unit 1 main vent flowrate resulted in flowrates as low as 82,541 scfm (-31%). The station initiated an Apparent Cause Investigation (CR# 02437002).

One of the resulting actions from the investigation was to recalculate continuous releases from the Unit 1 Main during the time periods when the stack flow was outside the 10 percent criteria. At no point during the time period was the flow > +10% (high), however, as stated above there were several instances when the flow was < -10% (low). The 2014 ARERR was corrected prior to submission in 2015.

For the periods that the flow from the maintenance surveillances was recorded below 107,406 scfm, the Unit 1 Main Vent Gaseous Release permits were re-calculated using the more accurate flow. The attachments below are the results for curie release Table 1A and 1C. The curie release from batch mode were not affected

## TABLE 1A - REG GUIDE 1.21
## GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES (2010)

| | | 1ST | 2ND | 3RD | 4TH | EST. TOTAL |
|---|---|---|---|---|---|---|
| A. FISSION AND ACTIVATION GASES | UNITS | QUARTER | QUARTER | QUARTER | QUARTER | ERROR, % |
| 1. Total Release | Ci | 1.50E+02 | 3.41E+01 | 9.42E+00 | 9.72E+00 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 1.90E+01 | 4.33E+00 | 1.20E+00 | 1.23E+00 | |
| 5. Percent of ODCM limit (1) | % | 1.88E-02 | 7.54E-04 | 1.13E-03 | 3.42E-03 | |
| 6. Percent of ODCM limit (2) | % | 8.00E-02 | 2.30E-02 | 6.25E-03 | 5.93E-03 | |
| **B. IODINES** | | | | | | |
| 1. Total Iodine - 131 | Ci | 4.38E-03 | 5.83E-05 | 4.44E-05 | 4.07E-06 | ±6.50E+00 |
| 2. Average release rate for period | µCi/sec | 5.55E-04 | 7.40E-06 | 5.63E-06 | 5.16E-07 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **C. PARTICULATES** | | | | | | |
| 1. Particulates with half lives greater than 8 days | Ci | 6.64E-06 | 4.98E-06 | <LLD | <LLD | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 8.42E-07 | 6.32E-07 | <LLD | <LLD | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 1.62E+00 | 1.95E+00 | 1.92E+00 | 8.94E-01 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 2.05E-01 | 2.48E-01 | 2.43E-01 | 1.13E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | <LLD | <LLD | 1.23E-06 | 3.18E-07 | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | <LLD | <LLD | 1.56E-07 | 4.03E-08 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)

(2) Percent of quarterly beta-air dose limit (20 mRad)

(3) % limit can be found in the following Dose Assessment Table

**Dose Assessments, 10CFR50, Appendix I**

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 1.88E-03 | 7.54E-05 | 1.13E-04 | 3.42E-04 | 2.41E-03 |
| % of Limit | 1.88E-02 | 7.54E-04 | 1.13E-03 | 3.42E-03 | 1.20E-02 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 1.60E-02 | 4.60E-03 | 1.25E-03 | 1.19E-03 | 2.30E-02 |
| % of Limit | 8.00E-02 | 2.30E-02 | 6.25E-03 | 5.93E-03 | 5.76E-02 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 1.26E-01 | 1.79E-03 | 1.41E-03 | 1.85E-04 | 1.29E-01 |
| % of Limit | 8.39E-01 | 1.19E-02 | 9.41E-03 | 1.23E-03 | 4.31E-01 |

