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

July 15, 2019

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 ISFSI Technical Specification 6.3
2. Calvert Cliffs ISFSI Technical Specification 6.3
3. Calvert Cliffs Unit Nos. 1 and 2 Technical Specification 5.5.1.c.3

As required by References 1 and 2, the Annual Radioactive Effluent Release Report is attached. Meteorological data is kept in an onsite file and is available upon request.

As required by Reference 3, a copy of Revision 2 and 3 of the Offsite Dose Calculation Manual, CY-CA-170-301, are also attached.

There are no regulatory commitments contained in this correspondence.

Should you have questions regarding this matter, please contact me at (410) 495-5219.

Respectfully,

Larry D. Smith
Regulatory Assurance Manager

LDS/lmd

IE48
A009
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Attachment: (1) Radioactive Effluent Release Annual Report - 2017
(2) Offsite Dose Calculation Manual for Calvert Cliffs Nuclear Power Plant, CY-CA-170-301, Revision 002
(3) Offsite Dose Calculation Manual for Calvert Cliffs Nuclear Power Plant, CY-CA-170-301, Revision 003

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EDMS
NRC 19-022

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, 2018 to December 31, 2018 for Calvert Cliffs Nuclear Power Plant.

This report covers the period June 1, 2018 to May 31, 2019 for the Independent Spent Fuel Storage Installation.

Calvert Cliffs Nuclear Power Plant, LLC
July 15, 2019

ENCLOSURE (1)
CALVERT CLIFFS NUCLEAR POWER PLANT AND
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
RADIOACTIVE EFFLUENT RELEASE ANNUAL REPORT - 2018

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, 2018 to December 31, 2018 for Calvert Cliffs Nuclear Power Plant.
This report covers the period June 1, 2018 to May 31, 2019 for the Independent Spent Fuel Storage Installation.

I. PREFACE

The following sections of the preface are meant to help define key concepts, provide clarity, and give context for the readers of this report.

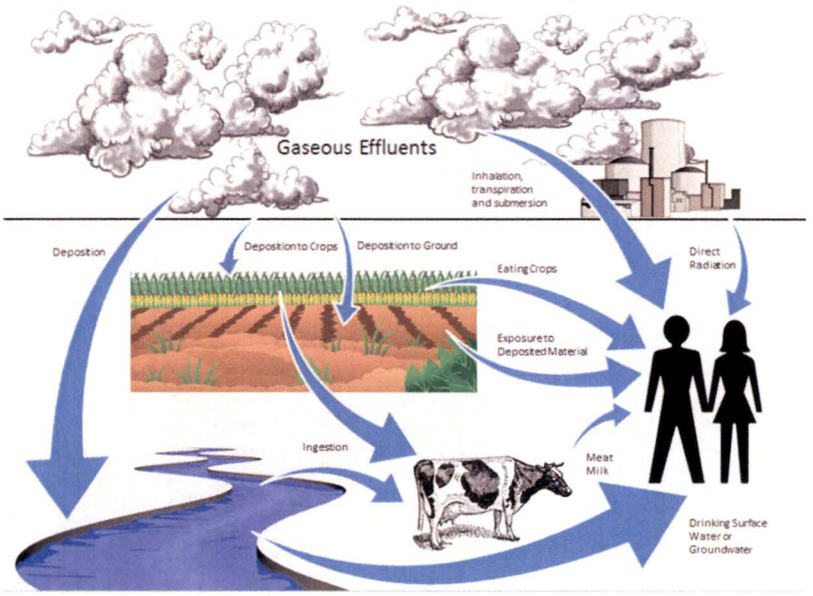
A. Annual Reports

The Nuclear Regulatory Commission (NRC) is the federal agency which has the role of protecting the health and safety of the public as it relates to nuclear energy. Nuclear Power Plants provide two reports annually to the NRC; these reports address how the station's operation impacts the environment of the local community. The NRC then reviews these reports and makes them available to the public. The names of the reports are the Annual Radioactive Effluent Release Report (ARERR) and the Annual Radiological Environmental Operating Report (AREOR).

The ARERR reports the results of a station's effluent monitoring program. An effluent is a liquid or gaseous waste containing plant-related radioactive material emitted at the boundary of the facility.

The AREOR reports the results of samples obtained in the environment surrounding the station; these sample are analyzed for radioactivity. Environmental samples include air, water, vegetation, and other sample types that are identified as potential pathways through which radioactivity can reach humans.

Graphic 1. Examples of Gaseous and Liquid Effluent Pathways

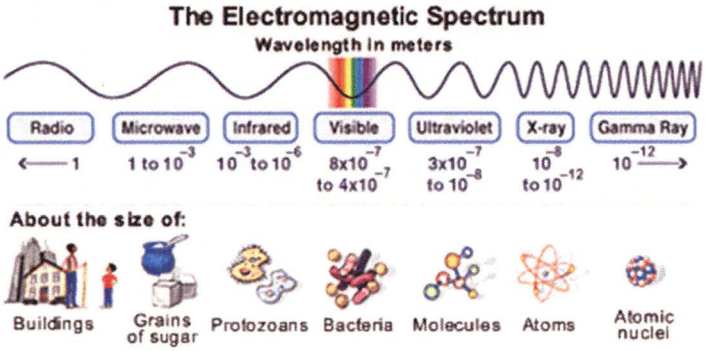


Graphic 1 demonstrates some potential exposure pathways from Calvert Cliffs Nuclear Power Plant. The ARERR and AREOR together ensure Nuclear Power Plants are operating in a manner that is within established regulatory commitments meant to adequately protect the public.

