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Constellation

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

NMP1L3522
April 30, 2023

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: 2022 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 2022. 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 Jeremy Kerling, Manager, Site Chemistry and Radwaste, at (315) 349-1683.

Sincerely,

Alexander D. Sterio
Plant Manager, Nine Mile Point Nuclear Station
Constellation Generation Company, LLC

ADS/KES

IE48
NMSS26
NRR
NMSS

Enclosures: (1) Nine Mile Point Nuclear Station, Unit 1
Radioactive Effluent Release Report, January – December 2022

(2) Nine Mile Point Nuclear Station, Unit 2
Radioactive Effluent Release Report, January – December 2022

Cc: NRC Regional Administrator, Region 1
NRC Project Manager
NRC Resident Inspector
S. Veunephechan, NRC

ENCLOSURE 1

Nine Mile Point Nuclear Station, Unit 1

Radiological Effluent Release Report, January - December 2022

Constellation

Nine Mile Point

Annual Radioactive Effluent Release Report 2022

Document Number: NMP1L3522

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ATTACHMENTS

1.0 LIST OF ACRONYMS AND DEFINITIONS

1. Airborne Activity Sampling: Sampling of air through the collection of particulates and radionuclides on filter media, collection of noble gases in a container, and collection of water vapor containing tritium.

2. Alpha Particle (α): A charged particle emitted from the nucleus of an atom having a mass and charge equal in magnitude of a helium nucleus.

3. BWR: Boiling Water Reactor

4. Composite Sample: A series of single collected portions (aliquots) analyzed as one sample. The aliquots making up the sample are collected at time intervals that are very short compared to the composite period.

5. Control: A sampling station in a location not likely to be affected by plant effluents due to its distance and/or direction from the Plant.

6. Counting Error: An estimate of the two-sigma uncertainty associated with the sample results based on total counts accumulated.

7. Curie (Ci): A measure of radioactivity; equal to 3.7×10^{10} disintegrations per second, or 2.22×10^{12} disintegrations per minute.

8. Direct Radiation Monitoring: The measurement of radiation dose at various distances from the plant is assessed using thermoluminescent dosimeters (TLDs), optically stimulated luminescent dosimeters (OSLDs), and/or pressurized ionization chambers.

9. Grab Sample: A single discrete sample drawn at one point in time.

10. Indicator: A sampling location that is likely to be affected by plant effluents due to its proximity and/or direction from the plant.

11. Ingestion Pathway: The ingestion pathway includes milk, fish, and garden produce. Meat or other food products may also be included.

12. ISFSI: Independent Spent Fuel Storage Installation

13. Lower Limit of Detection (LLD): The smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with a 5% probability of a false conclusion that a blank observation represents "real" signal.

14. MDA: Minimum Detectable Activity. - For radiochemistry instruments, the MDA is the a posteriori minimum concentration that a counting system detects. The smallest concentration or activity of radioactive material in a sample that will yield a net count above instrument background and that is detected with 95% probability, with only five % probability of falsely concluding that a blank observation represents a true signal.

15. MDC: Minimum Detectable Concentration, essentially synonymous with MDA for the purposes of radiological monitoring.

16. Mean: The average, i.e., the sum of results divided by the number of results.

17. Microcurie (µCi): 3.7×10^4 disintegrations per second, or 2.22×10^6 disintegrations per minute.

18. millirem (mrem): 1/1000 rem; a unit of radiation dose equivalent in tissue.

19. Milliroentgen (mR): 1/1000 Roentgen; a unit of exposure to X- or gamma radiation.

20. MWe: Megawatts Electric

21. MWTh: Megawatts Thermal

22. NA: Not Applicable

23. NEI: Nuclear Energy Institute

24. NRC: Nuclear Regulatory Commission

25. ODCM: Offsite Dose Calculation Manual

26. OSLD: Optically Stimulated Luminescence Dosimeter

27. Protected Area: The fenced area immediately surrounding the Plant. Access to the protected area requires a security badge or escort.

28. PWR: Pressurized Water Reactor

29. REC: Radiological Effluent Control

30. REMP: Radiological Environmental Monitoring Program

31. Restricted Area: Any area where access is controlled for the purpose of protecting individuals from exposure to radiation or radioactive materials.

32. SLCs: Selected Licensee Commitments

33. TEDE: Total Effective Dose Equivalent (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

34. TLD: Thermoluminescent Dosimeter

35. TRM: Technical Requirements Manual

36. TS: Technical Specification

2.0 EXECUTIVE SUMMARY

Nine Mile Point Unit 1 (NMP1) Radiological Effluent Control (REC) Program was established to limit the quantities of radioactive material that may be released based on calculated radiation doses or dose rates. Dose to Members of the Public due to radioactive materials released from the plant is limited by Appendix I of 10 CFR 50 and by 40 CFR 190. Operational doses to the public during 2022 were calculated to be very small compared to the limits required by regulation and compared to other sources of radiation dose and pose no health hazard. These doses are summarized and compared to the regulatory limits in Section 2.1, Comparison to Regulatory Limits, below.

The Annual Radioactive Effluent Release Report (ARERR) is published per REC requirements and provides data related to plant operation, including: quantities of radioactive materials released in liquid and gaseous effluents; radiation doses to members of the public; solid radioactive waste shipped offsite for disposal; and other information as required by site licensing documents.

In 2022 the Land Use Census dose assessments due to radioactive gaseous effluents showed that the critical receptor for Nine Mile Point Unit 1 is child, due to C-14, at the nearest resident. The maximum Annual Organ Dose calculated for this receptor was 3.67E-01 mrem to the bone. This annual dose is a small fraction of the 10 CFR 50, Appendix I guideline of 15 mrem to the Maximum Organ per reactor unit.

Solid radioactive waste shipped offsite for disposal included 3.47E+02 Curies and 3.30E+01 m^3, shipped in eight shipments.

In addition to monitoring radioactive effluents, NMP has a Radiological Environmental Monitoring Program (REMP) that monitors for buildup of radioactivity in the offsite environment. Data from the REMP is published in the John A. FitzPatrick Nuclear Power Plant and Nine Mile Point Nuclear Station Annual Radiological Environmental Operating Report (AREOR).

2.1 Comparison to Regulatory Limits

During 2022 all solid, liquid, and gaseous radioactive effluents from Nine Mile Point Unit 1 were well below regulatory limits, as summarized in Table 1 and Table 2.

Table 1, Nine Mile Point Unit 1 Dose Summary[1]

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liquid Effluent Dose Limit, Total Body	Limit	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
	Total Body Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	*
Liquid Effluent Dose Limit, Any Organ	Limit	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
	Max Organ Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	
Gaseous Effluent Dose Limit, Gamma Air (Noble Gas)	Limit	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
	Gamma Air Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	*
Gaseous Effluent Dose Limit, Beta Air (Noble Gas)	Limit	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
	Beta Air Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	*
Gaseous Effluent Organ Dose Limit (Iodine, Tritium, Particulates with > 8-day half-life)	Limit	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
	Max Organ Dose	7.36E-03	8.57E-03	7.60E-03	1.10E-02	3.45E-02
	% of Yearly Limit	4.91E-02	1.06E-01	1.57E-01	2.30E-01	5.42E-01

[1] Table 1 demonstrates compliance with 10 CFR Part 50, App. I Limits.

Table 2, Dose Potentially Received by the Likely Most Exposed Member of the Public Outside the Site Boundary During 2022

Exposure Pathway	Dose Type	Dose (mrem)
Fish and Vegetation Consumption	Total Whole Body	No Dose
	Total Maxium 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	1.47E-01
	Thyroid	1.59E-01
	Maximum Organ	Skin: 1.60E-01
	Bone	1.40E-01
Gaseous Effluent (C-14 only)	Total Whole Body	4.52E-02
	Maximum Organ	Bone: 2.27E-01
Direct Radiation	Total Whole Body	0.66E+00

3.0 INTRODUCTION

3.1 About Nuclear Power

Commercial nuclear power plants are generally classified as either Boiling Water Reactors (BWRs) or Pressurized Water Reactors (PWRs), based on their design. Nine Mile Point Units 1 and 2 are BWRs. A BWR includes a single coolant system where water used as reactor coolant boils as it passes through the core and the steam generated is used to turn the turbine generator for power production. A PWR, in contrast, includes two separate water systems: radioactive reactor coolant and a secondary system. Reactor coolant is maintained under high pressure, preventing boiling. The high-pressure coolant is passed through a heat exchanger called a steam generator where the secondary system water is boiled, and the steam is used to turn the turbine generator for power production.

