Exelon Generation®

10 CFR 50.36a
10 CFR 72.44(d)(3)
Technical Specifications

NMP1L3211
April 19, 2018

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Nine Mile Point Nuclear Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-63 and NPF-69
NRC Docket Nos. 50-220 and 50-410

Independent Spent Fuel Storage Installation (ISFSI)
ISFSI Docket No. 72-1036

Subject: 2017 Radioactive Effluent Release Report for Nine Mile Point Units 1 and 2

In accordance with 10 CFR 50.36a, and the Nine Mile Point Unit 1 (NMP1) and Nine Mile Point Unit 2 (NMP2) Technical Specifications, enclosed are the Radioactive Effluent Release Reports for NMP1 and NMP2 for the period of January through December 2017. This letter also satisfies the annual effluent reporting requirements for the ISFSI required by 10 CFR 72.44(d)(3).

The format used for the effluent data is outlined in Appendix B of Regulatory Guide 1.21, Revision 1. During the reporting period, NMP1, NMP2, and the ISFSI did not exceed any 10 CFR 20, 10 CFR 50, 10 CFR 72, Technical Specification, or ODCM limits for gaseous or liquid effluents.

Should you have questions regarding the information in this submittal, please contact Tom Tanguay, Site Chemistry Environmental & Radwaste Manager, at (315) 349-4264.

Sincerely,

Peter M. Orphanos
Vice President, Nine Mile Point Nuclear Station
Exelon Generation Company, LLC

PMO/RSP

IE48
NMSS26
NRR
NMSS

Enclosures: (1) Nine Mile Point Nuclear Station, Unit 1
Radioactive Effluent Release Report, January – December 2017

(2) Nine Mile Point Nuclear Station, Unit 2
Radioactive Effluent Release Report, January – December 2017

Cc: NRC Regional Administrator, Region 1
NRC Project Manager
NRC Resident Inspector
R. Rolph, NRC

# NINE MILE POINT NUCLEAR STATION - UNIT 1

# RADIOACTIVE EFFLUENT RELEASE REPORT

***January – December 2017***

# NINE MILE POINT NUCLEAR STATION - UNIT 1

# RADIOACTIVE EFFLUENT RELEASE REPORT

# JANUARY – DECEMBER 2017

## *SUPPLEMENTAL INFORMATION*

**Facility: Nine Mile Point Unit 1** **Licensee: Nine Mile Point Nuclear Station, LLC**

**1. TECHNICAL SPECIFICATION LIMITS/ODCM Limits**

A) FISSION AND ACTIVATION GASES

1. The dose rate limit of noble gases released in gaseous effluents from the site to areas at and beyond the site boundary shall be less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin.

2. The air dose due to noble gases released in gaseous effluents from Nine Mile Point Unit 1 to areas at and beyond the site boundary shall be limited during any calendar quarter to less than or equal to 5 milliroentgen for gamma radiation and less than or equal to 10 mrad for beta radiation, and during any calendar year to less than or equal to 10 milliroentgen for gamma radiation and less than or equal to 20 mrad for beta radiation.

B&C) TRITIUM, IODINES AND PARTICULATES, HALF LIVES > 8 DAYS

1. The dose rate limit of Iodine-131, Iodine-133, Tritium and all radionuclides in particulate form with half-lives greater than eight days, released in gaseous effluents from the site to areas at and beyond the site boundary shall be less than or equal to 1500 mrem/year to any organ.

2. The dose to a member of the public from Iodine-131, Iodine-133, Tritium and all radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from Nine Mile Point Unit 1 to areas at and beyond the site boundary shall be limited during any calendar quarter to less than or equal to 7.5 mrem to any organ, and during any calendar year to less than or equal to 15 mrem to any organ.

D) LIQUID EFFLUENTS

1. The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to ten times the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04 microcuries/ml total activity.

2. The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from Nine Mile Point Unit 1 to unrestricted areas shall be limited during any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ, and during any calendar year to less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ.

## 2. MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY

Described below are the methods used to measure or approximate the total radioactivity and radionuclide composition in effluents.

A) FISSION AND ACTIVATION GASES

Noble gas effluent activity is determined by on-line gross activity monitoring (calibrated against gamma isotopic analysis of a 4.0L Marinelli grab sample) of an isokinetic stack sample stream.

B) IODINES

Iodine effluent activity is determined by gamma spectroscopic analysis (at least weekly) of charcoal cartridges sampled from an isokinetic stack sample stream.

C) PARTICULATES

Activity released from the main stack is determined by gamma spectroscopic analysis (at least weekly) of particulate filters sampled from an isokinetic sample stream and composite analysis of the filters for non-gamma emitters.

D) TRITIUM

Tritium effluent activity is measured by liquid scintillation or gas proportional counting of monthly samples taken with an air sparging/water trap apparatus. Tritium effluent activity is measured during purge and weekly when fuel is offloaded until stable tritium release rates are demonstrated.

E) EMERGENCY CONDENSER VENT EFFLUENTS

The effluent curie quantities are estimated based on the isotopic distribution in the Condensate Storage Tank water and the Emergency Condenser shell water. Actual isotopic concentrations are found via gamma spectroscopy. Initial release rates of Sr-89, Sr-90 and Fe-55 are estimated by applying scaling factors to release rates of gamma emitters and actual release rates are determined from post offsite analysis results. The activity of fission and activation gases released due to tube leaks is based on reactor steam leak rates using offgas isotopic analyses.

F) LIQUID EFFLUENTS

Isotopic contents of liquid effluents are determined by isotopic analysis of a representative sample of each batch and composite analysis of non-gamma emitters. Tritium activity is estimated on the most recent analysis of the Condensate Storage Tank water. Initial release rates of Sr-89, Sr-90, and Fe-55 are estimated by applying scaling factors to release rates of gamma emitters and actual release rates are determined from post offsite analysis results.

G) SOLID EFFLUENTS

Isotopic contents of waste shipments are determined by gamma spectroscopy analysis of a representative sample of each batch. Scaling factors established from primary composite sample analyses conducted off-site are applied, where appropriate, to find estimated concentration of non-gamma emitters. For low activity trash shipments, curie content is estimated by dose rate measurement and application of appropriate scaling factors.

H) C-14

The production of C-14 and the effluent dose consequences are estimates based on EPRI methodology provided in EPRI Report 1021106, *Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents*, December 2010 and NUREG-0016, *Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents for Boiling Water Reactors (BWR-GALE Code)*.

## 3. METEOROLOGICAL DATA

An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distribution of wind speed, wind direction, and atmospheric stability. In lieu of submission with the Radiological Effluent Release Report, the licensee is exercising the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

# ATTACHMENT 1



Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

**Liquid Effluents:**

ODCM Required Maximum Effluent Concentration (MEC) = 10 x 10CFR20, Appendix B, Table 2, Column 2

There were no batch discharges of liquid radwaste requiring use of MEC to determine allowable release rate.

There were no Emergency Condenser Vent Liquid Discharges in 2017.

| | | | |
|---|---|---|---|
| Average MEC - µCi/ml (Qtr. 1) = | NO RELEASES | Average MEC - µCi/ml (Qtr. 3) = | NO RELEASES |
| Average MEC - µCi/ml (Qtr. 2) = | NO RELEASES | Average MEC - µCi/ml (Qtr. 4) = | NO RELEASES |

**Average Energy (Fission and Activation gases - MeV):**

| | | | | | |
|---|---|---|---|---|---|
| Qtr. 1: | $\bar{E}\gamma$ = | N/A | $\bar{E}\beta$ = | N/A |
| Qtr. 2: | $\bar{E}\gamma$ = | N/A | $\bar{E}\beta$ = | N/A |
| Qtr. 3: | $\bar{E}\gamma$ = | N/A | $\bar{E}\beta$ = | N/A |
| Qtr. 4: | $\bar{E}\gamma$ = | N/A | $\bar{E}\beta$ = | N/A |

**Liquid:**

| | Radwaste | EC Vent |
|---|---|---|
| Number of Batch Releases | 0 | 0 |
| Total Time Period for Batch Releases (hrs) | 0 | 0.00 |
| Maximum Time Period for a Batch Release (hrs) | 0 | 0.00 |
| Average Time Period for a Batch Release (hrs) | 0 | 0.00 |
| Minimum Time Period for a Batch Release (hrs) | 0 | 0.00 |

Total volume of water used to dilute the liquid effluent during release period (L)

| | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|
| Radwaste | N/A | N/A | N/A | N/A |

Total volume of water available to dilute the liquid effluent during report period (L)

| | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|
| Radwaste | 1.11E+11 | 1.26E+11 | 1.31E+11 | 1.30E+11 |

**Gaseous(Emergency Condenser Vent):**

| | |
|---|---|
| Number of Batch Releases | 0 |
| Total Time Period for Batch Releases (hrs) | 0.00 |
| Maximum Time Period for a Batch Release (hrs) | 0.00 |
| Average Time Period for a Batch Release (hrs) | 0.00 |
| Minimum Time Period for a Batch Release (hrs) | 0.00 |

**Gaseous (Primary Containment Purge):**

| | |
|---|---|
| Number of Batch Releases | 2 |
| Total Time Period for Batch Releases (hrs) | 10.58 |
| Maximum Time Period for a Batch Release (hrs) | 5.73 |
| Average Time Period for a Batch Release (hrs) | 5.29 |
| Minimum Time Period for a Batch Release (hrs) | 4.85 |

# ATTACHMENT 1

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

**Abnormal Releases:**

**A. Liquids:**

| | | |
|---|---|---|
| Number of Releases | 0 | |
| Total Activity Released | N/A | Ci |

**B. Gaseous:**

| | | |
|---|---|---|
| Number of Releases | 0 | |
| Total Activity Released | N/A | Ci |

Since 2003, the Emergency Condensers have been actuated 7 times. These are identified in the 2003, 2004, 2009, 2010 and 2013 RERRs. The perimeter drain pumps were out of service between 2008 and 2012. Releases prior to that are assumed to have been dicharged to the storm drains while the pumps were functional.

In August 2012, tritium was identified in ground water outside Unit 1. Subsequent investigations determined the source of tritium was Emergency Condenser Vent discharges (during periodic testing, as well as past events). Per the ODCM, and through station procedures, the gaseous and liquid effluent releases to the environment via the Emergency Condenser pathway are analyzed and reported in the monthly effluent releases and reported annually in the Radioactive Effluent Release Report (RERR). As a result of this discovery, the Unit 1 ODCM was revised (Revision 34) to require composite samples of discharges from the Reactor Building Perimeter Drain be collected and analyzed, and total curies reported in the RERR. Because this activity has been accounted for in previous RERRs, it is to be reported as a separate item, and not included in the liquid releases (Attachment 5).

On September 6, 2017 from 11:58 to 12:04, #11 Emergency Condenser String inlet and outlet isolation valves were opened. System parameters were monitored. Condenser temperatures never reached boiling as the temperature reached a maximum of 165°F for shell #111 and 182°F for shell #112. For the remainder of the month, average shell temperature was between 86° and 100° F. The outside of the reactor building where the vents are located was visually inspected. Below and surrounding the vents showed no indication that any liquid discharge took place. For this reason, it is concluded that an emergency condenser liquid release did not take place and is not documented in this report.