B. Understanding Radiation

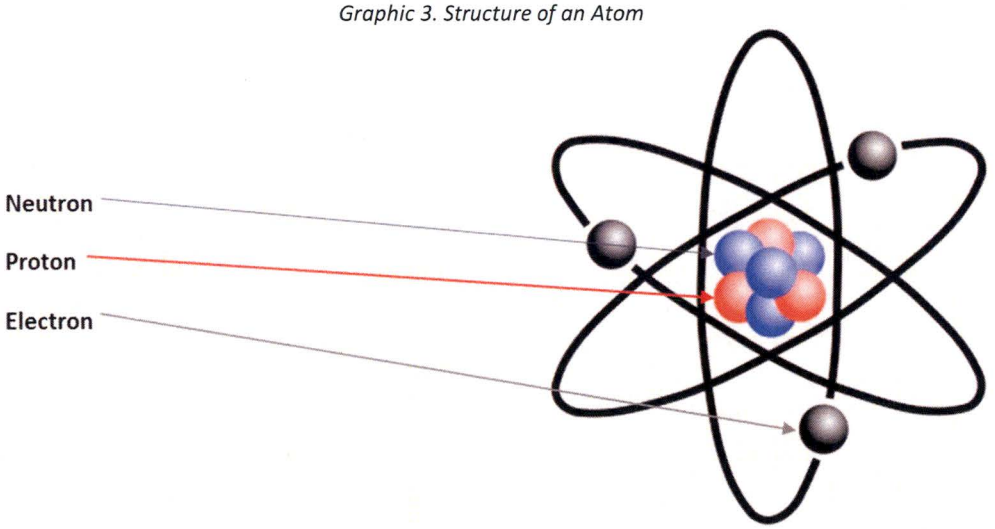
Generally radiation is defined as emitted energy in the form of waves or particles. If radiation has enough energy to displace electrons from an atom it is termed "ionizing", otherwise it is "non-ionizing". Non-Ionizing radiation includes light, heat given off from a stove, radiowaves and microwaves. Ionizing radiation occurs in atoms, particles too small for the eye to see. So, what are atoms and how does radiation come from them?

Graphic 2. Types of Radiation, from NASA Hubblesite



An atom is the smallest part of an element that maintains the characteristics of that element. Atoms are made up of three parts: protons, neutrons, and electrons.

Graphic 3. Structure of an Atom



The number of protons in an atom determines the element. For example, a hydrogen atom will always have one proton while an oxygen atom will always have eight protons. The protons are clustered with the neutrons forming the nucleus at the center of the atom. Orbiting around the nucleus are the relatively small electrons.

Isotopes are atoms that have the same number of protons but different numbers of neutrons. Different isotopes of an element will all have the same chemical properties and many isotopes are radioactive while other isotopes are not radioactive. A radioactive isotope can emit radiation because it contains excess energy in its nucleus. Radiactive atoms and isotopes are also referred to as radionuclides and radioisotopes.

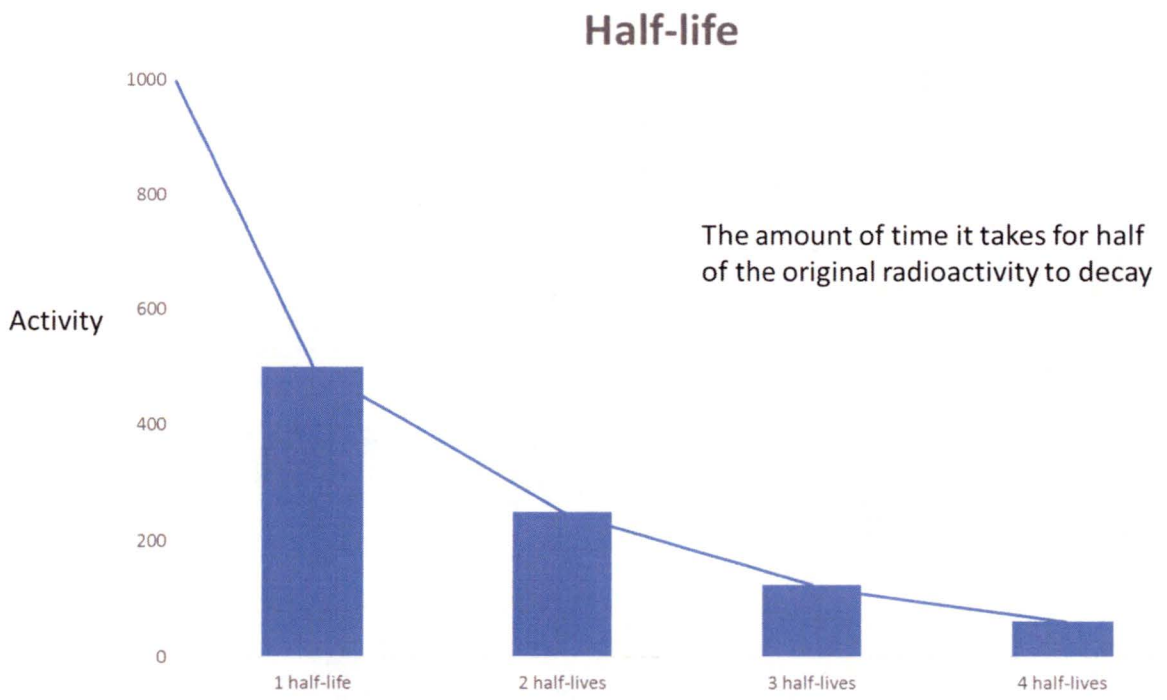
There are two basic ways that radionuclides are produced at a nuclear power plant. The first is fission, which creates radionucides that are called *fission products*. Fission occurs when a very large atom, such as uranium-235 (U-235) or