## TABLE 1C - REG GUIDE 1.21
## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2010)

| | | 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 | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -85 | Ci | 1.58E-01 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -85m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -87 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -88 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -131m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -133 | Ci | 6.19E+01 | 5.76E-01 | 7.57E-01 | 1.01E+00 | (2) | (2) | (2) | (2) |
| | Xenon -133m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -135 | Ci | 1.65E-01 | 1.35E-02 | 4.99E-01 | 4.16E-01 | (2) | (2) | (2) | (2) |
| | Xenon -135m | Ci | <LLD | <LLD | <LLD | 1.02E+00 | (2) | (2) | (2) | (2) |
| | Xenon -138 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Total for Period | Ci | 6.22E+01 | 5.89E-01 | 1.26E+00 | 2.45E+00 | (2) | (2) | (2) | (2) |
| **2.** | **IODINES** | | | | | | | | | |
| | Iodine -131 | Ci | 4.38E-03 | 5.83E-05 | 4.44E-05 | 4.07E-06 | (1) | (1) | (1) | (1) |
| | Iodine -132 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iodine -133 | Ci | 4.67E-05 | 3.14E-04 | 4.06E-04 | 2.05E-04 | (1) | (1) | (1) | (1) |
| | Iodine -135 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Total for Period | Ci | 4.42E-03 | 3.72E-04 | 4.51E-04 | 2.09E-04 | (1) | (1) | (1) | (1) |
| **3.** | **PARTICULATES (half life > 8 days)** | | | | | | | | | |
| | Manganese -54 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron -55 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron -59 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt -58 | Ci | 6.64E-06 | 4.98E-06 | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt -60 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Zinc -65 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium -89 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium -90 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Molybdenum -99 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |

**TABLE 1C - REG GUIDE 1.21**
**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2010)**

| | UNITS | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| Cesium -134 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium -137 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -141 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -144 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for period | Ci | 6.64E-06 | 4.98E-06 | <LLD | <LLD | (1) | (1) | (1) | (1) |
| **4. GROSS ALPHA RADIOACTIVITY** | | | | | | | | | |
| Gross Alpha | Ci | <LLD | <LLD | 1.23E-06 | 3.18E-07 | (2) | (2) | (2) | (2) |
| **5. TRITIUM** | | | | | | | | | |
| Tritium | Ci | 8.63E-01 | 1.95E+00 | 1.92E+00 | 8.94E-01 | (2) | (2) | (2) | (2) |

**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) Errata did not change the batch mode radionuclides.

## TABLE 1A - REG GUIDE 1.21
## GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES (2011)

| A. FISSION AND ACTIVATION GASES | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| 1. Total Release | Ci | 6.62E+01 | 6.20E+00 | 9.60E+00 | 1.26E+01 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 8.40E+00 | 7.86E-01 | 1.22E+00 | 1.60E+00 | |
| 5. Percent of ODCM limit (1) | % | 1.91E-02 | 4.31E-04 | 2.51E-03 | 2.18E-03 | |
| 6. Percent of ODCM limit (2) | % | 3.43E-02 | 4.17E-03 | 4.47E-03 | 7.71E-03 | |
| **B. IODINES** | | | | | | |
| 1. Total Iodine - 131 | Ci | 2.21E-03 | 4.91E-05 | 9.87E-05 | 3.56E-05 | ±6.50E+00 |
| 2. Average release rate for period | µCi/sec | 2.80E-04 | 6.23E-06 | 1.25E-05 | 4.51E-06 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **C. PARTICULATES** | | | | | | |
| 1. Particulates with half lives greater than 8 days | Ci | <LLD | <LLD | <LLD | <LLD | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | <LLD | <LLD | <LLD | <LLD | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 2.19E+00 | 4.44E+00 | 4.37E+00 | 1.85E+00 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 2.78E-01 | 5.63E-01 | 5.55E-01 | 2.34E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | 7.71E-07 | 9.29E-07 | <LLD | 1.98E-07 | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | 9.77E-08 | 1.18E-07 | <LLD | 2.51E-08 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)

(2) Percent of quarterly beta-air dose limit (20 mRad)

(3) % limit can be found in following Dose Assessment Table

**Dose Assessments, 10CFR50, Appendix I**

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 1.91E-03 | 4.31E-05 | 2.51E-04 | 2.18E-04 | 2.43E-03 |
| % of Limit | 1.91E-02 | 4.31E-04 | 2.51E-03 | 2.18E-03 | 1.21E-02 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 6.87E-03 | 8.34E-04 | 8.94E-04 | 1.54E-03 | 1.01E-02 |
| % of Limit | 3.43E-02 | 4.17E-03 | 4.47E-03 | 7.71E-03 | 2.54E-02 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 6.36E-02 | 1.58E-03 | 3.11E-03 | 1.13E-03 | 6.94E-02 |
| % of Limit | 4.24E-01 | 1.05E-02 | 2.08E-02 | 7.51E-03 | 2.31E-01 |