# ATTACHMENT 2

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES, ELEVATED AND GROUND LEVEL

| | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | EST. TOTAL ERROR, % |
|---|---|---|---|---|---|---|
| A. Fission & Activation Gases (1) | | | | | | |
| 1. Total Release | Ci | ** | ** | ** | ** | 5.00E+01 |
| 2. Average Release Rate | µCi/sec | ** | ** | ** | ** | |
| B. Iodines (1) | | | | | | |
| 1. Total Iodine - 131 | Ci | 1.03E-05 | ** | ** | ** | 3.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 1.31E-06 | ** | ** | ** | |
| C. Particulates (1) | | | | | | |
| 1. Particulates with Half-lives>8 days | Ci | 1.82E-03 | 2.52E-04 | 1.93E-04 | 1.64E-04 | 3.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 2.31E-04 | 3.21E-05 | 2.65E-05 | 2.09E-05 | |
| 3. Gross Alpha Radioactivity | Ci | ** | ** | ** | ** | 2.50E+01 |
| D. Tritium (1) | | | | | | |
| 1. Total Release | Ci | 1.94E+01 | 1.77E+01 | 1.79E+01 | 9.62E+00 | 5.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 2.48E+00 | 2.25E+00 | 2.41E+00 | 1.22E+00 | |
| E. Percent of Tech. Spec. Limits Fission and Activation Gases | | | | | | |
| Percent of Quarterly Gamma Air Dose Limit (5 mR) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Quarterly Beta Air Dose Limit (10 mrad) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Annual Gamma Air Dose Limit to Date (10 mR) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Annual Beta Air Dose Limit to Date (20 mrad) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Whole Body Dose Rate Limit (500 mrem/yr) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Skin Dose Rate Limit (3000 mrem/yr) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Tritium, Iodines, and Particulates (with half-lives greater than 8 days) | | | | | | |
| Percent of Quarterly Dose Limit (7.5 mrem) | % | 7.68E-02 | 1.31E-02 | 1.55E-02 | 9.56E-03 | |
| Percent of Annual Dose Limit to Date (15 mrem) | % | 3.84E-02 | 4.49E-02 | 5.27E-02 | 5.74E-02 | |
| Percent of Organ Dose Limit (1500 mrem/yr | % | 1.56E-03 | 2.62E-04 | 3.07E-04 | 1.90E-04 | |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk.

# ATTACHMENT 3

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - ELEVATED RELEASE

Continuous Mode (2)

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | 1.03E-05 | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Strontium-89 | Ci | 7.21E-05 | 2.07E-05 | 7.61E-05 | 7.65E-05 |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | 1.26E-03 | 8.81E-05 | 1.17E-04 | 8.78E-05 |
| Cobalt-58 | Ci | 9.21E-05 | ** | ** | ** |
| Manganese-54 | Ci | 6.04E-05 | 4.62E-06 | ** | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Chromium-51 | Ci | 1.91E-04 | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | 1.38E-04 | 1.39E-04 | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | 1.53E+01 | 1.45E+01 | 1.34E+01 | 7.58E+00 |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 1.00E-04 µCi/ml for required noble gases, 1.00E-11 µCi/ml for required particulates, 1.00E-12 µCi/ml for required Iodines, and 1.00E-06 µCi/ml for Tritium as required by the ODCM, has been verified.

(2) Contributions from purges are included. There were no other batch releases during the reporting period.

# ATTACHMENT 3

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - ELEVATED RELEASE

Batch Mode (2)

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | ** | ** |
| Cobalt-58 | Ci | ** | ** | ** | ** |
| Manganese-54 | Ci | ** | ** | ** | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | ** | ** | ** | ** |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 1.00E-04 µCi/ml for required noble gases, 1.00E-11 µCi/ml for required particulates, 1.00E-12 µCi/ml for required Iodines, and 1.00E-06 µCi/ml for Tritium as required by the ODCM, has been verified.

(2) Contributions from purges, if any, are included. There were no other batch releases during the reporting period.

# ATTACHMENT 4

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

Ground level releases are determined in accordance with the Off-Site Dose Calculation Manual and Chemistry procedures.

| Nuclides Released | | Continuous Mode 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | 4.41E-08 | ** |
| Cobalt-58 | Ci | ** | ** | 2.85E-08 | ** |
| Manganese-54 | Ci | ** | ** | 7.91E-09 | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | 4.16E+00 | 3.19E+00 | 4.45E+00 | 2.03E+00 |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk.

# ATTACHMENT 4

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

Ground level releases are determined in accordance with the Off-Site Dose Calculation Manual and Chemistry procedures.

| Nuclides Released | | Batch Mode 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | ** | ** |
| Cobalt-58 | Ci | ** | ** | ** | ** |
| Manganese-54 | Ci | ** | ** | ** | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | ** | ** | ** | ** |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk.

# ATTACHMENT 5

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES (1)

| | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Est. Total Error, % |
|---|---|---|---|---|---|---|
| A. Fission & Activation Products | | | | | | |
| 1. Total Release (not including Tritium, gases, alpha) | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| B. Tritium | | | | | | |
| 1.Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during the reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| C. Dissolved and Entrained Gases | | | | | | |
| 1. Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during the reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| D. Gross Alpha Radioactivity | | | | | | |
| 1. Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| E. Volumes | | | | | | |
| 1. Prior to Dilution | Liters | No Releases | No Releases | 1.89E+03 | No Releases | 5.00E+01 |
| 2. Volume of dilution water used during release period | Liters | No Releases | No Releases | 0.00E+00 | No Releases | 5.00E+01 |
| 3. Volume of dilution water available during reporting period - Cooling Water | Liters | 1.11E+11 | 1.26E+11 | 1.31E+11 | 1.30E+11 | 5.00E+01 |
| F. Percent of Tech. Spec. Limits | | | | | | |
| Percent of Quarterly Whole Body Dose Limit (1.5 mrem) | % | No Releases | No Releases | No Releases | No Releases | |
| Percent of Annual Whole Body Dose Limit to Date (3 mrem) | % | No Releases | No Releases | No Releases | No Releases | |
| Percent of Quarterly Organ Dose Limit (5 mrem) | % | No Releases | No Releases | No Releases | No Releases | |
| Percent of Annual Organ Dose Limit to Date (10 mrem) | % | No Releases | No Releases | No Releases | No Releases | |
| Percent of 10CFR20 Concentration Limit | % | No Releases | No Releases | No Releases | No Releases | |
| Percent of Dissolved or Entrained Noble Gas Limit (2.00E-04 µCi/ml) | % | No Releases | No Releases | No Releases | No Releases | |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk.

# ATTACHMENT 5

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## LIQUID EFFLUENTS RELEASED

| Nuclides Released | | Batch Mode (1),(2) 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Nuclides Released** | | | | | |
| Strontium-89 | Ci | No Releases | No Releases | No Releases | No Releases |
| Strontium-90 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-134 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-137 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iodine-131 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cobalt-58 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cobalt-60 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iron-59 | Ci | No Releases | No Releases | No Releases | No Releases |
| Zinc-65 | Ci | No Releases | No Releases | No Releases | No Releases |
| Manganese-54 | Ci | No Releases | No Releases | No Releases | No Releases |
| Chromium-51 | Ci | No Releases | No Releases | No Releases | No Releases |
| Zirconium-95 | Ci | No Releases | No Releases | No Releases | No Releases |
| Niobium-95 | Ci | No Releases | No Releases | No Releases | No Releases |
| Molybdenum-99 | Ci | No Releases | No Releases | No Releases | No Releases |
| Barium-140 | Ci | No Releases | No Releases | No Releases | No Releases |
| Lanthanum-140 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cerium-141 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iodine-133 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iron-55 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cerium-144 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-136 | Ci | No Releases | No Releases | No Releases | No Releases |
| Copper-64 | Ci | No Releases | No Releases | No Releases | No Releases |
| Manganese-56 | Ci | No Releases | No Releases | No Releases | No Releases |
| Nickel-65 | Ci | No Releases | No Releases | No Releases | No Releases |
| Sodium-24 | Ci | No Releases | No Releases | No Releases | No Releases |
| Dissolved or Entrained Gases | Ci | No Releases | No Releases | No Releases | No Releases |
| Tritium | Ci | No Releases | No Releases | No Releases | No Releases |

(1) No continuous mode release occurred during the report period as indicated by effluent sampling. There were no Radwaste Batch Releases.

(2) Concentrations less than the lower limit of detection of the counting system used have been verified for sampled effluents. A lower limit of detection of 5.00E-07 µCi/ml for required gamma emitting nuclides, 1.00E-05 µCi/ml for required dissolved and entrained noble gases and tritium, 5.00E-08 µCi/ml for Sr-89/90, 1.00E-06 µCi/ml for I-131 and Fe-55, and 1.00E-07 µCi/ml for gross alpha radioactivity, as identified in the ODCM, has been verified. Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk.

# ATTACHMENT 6



Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

| A1. TYPE | Volume ($m^3$) Class | | | Activity (1) (Ci) Class | | |
|---|---|---|---|---|---|---|
| | A | B | C | A | B | C |
| a.1 Spent Resin (Dewatered) | 2.02E+01 | 0.00E+00 | 0.00E+00 | 1.66E+02 | 0.00E+00 | 0.00E+00 |
| a.2 Filter Sludge | 0.00E+00 | 9.49E+00 | 0.00E+00 | 0.00E+00 | 4.67E+02 | 0.00E+00 |
| a.3 Concentrated Waste | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Totals | 2.02E+01 | 9.49E+00 | 0.00E+00 | 1.66E+02 | 4.67E+02 | 0.00E+00 |
| | | | | | | |
| b.1 Dry Compressible Waste | 2.89E+02 | 0.00E+00 | 0.00E+00 | 2.22E-01 | 0.00E+00 | 0.00E+00 |
| b.2 Dry Non-Compressible Waste (Contaminated Equipment) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Totals | 2.89E+02 | 0.00E+00 | 0.00E+00 | 2.22E-01 | 0.00E+00 | 0.00E+00 |
| | | | | | | |
| c. Irradiated Components, Control Rods, etc. | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | | | | | | |
| d. Other (to vendor for processing) | | | | | | |
| d.1 Sewage Sludge | 3.53E+01 | 0.00E+00 | 0.00E+00 | 4.99E-03 | 0.00E+00 | 0.00E+00 |

(1) The estimated total error is 5.0E+01%.

# ATTACHMENT 6

| Unit 1 X | Unit 2 | Reporting Period: January - December 2017 |
|---|---|---|

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

| A1. TYPE | Container | Package | Solidification Agent |
|---|---|---|---|
| a.1 Spent Resin | Poly Liner | General Design | None |
| a.2 Filter Sludge | Poly Liner | Type B | None |
| | | | |
| b.1 Dry Compressible Waste | Seavan | General Design | None |
| b.2 Dry Non-Compressible Waste (contaminated equipment) | N/A | N/A | N/A |
| | | | |
| c. Irradiated Components, Control Rods | N/A | N/A | N/A |
| | | | |
| d. Other (To vendor for processing) | | | |
| d.1 Sewage Sludge | Bags | General Design | None |

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

A2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (BY TYPE OF WASTE)

a. Spent Resins, Filter Sludges, Concentrated Waste

| Nuclide | Percent | Curies |
|---|---|---|
| Fe-55 | 16.03% | 1.02E+02 |
| Co-60 | 73.69% | 4.70E+02 |
| Ni-63 | 1.08% | 6.91E+00 |
| Cs-137 | 6.57% | 4.19E+01 |

b. Dry Compressible Waste, Dry Non-Compressible Waste (Contaminated Equipment)

| Nuclide | Percent | Curies |
|---|---|---|
| Mn-54 | 1.90% | 4.22E-03 |
| Fe-55 | 51.08% | 1.14E-01 |
| Co-60 | 41.59% | 9.25E-02 |
| Ni-63 | 1.40% | 3.12E-03 |
| Cs-137 | 1.44% | 3.19E-03 |

c. Irradiated Components, Control Rods: There were no shipments.

| Nuclide | Percent |
|---|---|
| NA | NA |

d. Other: (To vendor for processing)

1. Sump Liner

| Nuclide | Percent | Curies |
|---|---|---|
| Mn-54 | 2.03% | 9.88E-05 |
| Co-60 | 94.70% | 4.62E-03 |
| Cs-137 | 3.27% | 1.59E-04 |

# ATTACHMENT 6

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A3. SOLID WASTE DISPOSITION

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| 8 | Truck, highway | Bear Creek |
| 1 | Truck, highway | Gallaher Road |
| 5 | Truck, highway | Clive |
| 3 | Truck, highway | WCS |

B. IRRADIATED FUEL SHIPMENTS (Disposition)

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| | | |

D. SEWAGE WASTES SHIPPED TO A TREATMENT FACILITY FOR PROCESSING AND BURIAL

There were no shipments of sewage sludge with detectible quantities of plant-related nuclides from NMP to the treatment facility during the reporting period.

# ATTACHMENT 7

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## SUMMARY OF CHANGES TO THE OFF-SITE DOSE CALCULATION MANUAL (ODCM)

The following changes were made to the Unit 1 Off-Site Dose Calculation Manual (ODCM) during the reporting period.