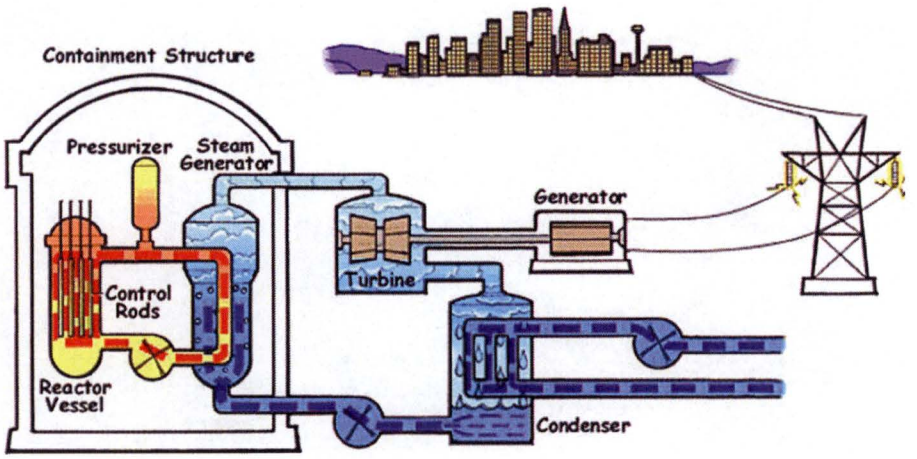

Figure 1, Pressurized Water Reactor (PWR) **[1]**

3.1 (Continued)

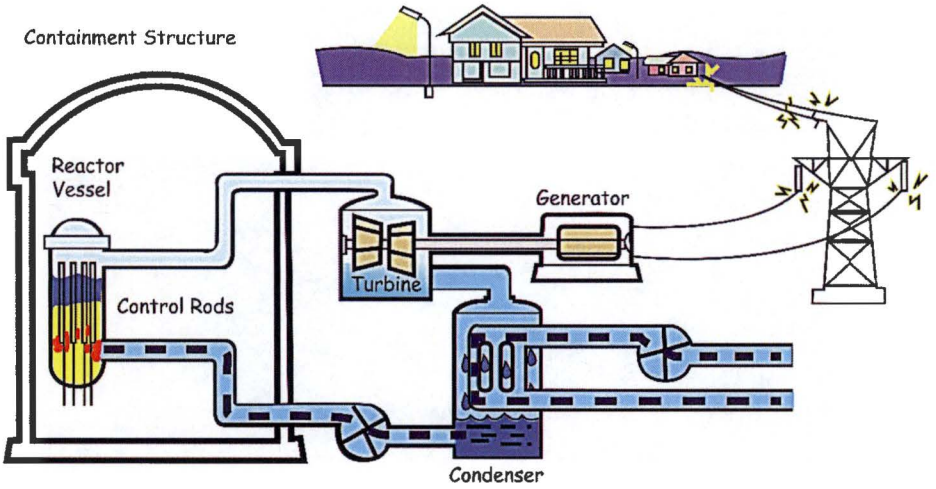

Figure 2, Boiling Water Reactor (BWR) **[2]**

Electricity is generated by a nuclear power plant similarly to the way that electricity is generated at other conventional types of power plants, such as those driven by coal or natural gas. Water is boiled to generate steam; the steam turns a turbine that is attached to a generator and the steam is condensed back into water to be returned to the boiler. What makes nuclear power different from these other types of power plants is that the heat is generated by fission and decay reactions occurring within and around the core containing fissionable uranium (U-235).

Nuclear fission occurs when certain nuclides (primarily U-233, U-235, or Pu-239) absorb a neutron and break into several smaller nuclides (called fission products) as well as some additional neutrons.

Fission results in production of radioactive materials including gases and solids that must be contained to prevent release or treated prior to release. These effluents are generally treated by filtration and/or hold-up prior to release. Releases are generally monitored by sampling and by continuously indicating radiation monitors. The effluent release data is used to calculate doses in order to ensure that dose to the public due to plant operation remains within required limits.

3.2 About Radiation Dose

Ionizing radiation, including alpha, beta, and gamma radiation from radioactive decay, has enough energy to break chemical bonds in tissues and result in damage to tissue or genetic material. The amount of ionization that will be generated by a given exposure to ionizing radiation is quantified as dose. Radiation dose is generally reported in units of millirem (mrem) in the US.

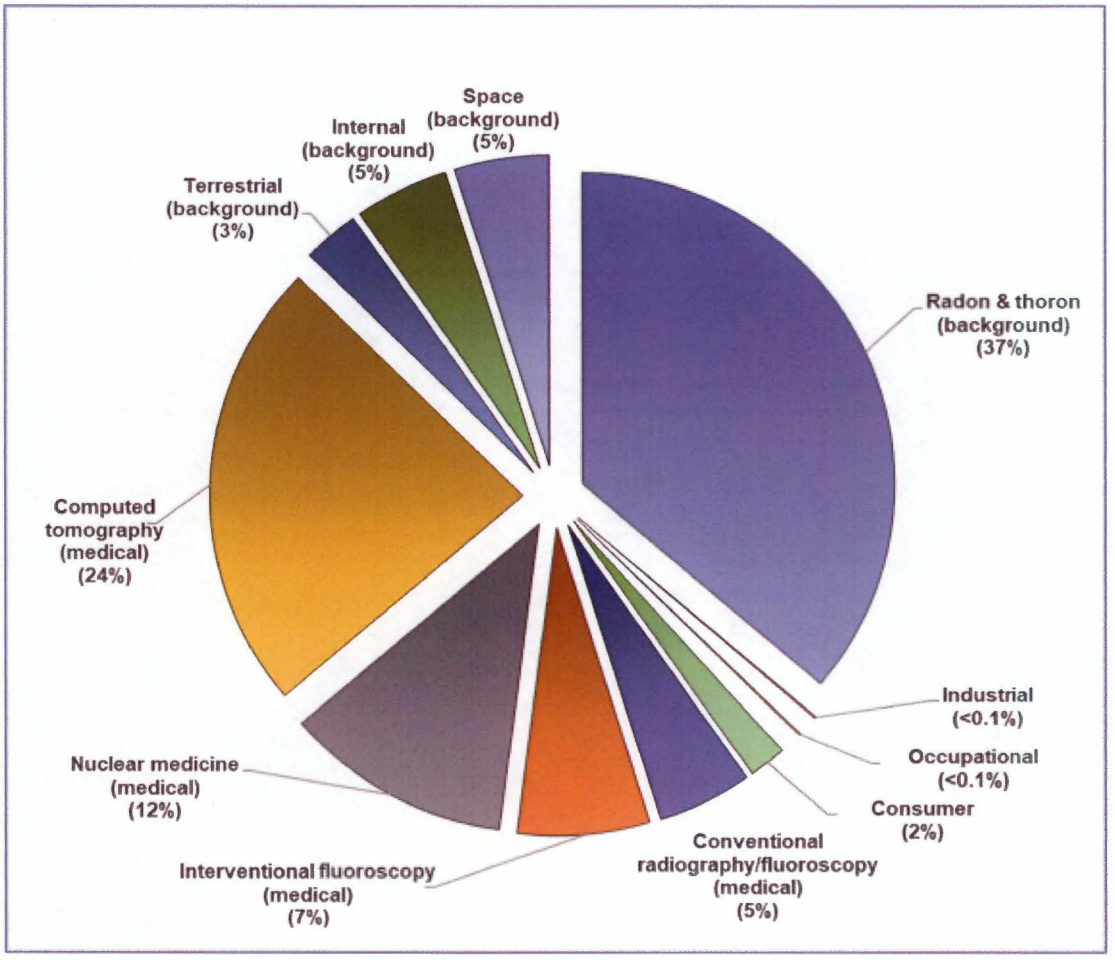

Figure 3, Sources of Radiation Exposure (NCRP Report No. 160) **[3]**

3.2 (Continued)

The National Council on Radiation Protection (NCRP) has evaluated the population dose for the US and determined that the average individual is exposed to approximately 620 mrem per year [3]. There are many sources for radiation dose, ranging from natural background sources to medical procedures, air travel, and industrial processes. Approximately half (310 mrem) of the average exposure is due to natural sources of radiation including exposure to Radon, cosmic radiation, and internal radiation and terrestrial due to naturally occurring radionuclides. The remaining 310 mrem of exposure is due to man-made sources of exposure, with the most significant contributors being medical (48%) due to radiation used in various types of medical scans and treatments. Of the remaining 2% of dose, most is due to consumer activities such as air travel, smoking cigarettes, and building materials. A small fraction of this 2% is due to industrial activities including generation of nuclear power.

Readers that are curious about common sources and effects of radiation dose that they may encounter can find excellent sources of information from the Health Physics Society, including the Radiation Fact Sheets [4], and from the US Nuclear Regulatory Commission website [5].