plutonium-239 (Pu-239), absorbs a neutron into its nucleus making the atom unstable. The unstable atom can then split into smaller atoms. When fission occurs there is a large amount of energy released in the form of heat. A nuclear power plant uses this heat to produce steam. The steam is directed toward a turbine, forcing it to spin. The spinning of the turbine is used to produce electricity.

The second way a radionuclide is produced at a nuclear power plant is through a process called activation. The radionuclides produced in this method are termed *activation products*. Pure water that is used to cool the reactor and also to produce steam to turn the turbines. Although this water is considered to be very pure, there are always some contaminiants within the water, either from material used in the plant's construction or from the operation of the plant. These contaminants are exposed to the fission process and may become activation products. The atoms in the water itself can also become activated and create radionuclides.

Over time, radioactive atoms will reach a stable state and no longer be radioactive. To do this they must release their excess energy. This release of excess energy is called radioactive decay. The time it takes for a radionuclide to become stable is measured in units called half-lives. A half-life is the amount of time it takes for half of the original radioactivity to decay. Each radionuclide has a specific half-life. Some half-lives can be very long and measured in years while others may be very short and measured in seconds.

Graphic 4. Radioactive Decay Half-Life



In the annual reports you will see both man made and naturally ocurring radionuclides listed, for example potassium-40 (K-40, natural) and cobalt-60 (Co-60, man-made). We are mostly concerned about man-made radionuclides because they can be produced as by-products when generating electricity at a nuclear power plant. It is important to note that there are also other ways man-made radionuclides are produced, such as detonating nuclear weapons. Weapons testing has deposited some of the same man-made radionuclides into the environment as those generated by nuclear power, and some are still present today because of long half-lives.

C. Measuring Radiation

There are four different but interrelated units for measuring radioactivity, exposure, absorbed dose, and dose equivalent. Together, they are used to report amounts of radiation and quantify its effects on humans.

- Radioactivity refers to the amount of ionizing radiation released by a material. The units of measure for radioactivity used within the AREOR and ARERR are the curie (Ci). Small fractions of the Ci often have a prefix, such as the microcurie (μCi), which means 1/1,000,000 of a Curie.

- Exposure describes the amount of radiation traveling through the air. The units of measure for exposure used within the AREOR and ARERR are the roentgen (R). Traditionally direct radiation monitors placed around the site are measured milliroentgen (mR), 1/1,000 of one R.

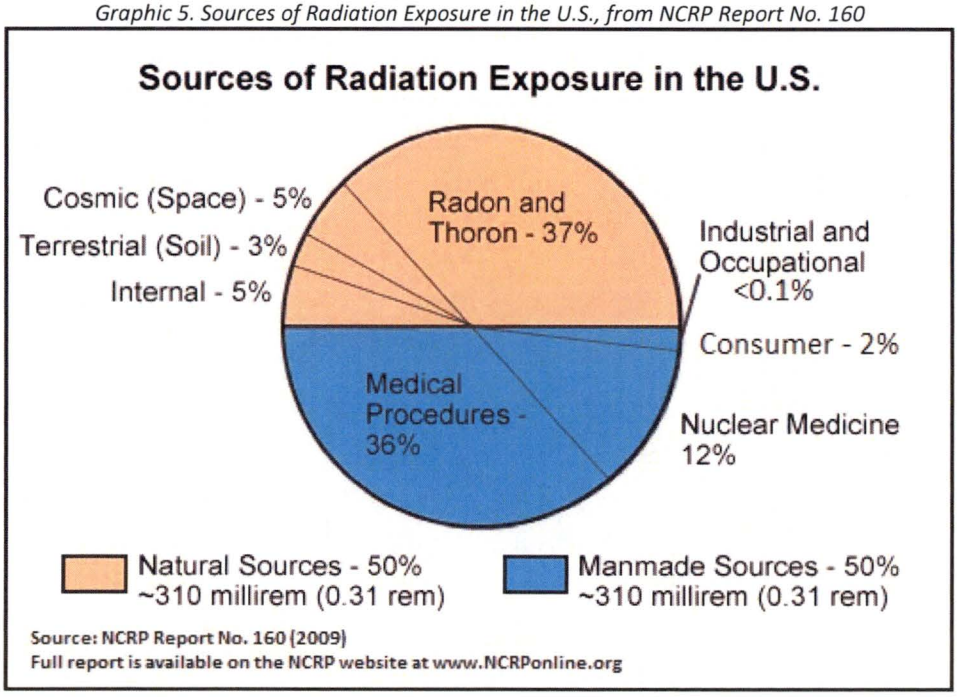
- Absorbed dose describes the amount of radiation absorbed by an object or person. The units of measure for absorbed dose used within the AREOR and ARERR are the rad. Noble gas air doses reported by the site are measured in millirad (mrad), 1/1,000 of one rad.