## TABLE 1C - REG GUIDE 1.21
## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2011)

| | | | | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| **1.** | **FISSION AND ACTIVATION GASES** | | | | | | | | | | |
| | Argon | -41 | Ci | 1.50E+00 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton | -85 | Ci | 2.18E+01 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton | -85m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton | -87 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton | -88 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon | -131m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon | -133 | Ci | 3.60E+01 | <LLD | 6.80E+00 | 3.18E+00 | (2) | (2) | (2) | (2) |
| | Xenon | -133m | Ci | 1.34E-02 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon | -135 | Ci | 2.00E-02 | 7.18E-02 | 4.65E-01 | 8.36E-01 | (2) | (2) | (2) | (2) |
| | Xenon | -135m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon | -138 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Total for Period | | Ci | 5.93E+01 | 7.18E-02 | 7.27E+00 | 4.02E+00 | (2) | (2) | (2) | (2) |
| **2.** | **IODINES** | | | | | | | | | | |
| | Iodine | -131 | Ci | 2.21E-03 | 4.91E-05 | 9.87E-05 | 3.56E-05 | (1) | (1) | (1) | (1) |
| | Iodine | -132 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iodine | -133 | Ci | 4.73E-04 | 3.84E-04 | 8.05E-04 | 2.89E-04 | (1) | (1) | (1) | (1) |
| | Iodine | -135 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Total for Period | | Ci | 2.68E-03 | 4.33E-04 | 9.04E-04 | 3.25E-04 | (1) | (1) | (1) | (1) |
| **3.** | **PARTICULATES (half life > 8 days)** | | | | | | | | | | |
| | Manganese | -54 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron | -55 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron | -59 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt | -58 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt | -60 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Zinc | -65 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium | -89 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium | -90 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Molybdenum | -99 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |

**TABLE 1C - REG GUIDE 1.21**
**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2011)**

| | UNITS | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| Cesium -134 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium -137 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -141 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -144 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for period | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| **4. GROSS ALPHA RADIOACTIVITY** | | | | | | | | | |
| Gross Alpha | Ci | 7.71E-07 | 9.29E-07 | <LLD | 1.98E-07 | (2) | (2) | (2) | (2) |
| **5. TRITIUM** | | | | | | | | | |
| Tritium | Ci | 2.19E+00 | 4.44E+00 | 4.37E+00 | 1.85E+00 | (2) | (2) | (2) | (2) |

**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) Errata did not change the batch mode radionuclides.

## TABLE 1A - REG GUIDE 1.21
## GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES (2012)

| A. FISSION AND ACTIVATION GASES | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| 1. Total Release | Ci | 7.25E+01 | 1.39E+01 | 1.33E+01 | 6.89E+00 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 9.20E+00 | 1.77E+00 | 1.68E+00 | 8.74E-01 | |
| 5. Percent of ODCM limit (1) | % | 5.41E-03 | 3.64E-03 | 1.06E-03 | 4.32E-04 | |
| 6. Percent of ODCM limit (2) | % | 4.55E-02 | 9.27E-03 | 7.77E-03 | 4.46E-03 | |
| **B. IODINES** | | | | | | |
| 1. Total Iodine - 131 | Ci | 1.44E-03 | 3.88E-05 | 3.32E-05 | <LLD | ±6.50E+00 |
| 2. Average release rate for period | µCi/sec | 1.83E-04 | 4.92E-06 | 4.20E-06 | 0.00E+00 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **C. PARTICULATES** | | | | | | |
| 1. Particulates with half lives greater than 8 days | Ci | <LLD | 1.42E-06 | <LLD | 2.34E-06 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | <LLD | 1.80E-07 | <LLD | 2.97E-07 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 7.26E-01 | 1.59E+00 | 2.28E+00 | 1.60E+00 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 9.20E-02 | 2.02E-01 | 2.89E-01 | 2.03E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | 3.74E-07 | 5.38E-07 | 7.74E-07 | 1.94E-06 | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | 4.75E-08 | 6.83E-08 | 9.81E-08 | 2.46E-07 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)