3.3 About Dose Calculation

Concentrations of radioactive material in the environment resulting from plant operations are very small and it is not possible to determine doses directly using measured activities of environmental samples. To overcome this, Dose Calculations based on measured activities of effluent streams are used to model the dose impact for Members of the Public due to plant operation and effluents. There are several mechanisms that can result in dose to Members of the Public, including: Ingestion of radionuclides in food or water; Inhalation of radionuclides in air; Immersion in a plume of noble gases; and Direct Radiation from the ground, the plant or from an elevated plume.

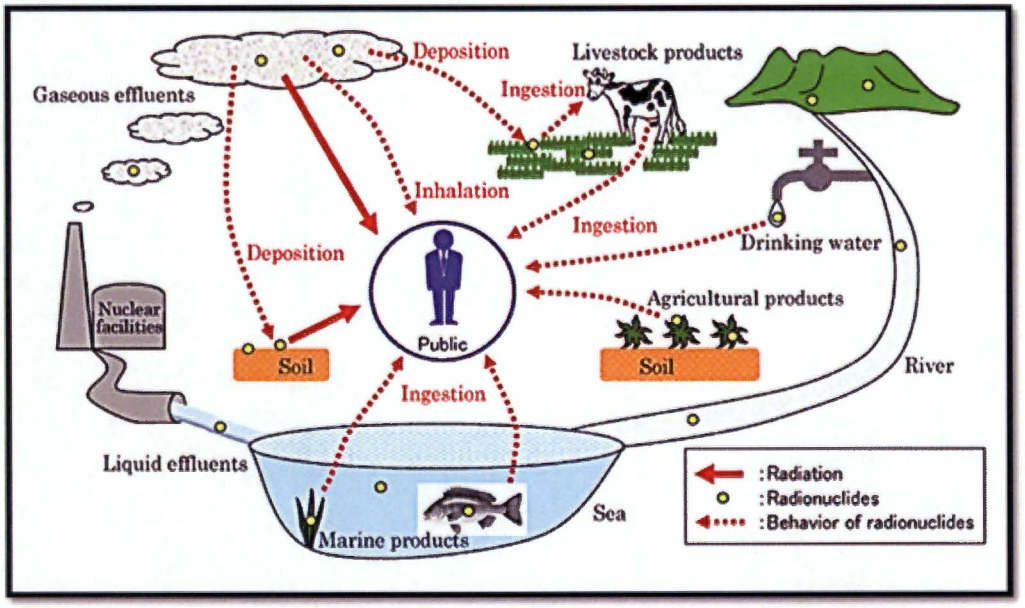

Figure 4, Potential exposure pathways to Members of the Public due to Plant Operations **[6]**

The Offsite Dose Calculation Manual (ODCM) specifies the methodology used to obtain the doses in the Dose Assessment section of this report. The methodology in the ODCM is based on NRC Regulatory Guide 1.109 [7] and NUREG-0133 [8]. Doses are calculated by determining what the nuclide concentration will be in air, water, on the ground, or in food products based on plant effluent releases. Release points are continuously monitored to quantify what concentrations of nuclides are being released. For gaseous releases meteorological data is used to determine how much of the released activity will be present at a given location outside of the plant either deposited onto the ground or in gaseous form. Intake patterns and nuclide bio-concentration factors are used to determine how much activity will be transferred into animal milk or meat. Finally, human ingestion factors and dose factors are used to determine how much activity will be consumed and how much dose the consumer will receive. Inhalation dose is calculated by determining the concentration of nuclides and how much air is breathed by the individual.

3.3 (Continued)

For liquid releases, dilution and mixing factors are used to model the environmental concentrations in water. Drinking water pathways are modeled by determining the concentration of nuclides in the water at the point where the drinking water is sourced. Fish and invertebrate pathways are determined by using concentration at the release point, bioaccumulation factors for the fish or invertebrate and an estimate of the quantity of fish consumed.

Each year a Land Use Census is performed to determine what potential dose pathways currently exist within a five-mile radius around the plant, the area most affected by plant operations. The Annual Land Use Census identifies the locations of vegetable gardens, nearest residences, milk animals and meat animals. The data from the census is used to determine who is the likely to be most exposed to radiation dose as a result of plant operation.

There is significant uncertainty in dose calculation results, due to modeling dispersion of material released and bioaccumulation factors, as well as assumptions associated with consumption and land-use patterns. Even with these sources of uncertainty, the calculations do provide a reasonable estimate of the order of magnitude of the exposure. Conservative assumptions are made in the calculation inputs such as the number of various foods and water consumed, the amount of air inhaled, and the amount of direct radiation exposure from the ground or plume, such that the actual dose received are likely lower than the calculated dose. Even with the built-in conservatism, doses calculated for the highest hypothetical exposed individual due to plant operation are a very small fraction of the annual dose that is received due to other sources. The low calculated doses due to plant effluents, along with REMP results, serve to provide assurance that the site is not having a negative impact on the environment or people living near the plant.

4.0 DOSE ASSESSMENT FOR PLANT OPERATIONS

4.1 Regulatory Limits

Regulatory limits are detailed in Station Licensing documents such as the Offsite Dose Calculation Manual (ODCM). The ODCM document contains the limits to which NMP unit 1 and 2 must adhere. NMP drives to maintain the philosophy to keep dose "as low as reasonably achievable" (ALARA) and actions are taken to reduce the amount of radiation released to the environment. Liquid and gaseous release data show that the dose from NMP is well below the ODCM limits. The concentration of liquid radioactive material released shall be limited to ten times the concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the total concentration released shall be limited to 2.0×10^{-4} (µCi/ml). These data reveals that the radioactive effluents have an overall minimal dose contribution to the surrounding environment.

The annual whole body, skin and organ dose was computed using the 2022 source term using the dose calculation methodology provided in the ODCM. The calculated doses due to gaseous effluents to demonstrate compliance with offsite dose limits are presented in Table 1, Nine Mile Point Unit 1 Dose Summary and Table 2.

4.2 Regulatory Limits for Gaseous Effluent Doses:

1. Fission and activation gases:

   a. Noble gases dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

      1) Less than or equal to 500 mrem/year to the total body

      2) Less than or equal to 3000 mrem/year to the skin

   b. Noble gas air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the site boundary shall be limited to the following:

      1) Quarterly

         a) Less than or equal to 5 mrads gamma

         b) Less than or equal to 10 mrads beta

      2) Yearly

         a) Less than or equal to 10 mrads gamma

         b) Less than or equal to 20 mrads beta

4.2 (Continued)

2. Iodine, tritium, and all radionuclides in particulate form with half-lives greater than 8 days.

   a. The dose rate for iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released from the site to areas at and beyond the site boundary shall be limited to the following:

      1) Less than or equal to 1500 mrem/yr to any organ

   b. 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 8 DAYS in gaseous effluents released, from each reactor unit, to areas at and beyond the site boundary shall be limited to the following:

      1) Quarterly

         a) Less than or equal to 7.5 mrem to any organ

      2) Yearly

         a) Less than or equal to 15 mrem to any organ

4.3 Regulatory Limits for Liquid Effluent Doses

1. The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor unit, to unrestricted areas shall be limited to the following:

   a. Quarterly

      1) Less than or equal to 1.5 mrem total body

      2) Less than or equal to 5 mrem critical organ

   b. Yearly

      1) Less than or equal to 3 mrem total body

      2) Less than or equal to 10 mrem critical organ

4.4 40 CFR 190 Regulatory Dose Limits for a Member of the Public

1. Total Dose (40 CFR 190)

   a. The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC in the unrestricted area due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to the following:

      1) Less than or equal to 25 mrem, Total Body or any Organ except Thyroid.

      2) Less than or equal to 75 mrem, Thyroid.

2. In accordance with NRC memorandum[19] HPPOS-140 PDR-9111210378, Guidance on Reporting Dose to Members of the Public from Normal Operations, updated October 17, 2017, NMP1 dose to the public is less than (<) 2.25 mrem dose to any organ or the total body and less than (<) 1.75 mrem dose to the thyroid. Memorandum can be found on the NRC website: https://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos140.html.

4.5 Onsite Doses (Within Site Boundary)

This section evaluates dose to non-occupationally exposed workers and members of the public that may be onsite for various reasons. The report must include any other information as may be required by the Commission to estimate maximum potential annual radiation doses to the public resulting from effluent releases as required by 10 CFR 50.36a(a)(2). While within controlled or restricted areas, the limits from Sections 4.1 through 4.4 do not apply; however, 10 CFR 20.1301 dose limit of 100 mrem per year TEDE and dose rate limit of 2 mrem per hour from external sources continue to apply. Occupancy times within the controlled areas are generally sufficiently low to compensate for increase in the atmospheric dispersion factor above the site boundary. Groups of concern include fishermen, visitors, and daily contractors. Use of a conservative assumption for fishermen is 8 hours per week for 39-weeks spent inside the site boundary by these groups conservatively represents the most-exposed individual.