### REVISION 36

| Page # | New/Amended Section # | Description of Change | Reason For Change |
|---|---|---|---|
| I 3.1-10 | NOTES FOR TABLE D 3.6.14-2 | Removed phrasing in (g) action | The basis for the change comes from NER-NC-17-001-Yellow "Review of Offsite Dose Calculation Manual (ODCM) for Shutdown or Power Reduction Action Statements" |
| I 3.1-11 | NOTES FOR TABLE D 3.6.14-2 | Added rewritten action (g)<br>"Place the nonfunctional channel in the tripped condition within 12 hours<br>OR<br>(2) (a) Take grab samples within 12 hours and once per 12 hours thereafter<br>AND<br>(b) Analyze samples for gross activity within 24 hours of sampling completion.<br>AND<br>(3) Restore nonfunctional channel(s) to FUNCTIONAL status within 30 days. (j)" | The basis for the change comes from NER-NC-17-001-Yellow |
| I 3.1-11 | NOTES FOR TABLE D 3.6.14-2 | Added action (j)<br>"If nonfunctional channel(s) not restored within specified time, explain why the inoperability was not corrected in a timely manner in the next Radioactive Effluent Release Report." | The basis for the change comes from NER-NC-17-001-Yellow |
| I B 3.1-1 | BASES FOR DLCO 3.6.14 and DSR 4.6.14 RADIOACTIVE EFFLUENT INSTRUMENTATION | BASES changed to align with notes from Table D 3.16.14-2 | The basis for the change comes from NER-NC-17-001-Yellow |
| I B 3.1-1 | BASES FOR DLCO 3.6.14 and DSR 4.6.14 RADIOACTIVE EFFLUENT INSTRUMENTATION | Removed the line to align with BASES change:<br>"When serving as backup<br>to the Offgas Monitors (Table D 3.6.14-2 Note g), this function may be satisfied by a single Low Range or High Range monitor because all Stack monitors function in the region of interest due to their design overlap." | The basis for the change comes from NER-NC-17-001-Yellow |
| II -19 | 2.2.1.1 Noble Gases | Added missing $Q_{is}$ in the whole body dose rates equation. | For whole body dose rates (mrem/sec) was missing the release rate of isotope i from the stack factor (Qis)in the equation. |
| II -19 | 2.2.1.1 Noble Gases | Elaborated the definition of the structural shielding factor adding:<br>"(dimensionless). A shielding factor of 0.7 is discussed in Table E-15 of<br>Regulatory Guide 1.109 Revision 1" | Definition was not comprehensive. |

# ATTACHMENT 8



| Unit 1 | X | Unit 2 | | Reporting Period: January - December 2017 |
|---|---|---|---|---|

## SUMMARY OF CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

RW-AA-100, PROCESS CONTROL PROGRAM FOR RADIOACTIVE WASTES, was updated to remove Fort Calhoun from the procedure and include James A. Fitzpatrick Nuclear.

# ATTACHMENT 9



Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

## SUMMARY OF NON-FUNCTIONAL MONITORS

| Monitor | Dates Monitor was Non-Functional | Cause and Corrective Actions |
|---|---|---|
| Liquid Radwaste Discharge Monitors 11 and 12 | January 1, 2017 to December 31, 2017 | These monitors were intentionally allowed to exceed their quarterly functional tests and annual calibration frequency, as no discharges are planned or expected. This condition is allowed as long as blank flanges are installed in the discharge line, precluding any unmonitored discharge. No liquid waste discharges were performed during 2017. This non-functionality is tracked in Equipment Status Log (ESL) 2006-0192. |

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY**

## Introduction

An assessment of the radiation dose potentially received by a Member of the Public due to their activities inside the site boundary from Nine Mile Point Unit 1 (NMP1) liquid and gaseous effluents has been conducted for the period January through December 2017.

This assessment considers the maximum exposed individual and the various exposure pathways resulting from liquid and gaseous effluents to identify the maximum dose received by a Member of the Public during their activities within the site boundary.

Prior to September 11, 2001, the public had access to the Energy Information Center for purposes of observing the educational displays or for picnicking and associated activities. Fishing also occurred near the shoreline adjacent to the Nine Mile Point (NMP) site. Fishing near the shoreline adjacent to the NMP site was the onsite activity that resulted in the potential maximum dose received by a Member of the Public. Following September 11, 2001 public access to the Energy Information Center has been restricted and fishing by Members of the Public at locations on site is also prohibited. Although fishing was not conducted during 2017, the annual dose to a hypothetical fisherman was still evaluated to provide continuity of data for the location.

## Dose Pathways

Dose pathways considered for this evaluation included direct radiation, inhalation and external ground (shoreline sediment or soil doses). Other pathways, such as ingestion pathways, are not considered because they are either not applicable, insignificant, or are considered as part of the evaluation of the total dose to a member of the public located off-site. In addition, only releases from the NMP1 stack and emergency condenser vent were evaluated for the inhalation pathway. Dose due to aquatic pathways such as liquid effluents is not applicable since swimming is prohibited at the NMP site.

Dose to a hypothetical fisherman is received through the following pathways while standing on the shoreline fishing:

- External ground pathway; this dose is received from plant related radionuclides detected in the shoreline sediment.
- Inhalation pathway; this dose is received through inhalation of gaseous effluents released from the NMP1 Stack and Emergency Condenser Vent.
- Direct radiation pathway; dose resulting from the operation of NMP1, Nine Mile Point Unit 2 (NMP2) and the James A. Fitzpatrick Nuclear Power Plant (JAFNPP) Facilities.

## Methodologies for Determining Dose for Applicable Pathways

### External Ground (Shoreline Sediment) Pathway

Dose from the external ground (shoreline sediment) is based on the methodology in the NMP1 Offsite Dose Calculation Manual (ODCM) as adapted from Regulatory Guide 1.109. For this evaluation it is assumed that the hypothetical maximum exposed individual fished from the shoreline at all times.

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY**

The total dose received by the whole body and skin of the maximum exposed individual during 2017 was calculated using the following input parameters:

- Usage Factor = 312 hours (fishing 8 hours per week, 39 weeks per year)
- Density in grams per square meter = 40,000
- Shore width factor = 0.3
- Whole body and skin dose factor for each radionuclide = Regulatory Guide 1.109, Table E-6.
- Fractional portion of the year = 1 (used average radionuclide concentration over total time period)
- Average Cs-137 concentration = 1.30E-01 pCi/g

The total whole body and skin doses received by a hypothetical maximum exposed fisherman from the external ground pathway is presented in Table 1, Exposure Pathway Annual Dose.

**Inhalation Pathway**

The inhalation dose pathway is evaluated by utilizing the inhalation equation in the NMP1 ODCM, as adapted from Regulatory Guide 1.109. The total whole body dose and organ dose received by the hypothetical maximum exposed fisherman during 2017 calculated using the following input parameters for gaseous effluents released from both the NMP1 Stack and Emergency Condenser Vent for the time period exposure is received:

***NMP 1 Stack:***

| Variable | Fisherman [1] |
|---|---|
| X/Q ($s/m^3$) | 8.90E-06 |
| Inhalation dose factor | Table E-7, Regulatory Guide 1.109 |
| Annual air intake ($m^3$/year) (adult) | 8000 |
| Fractional portion of the year | 0.0356 |
| H-3 (pCi/sec) | 1.55E+06 |
| Mn-54 (pCi.sec) | 2.01E-01 |
| C-14 (pCi/sec)[2] | 2.63E+05 |
| Fe-55 (pCi/sec) | 6.04E+00 |
| Co-60 (pCi/sec) | 1.27E+01 |
| Sr-89 (pCi/sec) | 6.64E+00 |

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY

*NMP1 Emergency Condenser Vent:*

| Variable | Fisherman [1] |
|---|---|
| X/Q ($s/m^3$) | 6.63E-06 |
| Inhalation dose factor | Table E-7, Regulatory Guide 1.109 |
| Annual air intake ($m^3$/year) (adult) | 8000 |
| Fractional portion of the year | 0.0356 |
| H-3 (pCi/sec) | 4.05E+05 |
| Mn-54 (pCi/sec) | 3.33E-04 |
| Co-58 (pCi/sec) | 1.20E-03 |
| Co-60 (pCi/sec) | 1.85E-03 |

1 The maximum exposed fisherman is assumed to be present on site during the period of April through December at a rate of 8 hours per week for 39 weeks per year equivalent to 312 hours for the year (fractional portion of the year = 0.0356). Therefore, the Average Stack and Emergency Condenser Vent flow rates and radionuclide concentrations used to determine the dose are represented by second, third and fourth quarter gaseous effluent flow and concentration values.

2 C-14 release rate determined from NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents for Boiling Water Reactors (BWR-GALE Code)," and EPRI Technical Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents."

The total whole body dose and maximum organ dose received by the hypothetical maximum exposed fisherman is presented in Table 1, Exposure Pathway Annual Dose.

**Direct Radiation Pathway**

The direct radiation pathway is evaluated in accordance with the methodology found in the NMP1 ODCM. This pathway considers four components: direct radiation from the generating facilities, direct radiation from any possible overhead plume, direct radiation from ground deposition and direct radiation from plume submersion. The direct radiation pathway is evaluated by the use of high sensitivity environmental Thermoluminescent Dosimeters (TLDs). Since fishing activities occur between April 1 and December 31, TLD data for the second, third, and fourth quarters of 2017 from TLDs placed in the general area where fishing once occurred were used to determine an average dose to the hypothetical maximum exposed fisherman from direct radiation. The following is a summary of the average dose rate and assumed time spent on site used to determine the total dose received:

| Variable | Fisherman |
|---|---|
| Average Dose Rate (mRem/hr) | 1.04E-03 |
| Exposure time (hours) | 312 |

Total doses received by the hypothetical maximum exposed fisherman from direct radiation is presented in Table 1, Exposure Pathway Annual Dose.

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY

**Dose Received By Hypothetical Maximum Exposed Member of the Public Inside the Site Boundary**

The following is a summary of the dose received by a hypothetical maximum exposed fisherman from liquid and gaseous effluents released from NMP1 during 2017:

**TABLE 1**
**Exposure Pathway Annual Dose**

| Exposure Pathway | Dose Type | Fisherman (mrem) |
|---|---|---|
| External Ground | Whole Body | 2.04 E-03 |
| | Skin of Whole Body | 2.38 E-03 |
| Inhalation | Whole Body | 1.02 E-03 |
| | Maximum Organ | Bone: 1.51 E-03 |
| | Thyroid | 1.02 E-03 |
| Direct Radiation | Whole Body | 0.32 |

Based on these values the total annual dose received by a hypothetical maximum exposed Member of the Public inside the site boundary is as follows:

**TABLE 2**
**Annual Dose Summary**

| Total Annual Dose for 2017 | Fisherman (mrem) |
|---|---|
| Total Whole Body | 3.26 E-01 |
| Skin of Whole Body | 2.38 E-03 |
| Maximum Organ | Bone: 1.51 E-03 |
| Thyroid | 1.02 E -03 |

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY**

## Introduction

An assessment of radiation doses potentially received by the likely most exposed Member of the Public located beyond the site boundary was conducted for the period January through December 2017 for comparison against the 40 CFR 190 annual dose limits.

The intent of 40 CFR 190 requires that the effluents of Nine Mile Point Unit 1 (NMP1), as well as other nearby uranium fuel cycle facilities, be considered. In this case, the effluents of NMP1, Nine Mile Point Unit 2 (NMP2) and the James A. FitzPatrick Nuclear Power Plant (JAFNPP) facilities must be considered.

40 CFR 190 requires the annual radiation dose received by Members of the Public in the general environment, as a result of plant operations, be limited to:

- < 25 mRem whole body
- < 25 mRem any organ (except thyroid)
- < 75 mRem thyroid

This evaluation compares doses resulting from liquid and gaseous effluents and direct radiation originating from the site as a result of the operation of the NMP1, NMP2 and JAFNPP nuclear facilities.

## Dose Pathways

Dose pathways considered for this evaluation included doses resulting from liquid effluents, gaseous effluents and direct radiation from all nuclear operating facilities located on the Nine Mile Point site.

