Exelon Generation®

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

NMP1L3273
April 23, 2019

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: 2018 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 2018. 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 Morgan Cazzolli, Manager, Site Chemistry and Radwaste, at (315) 349-4188.

Sincerely,

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

PMO/KJK

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Enclosures: (1) Nine Mile Point Nuclear Station, Unit 1
Radioactive Effluent Release Report, January – December 2018

(2) Nine Mile Point Nuclear Station, Unit 2
Radioactive Effluent Release Report, January – December 2018

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

Enclosure 1

Nine Mile Point Nuclear Station, Unit 1

Radioactive Effluent Release Report, January – December 2018

NINE MILE POINT NUCLEAR STATION - UNIT 1

RADIOACTIVE EFFLUENT RELEASE REPORT

January – December 2018

NINE MILE POINT NUCLEAR STATION - UNIT 1

RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER 2018

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

Meteorological data is 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 2018**

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.

MEC for Emergency Condenser Vent Liquid Discharges in the 2018 year are as follows:

Average MEC - µCi/ml (Qtr. 1) =	NO RELEASES	Average MEC - µCi/ml (Qtr. 3) =	NO RELEASES
Average MEC - µCi/ml (Qtr. 2) =	2.99E-03	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	1
Total Time Period for Batch Releases (hrs)	0	12.00
Maximum Time Period for a Batch Release (hrs)	0	12.00
Average Time Period for a Batch Release (hrs)	0	12.00
Minimum Time Period for a Batch Release (hrs)	0	12.00

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
EC Vent	N/A	2.65E+04	N/A	N/A

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

	1st	2nd	3rd	4th
Radwaste	1.29E+11	1.31E+11	1.36E+11	1.33E+11
EC Vent	N/A	4.14E+06	N/A	N/A

Gaseous (Emergency Condenser Vent):

Number of Batch Releases	1
Total Time Period for Batch Releases (hrs)	12.00
Maximum Time Period for a Batch Release (hrs)	12.00
Average Time Period for a Batch Release (hrs)	12.00
Minimum Time Period for a Batch Release (hrs)	12.00

Gaseous (Primary Containment Purge):

Number of Batch Releases	1
Total Time Period for Batch Releases (hrs)	1.17
Maximum Time Period for a Batch Release (hrs)	1.17
Average Time Period for a Batch Release (hrs)	1.17
Minimum Time Period for a Batch Release (hrs)	1.17

ATTACHMENT 1

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

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

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 04/03/2018, Emergency Condenser Vents were observed to be releasing small puffs of water vapor for less than an hour. Upon closer visual inspection, some of the water vapor had condensed and was dripping from vent pipe at approximately 3 drops per second. Berms were set-up to collect the leak and were removed late in the day after the drips were no longer observed. Based on less than one shift of observed leakage, a conservative discharge duration of 12 hours was established to calculate the total volume released for total estimated activity.

ATTACHMENT 2

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

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	6.90E-06	**	**	3.77E-06	3.00E+01
2. Average Release Rate for Period	µCi/sec	8.78E-07	**	**	4.80E-07	
C. Particulates (1)						
1. Particulates with Half-lives>8 days	Ci	1.67E-04	7.14E-05	2.25E-04	4.69E-04	3.00E+01
2. Average Release Rate for Period	µCi/sec	2.12E-05	9.08E-06	2.86E-05	5.96E-05	
3. Gross Alpha Radioactivity	Ci	**	**	**	**	2.50E+01
D. Tritium (1)						
1. Total Release	Ci	8.03E+00	5.84E+00	4.45E+00	6.39E+00	5.00E+01
2. Average Release Rate for Period	µCi/sec	1.02E+00	7.43E-01	5.65E-01	8.12E-01	
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)	%	9.07E-03	6.60E-03	1.30E-02	1.75E-02	
Percent of Annual Dose Limit to Date (15 mrem)	%	4.53E-03	7.29E-03	1.33E-02	2.20E-02	
Percent of Organ Dose Limit (1500 mrem/yr	%	1.84E-04	1.32E-04	2.57E-04	3.46E-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 2018