Table 3, Onsite Doses (Within Site Boundary)

Release Source	Sector	Approx. Distance (Meters)	X/Q s/m^3 (EC)	X/Q s/m^3 (Stack)	Total Body Dose (mrem)		External Dose	Total
					Noble Gas	Iodine, Particulate, C-14 & H-3	TLD and Gamma	
Combined	W	805	6.63E-06	8.90E-06	*	1.92E-01	6.60E-01	8.52E-01
Note: Combined refers to the combined dose from the stack and reactor building and radwaste. EC – Emergency Condenser								

5.0 SUPPLEMENTAL INFORMATION

5.1 Gaseous Batch Releases

5.1.1 NMP Unit 1

Number of batch releases	0
Total time period for a batch release	0 minutes
Maximum time period for a batch release	0 minutes
Average time period for a batch release	0 minutes
Minimum time period for a batch release	0 minutes

5.2 Liquid Batch Releases

5.2.1 NMP Unit 1

Number of batch releases	0
Total time period for a batch release	0 minutes
Maximum time period for a batch release	0 minutes
Average time period for a batch release	0 minutes
Minimum time period for a batch release	0 minutes
Average total flow during period of release	0 gpm

5.3 Abnormal Releases

5.3.1 Gaseous Abnormal Releases

Number of releases	0
Total activity released	0 Ci

5.3.2 Liquid Abnormal Releases

Number of releases	0
Total activity released	0 Ci

5.4 Land Use Census Changes

There were no significant changes to the Land Use Census in 2022. On site gardens were not operational for routine sampling in 2022.

5.5 Meteorological Data

Meteorology data provided via Murray and Trettel, Inc. report. The Nine Mile Point meteorology tower is primarily used to collect meteorology for both the JAF and NMP power plants. Accordingly, the NMP meteorological monitoring program produced 77,447 hours of valid data out of 78,840 parameter hours during 2022. Data recovery was 98.2%. Calibrations were performed in May, August, and October. Specific sensor and data errors are available upon request.

5.6 Effluent Radiation Monitors Out of Service Greater Than 30 Days

Radiation effluent monitoring equipment was operational throughout the year and there were no periods where radiation monitoring equipment was not operational for longer than 30-days.

5.7 Offsite Dose Calculation Manual (ODCM) Changes

NMP Unit 1 ODCM, CY-NM-170-301 Revision 38 was valid January to December 2022 with no changes required.

5.8 Process Control Program (PCP) Changes

There were no changes to PCP in 2022.

5.9 Radioactive Waste Treatment System Changes

There were no changes to the radioactive waste treatment system in 2022.

5.10 Other Supplemental Information

During 2022, Nine Mile Point Units 1 and 2 had two non-emergency notifications to the NRC:

1. Event 55821 was completed on April 5, 2022.
2. Event 56089 was completed on September 4, 2022.

5.10.1 Outside Tanks

During 2022, there were no external water storage tanks containing radioactive material that leaked onto the ground or storm drain.

5.10.2 Independent Spent Fuel Storage Installation (ISFSI) Monitoring Program

Information concerning the ISFSI monitoring program and 2022 annual dose can be found in the 2022 John A. FitzPatrick Nuclear Power Plant and Nine Mile Point Nuclear Station Annual Radiological Environmental Operating Report published on the Nuclear Regulatory Commission website: https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-specific-reports/nmp1-2.html.

5.10.3 Carbon-14

Carbon-14 (C-14) is a naturally occurring radionuclide with a 5730-year half-life. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. Nuclear power plants also produce C-14, but the amount is infinitesimal compared to what has been distributed in the environment due to weapons testing and what is produced by natural cosmic ray interactions.

In accordance with Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," the NRC recommended re-evaluating "principal radionuclides" and reporting C-14 as appropriate. Carbon-14 production and release estimates were calculated using EPRI Report 1021106, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents". This calculation uses active core coolant mass, average neutron flux by energy and reactor coolant nitrogen concentrations to determine Carbon-14 generation based upon an effective full power year. The estimated generation for NMP Unit 1 during 2022 was 8.84E+00 curies.

Public dose estimates were performed using methodology from the ODCM which is based on Regulatory Guide 1.109 methodology. Carbon dioxide is assumed to make up 20-30% of the Carbon-14 gaseous emissions from the station based upon available references and on-site testing.

5.10.4 Errata/Corrections to Previous ARERRs

There are no corrections to prior ARERRs.

6.0 NEI 07-07 ONSITE RADIOLOGICAL GROUNDWATER MONITORING PROGRAM

Nine Mile Point has developed a Groundwater Protection Initiative (GPI) program in accordance with NEI 07-07, Industry Ground Water Protection Initiative – Final Guidance Document [9]. The purpose of the GPI is to ensure timely detection and an effective response to situations involving inadvertent radiological releases to groundwater in order to prevent migration of licensed radioactive material off-site and to quantify impacts on decommissioning. During 2021, NMP Unit 1 and 2 collected and analyzed groundwater samples in accordance with the site requirements.

This section is included in this report to communicate results of NEI 07-07 Radiological Groundwater Monitoring Program. Monitoring wells installed as part of GPI program are sampled and analyzed annually and quarterly. In addition to reporting results from NEI 07-07 monitoring wells, new voluntary communications made for onsite leaks or spills per NEI 07-07 Objective 2.2, are also reported as part of this report. It is important to note, samples and results taken in support of NEI 07-07 groundwater monitoring program are not part of the Radiological Environmental Monitoring Program (REMP) but should be reported as part of AREOR or ARERR.

- Number of positive detections for Tritium: 6
- Number of analyses: 49
- Number of samples below lower level of detection: 43
- Maximum concentration identified: 381 pCi/L

Table 4, Groundwater Protection Program Monitoring Well Results

Well Name	Type of Analysis	Number of Positive Detections	Number of Analyses	Average Concentration[2] (pCi/L)	Maximum Concentration (pCi/L)
GMX-MW1 (control)	Tritium	0	1	<191	<191
MW-1	Tritium	0	1	<173	<173
MW-5	Tritum	0	4	<182	<194
MW-6	Tritium	0	1	<188	<188
MW-7	Tritium	0	1	<185	<185
MW-8	Tritium	0	4	<184	<184
MW-9 (sentinel well)	Tritium	0	4	<182	<182
MW-10 (sentinel well)	Tritium	1	1	227	227
MW-11	Tritium	0	1	<194	<194
MW-12	Tritium	0	1	<191	<191
MW-13	Tritium	0	1	<189	<189
MW-14 (control)	Tritium	0	1	<181	<181
MW-15	Tritium	1	4	<176	204
MW-16	Tritium	1	1	264	264

[2] Results <MDA should not be included in the average concentration calculation.

Table 4, Groundwater Protection Program Monitoring Well Results

Well Name	Type of Analysis	Number of Positive Detections	Number of Analyses	Average Concentration[2] (pCi/L)	Maximum Concentration (pCi/L)
MW-17	Tritium	0	4	<176	<194
MW-18	Tritium	0	4	<180	<197
MW-19	Tritium	0	1	<179	<179
MW-20	Tritium	0	1	<194	<194
MW-21	Tritium	0	1	<189	<189
NMP2 MAT[1]	Tritium	3	4	<184	**381**
PZ-7	Tritium	0	4	<177	<203
PZ-8	Tritium	0	4	<180	<191

Note 1: NMP2 MAT is the groundwater depression cone. Samples collected from storm drain system, which includes precipitation; likely atmospheric recapture.

6.1 Voluntary Notification

During 2022, Nine Mile Point Units 1 and 2 did not make a voluntary NEI 07-07 notification to State/Local officials, NRC, and to other stakeholders required by site procedures.