Dose to the likely most exposed Member of the Public, outside the site boundary, is received through the following pathways:

- Fish consumption pathway; this dose is received from plant radionuclides that have concentrated in fish that is consumed by a Member of the Public.
- Vegetation consumption pathway; this dose is received from plant radionuclides that have concentrated in vegetation that is consumed by a Member of the Public.
- Shoreline Sediment; this dose is received as a result of an individual's exposure to plant radionuclides in the shoreline sediment, which is used as a recreational area.
- Deposition, Inhalation and Ingestion pathways resulting from gaseous effluents; this dose is received through exposure to gaseous effluents released from NMP1, NMP2 and JAFNPP operating facilities.
- Direct Radiation pathway; radiation dose resulting from the operation of NMP1, NMP2 and JAFNPP facilities (including the Independent Spent Fuel Storage Installations (ISFSI)).

## Methodologies for Determining Dose for Applicable Pathways

### Fish Consumption

Dose received as a result of fish consumption is based on the methodology specified in the NMP1 Off-Site Dose Calculation Manual (ODCM) as adapted from Regulatory Guide 1.109. The dose for 2017 is calculated from actual analysis results of environmental fish samples taken near the site discharge points. For this evaluation it is assumed that the most likely exposed Member of the Public consumes fish taken near the site discharge points.

No radionuclides were detected in fish samples collected and analyzed during 2017; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY

**Vegetation Consumption**

Dose received as a result of vegetation consumption is based on the methodology specified in the NMP1 ODCM as adapted from Regulatory Guide 1.109. The dose for 2017 is calculated from actual analysis results of environmental vegetation samples taken near the most exposed Member of the Public.

No radionuclides were detected in vegetation samples collected and analyzed during 2017; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

For estimating C-14, dose received as a result of vegetation consumption is based on the methodology specified in the NMP1 ODCM as adapted from Regulatory Guide 1.109. The estimated concentration of C-14 in vegetation is based on the estimated concentration of C-14 in plant gaseous effluents.

**Shoreline Sediment**

Dose received from shoreline sediment is based on the methodology in the NMP1 ODCM as adapted from Regulatory Guide 1.109. For this evaluation it is assumed that the most likely exposed Member of the Public spends 67 hours/year along the shoreline for recreational purposes.

No radionuclides were detected in shoreline sediment samples collected and analyzed during 2017; therefore no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

**Dose Pathways Resulting From Gaseous Effluents**

Dose received by the likely most exposed Member of the Public due to gaseous effluents is calculated in accordance with the methodology provided in the NMP1 ODCM, NMP2 ODCM, and the JAFNPP ODCM. These calculations consider deposition, inhalation and ingestion pathways. Actual meteorological data was used to calculate doses to the likely most exposed Member of the Public. The total sum of doses resulting from gaseous effluents from NMP1, NMP2 and JAFNPP during 2017 provides a total dose to the whole body and maximum organ dose for this pathway.

**Carbon-14 Dose Pathways Resulting from Gaseous Effluents**

The Carbon-14 (C-14) effluent source terms are used to estimate radiological doses from C-14 in site gaseous waste effluents. These estimates were generated in order to meet the NRC requirement to incorporate C-14 in nuclear power plant 2017 Annual Radiological Effluent Release Reports (ARERRs). The C-14 production and effluent source term estimates were based on EPRI methodology provided in EPRI Report 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents, December 2010. The following methodology was used in estimating C-14 gaseous release activity and dose components for the 2017 ARERR.

EPRI methodology for estimating C-14 production rates in Boiling Water Reactors (BWRs):

For BWRs, EPRI Report 1021106 summarized the distribution of C-14 in release pathways as follows: gaseous 95% to 99%, liquid <0.5% and solid 1% to 5%. The report also states that ~95% of C-14 in BWR gaseous waste effluents exists in the carbon dioxide form, which contributes to population dose via photosynthesis uptake in the food consumption cycle.

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY**

For NMP1 and NMP2, C-14 gaseous dose calculations in the site ARERR are made using the following assumptions for each unit: (1) continuous release of the estimated C-14 generated during power operation based on the number of Effective Full Power Days (EFPDs) for the period, (2) maximum C-14 activity from literature values cited in EPRI Report 1021106, and (3) typical fraction as carbon dioxide for gaseous releases from literature values also cited in EPRI Report 1021106.

Equation 1 estimates the maximum annual production of C-14, $PR_{MAX}$, for each BWR unit.

$$PR_{MAX} = 5.1 \bullet MWT / 1000 \qquad [Eq\ 1]$$

Where:

| | | |
|---|---|---|
| 5.1 | = | BWR Normalized Production (Ci/GWt–yr) |
| MWT | = | MegaWatts Thermal (MWt) |
| 1000 | = | Conversion Factor (MWt to GWt) |

Equation 2 estimates the C-14 activity released, $A_{C-14}$, into the gaseous pathway during the time period for each BWR unit.

$$A_{C-14} = PR_{MAX} \bullet 0.99 \bullet EFPD / 365, Ci\ (for\ time\ period) \qquad [Eq\ 2]$$

Where:

| | | |
|---|---|---|
| $PR_{MAX}$ | = | maximum annual production rate of C-14 |
| *0.99* | = | fraction of C-14 in BWR gaseous pathway releases (maximum literature value in EPRI Report 1021106; also Table 1) |
| *EFPD* | = | number of effective full power days for the unit during the time period; e.g., quarterly or yearly (Table 1) |
| *365* | = | number of days in a typical year |

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY**

Equation 3 estimates the C-14 activity released in carbon dioxide form, $A_{C\text{-}14,\,CO2}$, into the gaseous pathway during the time period for each BWR unit.

$$A_{C\text{-}14,\,CO2} = PR_{MAX} \bullet 0.99 \bullet 0.95 \bullet EFPD / 365,\ Ci\ (for\ time\ period) \qquad [Eq\ 3]$$

Where:

| | | |
|---|---|---|
| $PR_{MAX}$ | = | maximum annual production rate of C-14 |
| *0.99* | = | fraction of C-14 in BWR gaseous pathway releases (maximum literature value in EPRI Report 1021106; also Table 1) |
| *0.95* | = | fraction of C-14 as carbon dioxide in BWR gaseous pathway releases (typical literature value in EPRI Report 1021106; also Table 1) |
| *EFPD* | = | number of effective full power days for the unit during the time period, e.g. quarterly or yearly (Table 1) |
| *365* | = | conversion factor, 365 days in a typical average year |

For each BWR unit, the 2017 estimated C-14 activity releases (total and carbon dioxide chemical form) are summarized in Table 1.

**Table 1**

**2017 BWR Estimated C-14 Gaseous Releases**

| BWR | Gaseous Release Fraction[(a)] | $CO_2$ Form Release Fraction[(b)] | EFPD Operation | Max. Annual Prod. Rate (Eq 1) | 2017 Total Release (Eq 2) | 2017 CO2 Release (Eq 3) |
|---|---|---|---|---|---|---|
| **NMP1** | 0.99 | 0.95 | 331.2 EFPD (90.7%) | 9.44 Ci/yr | 8.48 Ci | 8.05 Ci |
| **NMP2** | 0.99 | 0.95 | 359.85 EFPD (98.9%) | 20.33 Ci/yr[(c)] | 19.85 Ci | 18.86 Ci |
| **JAFNPP** | 0.99 | 0.95 | 309.1 EFPD (84.7%) | 12.93 Ci/yr | 9.09 Ci | 8.63 Ci |

(a) Maximum literature values from EPRI Report 1021106.
(b) Typical value from EPRI Report 1021106.
(c) NMP2 Reactor Power Rating increased to 3988 Megawatts thermal.

As long as the core designs and power ratings are not significantly changed, the maximum annual production rates and annual total and carbon dioxide activity releases in Table 1 should be acceptable for use in estimating C-14 gaseous release activity and dose components for the ARERR.

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2017

DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY

**Direct Radiation Pathway**

Dose as a result of direct gamma radiation from the site, encompasses doses from direct "shine" from the generating facilities, direct radiation from any overhead gaseous plumes, plume submersion, and ground deposition. This total dose is measured by environmental TLDs. The critical location is based on the closest year-round residence from the generating facilities as well as the closest residence in the critical downwind sector in order to evaluate both direct radiation from the generating facilities and gaseous plumes as determined by the local meteorology. During 2017, the closest residence and the critical downwind residence are at the same location.

**Table 2**

**Dose Potentially Received by the Likely Most Exposed Member of the Public Outside the Site Boundary During 2017**

| Exposure Pathway | Dose Type | Dose (mrem) |
|---|---|---|
| Fish and Vegetation Consumption | Total Whole Body | No Dose |
| | Total Maximum Organ | No Dose |
| Shoreline Sediment | Total Whole Body | No Dose |
| | Total Skin of Whole Body | No Dose |
| Gaseous Effluents (excluding C-14) | Total Whole Body | 4.42 E-03 |
| | Thyroid | 1.02 E-02 |
| | Maximum Organ | Thyroid: 1.02 E-02 |
| Gaseous Effluent (C-14) | Total Whole Body | 3.52 E-01 |
| | Maximum Organ | Bone: 1.76 E+00 |
| Direct Radiation | Total Whole Body | 0.91 |

Based on these values the maximum total annual dose potentially received by the likely most exposed Member of the Public during 2017 is as follows:

- Total Whole Body: 1.27 E+00 mrem
- Total Thyroid: 1.02 E-02 mrem
- Maximum Organ: Bone: 1.76 E+00 mrem

**40 CFR 190 Evaluation**

The maximum total doses presented in this attachment are the result of operations at the NMP1, NMP2 and the JAFNPP facilities. The maximum organ dose (Bone: 1.76 mrem), maximum thyroid dose (0.010 mrem) and the maximum whole body dose (1.27 mrem) are below the 40 CFR 190 criteria of 25 mrem per calendar year to the maximum exposed organ or the whole body, and below 75 mrem per calendar year to the thyroid.

# ATTACHMENT 12



Unit 1 X Unit 2 _____ Reporting Period: January - December 2017

| Well Identification Number | # Samples Collected | # Positive Samples | Minimum Concentration (pCi/l) | Maximum Concentration (pCi/l) |
|---|---|---|---|---|
| GMX-MW1* | 4 | 0 | <188 | <194 |
| MW-1 | 4 | 0 | <188 | <200 |
| MW-5 | 4 | 0 | <183 | <193 |
| MW-6 | 4 | 0 | <186 | <191 |
| MW-7 | 4 | 0 | <186 | <194 |
| MW-8 | 4 | 0 | <187 | <193 |
| MW-9[1] | 4 | 0 | <187 | <192 |
| MW-10[1] | 4 | 1 | <186 | 240 |
| MW-11 | 4 | 0 | <186 | <193 |
| MW-12 | 4 | 0 | <190 | <193 |
| MW-13 | 4 | 0 | <184 | <192 |
| MW-14* | 4 | 1 | <183 | 234 |
| MW-15 | 4 | 1 | <186 | 252 |
| MW-16 | 4 | 0 | <184 | <192 |
| MW-17 | 4 | 1 | <183 | 222 |
| MW-18 | 4 | 1 | <190 | 270 |
| MW-19 | 4 | 0 | <186 | <190 |
| MW-20 | 4 | 0 | <183 | <192 |
| MW-21 | 4 | 0 | <183 | <190 |
| NMP2 MAT [2,3] | 4 | 1 | <181 | 279 |
| PZ-1 | 4 | 0 | <190 | <193 |
| PZ-2 | 4 | 0 | <191 | <196 |
| PZ-3 | 4 | 0 | <187 | <194 |
| PZ-4 | 4 | 1 | <189 | 214 |
| PZ-5 | 4 | 0 | <190 | <191 |
| PZ-6 | 4 | 0 | <188 | <192 |
| PZ-7 | 4 | 4 | 291 | 435 |
| PZ-8 | 4 | 0 | <190 | <198 |
| PZ-9* | 4 | 0 | <189 | <194 |
| | | | | |

Notes:

* - Control Location

[1] - Sentinel well location

[2] - NMP2 Groundwater Depression Cone

[3] - Samples collected from storm drain system which includes precipitation

Enclosure 2

Nine Mile Point Nuclear Station, Unit 2

Radioactive Effluent Release Report, January – December 2017

# NINE MILE POINT NUCLEAR STATION - UNIT 2

# RADIOACTIVE EFFLUENT RELEASE REPORT

***January – December 2017***

# NINE MILE POINT NUCLEAR STATION - UNIT 2

# RADIOACTIVE EFFLUENT RELEASE REPORT

# JANUARY – DECEMBER 2017

## *SUPPLEMENTAL INFORMATION*

**Facility: Nine Mile Point Unit 2** **Licensee: Nine Mile Point Nuclear Station, LLC**

**1. TECHNICAL SPECIFICATION/ODCM LIMITS**

A) FISSION AND ACTIVATION GASES

1. The dose rate limit of noble gases released in gaseous effluents from the site to areas at or beyond the site boundary shall be less than or equal to 500 mrem/year to the whole body and less than or equal to 3000 mrem/year to the skin.