- Dose equivalent (or effective dose) combines the amount of radiation absorbed and the health effects of that type of radiation. The units used within the AREOR and ARERR are the roentgen equivalent man (rem). Regulations require doses to the whole body, specific organ, and direct radiation to be reported in millirem (mrem), 1/1,000 of one rem.

D. Sources of Radiation

People are exposed to radiation every day of their lives and have been since the dawn of mankind. Some of this radiation is naturally occurring while some is man-made. There are many factors that will determine the amount of radiation individuals will be exposed to such as where they live, medical treatments, etc. The average person in the United States is exposed to approximately 620 mrem each year. 310 mrem comes from natural sources and 310 from man-made sources. The Graphic 5 shows what the typical sources of radiation are for an individual over a calendar year:

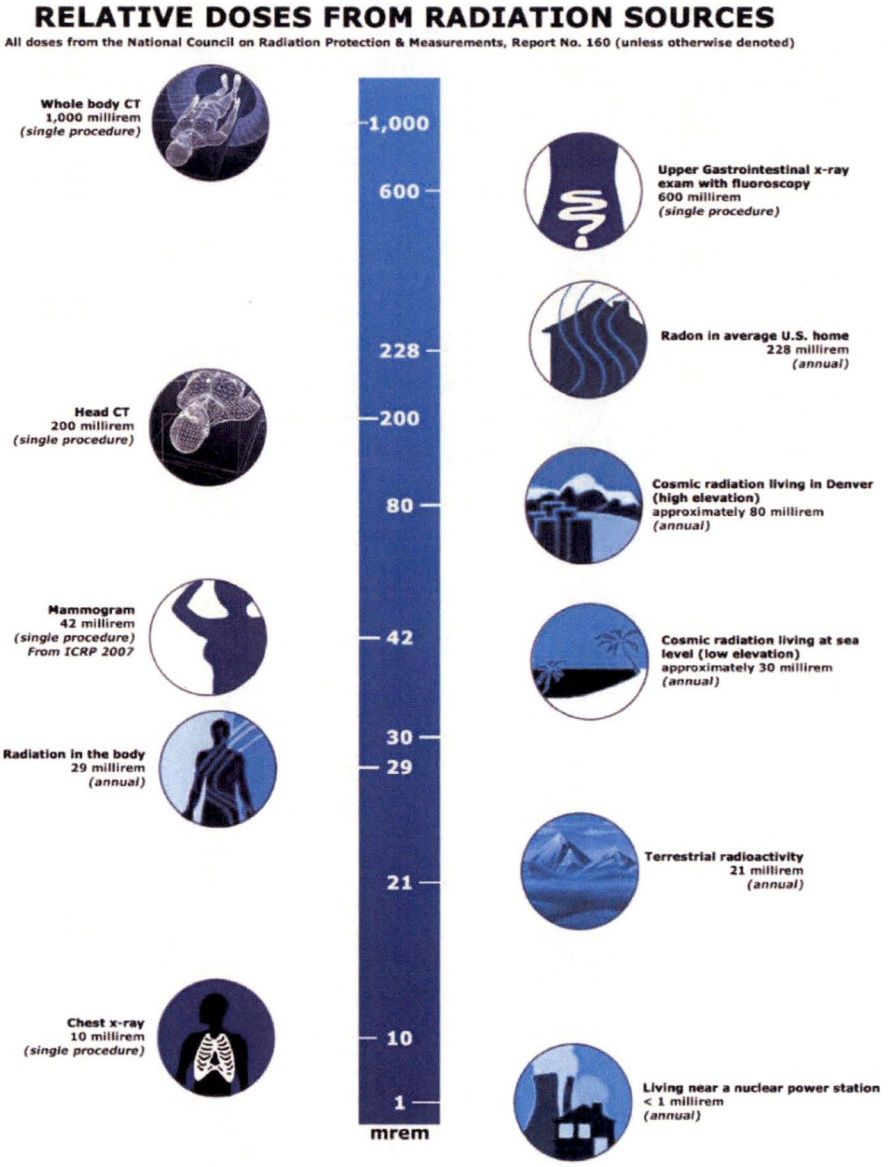
Graphic 5. Sources of Radiation Exposure in the U.S., from NCRP Report No. 160



The radiation from a nuclear power plant is included in the chart as part of the "Industrial and Occupational" fraction, <0.1%. The largest natural source of radiation is from radon, because radon gas travels in the air we breathe. Perhaps you know someone who had a CT scan at a hospital to check his or her bones, brain, or heart. CT scans are included in

the chart as "Medical Procedures", which make up the next largest fraction. Graphic 6 shows some of the common doses humans receive from radiation every year.