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Attachment 1, ARERR Release Summary Tables (RG-1.21 Tables)

1.0 GASEOUS EFFLUENTS

Table 5, Gaseous Effluents Summation of All Releases NMP1

A.	Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1.	Total Release	Ci	*	*	*	*	5.00E+01
2.	Average release rate for the period	µCi/sec	*	*	*	*	
B.	Iodine						
1.	Total Iodine – 131	Ci	8.05E-05	1.04E-04	4.96E-05	8.33E-05	3.00E+01
2.	Average release rate for the period	µCi/sec	1.04E-05	1.32E-05	6.23E-06	1.05E-05	
C.	Particulates						
1.	Particulates with half-lives > 8 days	Ci	2.70E-03	3.11E-03	3.92E-03	5.95E-03	3.00E+01
2.	Average release rate for the period	µCi/sec	3.47E-04	3.95E-04	4.94E-04	7.49E-04	
D.	Tritium						
1.	Total Release	Ci	5.80E+00	1.61E+01	8.35E+00	5.86E+00	5.00E+01
2.	Average release rate for the period	µCi/sec	7.46E-01	2.05E+00	1.05E+00	7.38E-01	
E.	Gross Alpha						
1.	Total Release	Ci	*	*	*	*	5.00E+01
2.	Average release rate for the period	µCi/sec	*	*	*	*	
F.	Carbon-14						
1.	Total Release	Ci	2.18E+00	2.20E+00	2.23E+00	2.23E+00	5.00E+01
2.	Average release rate for the period	µCi/sec	4.41E-02	4.46E-02	4.51E-02	4.50E-02	

% of limit is on Table 1, Nine Mile Point Unit 1 Dose Summary

Table 6, Gaseous Effluents – Ground Level Release Batch Mode NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 7, Gaseous Effluents – Ground Level Release Continuous Mode NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Tritium						
H-3	Ci	8.96E-01	8.87E-01	1.42E+00	7.73E-01	3.98E+00
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 8, Gaseous Effluents – Elevated Level Release Batch Mode NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 9, Gaseous Effluents – Elevated Level Release Continuous Mode NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	8.05E-05	1.04E-04	4.96E-05	8.33E-05	3.18E-04
I-133	Ci	2.83E-03	2.31E-03	1.08E-03	2.26E-03	8.50E-03
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	2.91E-03	2.41E-03	1.13E-03	2.34E-03	**8.82E-03**
Particulates						
Co-58	Ci	8.82E-04	7.76E-04	9.20E-04	1.26E-03	3.84E-03
Co-60	Ci	1.17E-03	1.33E-03	1.57E-03	2.23E-03	6.30E-03
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Mn-54	Ci	1.05E-04	2.01E-04	2.23E-04	2.54E-04	7.83E-04
Fe-55	Ci	3.27E-04	5.23E-04	6.67E-04	4.06E-04	1.92E-03
Zn-65	Ci	1.84E-04	2.59E-04	5.18E-04	7.46E-04	1.71E-03
Cs-137	Ci	3.12E-05	1.47E-05	3.01E-05	1.07E-05	8.67E-05
Ni-63	Ci	*	*	*	1.05E-03	1.05E-03
Ag-110m	Ci	*	4.69E-06	*	*	4.69E-06
Total for Period	**Ci**	2.70E-03	3.11E-03	3.93E-03	5.96E-03	**1.57E-02**
Tritium						
H-3	Ci	4.91E+00	1.52E+01	6.93E+00	5.09E+00	**3.21E+01**
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	2.18E+00	2.20E+00	2.23E+00	2.23E+00	**8.84E+00**

2.0 LIQUID EFFLUENTS

Table 10, Liquid Effluents – Summation of All Releases NMP1

A. Fission & Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1. Total Release	Ci	*	*	*	*	5.00E+01
2. Average diluted concentration	µCi/mL	*	*	*	*	
B. Tritium						
1. Total Release	Ci	*	*	*	*	5.00E+01
2. Average diluted concentration	µCi/mL	*	*	*	*	
C. Dissolved & Entrained Gases						
1. Total Release	Ci	*	*	*	*	5.00E+01
2. Average diluted concentration	µCi/mL	*	*	*	*	
D. Gross Alpha Activity						
1. Total Release	Ci	*	*	*	*	5.00E+01
E. Volume of Waste Released (prior to dilution)	Liters	*	*	*	*	
F. Volume of Dilution Water Used During Period	Liters	1.39E+11	1.36E+11	1.39E+11	1.30E+11	

% of limit is on the Table 1, Nine Mile Point Unit 1 Dose Summary

Table 11, Batch Mode Liquid Effluents NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission and Activation Products						
Cr-51	Ci	*	*	*	*	*
Mn-54	Ci	*	*	*	*	*
Fe-55	Ci	*	*	*	*	*
Fe-59	Ci	*	*	*	*	*
Co-57	Ci	*	*	*	*	*
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Nb-95	Ci	*	*	*	*	*
Zn-65	Ci	*	*	*	*	*
Ag-110m	Ci	*	*	*	*	*
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Cs-137	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Entrained Gases						
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*

Table 12, Continuous Mode Liquid Effluents NMP1

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission and Activation Products						
Cr-51	Ci	*	*	*	*	*
Mn-54	Ci	*	*	*	*	*
Fe-55	Ci	*	*	*	*	*
Fe-59	Ci	*	*	*	*	*
Co-57	Ci	*	*	*	*	*
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Nb-95	Ci	*	*	*	*	*
Zn-65	Ci	*	*	*	*	*
Ag-110m	Ci	*	*	*	*	*
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Cs-137	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Entrained Gases						
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*

Attachment 2, Solid Waste Information

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

Table 13, Types of Solid Waste Summary NMP Unit 1

Types of Waste	Total Volume (m3)	Total Activity (Ci)	Est. Total Error (%)
a. Spent resins, filter sludges, evaporator bottoms, etc.	3.30E+01	3.47E+02	25
b. Dry compressible waste, contaminated equip, etc.	0.00E+00	0.00E+00	25
c. Irradiated components, control rods, etc.	0.00E+00	0.00E+00	25
d. Other (None reported)	0.00E+00	0.00E+00	25

2.0 ESTIMATE OF MAJOR NUCLIDE COMPOSITION (BY WASTE TYPE) ONLY >1% ARE REPORTED. [NOTE 1]

Table 14, Major Nuclides NMP Unit 1

Major Nuclide Composition	Isotope	%	Curies
a. Spent resins, filter sludges, evaporator bottoms, etc.	Co-60	79.39	2.75E+02
C-14 <1 % (3.33E-01 curies)	Fe-55	13.2	4.58E+01
Zn-65 <1% 93.02E-01 curies)	Cs-137	3.09	1.07E+01
*	Mn-54	2.31	8.00E+00
b. Dry compressible waste, contaminated equip, etc.	*	0	00E+00
c. Irradiated components, control rods, etc.	*	0	00E+00
d. Other (describe)	*	0	00E+00

3.0 SOLID WASTE DISPOSITION

Table 15, Solid Waste Disposition NMP Unit 1

Number of Shipments	Mode of Transportation	Destination
5	NRC Class: A; DOT Type: A LSA-II	Energy Solutions Clive (CWF Containerized Waste Facility)
3	NRC Class: B, DOT Type: B	Waste Control Specialists LLC (CWF Facility)

4.0 IRRADIATED FUEL DISPOSITION

Table 16, Irradiated Fuel Shipments Disposition NMP Unit 1

Number of Shipments	Mode of Transportation	Destination
0	*	*

Attachment 3, Meteorological Data

1.0 METEOROLOGICAL DATA SUMMARY

1.1 Joint Frequency Distributions

1. Period of Record: 2022
2. Stability Class: All
   a. Periods of calm (hours): 12
   b. Hours of missing data: 155 hours
   c. Meteorological data quality 98.2% for all stability classes and parameters.
   d. Total annual precipitation: 27.32 inches
3. Elevation: 200 ft.

Wind Speed Range (m/s)												
Wind Direction	<0.5	0.5 1.0	1.1 1.5	1.6 2.0	2.1 3.0	3.1 4.0	4.1 5.0	5.1 6.0	6.1 8.0	8.1 10.0	>10.0	Total
N	0	4	12	17	40	58	43	27	54	19	44	318
NNE	1	2	8	9	38	67	34	47	99	50	116	471
NE	0	4	12	20	50	51	46	44	40	25	12	304
ENE	0	3	10	21	39	47	10	4	6	0	0	140
E	0	2	10	11	58	65	22	12	17	0	0	197
ESE	1	4	3	13	37	65	55	42	48	17	7	292
SE	0	3	9	10	35	96	103	113	303	116	38	826
SSE	0	1	6	10	27	114	80	132	355	125	44	894
S	0	5	3	11	25	95	109	132	344	108	45	877
SSW	1	3	6	6	31	76	109	133	210	21	1	597
SW	1	4	6	15	26	74	68	86	163	48	20	510
WSW	0	4	9	11	38	104	82	106	206	110	150	820
W	0	4	7	18	37	103	63	70	143	123	288	856
WNW	1	3	9	12	34	67	34	23	101	82	221	587
NW	1	5	4	9	38	42	40	41	116	84	141	521
NNW	1	3	12	13	43	44	34	26	82	45	46	349
Total	7	54	126	206	595	1168	932	1038	2287	973	1173	8559

1.2 Stability class

Table 17, Classification of Atmospheric Stability

Stability Condition	Pasquill Categories	Hours	Percentage
Extremely Unstable	A	969	11.3%
Moderately Stable	B	568	6.6%
Slightly Unstable	C	722	8.4%
Neutral	D	3306	38.6%
Slightly Stable	E	1865	21.8%
Moderately Stable	F	610	7.1%
Extremely Stable	G	519	6.1%

Note: Percentage is calculated based on the 200ft winds and 200ft-30ft stability hourly data for the year (8559 hours of valid data).