(2) Percent of quarterly beta-air dose limit (20 mRad)

(3) % limit can be found in following Dose Assessment Table

**Dose Assessments, 10CFR50, Appendix I**

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 5.41E-04 | 3.64E-04 | 1.06E-04 | 4.32E-05 | 1.05E-03 |
| % of Limit | 5.41E-03 | 3.64E-03 | 1.06E-03 | 4.32E-04 | 5.27E-03 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 9.10E-03 | 1.85E-03 | 1.55E-03 | 8.92E-04 | 1.34E-02 |
| % of Limit | 4.55E-02 | 9.27E-03 | 7.77E-03 | 4.46E-03 | 3.35E-02 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 4.16E-02 | 1.33E-03 | 1.01E-03 | 2.00E-03 | 4.39E-02 |
| % of Limit | 2.77E-01 | 8.85E-03 | 6.76E-03 | 1.33E-02 | 1.46E-01 |

**TABLE 1C - REG GUIDE 1.21**
**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2012)**

| | | 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 | 3.59E-01 | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -85 | Ci | 5.04E+01 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -85m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -87 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Krypton -88 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -131m | Ci | <LLD | <LLD | 2.99E+00 | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -133 | Ci | 1.26E+01 | 1.68E-01 | 8.26E-01 | 6.23E-01 | (2) | (2) | (2) | (2) |
| | Xenon -133m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -135 | Ci | 5.76E-01 | 4.69E-01 | 8.83E-02 | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -135m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Xenon -138 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| | Total for Period | Ci | 6.36E+01 | 9.95E-01 | 3.90E+00 | 6.23E-01 | (2) | (2) | (2) | (2) |
| **2.** | **IODINES** | | | | | | | | | |
| | Iodine -131 | Ci | 1.27E-03 | 3.88E-05 | 3.32E-05 | <LLD | (1) | (1) | (1) | (1) |
| | Iodine -132 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iodine -133 | Ci | 4.35E-04 | 1.46E-04 | 1.09E-04 | 1.02E-04 | (1) | (1) | (1) | (1) |
| | Iodine -135 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Total for Period | Ci | 1.71E-03 | 1.85E-04 | 1.43E-04 | 1.02E-04 | (1) | (1) | (1) | (1) |
| **3.** | **PARTICULATES (half life > 8 days)** | | | | | | | | | |
| | Manganese -54 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron -55 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Iron -59 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt -58 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Cobalt -60 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Zinc -65 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium -89 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Strontium -90 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| | Molybdenum -99 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |

**TABLE 1C - REG GUIDE 1.21**
**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2012)**

| | UNITS | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| Cesium -134 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium -137 | Ci | <LLD | 1.42E-06 | <LLD | 2.34E-06 | (1) | (1) | (1) | (1) |
| Cerium -141 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -144 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for period | Ci | <LLD | 1.42E-06 | <LLD | 2.34E-06 | (1) | (1) | (1) | (1) |
| **4. GROSS ALPHA RADIOACTIVITY** | | | | | | | | | |
| Gross Alpha | Ci | 3.74E-07 | 5.38E-07 | 7.74E-07 | 1.94E-06 | (2) | (2) | (2) | (2) |
| **5. TRITIUM** | | | | | | | | | |
| Tritium | Ci | 7.26E-01 | 1.59E+00 | 2.28E+00 | 1.60E+00 | (2) | (2) | (2) | (2) |