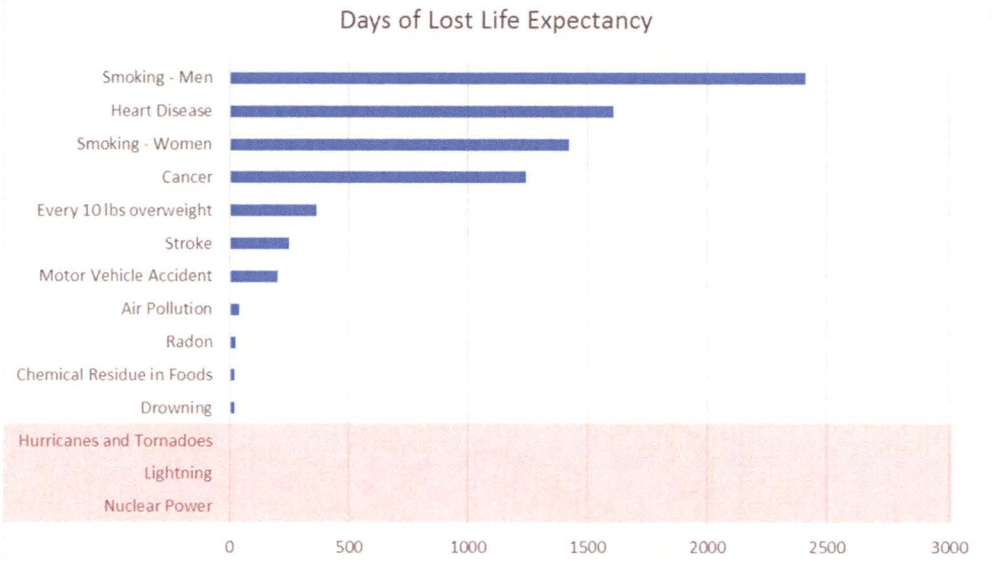
Graphic 6 .Relative Doses from Radiation Sources, from EPA Radiation Doses and Sources

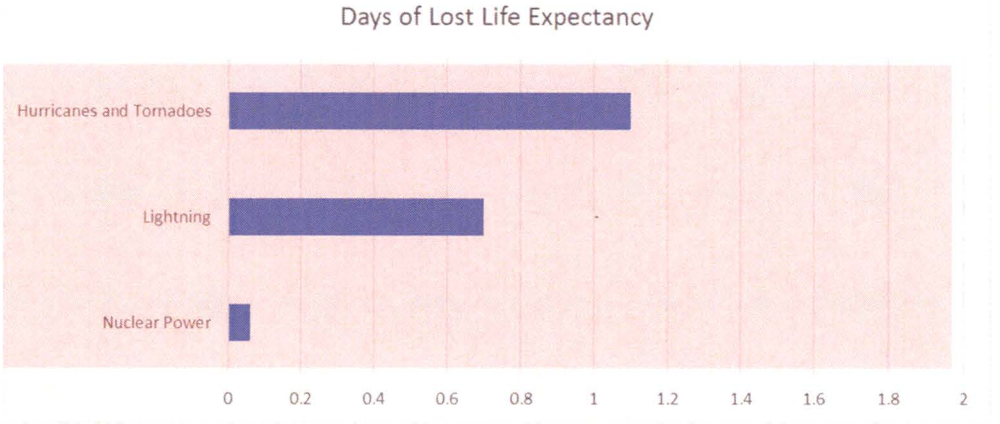


E. Radiation Risk

Current science suggests there is some risk from any exposure to radiation. However, it is very hard to tell whether cancers or deaths can be attributed to very low doses of radiation or by something else. U.S. radiation protection standards are based on the premise that any radiation exposure carries some risk.
The following graph is an example of one study that tries to relate risk from many different factors. This graph represents risk as "Days of Lost Life Expectancy". All the categories are averaged over the entire population except Male Smokers, Female Smokers, and individuals that are overweight. Those risks are only for people that fall into those categories. The category for Nuclear Power is a government estimate based on all radioactivity releases from nuclear power, including accidents and wastes.

Graphic 7. Days of Lost Life Expectancy, Adapted from the Journal of American Physicians and Surgeons Volume 8 Number 2 Summer 2003





II. REGULATORY LIMITS

A. Fission and Activation Gases

1. The instantaneous release rate of noble gases in gaseous effluents shall not result in a site boundary dose rate greater than 500 mrem/year to the whole body or greater than 3000 mrem/year to the skin (Offsite Dose Calculation Manual (ODCM 3.11.2.1).
2. Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce gaseous emissions when the calculated gamma-air dose due to gaseous effluents exceeds 1.20

mRad or the calculated beta-air dose due to gaseous effluents exceeds 2.4 mRad at the site boundary in a 92 day period (ODCM 3.11.2.4).

3. The air dose at the site boundary due to noble gases released in gaseous effluents shall not exceed (ODCM 3.11.2.2):

   10 mRad/qtr, gamma-air
   20 mRad/qtr, beta-air
   20 mRad/year, gamma-air
   40 mRad/year, beta-air

4. All of the above parameters are calculated according to the methodology specified in the ODCM.

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

1. The instantaneous release rate of iodines and particulates in gaseous effluents shall not result in a site boundary dose-rate in excess of 1500 mrem/year to any organ (ODCM 3.11.2.1).
2. The Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous effluents when calculated doses exceed 1.8 mrem to any organ in a 92 day period at or beyond the site boundary (ODCM 3.11.2.4).
3. The dose to a member of the public at or beyond the site boundary from iodine-131 and particulates with half-lives greater than eight days in gaseous effluents shall not exceed (ODCM 3.11.2.3):

   15 mrem/qtr, any organ
   30 mrem/year, any organ
   less than 0.1% of the above limits as a result of burning contaminated oil.