2. The air dose from noble gases released in gaseous effluents from Nine Mile Point Unit 2 to areas at or beyond the site boundary shall be limited during any calendar quarter to less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation, and during any calendar year to less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

B&C) TRITIUM, IODINES AND PARTICULATES, HALF LIVES > 8 DAYS

1. The dose rate limit of Iodine-131, Iodine-133, Tritium and all radionuclides in particulate form with half-lives greater than eight days, released in gaseous effluents from the site to areas at or beyond the site boundary shall be less than or equal to 1500 mrem/year to any organ.

2. The dose to a member of the public from Iodine-131, Iodine-133, Tritium and all radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from Nine Mile Point Unit 2 to areas at or beyond the site boundary shall be limited during any calendar quarter to less than or equal to 7.5 mrem to any organ, and during any calendar year to less than or equal to 15 mrem to any organ.

D) LIQUID EFFLUENTS

1. Improved Technical Specifications (ITS) limit the concentration of radioactive material released in the liquid effluents to unrestricted areas to ten times the concentrations specified in 10CFR20.1001-20.2402, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04 microcuries/ml total activity.

2. The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from Nine Mile Point Unit 2 to unrestricted areas shall be limited during any calendar quarter to less than or equal to 1.5 mrem to the whole body and to less than or equal to 5 mrem to any organ, and during any calendar year to less than or equal to 3 mrem to the whole body and to less than or equal to 10 mrem to any organ.

## 2. MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY

Described below are the methods used to measure or approximate the total radioactivity and radionuclide composition in effluents.

A) FISSION AND ACTIVATION GASES

Noble gas effluent activity is determined by an on-line scintillation detector (calibrated against gamma isotopic analysis of a 4.0L Marinelli grab sample) of an isokinetic sample stream.

B) IODINES

Iodine effluent activity is determined by gamma spectroscopic analysis (at least weekly) of charcoal cartridges sampled from an isokinetic sample stream.

C) PARTICULATES

Activity released from the main stack and the combined Radwaste/Reactor Building vent is determined by gamma spectroscopic analysis (at least weekly) of particulate filters sampled from an isokinetic sample stream and composite analysis of the filters for non-gamma emitters.

D) TRITIUM

Tritium effluent activity is measured by liquid scintillation or gas proportional counting of monthly samples taken with an air sparging/water trap apparatus.

E) LIQUID EFFLUENTS

Isotopic contents of liquid effluents are determined by isotopic analysis of a representative sample of each batch and composite analysis of non-gamma emitters.

F) SOLID EFFLUENTS

Isotopic contents of waste shipments are determined by gamma spectroscopy analyses of a representative sample of each batch. Scaling factors established from primary composite sample analyses conducted off-site are applied, where appropriate, to find estimated concentration of non-gamma emitters. For low activity trash shipments, curie content is estimated by dose rate measurement and application of appropriate scaling factors.

G) C-14

The production of C-14 and the effluent dose consequences are estimates based on EPRI methodology provided in EPRI Report 1021106, *Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents*, December 2010 and NUREG-0016, *Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents for Boiling Water Reactors (BWR-GALE Code)*.

## 3. METEOROLOGICAL DATA

An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distribution of wind speed, wind direction, and atmospheric stability. In lieu of submission with the Radiological Effluent Release Report, the licensee is exercising the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

# ATTACHMENT 1
## SUMMARY DATA



**Unit 1** _____ **Unit 2** X **Reporting Period: January - December 2017**

**Liquid Effluents:**

ODCM Required Maximum Effluent Concentration (MEC) = 10 x 10CFR20.1001 - 20.2402, Appendix B, Table 2, Column 2

| | | | |
|---|---|---|---|
| Average MEC - µCi/ml (Qtr. 1) = | NO RELEASES | Average MEC - µCi/ml (Qtr. 3) = | NO RELEASES |
| Average MEC - µCi/ml (Qtr. 2) = | NO RELEASES | Average MEC - µCi/ml (Qtr. 4) = | NO RELEASES |

**Average Energy (Fission and Activation gases - MEV):**

| | | | | | | |
|---|---|---|---|---|---|---|
| Qtr. 1: | $\bar{E}\gamma$ | = | N/A | $\bar{E}\beta$ | = | N/A |
| Qtr. 2: | $\bar{E}\gamma$ | = | N/A | $\bar{E}\beta$ | = | N/A |
| Qtr. 3: | $\bar{E}\gamma$ | = | 1.01E+00 | $\bar{E}\beta$ | = | 5.69E-01 |
| Qtr. 4: | $\bar{E}\gamma$ | = | N/A | $\bar{E}\beta$ | = | N/A |

**Liquid:**

| | |
|---|---|
| Number of Batch Releases | 0 |
| Total Time Period for Batch Releases (hrs) | 0.0 |
| Maximum Time Period for a Batch Release (hrs) | 0.0 |
| Average Time Period for a Batch Release (hrs) | 0.0 |
| Minimum Time Period for a Batch Release | 0.0 |

| Total volume of water used to dilute the liquid during the release period (L) | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|
| | N/A | N/A | N/A | N/A |

| Total volume of water available to dilute the liquid effluent during the report period (L) | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|
| | 1.08E+10 | 1.15E+10 | 1.31E+10 | 1.16E+10 |

**Gaseous (Emergency Condenser Vent) "Not applicable for Unit 2"**

| | |
|---|---|
| Number of Batch Releases | N/A |
| Total Time Period for Batch Releases (hrs) | N/A |
| Maximum Time Period for a Batch Release (hrs) | N/A |
| Average Time Period for a Batch Release (hrs) | N/A |
| Minimum Time Period for a Batch Release | N/A |

**Gaseous (Primary Containment Purge)**

| | |
|---|---|
| Number of Batch Releases | 7 |
| Total Time Period for Batch Releases (hrs) | 386.5 |
| Maximum Time Period for a Batch Release (hrs) | 133.2 |
| Average Time Period for a Batch Release (hrs) | 55.2 |
| Minimum Time Period for a Batch Release (hrs) | 3.3 |

# ATTACHMENT 1
SUMMARY DATA



Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**Abnormal Releases:**

**A. Liquids:**

| | | |
|---|---|---|
| Number of Releases | 0 | |
| Total Activity Released | N/A | Ci |

**B. Gaseous:**

| | | |
|---|---|---|
| Number of Releases | 0 | |
| Total Activity Released | N/A | Ci |

Table 1A Gaseous Effluents - Summation of All Releases - Elevated and Ground Level

# ATTACHMENT 2



Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES, ELEVATED AND GROUND LEVEL**

| | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Est. Total Error, % |
|---|---|---|---|---|---|---|
| A. Fission & Activation Gases | | | | | | |
| 1. Total Release | Ci | 0.00E+00 | 0.00E+00 | 2.19E+00 | 0.00E+00 | 5.00E+01 |
| 2. Average Release Rate | µCi/sec | 0.00E+00 | 0.00E+00 | 3.91E-01 | 0.00E+00 | |
| B. Iodines | | | | | | |
| 1. Total Iodine - 131 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| C. Particulates | | | | | | |
| 1. Particulates with Half-lives>8days | Ci | 0.00E+00 | 0.00E+00 | 3.29E-05 | 3.92E-06 | 3.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 0.00E+00 | 0.00E+00 | 4.19E-06 | 4.99E-07 | |
| 3. Gross Alpha Radioactivity | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.50E+01 |
| D. Tritium | | | | | | |
| 1. Total Release | Ci | 2.63E+01 | 4.38E+01 | 3.56E+01 | 4.14E+01 | 5.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 3.35E+00 | 5.56E+00 | 4.54E+00 | 5.27E+00 | |
| E. Percent of Tech. Spec. Limits Fission and Activation Gases | | | | | | |
| Percent of Quarterly Gamma Air Dose Limit (5 mR) | % | 0.00E+00 | 0.00E+00 | 5.24E-03 | 0.00E+00 | |
| Percent of Quarterly Beta Air Dose Limit (10 mrad) | % | 0.00E+00 | 0.00E+00 | 1.39E-04 | 0.00E+00 | |
| Percent of Annual Gamma Air Dose Limit to Date (10 mR) | % | 0.00E+00 | 0.00E+00 | 2.62E-03 | 2.62E-03 | |
| Percent of Annual Beta Air Dose Limit to Date (20 mrad) | % | 0.00E+00 | 0.00E+00 | 6.95E-05 | 6.95E-05 | |
| Percent of Whole Body Dose Rate Limit (500 mrem/yr) | % | 0.00E+00 | 0.00E+00 | 1.99E-04 | 0.00E+00 | |
| Percent of Skin Dose Rate Limit (3000 mrem/yr) | % | 0.00E+00 | 0.00E+00 | 4.00E-05 | 0.00E+00 | |
| Tritium, Iodines, and Particulates (with half-lives greater than 8 days) | | | | | | |
| Percent of Quarterly Dose Limit (7.5 mrem) | % | 5.71E-03 | 1.29E-02 | 1.07E-02 | 1.09E-02 | |
| Percent of Annual Dose Limit to Date (15 mrem) | % | 2.85E-03 | 9.28E-03 | 1.46E-02 | 1.99E-02 | |
| Percent of Organ Dose Limit (1500 mrem/yr | % | 1.16E-04 | 2.57E-04 | 2.11E-04 | 2.20E-04 | |

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**GASEOUS EFFLUENTS - ELEVATED RELEASE**

**Continuous Mode (2)**

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | 1.43E-01 | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | 5.76E-02 | ** |
| Xenon-135m | Ci | ** | ** | 3.43E-01 | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | 1.65E+00 | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | 1.16E-04 | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Manganese-54 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cobalt-58 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Zirconium-95 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Ruthenium-103 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | 1.69E+01 | 1.63E+01 | 1.57E+01 | 2.01E+01 |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 1.00E-04 µCi/ml for required noble gases, 1.00E-11 µCi/ml for required particulates and gross alpha, 1.00E-12 µCi/ml for required Iodines, 1.00E-11 µCi/ml for Sr-89/90 and 1.00E-06 µCi/ml for Tritium, as required by the ODCM, has been verified.

(2) Contributions from purges are included. There were no other batch releases during the reporting period.

# ATTACHMENT 3

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

## GASEOUS EFFLUENTS - ELEVATED RELEASE

Batch Mode (2)

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Manganese-54 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cobalt-58 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | ** | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Stronium-90 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Zirconium-95 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Ruthenium-103 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | ** |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | ** | ** | ** | ** |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 1.00E-04 µCi/ml for required noble gases, 1.00E-11 µCi/ml for required particulates and gross alpha, 1.00E-12 µCi/ml for required Iodines, 1.00E-11 µCi/ml for Sr-89/90 and 1.00E-06 µCi/ml for Tritium, as required by the ODCM, has been verified.