**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) Errata did not change the batch mode radionuclides.

## TABLE 1A - REG GUIDE 1.21
## GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES (2013)

| A. FISSION AND ACTIVATION GASES | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| 1. Total Release | Ci | 7.03E+01 | 2.99E+00 | 5.48E+00 | 1.28E+00 | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 8.91E+00 | 3.80E-01 | 6.94E-01 | 1.62E-01 | |
| 5. Percent of ODCM limit (1) | % | 8.85E-03 | 3.87E-04 | 5.70E-04 | 5.95E-04 | |
| 6. Percent of ODCM limit (2) | % | 3.95E-02 | 2.07E-03 | 3.64E-03 | 8.50E-04 | |
| **B. IODINES** | | | | | | |
| 1. Total Iodine - 131 | Ci | 7.90E-04 | 2.05E-05 | 2.41E-05 | 2.28E-05 | ±6.50E+00 |
| 2. Average release rate for period | µCi/sec | 1.00E-04 | 2.60E-06 | 3.05E-06 | 2.89E-06 | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **C. PARTICULATES** | | | | | | |
| 1. Particulates with half lives greater than 8 days | Ci | 3.09E-06 | <LLD | <LLD | <LLD | ±1.20E+01 |
| 2. Average release rate for period | µCi/sec | 3.92E-07 | <LLD | <LLD | <LLD | |
| 3. Percent of ODCM limit | % | (3) | (3) | (3) | (3) | |
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 2.25E+00 | 2.03E+00 | 2.81E+00 | 1.99E+00 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 2.85E-01 | 2.58E-01 | 3.56E-01 | 2.53E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | 3.83E-07 | <LLD | <LLD | 9.55E-07 | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | 4.86E-08 | <LLD | <LLD | 1.21E-07 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)

(2) Percent of quarterly beta-air dose limit (20 mRad)

(3) % limit can be found in following Dose Assessment Table

**Dose Assessments, 10CFR50, Appendix I**

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 8.85E-04 | 3.87E-05 | 5.70E-05 | 5.95E-05 | 1.04E-03 |
| % of Limit | 8.85E-03 | 3.87E-04 | 5.70E-04 | 5.95E-04 | 5.20E-03 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 7.89E-03 | 4.13E-04 | 7.27E-04 | 1.70E-04 | 9.20E-03 |
| % of Limit | 3.95E-02 | 2.07E-03 | 3.64E-03 | 8.50E-04 | 2.30E-02 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 2.28E-02 | 6.26E-04 | 8.11E-04 | 7.54E-04 | 2.50E-02 |
| % of Limit | 1.52E-01 | 4.18E-03 | 5.41E-03 | 5.03E-03 | 8.32E-02 |

## TABLE 1C - REG GUIDE 1.21
## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2013)

| | | 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 | 3.31E-02 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Krypton | -85 | Ci | 3.56E+01 | <LLD | 1.33E-01 | <LLD | (2) | (2) | (2) | (2) |
| Krypton | -85m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Krypton | -87 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Krypton | -88 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Xenon | -131m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Xenon | -133 | Ci | 2.69E+01 | <LLD | 3.77E-01 | 2.11E-01 | (2) | (2) | (2) | (2) |
| Xenon | -133m | Ci | 1.30E-01 | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Xenon | -135 | Ci | 9.42E-01 | 9.65E-02 | 1.83E-01 | 2.74E-01 | (2) | (2) | (2) | (2) |
| Xenon | -135m | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Xenon | -138 | Ci | <LLD | <LLD | <LLD | <LLD | (2) | (2) | (2) | (2) |
| Total for Period | | Ci | 6.36E+01 | 9.65E-02 | 6.93E-01 | 4.85E-01 | (2) | (2) | (2) | (2) |
| **2. IODINES** | | | | | | | | | | |
| Iodine | -131 | Ci | 7.90E-04 | 2.05E-05 | 2.41E-05 | 2.28E-05 | (1) | (1) | (1) | (1) |
| Iodine | -132 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iodine | -133 | Ci | 1.92E-04 | 3.25E-05 | 2.96E-04 | 2.62E-04 | (1) | (1) | (1) | (1) |
| Iodine | -135 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for Period | | Ci | 9.82E-04 | 5.30E-05 | 3.20E-04 | 2.85E-04 | (1) | (1) | (1) | (1) |
| **3. PARTICULATES (half life > 8 days)** | | | | | | | | | | |
| Manganese | -54 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iron | -55 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Iron | -59 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cobalt | -58 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cobalt | -60 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Zinc | -65 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Strontium | -89 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Strontium | -90 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Molybdenum | -99 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium | -134 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cesium | -137 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |

## TABLE 1C - REG GUIDE 1.21
## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (2013)

| | UNITS | CONTINUOUS MODE | | | | BATCH MODE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
| Cerium -141 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Cerium -144 | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| Total for period | Ci | <LLD | <LLD | <LLD | <LLD | (1) | (1) | (1) | (1) |
| **4. GROSS ALPHA RADIOACTIVITY** | | | | | | | | | |
| Gross Alpha | Ci | 3.83E-07 | <LLD | <LLD | 9.55E-07 | (2) | (2) | (2) | (2) |
| **5. TRITIUM** | | | | | | | | | |
| Tritium | Ci | 2.25E+00 | 2.03E+00 | 2.81E+00 | 1.99E+00 | (2) | (2) | (2) | (2) |

### 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) Errata did not change batch mode radionuclides.

**APPENDIX C**

**ERRATA/CORRECTIONS TO 2014 ARERR PAGES 4, 5, 6, A-2**

**CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION EFFLUENT AND WASTE DISPOSAL 2015 ANNUAL REPORT**

**Corrected pages 4,5,6**

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. 2014 Offsite Dose Due to Carbon-14

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

f. C-14 released to the atmosphere: 9.26 Curies of C-14 from Unit 1 and 10.22 curies from Unit 2.

g. Release was consistent throughout the year.

h. Carbon-14 release values were estimated using the methodology included in the
Electric Power Research Institute (EPRI) Technical Report 1021106, using the 2014 Calvert Cliffs Nuclear Power Plant assumed parameters of normalized Carbon-14 production rate of 3.822 Ci/GWt-yr, a gaseous release fraction of 0.98, a Carbon-14 carbon dioxide fraction of 0.30, a reactor power rating of 2737 MWt for Unit 1 and 2737 MWt for Unit 2, and equivalent full power operation of 323.18 days for Unit 1 and 356.64 days for Unit 2.

i. Meteorological dispersion factor (X/Q) at the nearest residence and garden location at 1.1 miles in the southwest meteorological sector and to the hypothetical maximally exposed member of the public (child) is 3.38E-7 sec/$m^3$.

j. Pathways considered were inhalation and leafy vegetation ingestion.

2. 2014 Dose Assessment Summary

| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 | Yearly |
|---|---|---|---|---|---|
| **Liquid Effluent Dose Limit, Total Body** | 3 mrem | 3 mrem | 3 mrem | 3 mrem | 6 mrem |
| Total Body Dose | 6.61E-04 | 2.89E-04 | 4.43E-04 | 3.74E-04 | 1.77E-03 |
| % of Limit | 2.20E-02 | 9.63E-03 | 1.48E-02 | 1.25E-02 | 2.94E-02 |
| **Liquid Effluent Dose Limit, Any Organ** | 10 mrem | 10 mrem | 10 mrem | 10 mrem | 20 mrem |
| Organ Dose | 1.02E-03 | 6.80E-04 | 7.09E-04 | 4.18E-04 | 2.50E-03 |
| % of Limit | 1.02E-02 | 6.80E-03 | 7.09E-03 | 4.18E-03 | 1.25E-02 |
| **Gaseous Effluent Dose Limit, Gamma Air** | 10 mrad | 10 mrad | 10 mrad | 10 mrad | 20 mrad |
| Gamma Air Dose | 3.29E-04 | 4.03E-05 | 3.66E-05 | 2.41E-05 | 4.30E-04 |
| % of Limit | 3.29E-03 | 4.03E-04 | 3.66E-04 | 2.41E-04 | 2.15E-03 |
| **Gaseous Effluent Dose Limit, Beta Air** | 20 mrad | 20 mrad | 20 mrad | 20 mrad | 40 mrad |
| Beta Air Dose | 1.09E-03 | 2.44E-04 | 1.22E-03 | 3.99E-05 | 2.59E-03 |
| % of Limit | 5.44E-03 | 1.22E-03 | 6.08E-03 | 2.00E-04 | 6.47E-03 |
| **Gaseous Effluent Dose Limit, Any Organ** (Iodine, Tritium, Particulates with >8 day half-life) | 15 mrem | 15 mrem | 15 mrem | 15 mrem | 30 mrem |
| Organ Dose | 2.30E-03 | 4.65E-04 | 3.22E-04 | 2.49E-04 | 3.18E-03 |
| % of Limit | 1.54E-02 | 3.10E-03 | 2.14E-03 | 1.66E-03 | 1.06E-02 |
| Total Body Dose | 2.27E-04 | 3.67E-04 | 2.26E-04 | 2.49E-04 | 1.07E-03 |
| Skin Dose | | | | | 2.00E-03 |
| C-14 Total Body/Organ | mrem | | | | |
| Bone Dose | 4.25E-03 | 5.52E-03 | 5.61E-03 | 5.67E-03 | 2.11E-02 |
| Total Body Dose | 8.32E-04 | 1.08E-03 | 1.10E-03 | 1.11E-03 | 4.12E-03 |