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	6.90E-06	**	**	3.77E-06
Iodine-133	Ci	**	**	1.48E-04	1.95E-04
Iodine-135	Ci	**	**	**	**
Particulates (1)					
Strontium-89	Ci	9.57E-05	**	**	3.13E-05
Strontium-90	Ci	**	**	**	**
Cesium-134	Ci	**	**	**	**
Cesium-137	Ci	5.28E-06	1.74E-05	4.63E-05	3.10E-05
Cobalt-60	Ci	5.85E-05	5.40E-05	1.44E-04	2.54E-04
Cobalt-58	Ci	7.21E-06	**	3.43E-05	2.74E-05
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	**	**	**	1.25E-04
Molybdenum-99	Ci	**	**	**	**
Neodymium-147	Ci	**	**	**	**
Tritium (1)	Ci	6.54E+00	5.10E+00	3.39E+00	5.81E+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 2018

GASEOUS EFFLUENTS - ELEVATED RELEASE

Nuclides Released		Batch Mode (2) 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 2018

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	**	1.06E-11	**	**
Cobalt-60	Ci	**	6.61E-10	**	**
Cobalt-58	Ci	**	5.75E-10	**	**
Manganese-54	Ci	**	2.01E-10	**	**
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	1.50E+00	7.46E-01	1.07E+00	5.82E-01

(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 2018

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 2018

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	7.33E-09	No Releases	No Releases	5.00E+01
2. Average diluted concentration during reporting period	µCi/ml	No Releases	5.61E-17	No Releases	No Releases	
B. Tritium						
1.Total release	Ci	No Releases	2.50E-06	No Releases	No Releases	5.00E+01
2. Average diluted concentration during the reporting period	µCi/ml	No Releases	1.91E-14	No Releases	No Releases	
C. Dissolved and Entrained Gases						
1. Total release	Ci	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	
D. Gross Alpha Radioactivity						
1. Total release	Ci	No Releases	**	No Releases	No Releases	5.00E+01
E. Volumes						
1. Prior to Dilution	Liters	No Releases	6.47E+00	No Releases	No Releases	5.00E+01
2. Volume of dilution water used during release period	Liters	No Releases	2.65E+04	No Releases	No Releases	5.00E+01
3. Volume of dilution water available during reporting period - Cooling Water	Liters	1.29E+11	1.31E+11	1.36E+11	1.33E+11	5.00E+01
F. Percent of Tech. Spec. Limits						
Percent of Quarterly Whole Body Dose Limit (1.5 mrem)	%	No Releases	5.44E-05	No Releases	No Releases	
Percent of Annual Whole Body Dose Limit to Date (3 mrem)	%	No Releases	2.72E-05	No Releases	No Releases	
Percent of Quarterly Organ Dose Limit (5 mrem)	%	No Releases	2.80E-05	No Releases	No Releases	
Percent of Annual Organ Dose Limit to Date (10 mrem)	%	No Releases	1.40E-05	No Releases	No Releases	
Percent of 10CFR20 Concentration Limit	%	No Releases	1.09E-02	No Releases	No Releases	
Percent of Dissolved or Entrained Noble Gas Limit (2.00E-04 µCi/ml)	%	No Releases	0.00E+00	No Releases	No Releases	

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

(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 5

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

LIQUID EFFLUENTS RELEASED

Nuclides Released		Batch Mode (1),(2) 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Nuclides Released					
Strontium-89	Ci	No Releases	2.02E-10	No Releases	No Releases
Strontium-90	Ci	No Releases	2.52E-09	No Releases	No Releases
Cesium-134	Ci	No Releases	**	No Releases	No Releases
Cesium-137	Ci	No Releases	5.04E-11	No Releases	No Releases
Iodine-131	Ci	No Releases	**	No Releases	No Releases
Cobalt-58	Ci	No Releases	**	No Releases	No Releases
Cobalt-60	Ci	No Releases	2.28E-09	No Releases	No Releases
Iron-59	Ci	No Releases	**	No Releases	No Releases
Zinc-65	Ci	No Releases	**	No Releases	No Releases
Manganese-54	Ci	No Releases	**	No Releases	No Releases
Chromium-51	Ci	No Releases	**	No Releases	No Releases
Zirconium-95	Ci	No Releases	**	No Releases	No Releases
Niobium-95	Ci	No Releases	**	No Releases	No Releases
Molybdenum-99	Ci	No Releases	**	No Releases	No Releases
Barium-140	Ci	No Releases	**	No Releases	No Releases
Lanthanum-140	Ci	No Releases	**	No Releases	No Releases
Cerium-141	Ci	No Releases	**	No Releases	No Releases
Iodine-133	Ci	No Releases	**	No Releases	No Releases
Iron-55	Ci	No Releases	2.28E-09	No Releases	No Releases
Cerium-144	Ci	No Releases	**	No Releases	No Releases
Cesium-136	Ci	No Releases	**	No Releases	No Releases
Copper-64	Ci	No Releases	**	No Releases	No Releases
Manganese-56	Ci	No Releases	**	No Releases	No Releases
Nickel-65	Ci	No Releases	**	No Releases	No Releases
Sodium-24	Ci	No Releases	**	No Releases	No Releases
Dissolved or Entrained Gases	Ci	No Releases	**	No Releases	No Releases
Tritium	Ci	No Releases	2.50E-06	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 2018