4. All of the above parameters are calculated according to the methodology specified in the ODCM.

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.

III. 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.

IV. TECHNICAL SPECIFICATION REPORTING REQUIREMENTS

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

1. 2018 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: 9.63 Curies of C-14 from Unit 1 and 10.42 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 2018 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 335.97 days for Unit 1 and 363.52 days for Unit 2.
   d. Meteorological dispersion factor (X/Q) at the nearest residence with a garden located at 1.5 miles in the southeast meteorological sector is 2.29E-07 sec/m^3.
   e. Pathways considered to the hypothetical maximally exposed member of the public (child) were inhalation and leafy vegetation ingestion.

2. 2018 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	2.71E-04	2.34E-04	4.09E-04	4.36E-04	1.35E-03
% of Limit	0.009	0.008	0.014	0.015	0.023
Liquid Effluent Dose Limit, Any Organ	10 mrem	10 mrem	10 mrem	10 mrem	20 mrem
Organ Dose	5.73E-04	6.49E-04	5.15E-04	4.97E-04	2.23E-03[1]
% of Limit	0.006	0.006	0.005	0.005	0.011
Gaseous Effluent Dose Limit, Gamma Air	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
Gamma Air Dose	4.22E-05	2.58E-05	1.83E-05	1.94E-05	1.06E-04
% of Limit	0.0004	0.0003	0.0002	0.0002	0.0005
Gaseous Effluent Dose Limit, Beta Air	20 mrad	20 mrad	20 mrad	20 mrad	40 mrad
Beta Air Dose	3.38E-05	1.39E-05	1.78E-05	1.71E-05	8.26E-05
% of Limit	0.0002	0.00007	0.00009	0.00009	0.0002
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	1.71E-04	1.31E-04	2.62E-04	7.06E-05	6.34E-04[2]
% of Limit	0.001	0.0009	0.002	0.0005	0.002
Total Body Dose (NG)	3.96E-05	2.43E-05	1.73E-05	1.83E-05	9.95E-05
Skin Dose (due to NG)	6.67E-05	3.70E-05	3.19E-05	3.23E-05	1.68E-04
C-14 Total Body/Organ	Mrem				
Bone Dose	8.19E-03	9.77E-03	9.87E-03	9.91E-03	3.78E-02
Total Body Dose	1.62E-03	1.94E-03	1.96E-03	1.97E-03	7.49E-03

[1] The controlling liquid pathway was the fish and shellfish pathway with adult as the controlling age group and the GI representing the organ with the highest calculated annual dose during the calendar year of 2018.

[2] The controlling gaseous pathway was the teen-lung pathway representing the organ with the highest calculated dose during the calendar year of 2018. There is currently no milk pathway.

3. 40 CFR 190 Total Dose Compliance

Based upon the calendar year 2018 and the ODCM calculations, the maximum exposed individual would receive 0.16% of the allowable dose. During the calendar year 2018, 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	1.35E-03	1.28E-03	2.23E-03
Gas	6.34E-04	6.34E-04	6.34E-04
C-14	7.49E-03		3.78E-02
Dose	9.47E-03	1.91E-03	4.07E-02
% of Limit	0.038	0.003	0.163

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

4. Solid Waste Report Requirements

During 2018, 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 2018 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

Offsite Dose Calculation Manual – Two revisions were performed to the ODCM in 2018. Revision 2 implemented in June 2018, incorporated editorial corrections to maintain references and update the REMP locations. Revision 3, implemented in December 2018, updates included administrative changes for clarity, such as adding formulas for calculations and enhancing wording. Both revisions are attached to this report.

There were no changes to RW-AA-100, Process Control Program, in 2018.

B. Radioactive Effluent Monitoring Instrumentation

1. The waste gas RMS, 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. The RMS is scheduled to be replaced in the year 2020.
2. The unit 1 steam generator blowdown effluent line radiation monitors exceeded the 30 days inoperable time period allowed in ODCM section 3.3.3.10. Compensatory grab samples were performed at least once per 48 hours during discharges. One channel of radiation monitors was restored on January 27th, 2018 when 1RIC4014 was returned to service. 1RIC4014 went out of service on December 13th, 2017. 1RIC4095 was retroactively declared inoperable from November 22nd, 2017 through the entire calendar year due to a missed surveillance test (calibration).
3. The unit 2 steam generator blowdown flow rate measurement exceeded the 30 days inoperable time period allowed in ODCM section 3.3.3.10. Compensatory flow estimates were performed once per 4 hours during releases. The indication issue occurred on November 24th, 2018. The flow indicator 2FT4089 required corrective maintenance that could not be completed within 30 days due to parts availability. The flow indicator was repaired and the flow measurement channel restored on January 16th, 2019.

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 2018. Additional information regarding the ISFSI radiological environmental monitoring program is included in the Annual Radiological Environmental Operation Report.

V. AVERAGE ENERGY

Not Applicable.

VI. 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 IV.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 IV.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 VI.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 II.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.