ENCLOSURE 2

Nine Mile Point Nuclear Station, Unit 2

Radiological Effluent Release Report, January - December 2022

Constellation

Nine Mile Point

Annual Radioactive Effluent Release Report 2022

Document Number: NMP1L3522

TABLE OF CONTENTS

TABLES

1.0 LIST OF ACRONYMS AND DEFINITIONS

1. Airborne Activity Sampling: Sampling of air through the collection of particulates and radionuclides on filter media, collection of noble gases in a container, and collection of water vapor containing tritium.

2. Alpha Particle (α): A charged particle emitted from the nucleus of an atom having a mass and charge equal in magnitude of a helium nucleus.

3. BWR: Boiling Water Reactor

4. Composite Sample: A series of single collected portions (aliquots) analyzed as one sample. The aliquots making up the sample are collected at time intervals that are very short compared to the composite period.

5. Control: A sampling station in a location not likely to be affected by plant effluents due to its distance and/or direction from the Plant.

6. Counting Error: An estimate of the two-sigma uncertainty associated with the sample results based on total counts accumulated.

7. Curie (Ci): A measure of radioactivity; equal to 3.7×10^{10} disintegrations per second, or 2.22×10^{12} disintegrations per minute.

8. Direct Radiation Monitoring: The measurement of radiation dose at various distances from the plant is assessed using thermoluminescent dosimeters (TLDs), optically stimulated luminescent dosimeters (OSLDs), and/or pressurized ionization chambers.

9. Grab Sample: A single discrete sample drawn at one point in time.

10. Indicator: A sampling location that is likely to be affected by plant effluents due to its proximity and/or direction from the plant.

11. Ingestion Pathway: The ingestion pathway includes milk, fish, and garden produce. Meat or other food products may also be included.

12. ISFSI: Independent Spent Fuel Storage Installation

13. Lower Limit of Detection (LLD): The smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with a 5% probability of a false conclusion that a blank observation represents "real" signal.

14. MDA: Minimum Detectable Activity. - For radiochemistry instruments, the MDA is the a posteriori minimum concentration that a counting system detects. The smallest concentration or activity of radioactive material in a sample that will yield a net count above instrument background and that is detected with 95% probability, with only five % probability of falsely concluding that a blank observation represents a true signal.

15. MDC: Minimum Detectable Concentration, essentially synonymous with MDA for the purposes of radiological monitoring.

16. Mean: The average, i.e., the sum of results divided by the number of results.

17. Microcurie (µCi): 3.7×10^4 disintegrations per second, or 2.22×10^6 disintegrations per minute.

18. millirem (mrem): 1/1000 rem; a unit of radiation dose equivalent in tissue.

19. Milliroentgen (mR): 1/1000 Roentgen; a unit of exposure to X- or gamma radiation.

20. MWe: Megawatts Electric

21. MWTh: Megawatts Thermal

22. NA: Not Applicable

23. NEI: Nuclear Energy Institute

24. NRC: Nuclear Regulatory Commission

25. ODCM: Offsite Dose Calculation Manual

26. OSLD: Optically Stimulated Luminescence Dosimeter

27. Protected Area: The fenced area immediately surrounding the Plant. Access to the protected area requires a security badge or escort.

28. PWR: Pressurized Water Reactor

29. REC: Radiological Effluent Control

30. REMP: Radiological Environmental Monitoring Program

31. Restricted Area: Any area where access is controlled for the purpose of protecting individuals from exposure to radiation or radioactive materials.

32. SLCs: Selected Licensee Commitments

33. TEDE: Total Effective Dose Equivalent (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

34. TLD: Thermoluminescent Dosimeter

35. TRM: Technical Requirements Manual

36. TS: Technical Specification

2.0 EXECUTIVE SUMMARY

Nine Mile Point Unit 2 (NMP2) Radiological Effluent Control (REC) Program was established to limit the quantities of radioactive material that may be released based on calculated radiation doses or dose rates. Dose to Members of the Public due to radioactive materials released from the plant is limited by Appendix I of 10 CFR 50 and by 40 CFR 190. Operational doses to the public during 2022 were calculated to be very small compared to the limits required by regulation and compared to other sources of radiation dose and pose no health hazard. These doses are summarized and compared to the regulatory limits in Section 2.1, Comparison to Regulatory Limits, below.

The Annual Radioactive Effluent Release Report (ARERR) is published per NMP requirements and provides data related to plant operation, including: quantities of radioactive materials released in liquid and gaseous effluents; radiation doses to members of the public; solid radioactive waste shipped offsite for disposal; and other information as required by site licensing documents.

In 2022 the Land Use Census dose assessments due to radioactive gaseous effluents showed that the critical receptor for Nine Mile Point Unit 2 is child, due to C-14, at the nearest resident. The maximum Annual Organ Dose calculated for this receptor was 3.67E-01 mrem to the bone. This annual dose is a small fraction of the 10 CFR 50, Appendix I guideline of 15 mrem to the Maximum Organ per reactor unit

Solid radioactive waste shipped offsite for disposal included 1.89E+01 Curies and 5.73E+02 m^3, shipped in twenty-one shipments.

In addition to monitoring radioactive effluents, NMP has a Radiological Environmental Monitoring Program (REMP) that monitors for buildup of radioactivity in the offsite environment. Data from the REMP is published in the John A. FitzPatrick Nuclear Power Plant and Nine Mile Point Nuclear Station Annual Radiological Environmental Operating Report (AREOR).

2.1 Comparison to Regulatory Limits

During 2022 all solid, liquid, and gaseous radioactive effluents from Nine Mile Point Unit 2 were well below regulatory limits, as summarized in Table 1 and Table 2.

Table 1, Nine Mile Point Unit 2 Dose Summary[1]

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liquid Effluent Dose Limit, Total Body	Limit	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
	Total Body Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	*
Liquid Effluent Dose Limit, Any Organ	Limit	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
	Max Organ Dose	00E+00	00E+00	00E+00	00E+00	00E+00
	% of Yearly Limit	*	*	*	*	
Gaseous Effluent Dose Limit, Gamma Air (Noble Gas)	Limit	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
	Gamma Air Dose	00E+00	00E+00	3.65E-04	00E+00	5.55E-04
	% of Yearly Limit	*	*	<1.0E-02	*	5.55E-03
Gaseous Effluent Dose Limit, Beta Air (Noble Gas)	Limit	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
	Beta Air Dose	00E+00	00E+00	1.13E-05	00E+00	5.15E-05
	% of Yearly Limit	*	*	<1.0E-02	*	2.58E-04
Gaseous Effluent Organ Dose Limit (Iodine, Tritium, Particulates with > 8-day half-life)	Limit	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
	Max Organ Dose	1.34E-02	9.79E-03	9.23E-01	8.43E-01	1.79E+00
	% of Yearly Limit	6.68E-03	1.03E-02	4.67E-01	8.89E-01	1.37E+00

[1] Table 1 demonstrates compliance with 10 CFR Part 50, App. I Limits.

Table 2, Dose Potentially Received by the Likely Most Exposed Member of the Public Outside the Site Boundary During 2022

Exposure Pathway	Dose Type	Dose (mrem)
Fish and Vegetation Consumption	Total Whole Body	No Dose
	Total Maxium 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	1.47E-01
	Thyroid	1.59E-01
	Maximum Organ	Skin: 1.60E-01
	Bone	1.40E-01
Gaseous Effluent (C-14 only)	Total Whole Body	4.52E-02
	Maximum Organ	Bone: 2.27E-01
Direct Radiation	Total Whole Body	0.66E+00

3.0 INTRODUCTION

3.1 About Nuclear Power

Commercial nuclear power plants are generally classified as either Boiling Water Reactors (BWRs) or Pressurized Water Reactors (PWRs), based on their design. Nine Mile Point Units 1 and 2 are BWRs. A BWR includes a single coolant system where water used as reactor coolant boils as it passes through the core and the steam generated is used to turn the turbine generator for power production. A PWR, in contrast, includes two separate water systems: radioactive reactor coolant and a secondary system. Reactor coolant is maintained under high pressure, preventing boiling. The high-pressure coolant is passed through a heat exchanger called a steam generator where the secondary system water is boiled, and the steam is used to turn the turbine generator for power production.