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)	2.94E+01	0.00E+00	0.00E+00	2.79E+01	0.00E+00	0.00E+00
a.2 Filter Sludge	0.00E+00	1.90E+01	0.00E+00	0.00E+00	4.21E+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	2.94E+01	1.90E+01	0.00E+00	2.79E+01	4.21E+02	0.00E+00
b.1 Dry Compressible Waste	6.10E+01	0.00E+00	0.00E+00	1.80E+00	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	6.10E+01	0.00E+00	0.00E+00	1.80E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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 2018
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		N/A	N/A	N/A

ATTACHMENT 6

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

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
Mn-54	2.72%	1.22E+01
Fe-55	25.79%	1.16E+02
Co-58	1.49%	6.69E+00
Co-60	51.72%	2.32E+00
Ni-63	3.06%	1.37E+01
Zn-65	1.64%	7.35E+00
Cs-137	13.27%	5.95E+01

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

Nuclide	Percent	Curies
Mn-54	3.56%	6.40E-02
Fe-55	19.52%	3.51E-01
Co-60	70.10%	1.26E+00
Zn-65	1.13%	2.03E-02
Cs-137	3.94%	7.08E-02

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
NA	NA	NA

ATTACHMENT 6

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
4	Truck, highway	Bear Creek
1	Truck, highway	Clive BWF
5	Truck, highway	Clive CWF
4	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 2018

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

No changes were made to the Unit 1 Off-Site Dose Calculation Manual (ODCM) during the reporting period.

ATTACHMENT 8

Unit 1 X Unit 2 Reporting Period: January - December 2018

SUMMARY OF CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

There were no changes to the Process Control Program during this reporting period.

ATTACHMENT 9

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

SUMMARY OF NON-FUNCTIONAL MONITORS

Monitor	Dates Monitor was Non-Functional	Cause and Corrective Actions
Liquid Radwaste Discharge Monitors 11 and 12	January 1, 2018 to December 31, 2018	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 2018. This non-functionality is tracked in Equipment Status Log (ESL) 2006-0192.

ATTACHMENT 10

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2018

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 2018.

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 2018, 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 2018

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 2018 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 2018 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)	9.52E+05
C-14 (pCi/sec)2	2.79E+05
Fe-55 (pCi/sec)	7.50E+00
Co-58 (pCi/sec)	2.61E+00
Co-60 (pCi/sec)	1.92E+01
Sr-89 (pCi/sec)	4.80E+00
Sr-90 (pCi/sec)	4.35E-01
I-133 (pCi/sec)	1.47E+01
Cs-137 (pCi/sec)	4.01E+00

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2018

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)	1.01E+05
Mn-54 (pCi/sec)	8.48E-06
Co-58 (pCi/sec)	2.42E-05
Co-60 (pCi/sec)	2.78E-05
CS-137 (pCi/sec)	4.45E-07

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 2018 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)	1.76E-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 2018

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 2018:

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	7.14E-04
	Maximum Organ	Bone: 1.62 E-03
	Thyroid	7.12E-04
Direct Radiation	Whole Body	0.55

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 2018	Fisherman (mrem)
Total Whole Body	5.53E-01
Skin of Whole Body	2.38 E-03
Maximum Organ	Bone: 1.62 E-03
Thyroid	7.12E-04

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2018

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 2018 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 2018 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 2018; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

Unit 1 __X__ Unit 2 _____ Reporting Period: January - December 2018

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 2018 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 2018; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

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 2018; therefore no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

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 2018 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 2018 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 2018 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 2018

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 2018

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 2018 estimated C-14 activity releases (total and carbon dioxide chemical form) are summarized in Table 1.