[1] 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 2014.

[2] The controlling pathway was the infant-thyroid pathway representing the organ with the highest calculated dose during the calendar year of 2014. There is currently no milk pathway.

3. 40 CFR 190 Total Dose Compliance

Based upon the calendar year 2014 and the ODCM calculations, the maximum exposed individual would receive 0.18% of the allowable dose. During the calendar year 2014, 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.

**EPA 40CFR190 Individual in the Unrestricted Area**

| | Whole Body | Thyroid | Any Other Organ |
|---|---|---|---|
| **Dose Limit** | 25 mrem | 75 mrem | 25 mrem |
| Liquid | 1.77E-03 | 1.15E-03 | 2.03E-03 |
| Gas | 1.07E-03 | 3.18E-03 | 3.20E-04 |
| C-14 | 4.12E-03 | | 2.11E-02 |
| **Dose** | 6.96E-03 | 4.33E-03 | 2.35E-02 |
| **% of Limit** | 2.78E-02 | 5.77E-03 | 9.38E-02 |

Child bone dose was used for Any Other Organ due to C-14

4. Solid Waste Report Requirements

During 2014, 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 2014 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 2014.

B. Radioactive Effluent Monitoring Instrumentation

1. During 2014, one gaseous effluent monitor exceeded the 30 day inoperable time period allowed in ODCM section 3.3.3.9. The Waste Gas RMS monitor, 0-RE-

2191, was declared inoperable on 7/12/13, and has remained inoperable since that time. A plant modification is being prepared to correct the operability issues associated with this monitor.

2. For 2014, inoperable liquid effluent monitors were returned to service within 30 days in accordance with section 3.3.3.10 of the Offsite Dose Calculation Manual.

Corrected page A-2

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

| | UNITS | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| **D. TRITIUM** | | | | | | |
| 1. Total Release | Ci | 5.57E-01 | 3.89E+00 | 2.40E+00 | 2.74E+00 | ±1.32E+01 |
| 2. Average release rate for period | µCi/sec | 7.06E-02 | 4.93E-01 | 3.04E-01 | 3.47E-01 | |
| **E. GROSS ALPHA** | | | | | | |
| 1. Total Release | Ci | <LLD | 9.80E-08 | 6.21E-07 | <LLD | ±2.50E+01 |
| 2. Average release rate for period | µCi/sec | <LLD | 1.24E-08 | 7.88E-08 | <LLD | |
| **F. Carbon-14** | | | | | | |
| 1. Total Release | Ci | 3.93E+00 | 5.11E+00 | 5.19E+00 | 5.25E+00 | N/A |
| 2. Average release rate for period | µCi/sec | 5.05E-01 | 6.50E+00 | 6.53E+00 | 6.60E+00 | |

### NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad)
(2) Percent of quarterly beta-air dose limit (20 mRad)
(3) Iodine, Tritium, Carbon-14, and Particulates are treated as a group. % limit can be found in Section III.A.2