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. 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. The 2018 analysis results for tritium and gamma are listed in the Annual Radiological Environmental Operating Report and are not included in this report.

VII. ERRATA

I. None

VIII. BATCH RELEASES

A Liquid (1)	2018 1ST QUARTER	2018 2ND QUARTER	2018 3RD QUARTER	2018 4TH QUARTER
1. Number of batch releases	11	7	7	8
2. Total time period for batch releases (min)	6.03E+03	4.27E+03	4.10E+03	4.83E+03
3. Maximum time period for a batch release (min)	6.67E+02	6.68E+02	6.19E+02	7.31E+02
4. Average time period for batch release (min)	5.48E+02	6.10E+02	5.85E+02	6.04E+02
5. Minimum time period for a batch release (min)	4.26E+02	5.52E+02	5.21E+02	5.20E+02
6. Average stream flow during periods of effluent into a flowing stream (liters/min of dilution water)	4.50E+06	4.57E+06	4.61E+06	4.56E+06

(1) This table excludes batch releases from the Waste Neutralizing Tanks. 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	24	24	18	17
2. Total time period for batch releases (min)	1.02E+04	9.89E+03	7.28E+03	7.30E+03
3. Maximum time period for a batch release (min)	1.32E+03	7.44E+02	5.98E+02	6.99E+02
4. Average time period for batch release (min)	4.25E+02	4.12E+02	4.04E+02	4.29E+02
5. Minimum time period for a batch release (min)	8.00E+00	1.11E+02	3.00E+01	2.98E+02

IX. ABNORMAL RELEASES

	2018			
	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 -	- 0 -	- 0 -
2. Total activity releases (Curies)	- 0 -	- 0 -	- 0 -	- 0 -

APPENDIX A
CALVERT CLIFFS NUCLEAR POWER PLANT AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION EFFLUENT AND WASTE DISPOSAL 2018 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	2.84E-01	1.09E-01	1.34E-01	1.34E-01	±1.20E+01
2. Average release rate for period	µCi/sec	3.60E-02	1.38E-02	1.70E-02	1.70E-02	
3. Percent of ODCM limit (1)	%	(1)	(1)	(1)	(1)	
4. Percent of ODCM limit (2)	%	(2)	(2)	(2)	(2)	
B. IODINES						
1. Total Iodine - 131	Ci	<LLD	<LLD	<LLD	<LLD	±6.50E+00
2. Average release rate for period	µCi/sec	<LLD	<LLD	<LLD	<LLD	
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	1.92E+00	1.47E+00	2.95E+00	7.96E-01	±1.32E+01
2. Average release rate for period	µCi/sec	2.44E-01	1.87E-01	3.74E-01	1.01E-01	
E. GROSS ALPHA						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	±2.50E+01
2. Average release rate for period	µCi/sec	<LLD	<LLD	<LLD	<LLD	
F. Carbon-14						
1. Total Release	Ci	4.35E+00	5.19E+00	5.24E+00	5.26E+00	N/A
2. Average release rate for period	µCi/sec	5.59E-01	6.60E-01	6.59E-01	6.62E-01	

NOTES TO TABLE 1A

(1) Percent of quarterly gamma-air dose limit (10 mRad) can be found in Section IV.A.2

(2) Percent of quarterly beta-air dose limit (20 mRad) can be found in Section IV.A.2

(3) Iodine, Tritium, Carbon-14, and Particulates are treated as a group. % limit can be found in Section IV.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	8.26E-03	<LLD	<LLD	<LLD	4.49E-02	3.68E-02	2.62E-02	2.74E-02
Krypton-85	Ci	<LLD	<LLD	<LLD	<LLD	3.43E-02	<LLD	6.13E-02	4.72E-02
Krypton-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<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	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon-133	Ci	9.15E-02	<LLD	<LLD	<LLD	7.90E-02	7.02E-02	4.59E-02	5.82E-02
Xenon-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon-135	Ci	2.57E-02	<LLD	<LLD	<LLD	5.47E-04	1.79E-03	8.30E-04	1.06E-03
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	1.25E-01	<LLD	<LLD	<LLD	1.59E-01	1.09E-01	1.34E-01	1.34E-01
2. IODINES									
Iodine-131	Ci	<LLD	<LLD	<LLD	<LLD	(1)	(1)	(1)	(1)
Iodine-132	Ci	<LLD	<LLD	<LLD	<LLD	(1)	(1)	(1)	(1)
Iodine-133	Ci	<LLD	<LLD	<LLD	<LLD	(1)	(1)	(1)	(1)
Iodine-135	Ci	<LLD	<LLD	<LLD	<LLD	(1)	(1)	(1)	(1)
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	(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)
Cerium-141	Ci	<LLD	<LLD	<LLD	<LLD	(1)	(1)	(1)	(1)