Table 1

2018 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)	2018 Total Release (Eq 2)	2018 CO2 Release (Eq 3)
NMP1	0.99	0.95	360.74 EFPD (98.9%)	9.44 Ci/yr	9.23 Ci	8.77 Ci
NMP2	0.99	0.95	328.48 EFPD (90.0%)	20.33 Ci/yr[(c)]	18.12 Ci	17.21 Ci
JAFNPP	0.99	0.95	324.38 EFPD (88.9%)	12.93 Ci/yr	9.53 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 2018

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 2018, 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 2018

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	6.92E-03
	Thyroid	1.94E-02
	Maximum Organ	Thyroid: 1.94 E-02
Gaseous Effluent (C-14)	Total Whole Body	2.46E-01
	Maximum Organ	Bone: 1.23 E+00
Direct Radiation	Total Whole Body	2.36

Based on these values the maximum total annual dose potentially received by the likely most exposed Member of the Public during 2018 is as follows:

- Total Whole Body: 2.61 E+00 mrem
- Total Thyroid: 1.94 E-02 mrem
- Maximum Organ: Bone: 1.23 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: 1.23 mrem), maximum thyroid dose (0.019 mrem) and the maximum whole body dose (2.61 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 2018**

Well Identification Number	# Samples Collected	# Positive Samples	Minimum Concentration (pCi/l)	Maximum Concentration (pCi/l)
GMX-MW1*	4	0	<182	<194
MW-1	4	0	<176	<190
MW-5	4	0	<178	<189
MW-6	4	0	<177	<195
MW-7	4	1	<180	226
MW-8	4	0	<182	<195
MW-9[1]	4	0	<183	<193
MW-10[1]	4	0	<187	<198
MW-11	4	0	<184	<193
MW-12	4	0	<183	<190
MW-13	4	0	<187	<193
MW-14*	4	0	<186	<194
MW-15	4	0	<179	<192
MW-16	4	0	<183	<195
MW-17	4	2	<189	366
MW-18	4	0	<185	<193
MW-19	4	0	<181	<193
MW-20	4	0	<184	<192
MW-21	4	0	<180	<192
NMP2 MAT[2,3]	4	1	<168	1,875
PZ-1	4	0	<182	<191
PZ-2	4	0	<186	<190
PZ-3	4	0	<184	<191
PZ-4	4	0	<186	<190
PZ-5	4	0	<185	<222
PZ-6	4	1	<181	268
PZ-7	4	4	278	470
PZ-8	4	0	<182	<220
PZ-9*	4	0	<178	<234

Notes:

* - Control Location

[1] - Sentinel well location

[2] - NMP2 Groundwater Depression Cone

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

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

Off-Site Dose Calculation Manual (ODCM)

There was no revision to the Off-Site Dose Calculation Manual for 2018.

Unit 1 X Unit 2 _____ Reporting Period: January - December 2018

Process Control Program (PCP)

There were no changes to the Process Control Program in 2018.

Enclosure 2

Nine Mile Point Nuclear Station, Unit 2

Radioactive Effluent Release Report, January – December 2018

NINE MILE POINT NUCLEAR STATION - UNIT 2

RADIOACTIVE EFFLUENT RELEASE REPORT

January – December 2018

NINE MILE POINT NUCLEAR STATION - UNIT 2

RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER 2018

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

Meteorological data is 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 2018**

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:	$\bar{E}\gamma$ =	1.18E-01	$\bar{E}\beta$ =	1.37E-01
Qtr. 3:	$\bar{E}\gamma$ =	2.40E-01	$\bar{E}\beta$ =	2.41E-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

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

	1st	2nd	3rd	4th
Total volume of water available to dilute the liquid effluent during the report period (L)	1.01E+10	1.23E+10	1.30E+10	1.22E+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	3
Total Time Period for Batch Releases (hrs)	12.0
Maximum Time Period for a Batch Release (hrs)	7.2
Average Time Period for a Batch Release (hrs)	4.0
Minimum Time Period for a Batch Release (hrs)	1.2