(2) Contributions from purges are included. There were no other batch releases during the reporting period.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES**

**Continuous Mode (2)**

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Argon-41 | Ci | ** | ** | ** | ** |
| Krypton-85 | Ci | ** | ** | ** | ** |
| Krypton-85m | Ci | ** | ** | ** | ** |
| Krypton-87 | Ci | ** | ** | ** | ** |
| Krypton-88 | Ci | ** | ** | ** | ** |
| Xenon-127 | Ci | ** | ** | ** | ** |
| Xenon-131m | Ci | ** | ** | ** | ** |
| Xenon-133 | Ci | ** | ** | ** | ** |
| Xenon-133m | Ci | ** | ** | ** | ** |
| Xenon-135 | Ci | ** | ** | ** | ** |
| Xenon-135m | Ci | ** | ** | ** | ** |
| Xenon-137 | Ci | ** | ** | ** | ** |
| Xenon-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| Iodine-131 | Ci | ** | ** | ** | ** |
| Iodine-133 | Ci | ** | ** | ** | ** |
| Iodine-135 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Chromium-51 | Ci | ** | ** | ** | ** |
| Manganese-54 | Ci | ** | ** | ** | ** |
| Iron-55 | Ci | ** | ** | ** | ** |
| Iron-59 | Ci | ** | ** | ** | ** |
| Cobalt-58 | Ci | ** | ** | ** | ** |
| Cobalt-60 | Ci | ** | ** | 3.29E-05 | ** |
| Neodymium-147 | Ci | ** | ** | ** | ** |
| Zinc-65 | Ci | ** | ** | ** | ** |
| Strontium-89 | Ci | ** | ** | ** | ** |
| Strontium-90 | Ci | ** | ** | ** | ** |
| Niobium-95 | Ci | ** | ** | ** | ** |
| Zirconium-95 | Ci | ** | ** | ** | ** |
| Molybdenum-99 | Ci | ** | ** | ** | ** |
| Ruthenium-103 | Ci | ** | ** | ** | ** |
| Cesium-134 | Ci | ** | ** | ** | ** |
| Cesium-136 | Ci | ** | ** | ** | ** |
| Cesium-137 | Ci | ** | ** | ** | 3.92E-06 |
| Barium-140 | Ci | ** | ** | ** | ** |
| Lanthanum-140 | Ci | ** | ** | ** | ** |
| Cerium-141 | Ci | ** | ** | ** | ** |
| Cerium-144 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | 9.44E+00 | 2.75E+01 | 1.99E+01 | 2.13E+01 |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 1.00E-04 µCi/ml for required noble gases, 1.00E-11 µCi/ml for required particulates and gross alpha, 1.00E-12 µCi/ml for required iodines, 1.00E-11 µCi/ml for Sr-89/90 and 1.00E-06 µCi/ml for Tritium, as required by the ODCM, has been verified.

(2) There were no batch releases from this path during the reporting period.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**GASEOUS EFFLUENTS - GROUND LEVEL RELEASES**

**Batch Mode**

| Nuclides Released | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Fission Gases (1)** | | | | | |
| Ar-41 | Ci | ** | ** | ** | ** |
| Kr-85 | Ci | ** | ** | ** | ** |
| Kr-85m | Ci | ** | ** | ** | ** |
| Kr-87 | Ci | ** | ** | ** | ** |
| Kr-88 | Ci | ** | ** | ** | ** |
| Xe-127 | Ci | ** | ** | ** | ** |
| Xe-131m | Ci | ** | ** | ** | ** |
| Xe-133 | Ci | ** | ** | ** | ** |
| Xe-133m | Ci | ** | ** | ** | ** |
| Xe-135 | Ci | ** | ** | ** | ** |
| Xe-135m | Ci | ** | ** | ** | ** |
| Xe-137 | Ci | ** | ** | ** | ** |
| Xe-138 | Ci | ** | ** | ** | ** |
| **Iodines (1)** | | | | | |
| I-131 | Ci | ** | ** | ** | ** |
| I-132 | Ci | ** | ** | ** | ** |
| I-133 | Ci | ** | ** | ** | ** |
| **Particulates (1)** | | | | | |
| Cr-51 | Ci | ** | ** | ** | ** |
| Mn-54 | Ci | ** | ** | ** | ** |
| Fe-55 | Ci | ** | ** | ** | ** |
| Fe-59 | Ci | ** | ** | ** | ** |
| Co-58 | Ci | ** | ** | ** | ** |
| Co-60 | Ci | ** | ** | ** | ** |
| Nd-147 | Ci | ** | ** | ** | ** |
| Zn-65 | Ci | ** | ** | ** | ** |
| Sr-89 | Ci | ** | ** | ** | ** |
| Sr-90 | Ci | ** | ** | ** | ** |
| Nb-95 | Ci | ** | ** | ** | ** |
| Zr-95 | Ci | ** | ** | ** | ** |
| Mo-99 | Ci | ** | ** | ** | ** |
| Ru-103 | Ci | ** | ** | ** | ** |
| Cs-134 | Ci | ** | ** | ** | ** |
| Cs-136 | Ci | ** | ** | ** | ** |
| Cs-137 | Ci | ** | ** | ** | ** |
| Ba-140 | Ci | ** | ** | ** | ** |
| La-140 | Ci | ** | ** | ** | ** |
| Ce-141 | Ci | ** | ** | ** | ** |
| Ce-144 | Ci | ** | ** | ** | ** |
| **Tritium (1)** | Ci | ** | ** | ** | ** |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double **.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES (1)**

| | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Est. Total Error, % |
|---|---|---|---|---|---|---|
| A. Fission & Activation Products | | | | | | |
| 1. Total Release (not including Tritium, gases, alpha) | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| B. Tritium | | | | | | |
| 1.Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during the reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| C. Dissolved and Entrained Gases | | | | | | |
| 1. Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Average diluted concentration during the reporting period | µCi/ml | No Releases | No Releases | No Releases | No Releases | |
| D. Gross Alpha Radioactivity | | | | | | |
| 1. Total release | Ci | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| E. Volumes | | | | | | |
| 1. Prior to Dilution | Liters | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 2. Volume of dilution water used during release period | Liters | No Releases | No Releases | No Releases | No Releases | 5.00E+01 |
| 3. Volume of dilution water available during reporting period | Liters | 1.08E+10 | 1.15E+10 | 1.31E+10 | 1.16E+10 | 5.00E+01 |
| F. Percent of Tech. Spec. Limits | | | | | | |
| Percent of Quarterly Whole Body Dose Limit (1.5 mrem) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Annual Whole Body Dose Limit to Date (3 mrem) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Quarterly Organ Dose Limit (5 mrem) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Annual Organ Dose Limit to Date (10 mrem) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of 10CFR20 Concentration Limit (2), (3) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Percent of Dissolved or Entrained Noble Gas Limit (2.00E-04 µCi/ml) | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |

(1) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 5.00E-07 µCi/ml for required gamma emitting nuclides, 1.00E-05 µCi/ml for required dissolved and entrained noble gases and tritium, 5.00E-08 µCi/ml for Sr-89/90, 1.00E-06 µCi/ml for I-131 and Fe-55, and 1.00E-07 µCi/ml for gross alpha radioactivity, as required by the Off-Site Dose Calculation Manual (ODCM), has been verified.

(2) The percent of 10CFR20 concentration limit is based on the average concentration during the quarter.

(3) Improved Technical Specifications limit the concentration of radioactive material released in the liquid effluents to unrestricted areas to ten times the concentrations specified in 10CFR20.1001 - 20.2402, Appendix B, Table 2, Column 2. Maximum Effluent Concentrations (MEC) numerically equal to ten times the 10CFR20.1001 - 20.2402 concentrations were adopted to evaluate liquid effluents.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**LIQUID EFFLUENTS RELEASED**

| Nuclides Released | | Batch Mode (1),(2) 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| **Nuclides Released** | | | | | |
| Strontium-89 | Ci | No Releases | No Releases | No Releases | No Releases |
| Strontium-90 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-134 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-137 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iodine-131 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cobalt-58 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cobalt-60 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iron-59 | Ci | No Releases | No Releases | No Releases | No Releases |
| Zinc-65 | Ci | No Releases | No Releases | No Releases | No Releases |
| Manganese-54 | Ci | No Releases | No Releases | No Releases | No Releases |
| Chromium-51 | Ci | No Releases | No Releases | No Releases | No Releases |
| Zirconium-95 | Ci | No Releases | No Releases | No Releases | No Releases |
| Niobium-95 | Ci | No Releases | No Releases | No Releases | No Releases |
| Molybdenum-99 | Ci | No Releases | No Releases | No Releases | No Releases |
| Technetium-99m | Ci | No Releases | No Releases | No Releases | No Releases |
| Barium-140 | Ci | No Releases | No Releases | No Releases | No Releases |
| Lanthanum-140 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cerium-141 | Ci | No Releases | No Releases | No Releases | No Releases |
| Tungsten-187 | Ci | No Releases | No Releases | No Releases | No Releases |
| Arsenic-76 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iodine-133 | Ci | No Releases | No Releases | No Releases | No Releases |
| Iron-55 | Ci | No Releases | No Releases | No Releases | No Releases |
| Neptunium-239 | Ci | No Releases | No Releases | No Releases | No Releases |
| Silver-110m | Ci | No Releases | No Releases | No Releases | No Releases |
| Gold-199 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cerium-144 | Ci | No Releases | No Releases | No Releases | No Releases |
| Cesium-136 | Ci | No Releases | No Releases | No Releases | No Releases |
| Copper-64 | Ci | No Releases | No Releases | No Releases | No Releases |
| Dissolved or Entrained Gases | Ci | No Releases | No Releases | No Releases | No Releases |
| Tritium | Ci | No Releases | No Releases | No Releases | No Releases |

(1) No continuous mode release occurred during the report period as indicated by effluent sampling.

(2) Concentrations less than the lower limit of detection of the counting system used are indicated with a double asterisk. A lower limit of detection of 5.00E-07 µCi/ml for required gamma-emitting nuclides, 1.00E-05 µCi/ml for required dissolved and entrained noble gases and tritium, 5.00E-08 µCi/ml for Sr-89/90, 1.00E-06 µCi/ml for I-131 and Fe-55, and 1.00E-07 µCi/ml for gross alpha radioactivity, as identified in the ODCM, has been verified.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

| A1. TYPE | Volume ($m^3$) Class | | | Activity (1) (Ci) Class | | |
|---|---|---|---|---|---|---|
| | A | B | C | A | B | C |
| a.1 Spent Resin (Dewatered) | 2.70E+01 | 0.00E+00 | 0.00E+00 | 5.17E+01 | 0.00E+00 | 0.00E+00 |
| a.2 Filter Sludge | 0.00E+00 | 5.38E+00 | 0.00E+00 | 0.00E+00 | 1.11E+03 | 0.00E+00 |
| a.3 Concentrated Waste | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Totals | 2.70E+01 | 5.38E+00 | 0.00E+00 | 5.17E+01 | 1.11E+03 | 0.00E+00 |
| | | | | | | |
| b.1 Dry Compressible Waste | 3.75E+02 | 0.00E+00 | 0.00E+00 | 2.69E-01 | 0.00E+00 | 0.00E+00 |
| b.2 Dry Non-Compressible Waste (Contaminated Equipment) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Totals | 3.75E+02 | 0.00E+00 | 0.00E+00 | 2.69E-01 | 0.00E+00 | 0.00E+00 |
| | | | | | | |
| c. Irradiated Components, Control Rods, etc. | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | | | | | | |
| d. Other (to vendor for processing) | | | | | | |
| d.1 Oily waste | 3.67E+01 | 0.00E+00 | 0.00E+00 | 2.95E+02 | 0.00E+00 | 0.00E+00 |

(1) The estimated total error is 5.0E+01%.

| Unit 1 | | Unit 2 | X | Reporting Period: January - December 2017 |
|---|---|---|---|---|
| **SOLID WASTE AND IRRADIATED FUEL SHIPMENTS** | | | | |
| **A1. TYPE** | | **Container** | **Package** | **Solidification Agent** |
| a.1 Spent Resin (Dewatered) | | Poly Liner | General Design | None |
| a.2 Filter Sludge | | Poly Liner | Type B | None |
| b.1 Dry Compressible Waste | | Seavan | General Design | None |
| b.2 Dry Non-Compressible Waste (contaminated equipment) | | N/A | N/A | N/a |
| c. Irradiated Components, Control Rods | | N/A | N/A | N/A |
| d. Other (To vendor for processing) | | | | |
| Oil/Aqueous Liquid | | 55 gallon drums | General Design | None |
| | | | | |

| Unit 1 | | Unit 2 | X | Reporting Period: January - December 2017 |
|---|---|---|---|---|