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
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	<LLD	<LLD	<LLD	<LLD	N/A	N/A	N/A	N/A
5. TRITIUM									
Tritium	Ci	1.92E+00	1.47E+00	2.95E+00	7.96E-01	<LLD	<LLD	<LLD	<LLD
6. Carbon-14(2)									
Carbon-14	Ci	4.35E+00	5.19E+00	5.24E+00	5.26E+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 IV.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	1.49E-03	1.25E-03	1.59E-03	8.63E-04	±1.03E+01
2. Average diluted concentration during period	µCi/ml	1.42E-12	1.04E-12	1.31E-12	7.13E-13	
3. Percent of ODCM limit (1)	%	(1)	(1)	(1)	(1)	
4. Percent of ODCM limit (2)	%	(2)	(2)	(2)	(2)	
B. TRITIUM						
1. Total Release	Ci	2.46E+02	1.98E+02	3.79E+02	4.11E+02	±1.03E+01
2. Average diluted concentration during period	µCi/ml	2.35E-07	1.64E-07	3.14E-07	3.40E-07	
3. Percent of applicable limit (3)	%	7.83E-5	5.47E-5	1.05E-4	1.13E-4	
C. DISSOLVED AND ENTRAINED GASES						
1. Total Release	Ci	1.10E-03	<LLD	<LLD	1.00E-04	±1.03E+01
2. Average diluted concentration during period	µCi/ml	1.05E-12	<LLD	<LLD	8.29E-14	
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	1.43E+08	1.11E+08	9.13E+07	1.17E+08	±1.30E+00
F. VOLUME OF DILUTION WATER USED DURING PERIOD (4)	liters	1.05E+12	1.21E+12	1.21E+12	1.21E+12	±1.64E+01

NOTES TO TABLE 2A

(1) Percent of II.C.3 Quarterly Organ Dose Limit (10 mrem) can be found in Section IV.A.2
(2) Percent of II.C.3 Quarterly Whole Body Dose Limit (3 mrem) can be found in Section IV.A.2
(3) Limit used is 3 x 10-3 µCi/ml
(4) Includes dilution water used during continuous discharges.

TABLE 2B - REG GUIDE 1.21
LIQUID EFFLUENTS

		CONTINUOUS MODE				BATCH MODE			
NUCLIDES RELEASED	Units	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	2.41E-04	<LLD	<LLD	<LLD
Manganese - 54	Ci	<LLD	<LLD	<LLD	<LLD	4.68E-05	2.14E-05	5.99E-05	<LLD
Iron – 55	Ci	(2)	(2)	(2)	(2)	<LLD	<LLD	<LLD	<LLD
Cobalt – 57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cobalt – 58	Ci	<LLD	<LLD	<LLD	<LLD	4.77E-04	4.14E-04	2.73E-04	2.62E-05
Iron – 59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cobalt – 60	Ci	<LLD	<LLD	<LLD	<LLD	2.50E-04	6.33E-04	9.60E-04	6.23E-04
Nickel-63	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zinc – 65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<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	4.86E-05	6.09E-05	<LLD	<LLD
Zirconium - 95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
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	<LLD	<LLD	<LLD
Antimony - 125	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tellurium – 125m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tellurium - 132	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
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	<LLD	<LLD	<LLD	<LLD
Cesium – 136	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cesium – 137	Ci	<LLD	<LLD	<LLD	<LLD	4.28E-04	1.25E-04	2.94E-04	2.14E-04
Cesium – 138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
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	1.49E-03	1.25E-03	1.59E-03	8.63E-04
Krypton – 85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon - 131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon – 133	Ci	<LLD	<LLD	<LLD	<LLD	1.10E-03	<LLD	<LLD	1.00E-04
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	1.10E-03	<LLD	<LLD	1.00E-04
Tritium	Ci	1.71E-01	1.96E-01	1.71E-01	1.65E-01	2.46E+02	1.98E+02	3.79E+02	4.11E+02
Total For Period (Tritium)	Ci	1.71E-01	1.96E-01	1.71E-01	1.65E-01	2.46E+02	1.98E+02	3.79E+02	4.11E+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 Ci	1.11E+01 6.93E+01	25%
b)	Dry compressible waste, contaminated equipment, etc.	m^3 Ci	3.58E+02 1.65E-01	25%
c)	Irradiated components, control rods, etc.	m^3 Ci	N/A	N/A
d)	Other (cartridge filters, misc. dry compressible, Oil)	m^3 Ci	2.75E+01 9.67E-03	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	4.34
Fe-55	19.97
Co-58	2.20
Co-60	34.59
Ni-63	14.31
Zn-65	1.32
Cs-134	1.27
Cs-137	20.86

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

Dry Active Waste	
Nuclide	Abundance (%)
Cr-51	3.19
Fe-55	13.00
Co-58	20.13
Co-60	9.19
Ni-63	29.02
Zr-95	3.90
Nb-95	5.57
Sb-125	1.18
Cs-137	13.09

Irradiated Components	
Nuclide	Abundance (%)
N/A	

Other Waste	
Nuclide	Abundance%)
Fe-55	15.41
Co-58	12.96
Co-60	11.14
Ni-63	35.96
Zr-95	2.33
Nb-95	1.97
Sb-125	1.40
Cs-137	16.18

3. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
8	Motor Surface Transit (Hittman)	Energy Solutions Oak Ridge, TN
2	Motor Surface Transit (Hittman)	Energy Solutions Oak Ridge, TN
1	Motor Surface Transit (Hittman)	Energy Solutions Clive, UT
1	Motor Surface Transit (Hittman)	Waste Control Specialists LLC Andrews, TX
1	Motor Surface Transit (Interstate Ventures)	Energy Solutions Oak Ridge, TN

B. IRRADIATED FUEL SHIPMENTS (DISPOSITION) N/A