ATTACHMENT 1
SUMMARY DATA

Unit 1 _____ Unit 2 X

Reporting Period: January - December 2018

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 2018

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	5.69E+00	3.66E+01	0.00E+00	5.00E+01
2. Average Release Rate	µCi/sec	0.00E+00	7.32E-01	4.61E+00	0.00E+00	
B. Iodines						
1. Total Iodine - 131	Ci	0.00E+00	8.30E-05	3.49E-05	0.00E+00	3.00E+01
2. Average Release Rate for Period	µCi/sec	0.00E+00	1.06E-05	4.44E-06	0.00E+00	
C. Particulates						
1. Particulates with Half-lives>8days	Ci	5.19E-05	4.65E-04	3.81E-04	1.43E-04	3.00E+01
2. Average Release Rate for Period	µCi/sec	6.60E-06	5.92E-05	4.85E-05	1.67E-05	
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	2.87E+01	1.74E+01	2.72E+01	4.21E+01	5.00E+01
2. Average Release Rate for Period	µCi/sec	3.64E+00	2.22E+00	3.47E+00	4.92E+00	
E. Percent of Tech. Spec. Limits Fission and Activation Gases						
Percent of Quarterly Gamma Air Dose Limit (5 mR)	%	0.00E+00	1.21E-03	1.82E-02	0.00E+00	
Percent of Quarterly Beta Air Dose Limit (10 mrad)	%	0.00E+00	8.69E-05	9.79E-04	0.00E+00	
Percent of Annual Gamma Air Dose Limit to Date (10 mR)	%	0.00E+00	6.06E-04	9.73E-03	9.73E-03	
Percent of Annual Beta Air Dose Limit to Date (20 mrad)	%	0.00E+00	4.35E-05	9.25E-04	9.25E-04	
Percent of Whole Body Dose Rate Limit (500 mrem/yr)	%	0.00E+00	4.59E-05	1.04E-03	0.00E+00	
Percent of Skin Dose Rate Limit (3000 mrem/yr)	%	0.00E+00	9.57E-06	2.13E-04	0.00E+00	
Tritium, Iodines, and Particulates (with half-lives greater than 8 days)						
Percent of Quarterly Dose Limit (7.5 mrem)	%	6.85E-03	3.19E-02	2.00E-02	1.22E-02	
Percent of Annual Dose Limit to Date (15 mrem)	%	3.43E-03	1.93E-02	2.93E-02	3.53E-02	
Percent of Organ Dose Limit (1500 mrem/yr	%	1.39E-04	6.45E-04	5.98E-04	2.48E-04	

Unit 1 _____ Unit 2 X

Reporting Period: January - December 2018

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	**	4.36E-01	9.55E-01	**
Krypton-87	Ci	**	**	9.43E-01	**
Krypton-88	Ci	**	**	2.07E+00	**
Xenon-127	Ci	**	**	**	**
Xenon-131m	Ci	**	**	**	**
Xenon-133	Ci	**	4.31E+00	2.08E+01	**
Xenon-133m	Ci	**	**	**	**
Xenon-135	Ci	**	**	1.18E+01	**
Xenon-135m	Ci	**	9.43E-01	**	**
Xenon-137	Ci	**	**	**	**
Xenon-138	Ci	**	**	**	**
Iodines (1)					
Iodine-131	Ci	**	7.35E-05	3.49E-05	**
Iodine-133	Ci	**	1.55E-04	9.18E-04	1.71E-05
Iodine-135	Ci	**	**	**	**
Particulates (1)					
Chromium-51	Ci	**	**	**	**
Manganese-54	Ci	**	**	**	**
Iron-55	Ci	**	4.28E-05	**	**
Iron-59	Ci	**	**	**	**
Cobalt-58	Ci	**	**	**	**
Cobalt-60	Ci	**	**	**	3.01E-05
Neodymium-147	Ci	**	**	**	**
Zinc-65	Ci	**	**	**	**
Strontium-89	Ci	**	8.70E-05	1.26E-05	1.96E-05
Strontium-90	Ci	**	**	**	**
Niobium-95	Ci	**	**	**	**
Zirconium-95	Ci	**	**	**	**
Molybdenum-99	Ci	**	**	**	**
Ruthenium-103	Ci	**	**	**	**
Cesium-134	Ci	**	**	**	**
Cesium-136	Ci	**	**	**	**
Cesium-137	Ci	**	**	**	1.86E-06
Barium-140	Ci	**	**	**	**
Lanthanum-140	Ci	**	**	**	**
Cerium-141	Ci	**	**	**	**
Cerium-144	Ci	**	**	**	**
Tritium (1)	Ci	2.04E+01	1.26E+01	2.10E+01	2.60E+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 2018