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

A2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (BY TYPE OF WASTE)

a. Spent Resins, Filter Sludges, Concentrated Waste

| Nuclide | Percent | Curies |
|---|---|---|
| Fe-55 | 59.09% | 6.89E+02 |
| Co-60 | 37.00% | 4.31E+02 |
| Mn-54 | 1.51% | 1.76E+01 |
| Zn-65 | 1.39% | 1.62E+01 |

b. Dry Compressible Waste, Dry Non-Compressible Waste (Contaminated Equipment)

| Nuclide | Percent | Curies |
|---|---|---|
| Fe-55 | 67.14% | 1.80E-01 |
| Co-60 | 28.91% | 7.76E-02 |
| Mn-54 | 1.56% | 4.20E-03 |

c. Irradiated Components, Control Rods: There were no shipments.

| Nuclide | Percent |
|---|---|
| N/A | N/A |

d. Other: (To vendor for processing)

| Nuclide | Percent | Curies |
|---|---|---|
| Fe-55 | 79.67% | 2.35E+02 |
| Co-60 | 18.61% | 5.50E+01 |
| Mn-54 | 1.21% | 3.57E+00 |

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

**SOLID WASTE AND IRRADIATED FUEL SHIPMENTS**

A3. SOLID WASTE DISPOSITION

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| 14 | Truck,highway | Bear Creek |
| 6 | Truck,highway | Clive |
| 2 | Truck,highway | WCS |
| | | |

B. IRRADIATED FUEL SHIPMENTS (Disposition)

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| 0 | N/A | N/A |

D. SEWAGE WASTES SHIPPED TO A TREATMENT FACILITY FOR PROCESSING AND BURIAL

There are no shipments of sewage sludge with detectible quantities of plant-related nuclides from NMP to the treatment facility during the reporting period.

# ATTACHMENT 7

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

## SUMMARY OF CHANGES TO THE OFF-SITE DOSE CALCULATION MANUAL (ODCM)

The Unit 2 Off-Site Dose Calculation Manual (ODCM) was not revised during the reporting period.

**REVISION XX**

| Page # | New/Amended Section # | Description of Change | Reason For Change |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
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**REVISION XX**

| Page # | New/Amended Section # | Description of Change | Reason For Change |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

# ATTACHMENT 8

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

## SUMMARY OF CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

RW-AA-100, PROCESS CONTROL PROGRAM FOR RADIOACTIVE WASTES, was updated to remove Fort Calhoun from the procedure and include James A. Fitzpatrick Nuclear.

# ATTACHMENT 9

Unit 1 _____ Unit 2 X Reporting Period: January - December 2017

## SUMMARY OF NON-FUNCTIONAL MONITORS

| Monitor | Dates Monitor was Non-Functional | Cause and Corrective Actions |
|---|---|---|
| 2LWS-CAB206, 2LWS-FT330 & 2LWS-FT331, Liquid Waste Discharge Monitor | January 1, 2017 to December 31, 2017 | No liquid waste discharges were performed during 2017, and therefore, these monitors were not returned to service. The discharge manual isolation valves, 2LWS-V420 and 2LWS-V422, are locked closed during inoperable periods, therefore, no inadvertent discharge can occur. Reference Equipment Status Log (ESL) 2010-0243. |

| Unit 1 ____ Unit 2 __X__ | Reporting Period: January - December 2017 |
|---|---|
| DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY | |

## Introduction

An assessment of the radiation dose potentially received by a Member of the Public due to their activities inside the site boundary from Nine Mile Point Unit 2 (NMP2).liquid and gaseous effluents has been conducted for the period January through December 2017.

This assessment considers the maximum exposed individual and the various exposure pathways resulting from liquid and gaseous effluents to identify the maximum dose received by a Member of the Public during their activities within the site boundary.

Prior to September 11, 2001, the public had access to the Energy Information Center for purposes of observing the educational displays or for picnicking and associated activities. Fishing also occurred near the shoreline adjacent to the Nine Mile Point (NMP) site. Fishing near the shoreline adjacent to the NMP site was the onsite activity that resulted in the potential maximum dose received by a Member of the Public. Following September 11, 2001 public access to the Energy Information Center has been restricted and fishing by Members of the Public at locations on site is also prohibited. Although fishing was not conducted during 2017 the annual dose to a hypothetical fisherman was still evaluated to provide continuity of data for the location.

## Dose Pathways

Dose pathways considered for this evaluation included direct radiation, inhalation and external ground (shoreline sediment or soil doses). Other pathways, such as ingestion pathways, are not considered because they are either not applicable, insignificant, or are considered as part of the evaluation of the total dose to a member of the public located off-site. In addition, only releases from the NMP2 Stack and Radwaste/Reactor Building Vent were evaluated for the inhalation pathway. Dose due to aquatic pathways such as liquid effluents is not applicable since swimming is prohibited at the NMP site.

Dose to a hypothetical fisherman is received through the following pathways while standing on the shoreline fishing:

- External ground pathway; this dose is received from plant related radionuclides detected in the shoreline sediment.
- Inhalation pathway; this dose is received through inhalation of gaseous effluents released from the NMP2 Stack and Radwaste/Reactor Building Vent.
- Direct radiation pathway; dose resulting from the operation of Nine Mile Point Unit 1 (NMP1), NMP2 and the James A. Fitzpatrick Nuclear Power Plant (JAFNPP) Facilities.

## Methodologies for Determining Dose for Applicable Pathways

### External Ground (Shoreline Sediment) Pathway

Dose from the external ground (shoreline sediment) is based on the methodology in the NMP2 Offsite Dose Calculation Manual (ODCM) as adapted from Regulatory Guide 1.109. For this evaluation it is assumed that the hypothetical maximum exposed individual fished from the shoreline at all times.

Unit 1 _____ Unit 2 __X__ Reporting Period: January - December 2017

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY**

The total dose received by the whole body and skin of the maximum exposed individual during 2017 was calculated using the following input parameters:

- Usage Factor = 312 hours (fishing 8 hours per week, 39 weeks per year)
- Density in grams per square meter = 40,000
- Shore width factor = 0.3
- Whole body and skin dose factor for each radionuclide = Regulatory Guide 1.109, Table E-6.
- Fractional portion of the year = 1 (used average radionuclide concentration over total time period)
- Average Cs-137 concentration = 1.30E-01 pCi/g

The total whole body and skin doses received by a hypothetical maximum exposed fisherman from the external ground pathway is presented in Table 1, Exposure Pathway Annual Dose.

**Inhalation Pathway**

The inhalation dose pathway is evaluated by utilizing the inhalation equation in the NMP2 ODCM, as adapted from Regulatory Guide 1.109. The total whole body dose and organ dose received by the hypothetical maximum exposed fisherman during 2017 calculated using the following input parameters for gaseous effluents released from both the NMP2 Stack and Radwaste/Reactor Building Vent for the time period exposure is received:

***NMP2 Stack:***

| Variable | Fisherman [1] |
|---|---|
| X/Q ($s/m^3$) | 9.6 E-07 |
| Inhalation dose factor | Table E-7, Regulatory Guide 1.109 |
| Annual air intake ($m^3$/year) (adult) | 8000 |
| Fractional portion of the year | 0.0356 |
| H-3 (pCi/sec) | 2.21 E+06 |
| C-14 (pCi/sec)[2] | 6.00 E+05 |

***NMP2 Radwaste/Reactor Building Vent:***

| Variable | Fisherman [1] |
|---|---|
| X/Q ($s/m^3$) | 2.8 E-06 |
| Inhalation dose factor | Table E-7, Regulatory Guide 1.109 |
| Annual air intake ($m^3$/year) (adult) | 8000 |
| Fractional portion of the year | 0.0356 |
| H-3 (pCi/sec) | 2.91E+06 |
| Co-60 (pCi/sec) | 1.40E+00 |
| Cs-137(pCi/sec) | 1.66E-01 |

| Unit 1 _____ Unit 2 __X__ | Reporting Period: January - December 2017 |
|---|---|
| DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY | |

1. The maximum exposed fisherman is assumed to be present on site during the period of April through December at a rate of 8 hours per week for 39 weeks per year equivalent to 312 hours for the year (fractional portion of the year = 0.0356). Therefore, the Average Stack and Radwaste/Reactor Building Vent flow rates and radionuclide concentrations used to determine the dose are represented by second, third and fourth quarter gaseous effluent flow and concentration values.
2. C-14 release rate determined from NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents for Boiling Water Reactors (BWR-GALE Code)," and EPRI Technical Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents."

The total whole body dose and maximum organ dose received by the hypothetical maximum exposed fisherman is presented in Table 1, Exposure Pathway Annual Dose.

**Direct Radiation Pathway**

The direct radiation pathway is evaluated in accordance with the methodology found in the NMP2 ODCM. This pathway considers four components: direct radiation from the generating facilities, direct radiation from any possible overhead plume, direct radiation from ground deposition and direct radiation from plume submersion. The direct radiation pathway is evaluated by the use of high sensitivity environmental Thermoluminescent Dosimeters (TLDs). Since fishing activities occur between April 1 and December 31, TLD data for the second, third, and fourth quarters of 2017 from TLDs placed in the general area where fishing once occurred were used to determine an average dose to the hypothetical maximum exposed fisherman from direct radiation. The following is a summary of the average dose rate and assumed time spent on site used to determine the total dose received:

| Variable | Fisherman |
|---|---|
| Average Dose Rate (mRem/hr) | 1.04E-03 |
| Exposure time (hours) | 312 |

Total Doses received by the hypothetical maximum exposed fisherman from direct radiation is presented in Table 1, Exposure Pathway Annual Dose.

Unit 1 _____ Unit 2 __X__ Reporting Period: January - December 2017

DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY

**Dose Received By A Hypothetical Maximum Exposed Member of the Public Inside the Site Boundary During 2017**

The following is a summary of the dose received by a hypothetical maximum exposed fisherman from liquid and gaseous effluents released from NMP2 during 2017:

**TABLE 1**
**Exposure Pathway Annual Dose**

| Exposure Pathway | Dose Type | Fisherman (mrem) |
|---|---|---|
| External Ground | Whole Body | 2.04E-03 |
| | Skin of Whole Body | 2.38E-03 |
| Inhalation | Whole Body | 5.32E-04 |
| | Maximum Organ | Lung: 5.33E-04 |
| | Thyroid | 5.32E-04 |
| Direct Radiation | Whole Body | 0.32 |

Based on these values, the total annual dose received by a hypothetical maximum exposed Member of the Public inside the site boundary is as follows:

**TABLE 2**
**Annual Dose Summary**

| Total Annual Dose for 2017 | Fisherman (mrem) |
|---|---|
| Total Whole Body | 3.26E-01 |
| Skin of Whole Body | 2.38E-03 |
| Maximum Organ | Lung: 5.33E-04 |
| Thyroid | 5.32E-04 |

| Unit 1 ____ Unit 2 X | Reporting Period: January - December 2017 |
|---|---|

**DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES OUTSIDE THE SITE BOUNDARY**

## Introduction

An assessment of radiation doses potentially received by the likely most exposed Member of the Public located beyond the site boundary was conducted for the period January through December 2017 for comparison against the 40 CFR 190 annual dose limits.

The intent of 40 CFR 190 requires that the effluents of Nine Mile Point Unit 2 (NMP2), as well as other nearby uranium fuel cycle facilities, be considered. In this case, the effluents of Nine Mile Point Unit 1 (NMP1), NMP2 and the James A. FitzPatrick Nuclear Power Plant (JAFNPP) facilities must be considered.

40 CFR 190 requires the annual radiation dose received by Members of the Public in the general environment, as a result of plant operations, be limited to:

- < 25 mRem whole body
- < 25 mRem any organ (except thyroid)
- < 75 mRem thyroid

This evaluation compares doses resulting from liquid and gaseous effluents and direct radiation originating from the site as a result of the operation of the NMP1, NMP2 and JAFNPP nuclear facilities.

## Dose Pathways

Dose pathways considered for this evaluation included doses resulting from liquid effluents, gaseous effluents and direct radiation from all nuclear operating facilities located on the Nine Mile Point site.