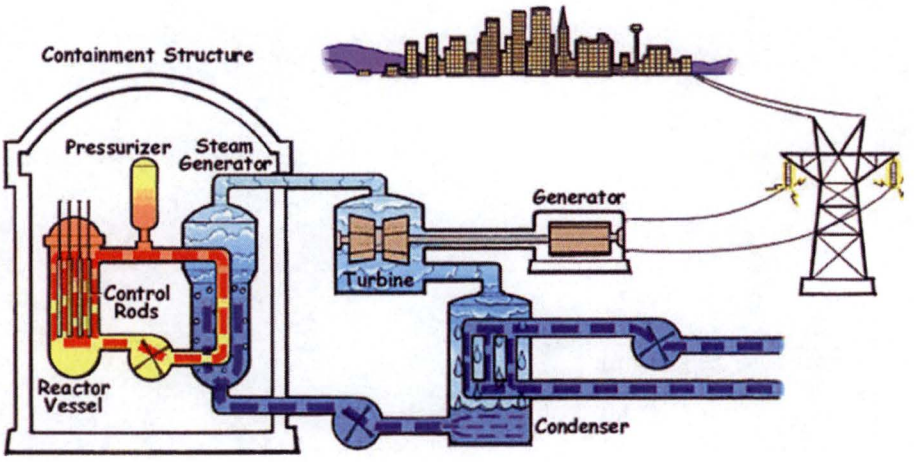

Figure 1, Pressurized Water Reactor (PWR) **[1]**

3.1 (Continued)

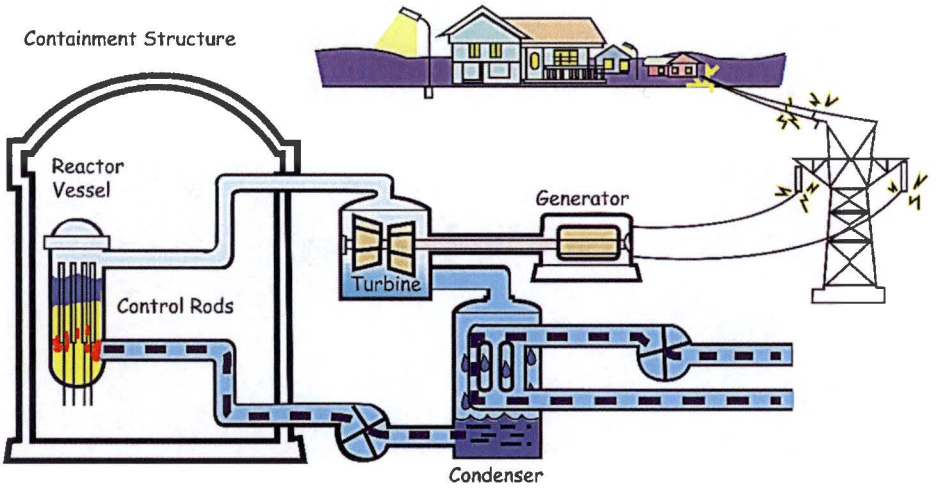

Figure 2, Boiling Water Reactor (BWR) **[2]**

Electricity is generated by a nuclear power plant similarly to the way that electricity is generated at other conventional types of power plants, such as those driven by coal or natural gas. Water is boiled to generate steam; the steam turns a turbine that is attached to a generator and the steam is condensed back into water to be returned to the boiler. What makes nuclear power different from these other types of power plants is that the heat is generated by fission and decay reactions occurring within and around the core containing fissionable uranium (U-235).

Nuclear fission occurs when certain nuclides (primarily U-233, U-235, or Pu-239) absorb a neutron and break into several smaller nuclides (called fission products) as well as some additional neutrons.

Fission results in production of radioactive materials including gases and solids that must be contained to prevent release or treated prior to release. These effluents are generally treated by filtration and/or hold-up prior to release. Releases are generally monitored by sampling and by continuously indicating radiation monitors. The effluent release data is used to calculate doses in order to ensure that dose to the public due to plant operation remains within required limits.

3.2 About Radiation Dose

Ionizing radiation, including alpha, beta, and gamma radiation from radioactive decay, has enough energy to break chemical bonds in tissues and result in damage to tissue or genetic material. The amount of ionization that will be generated by a given exposure to ionizing radiation is quantified as dose. Radiation dose is generally reported in units of millirem (mrem) in the US.

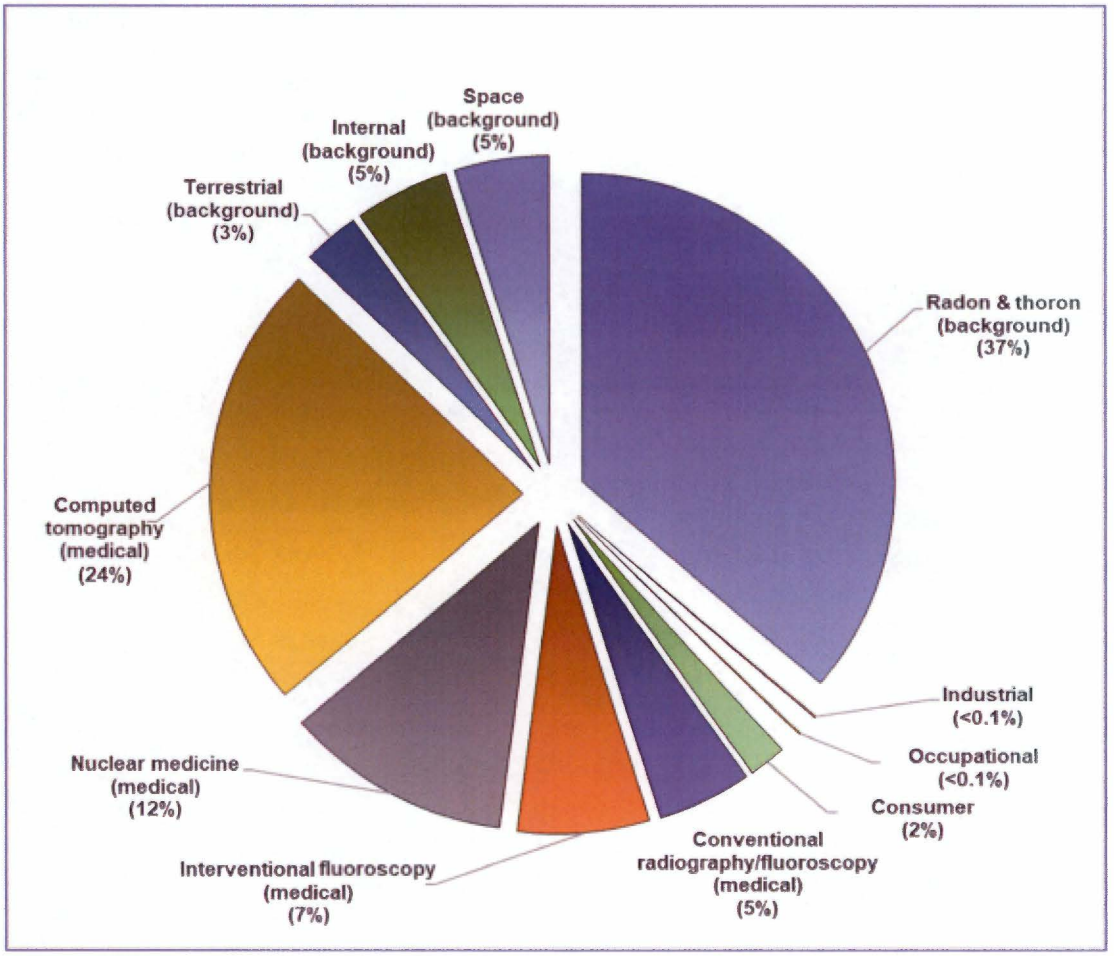

Figure 3, Sources of Radiation Exposure (NCRP Report No. 160) **[3]**

3.2 (Continued)

The National Council on Radiation Protection (NCRP) has evaluated the population dose for the US and determined that the average individual is exposed to approximately 620 mrem per year [3]. There are many sources for radiation dose, ranging from natural background sources to medical procedures, air travel, and industrial processes. Approximately half (310 mrem) of the average exposure is due to natural sources of radiation including exposure to Radon, cosmic radiation, and internal radiation and terrestrial due to naturally occurring radionuclides. The remaining 310 mrem of exposure is due to man-made sources of exposure, with the most significant contributors being medical (48%) due to radiation used in various types of medical scans and treatments. Of the remaining 2% of dose, most is due to consumer activities such as air travel, smoking cigarettes, and building materials. A small fraction of this 2% is due to industrial activities including generation of nuclear power.

Readers that are curious about common sources and effects of radiation dose that they may encounter can find excellent sources of information from the Health Physics Society, including the Radiation Fact Sheets [4], and from the US Nuclear Regulatory Commission website [5].