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 2018

GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

Nuclides Released		Continuous Mode (2) 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	**	9.53E-06	**	**
Iodine-133	Ci	**	**	**	**
Iodine-135	Ci	**	**	**	**
Particulates (1)					
Chromium-51	Ci	**	**	**	**
Manganese-54	Ci	**	**	6.30E-05	**
Iron-55	Ci	**	**	9.34E-05	**
Iron-59	Ci	**	**	**	**
Cobalt-58	Ci	**	**	**	**
Cobalt-60	Ci	5.19E-05	3.36E-04	2.12E-04	9.10E-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	**	**	**	**
Barium-140	Ci	**	**	**	**
Lanthanum-140	Ci	**	**	**	**
Cerium-141	Ci	**	**	**	**
Cerium-144	Ci	**	**	**	**
Tritium (1)	Ci	8.24E+00	4.82E+00	6.24E+00	1.61E+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 2018

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 2018	
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	1.01E+10	1.23E+10	1.30E+10	1.22E+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 2018

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 2018
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)	4.94E+01	0.00E+00	0.00E+00	1.69E+02	0.00E+00	0.00E+00
a.2 Filter Sludge	0.00E+00	1.89E+01	0.00E+00	0.00E+00	3.20E+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	4.94E+01	1.89E+01	0.00E+00	1.69E+02	3.20E+03	0.00E+00
b.1 Dry Compressible Waste	1.01E+03	0.00E+00	0.00E+00	2.33E+00	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	1.01E+03	0.00E+00	0.00E+00	2.33E+00	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	4.33E+01	0.00E+00	0.00E+00	2.29E+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 2018
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	
Iron Prefilter Septa	Seavan	General Design	None	

Unit 1		Unit 2	X	Reporting Period: January - December 2018

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
Co-60	61.26%	2.07E+03
Fe-55	31.81%	1.08E+03
Zn-65	2.38%	8.05E+01
Mn-54	3.20%	1.09E+02

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

Nuclide	Percent	Curies
Co-60	80.22%	1.87E+00
Fe-55	13.48%	3.14E-01
Zn-65	1.49%	3.48E-02
Mn-54	3.77%	8.79E-02

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

Nuclide	Percent
N/A	N/A

d. Other: (To vendor for processing)

Nuclide	Percent	Curies
Co-60	18.77%	4.31E+01
Fe-55	79.56%	1.83E+02
Mn-54	1.16%	2.66E+00

Unit 1 _____ Unit 2 X Reporting Period: January - December 2018

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
28	Truck,highway	Bear Creek
12	Truck,highway	Clive
6	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 2018

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.

ATTACHMENT 8

Unit 1 _____ Unit 2 X Reporting Period: January - December 2018

SUMMARY OF CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

There were no revisions or changes to PCP procedures during the 2018 year.

ATTACHMENT 9

Unit 1 _____ Unit 2 X Reporting Period: January - December 2018

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, 2018 to December 31, 2018	No liquid waste discharges were performed during 2018, 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) 2011-0243.

Unit 1 ____ Unit 2 __X__	Reporting Period: January - December 2018
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 2018.

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 2018 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 2018

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 2018 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 2018 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)	9.60E-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)	2.36E+06
C-14 $(pCi/sec)^2$	5.32E+05
Fe-55 (pCi/sec)	1.76E+00
Co-60 (pCi/sec)	1.24E+00
Sr-89 (pCi/sec)	4.91E+00
Cs-137 (pCi/sec)	7.65E-02
I-131 (pCi/sec)	4.47E+00
I-133 (pCi/sec)	4.49E-01

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)	1.12E+06
Co-60 (pCi/sec)	2.63E+01
Mn-54 (pCi/sec)	2.59E+00
Fe-55 (pCi/sec)	3.85E+00
I-131 (pCi/sec)	3.93E-01