Dose to the likely most exposed Member of the Public, outside the site boundary, is received through the following pathways:

- Fish consumption pathway; this dose is received from plant radionuclides that have concentrated in fish that is consumed by a Member of the Public.
- Vegetation consumption pathway; this dose is received from plant radionuclides that have concentrated in vegetation that is consumed by a Member of the Public.
- Shoreline Sediment; this dose is received as a result of an individual's exposure to plant radionuclides in the shoreline sediment, which is used as a recreational area.
- Deposition, Inhalation and Ingestion pathways resulting from gaseous effluents; this dose is received through exposure to gaseous effluents released from NMP1, NMP2 and JAFNPP operating facilities.
- Direct Radiation pathway; radiation dose resulting from the operation of NMP1, NMP2 and JAFNPP facilities (including the Independent Spent Fuel Storage Installations (ISFSI)).

## Methodologies for Determining Dose for Applicable Pathways

### Fish Consumption

Dose received as a result of fish consumption is based on the methodology specified in the NMP2 Off-Site Dose Calculation Manual (ODCM) as adapted from Regulatory Guide 1.109. The dose for 2017 is calculated from actual analysis results of environmental fish samples taken near the site discharge points. For this evaluation it is assumed that the most likely exposed Member of the Public consumes fish taken near the site discharge points.

No radionuclides were detected in fish samples collected and analyzed during 2017; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

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**Vegetation Consumption**

Dose received as a result of vegetation consumption is based on the methodology specified in the NMP2 ODCM as adapted from Regulatory Guide 1.109. The dose for 2017 is calculated from actual analysis results of environmental vegetation samples taken near the most exposed Member of the Public.

No radionuclides were detected in vegetation samples collected and analyzed during 2017; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

For estimating C-14, dose received as a result of vegetation consumption is based on the methodology specified in the NMP2 ODCM as adapted from Regulatory Guide 1.109. The estimated concentration of C-14 in vegetation is based on the estimated concentration of C-14 in plant gaseous effluents.

**Shoreline Sediment**

Dose received from shoreline sediment is based on the methodology in the NMP2 ODCM as adapted from Regulatory Guide 1.109. For this evaluation it is assumed that the most likely exposed Member of the Public spends 67 hours/year along the shoreline for recreational purposes.

No radionuclides were detected in shoreline sediment samples collected and analyzed during 2017; therefore no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2017.

**Dose Pathways Resulting From Gaseous Effluents**

Dose received by the likely most exposed Member of the Public due to gaseous effluents is calculated in accordance with the methodology provided in the NMP1 ODCM, NMP2 ODCM, and the JAFNPP ODCM. These calculations consider deposition, inhalation and ingestion pathways. Actual meteorological data was used to calculate doses to the likely most exposed Member of the Public. The total sum of doses resulting from gaseous effluents from NMP1, NMP2 and JAFNPP during 2017 provides a total dose to the whole body and maximum organ dose for this pathway.

**Carbon-14 Dose Pathways Resulting from Gaseous Effluents**

The Carbon-14 (C-14) effluent source terms are used to estimate radiological doses from C-14 in site gaseous waste effluents. These estimates were generated in order to meet the NRC requirement to incorporate C-14 in nuclear power plant 2017 Annual Radiological Effluent Release Reports (ARERRs). The C-14 production and effluent source term estimates were based on EPRI methodology provided in EPRI Report 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents, December 2010. The following methodology was used in estimating C-14 gaseous release activity and dose components for the 2017 ARERR.

EPRI methodology for estimating C-14 production rates in Boiling Water Reactors (BWRs):

For BWRs, EPRI Report 1021106 summarized the distribution of C-14 in release pathways as follows: gaseous 95% to 99%, liquid <0.5% and solid 1% to 5%. The report also states that ~95% of C-14 in BWR gaseous waste effluents exists in the carbon dioxide form, which contributes to population dose via photosynthesis uptake in the food consumption cycle.

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For NMP1 and NMP2, C-14 gaseous dose calculations in the site ARERR are made using the following assumptions for each unit: (1) continuous release of the estimated C-14 generated during power operation based on the number of Effective Full Power Days (EFPDs) for the period, (2) maximum C-14 activity from literature values cited in EPRI Report 1021106, and (3) typical fraction as carbon dioxide for gaseous releases from literature values also cited in EPRI Report 1021106.

Equation 1 estimates the maximum annual production of C-14, $PR_{MAX}$, for each BWR unit.

$$PR_{MAX} = 5.1 \bullet MWT / 1000 \qquad [Eq\ 1]$$

Where:

| | | |
|---|---|---|
| 5.1 | = | BWR Normalized Production (Ci/GWt–yr) |
| MWT | = | MegaWatts Thermal (MWt) |
| 1000 | = | Conversion Factor (MWt to GWt) |

Equation 2 estimates the C-14 activity released, $A_{C-14}$, into the gaseous pathway during the time period for each BWR unit.

$$A_{C-14} = PR_{MAX} \bullet 0.99 \bullet EFPD / 365, Ci\ (for\ time\ period) \qquad [Eq\ 2]$$

Where:

| | | |
|---|---|---|
| $PR_{MAX}$ | = | maximum annual production rate of C-14 |
| *0.99* | = | fraction of C-14 in BWR gaseous pathway releases (maximum literature value in EPRI Report 1021106; also Table 1) |
| *EFPD* | = | number of effective full power days for the unit during the time period; e.g., quarterly or yearly (Table 1) |
| *365* | = | number of days in a typical year |

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Equation 3 estimates the C-14 activity released in carbon dioxide form, $A_{C\text{-}14,\,CO2}$, into the gaseous pathway during the time period for each BWR unit.

$$A_{C\text{-}14,\,CO2} = PR_{MAX} \bullet 0.99 \bullet 0.95 \bullet EFPD / 365, Ci \text{ (for time period)} \qquad [Eq\ 3]$$

Where:

| | | |
|---|---|---|
| $PR_{MAX}$ | = | maximum annual production rate of C-14 |
| *0.99* | = | fraction of C-14 in BWR gaseous pathway releases (maximum literature value in EPRI Report 1021106; also Table 1) |
| *0.95* | = | fraction of C-14 as carbon dioxide in BWR gaseous pathway releases (typical literature value in EPRI Report 1021106; also Table 1) |
| *EFPD* | = | number of effective full power days for the unit during the time period, e.g. quarterly or yearly (Table 1) |
| *365* | = | conversion factor, 365 days in a typical average year |

For each BWR unit, the 2017 estimated C-14 activity releases (total and carbon dioxide chemical form) are summarized in Table 1.

**Table 1**

**2017 BWR Estimated C-14 Gaseous Releases**

| BWR | Gaseous Release Fraction[(a)] | $CO_2$ Form Release Fraction[(b)] | EFPD Operation | Max. Annual Prod. Rate (Eq 1) | 2017 Total Release (Eq 2) | 2017 CO2 Release (Eq 3) |
|---|---|---|---|---|---|---|
| NMP1 | 0.99 | 0.95 | 331.2 EFPD (90.7%) | 9.44 Ci/yr | 8.48 Ci | 8.05 Ci |
| NMP2 | 0.99 | 0.95 | 359.85 EFPD (98.6%) | 20.34 Ci/yr[(c)] | 19.85 Ci | 18.86 Ci |
| JAFNPP | 0.99 | 0.95 | 309.1 EFPD (84.7%) | 12.93 Ci/yr | 9.09 Ci | 8.63 Ci |

(a) Maximum literature values from EPRI Report 1021106.

(b) Typical value from EPRI Report 1021106.

(c) NMP2 Reactor Power Rating increased to 3988 Megawatts thermal.

As long as the core designs and power ratings are not significantly changed, the maximum annual production rates and annual total and carbon dioxide activity releases in Table 1 should be acceptable for use in estimating C-14 gaseous release activity and dose components for the ARERR.

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**Direct Radiation Pathway**

Dose as a result of direct gamma radiation from the site, encompasses doses from direct "shine" from the generating facilities, direct radiation from any overhead gaseous plumes, plume submersion, and ground deposition. This total dose is measured by environmental TLDs. The critical location is based on the closest year-round residence from the generating facilities as well as the closest residence in the critical downwind sector in order to evaluate both direct radiation from the generating facilities and gaseous plumes as determined by the local meteorology. During 2017, the closest residence and the critical downwind residence are at the same location.

**Table 2**

**Dose Potentially Received by the Likely Most Exposed Member of the Public Outside the Site Boundary During 2017**

| Exposure Pathway | Dose Type | Dose (mrem) |
|---|---|---|
| Fish and Vegetation Consumption | Total Whole Body | No Dose |
| | Total Maximum Organ | No Dose |
| Shoreline Sediment | Total Whole Body | No Dose |
| | Total Skin of Whole Body | No Dose |
| Gaseous Effluents (excluding C-14) | Total Whole Body | 4.42 E-03 |
| | Thyroid | 1.02 E-02 |
| | Maximum Organ | Thyroid: 1.02 E-02 |
| Gaseous Effluent (C-14) | Total Whole Body | 3.52 E-01 |
| | Maximum Organ | Bone: 1.76 E+00 |
| Direct Radiation | Total Whole Body | 0.91 |

Based on these values the maximum total annual dose potentially received by the likely most exposed Member of the Public during 2017 is as follows:

- Total Whole Body: 1.27 E+00 mrem
- Total Thyroid: 1.02 E-02
- Maximum Organ: Bone: 1.76 E+00 mrem

**40 CFR 190 Evaluation**

The maximum total doses presented in this attachment are the result of operations at the NMP1, NMP2 and the JAFNPP facilities. The maximum organ dose (Bone: 1.76 mrem), maximum thyroid dose (0.010 mrem) and the maximum whole body dose (1.27 mrem) are below the 40 CFR 190 criteria of 25 mrem per calendar year to the maximum exposed organ or the whole body, and below 75 mrem per calendar year to the thyroid.

# ATTACHMENT 12



| Unit 1 _____ Unit 2 X | | | Reporting Period: January - December 2017 | |
|---|---|---|---|---|
| **Well Identification Number** | **# Samples Collected** | **# Positive Samples** | **Minimum Concentration (pCi/l)** | **Maximum Concentration (pCi/l)** |
| GMX-MW1* | 4 | 0 | <188 | <194 |
| MW-1 | 4 | 0 | <188 | <200 |
| MW-5 | 4 | 0 | <183 | <193 |
| MW-6 | 4 | 0 | <186 | <191 |
| MW-7 | 4 | 0 | <186 | <194 |
| MW-8 | 4 | 0 | <187 | <193 |
| MW-9[1] | 4 | 0 | <187 | <192 |
| MW-10[1] | 4 | 1 | <186 | 240 |
| MW-11 | 4 | 0 | <186 | <193 |
| MW-12 | 4 | 0 | <190 | <193 |
| MW-13 | 4 | 0 | <184 | <192 |
| MW-14* | 4 | 1 | <183 | 234 |
| MW-15 | 4 | 1 | <186 | 252 |
| MW-16 | 4 | 0 | <184 | <192 |
| MW-17 | 4 | 1 | <183 | 222 |
| MW-18 | 4 | 1 | <190 | 270 |
| MW-19 | 4 | 0 | <186 | <190 |
| MW-20 | 4 | 0 | <183 | <192 |
| MW-21 | 4 | 0 | <183 | <190 |
| NMP2 MAT [2,3] | 4 | 1 | <181 | 279 |
| PZ-1 | 4 | 0 | <190 | <193 |
| PZ-2 | 4 | 0 | <191 | <196 |
| PZ-3 | 4 | 0 | <187 | <194 |
| PZ-4 | 4 | 1 | <189 | 214 |
| PZ-5 | 4 | 0 | <190 | <191 |
| PZ-6 | 4 | 0 | <188 | <192 |
| PZ-7 | 4 | 4 | 291 | 435 |
| PZ-8 | 4 | 0 | <190 | <198 |
| PZ-9* | 4 | 0 | <189 | <194 |

Notes:

* - Control Location

[1] - Sentinel well location

[2] - NMP2 Groundwater Depression Cone

[3] - Samples collected from storm drain system which includes precipitation