Unit 1 ____ Unit 2 __X__	Reporting Period: January - December 2018
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 2018 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)	1.76E-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 2018

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 2018

The following is a summary of the dose received by a hypothetical maximum exposed fisherman from liquid and gaseous effluents released from NMP2 during 2018:

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	1.85E-03
	Maximum Organ	Bone: 3.06E-3
	Thyroid	1.86E-03
Direct Radiation	Whole Body	0.55

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 2018	Fisherman (mrem)
Total Whole Body	5.54E-01
Skin of Whole Body	2.38E-03
Maximum Organ	Bone: 3.06E-03
Thyroid	1.86E-03

Unit 1 ____ Unit 2 X	Reporting Period: January - December 2018
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 2018 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 2018 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 2018; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

Unit 1 ____ Unit 2 X	Reporting Period: January - December 2018
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 2018 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 2018; therefore, no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

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 2018; therefore no dose was received by the whole body and organs of the likely most exposed Member of the Public during 2018.

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 2018 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 2018 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 2018 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 ____ Unit 2 __X__	Reporting Period: January - December 2018
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 ____ Unit 2 __X___ Reporting Period: January - December 2018

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 2018 estimated C-14 activity releases (total and carbon dioxide chemical form) are summarized in Table 1.

Table 1

2018 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)	2018 Total Release (Eq 2)	2018 CO2 Release (Eq 3)
NMP1	0.99	0.95	360.73 EFPD (98.1%)	9.44 Ci/yr	9.23 Ci	8.77 Ci
NMP2	0.99	0.95	328.48 EFPD (90.0%)	20.34 Ci/yr[(c)]	18.12 Ci	17.20 Ci
JAFNPP	0.99	0.95	324.38 EFPD (88.9%)	12.93 Ci/yr	9.53 Ci	9.06 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 ____ Unit 2 __X__ Reporting Period: January - December 2018

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 2018, 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 2018

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	6.92E-03
	Thyroid	1.94E-02
	Maximum Organ	Thyroid: 1.94E-02
Gaseous Effluent (C-14)	Total Whole Body	2.46E-01
	Maximum Organ	Bone: 1.23E+00
Direct Radiation	Total Whole Body	2.36

Based on these values the maximum total annual dose potentially received by the likely most exposed Member of the Public during 2018 is as follows:

- Total Whole Body: 2.61 E+00 mrem
- Total Thyroid: 1.94E-02
- Maximum Organ: Bone: 1.23 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: 1.23 mrem), maximum thyroid dose (0.019 mrem) and the maximum whole body dose (2.61 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 2018	
Well Identification Number	**# Samples Collected**	**# Positive Samples**	**Minimum Concentration (pCi/l)**	**Maximum Concentration (pCi/l)**
GMX-MW1*	4	0	<182	<194
MW-1	4	0	<176	<190
MW-5	4	0	<178	<189
MW-6	4	0	<177	<195
MW-7	4	1	<180	226
MW-8	4	0	<182	<195
MW-91	4	0	<183	<193
MW-101	4	0	<187	<198
MW-11	4	0	<184	<193
MW-12	4	0	<183	<190
MW-13	4	0	<187	<193
MW-14*	4	0	<186	<194
MW-15	4	0	<179	<192
MW-16	4	0	<183	<195
MW-17	4	2	<189	366
MW-18	4	0	<185	<193
MW-19	4	0	<181	<193
MW-20	4	0	<184	<192
MW-21	4	0	<180	<192
NMP2 MAT 2,3	4	1	<168	1875
PZ-1	4	0	<182	<191
PZ-2	4	0	<186	<190
PZ-3	4	0	<184	<191
PZ-4	4	0	<186	<190
PZ-5	4	0	<185	<222
PZ-6	4	1	<181	268
PZ-7	4	4	278	470
PZ-8	4	0	<182	<220
PZ-9*	4	0	<178	<234

Notes:

* - Control Location

[1] - Sentinel well location

[2] - NMP2 Groundwater Depression Cone

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

Unit 1 _____ Unit 2 X Reporting Period: January - December 2018

Off-Site Dose Calculation Manual (ODCM)

There was no revision to the Off-Site Dose Calculation Manual for 2018.

Unit 1 _____ Unit 2 X Reporting Period: January - December 2018

Process Control Program (PCP)

There were no changes to the Process Control Program in 2018.