3.3 About Dose Calculation

Concentrations of radioactive material in the environment resulting from plant operations are very small and it is not possible to determine doses directly using measured activities of environmental samples. To overcome this, Dose Calculations based on measured activities of effluent streams are used to model the dose impact for Members of the Public due to plant operation and effluents. There are several mechanisms that can result in dose to Members of the Public, including: Ingestion of radionuclides in food or water; Inhalation of radionuclides in air; Immersion in a plume of noble gases; and Direct Radiation from the ground, the plant or from an elevated plume.

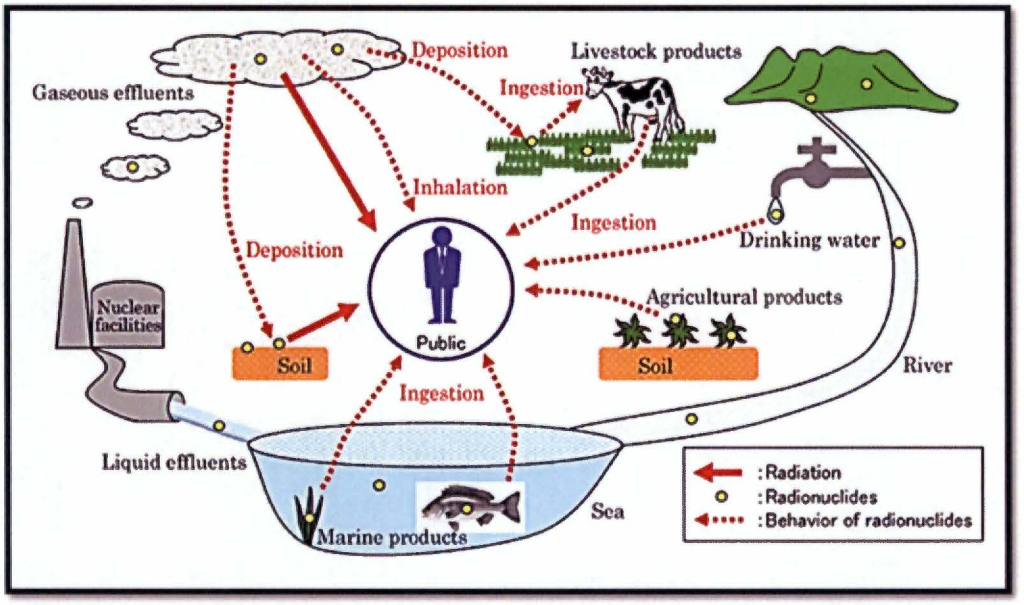

Figure 4, Potential exposure pathways to Members of the Public due to Plant Operations **[6]**

The Offsite Dose Calculation Manual (ODCM) specifies the methodology used to obtain the doses in the Dose Assessment section of this report. The methodology in the ODCM is based on NRC Regulatory Guide 1.109 [7] and NUREG-0133 [8]. Doses are calculated by determining what the nuclide concentration will be in air, water, on the ground, or in food products based on plant effluent releases. Release points are continuously monitored to quantify what concentrations of nuclides are being released. For gaseous releases meteorological data is used to determine how much of the released activity will be present at a given location outside of the plant either deposited onto the ground or in gaseous form. Intake patterns and nuclide bio-concentration factors are used to determine how much activity will be transferred into animal milk or meat. Finally, human ingestion factors and dose factors are used to determine how much activity will be consumed and how much dose the consumer will receive. Inhalation dose is calculated by determining the concentration of nuclides and how much air is breathed by the individual.

3.3 (Continued)

For liquid releases, dilution and mixing factors are used to model the environmental concentrations in water. Drinking water pathways are modeled by determining the concentration of nuclides in the water at the point where the drinking water is sourced. Fish and invertebrate pathways are determined by using concentration at the release point, bioaccumulation factors for the fish or invertebrate and an estimate of the quantity of fish consumed.

Each year a Land Use Census is performed to determine what potential dose pathways currently exist within a five-mile radius around the plant, the area most affected by plant operations. The Annual Land Use Census identifies the locations of vegetable gardens, nearest residences, milk animals and meat animals. The data from the census is used to determine who is the likely to be most exposed to radiation dose as a result of plant operation.

There is significant uncertainty in dose calculation results, due to modeling dispersion of material released and bioaccumulation factors, as well as assumptions associated with consumption and land-use patterns. Even with these sources of uncertainty, the calculations do provide a reasonable estimate of the order of magnitude of the exposure. Conservative assumptions are made in the calculation inputs such as the number of various foods and water consumed, the amount of air inhaled, and the amount of direct radiation exposure from the ground or plume, such that the actual dose received are likely lower than the calculated dose. Even with the built-in conservatism, doses calculated for the highest hypothetical exposed individual due to plant operation are a very small fraction of the annual dose that is received due to other sources. The low calculated doses due to plant effluents, along with REMP results, serve to provide assurance that the site is not having a negative impact on the environment or people living near the plant.

4.0 DOSE ASSESSMENT FOR PLANT OPERATIONS

4.1 Regulatory Limits

Regulatory limits are detailed in Station Licensing documents such as the Offsite Dose Calculation Manual (ODCM). The ODCM document contains the limits to which NMP unit 1 and 2 must adhere. NMP drives to maintain the philosophy to keep dose "as low as reasonably achievable" (ALARA) and actions are taken to reduce the amount of radiation released to the environment. Liquid and gaseous release data show that the dose from NMP is well below the ODCM limits. The concentration of liquid radioactive material released shall be limited to ten times the concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the total concentration released shall be limited to 2.0×10^{-4} µCi/ml. These data reveals that the radioactive effluents have an overall minimal dose contribution to the surrounding environment.

The annual whole body, skin and organ dose was computed using the 2022 source term using the dose calculation methodology provided in the ODCM. The calculated doses due to gaseous effluents to demonstrate compliance with offsite dose limits are presented in Table 1, Nine Mile Point Unit 1 Dose Summary and Table 2.

4.2 Regulatory Limits for Gaseous Effluent Doses:

1. Fission and activation gases:

    a. Noble gases dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

        1) Less than or equal to 500 mrem/year to the total body

        2) Less than or equal to 3000 mrem/year to the skin

    b. Noble gas air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the site boundary shall be limited to the following:

        1) Quarterly

            a) Less than or equal to 5 mrads gamma

            b) Less than or equal to 10 mrads beta

        2) Yearly

            a) Less than or equal to 10 mrads gamma

            b) Less than or equal to 20 mrads beta

4.2 (Continued)

2. Iodine, tritium, and all radionuclides in particulate form with half-lives greater than 8 days.

   a. The dose rate for iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released from the site to areas at and beyond the site boundary shall be limited to the following:

      1) Less than or equal to 1500 mrem/yr to any organ

   b. 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 8 DAYS in gaseous effluents released, from each reactor unit, to areas at and beyond the site boundary shall be limited to the following:

      1) Quarterly

         a) Less than or equal to 7.5 mrem to any organ

      2) Yearly

         a) Less than or equal to 15 mrem to any organ

4.3 Regulatory Limits for Liquid Effluent Doses

1. The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor unit, to unrestricted areas shall be limited to the following:

   a. Quarterly

      1) Less than or equal to 1.5 mrem total body

      2) Less than or equal to 5 mrem critical organ

   b. Yearly

      1) Less than or equal to 3 mrem total body

      2) Less than or equal to 10 mrem critical organ

4.4 40 CFR 190 Regulatory Dose Limits for a Member of the Public

1. Total Dose (40 CFR 190)

   a. The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC in the unrestricted area due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to the following:

      1) Less than or equal to 25 mrem, Total Body or any Organ except Thyroid.

      2) Less than or equal to 75 mrem, Thyroid.

2. In accordance with NRC memorandum[19] HPPOS-140 PDR-9111210378, Guidance on Reporting Dose to Members of the Public from Normal Operations, updated October 17, 2017, NMP2 dose to the public is less than (<) 2.25 mrem dose to any organ or the total body and less than (<) 1.75 mrem dose to the thyroid. Memorandum can be found on the NRC website: https://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos140.html.

4.5 Onsite Doses (Within Site Boundary)

This section evaluates dose to non-occupationally exposed workers and members of the public that may be onsite for various reasons. The report must include any other information as may be required by the Commission to estimate maximum potential annual radiation doses to the public resulting from effluent releases as required by 10 CFR 50.36a(a)(2). While within controlled or restricted areas, the limits from Sections 4.1 through 4.4 do not apply; however, 10 CFR 20.1301 dose limit of 100 mrem per year TEDE and dose rate limit of 2 mrem per hour from external sources continue to apply. Occupancy times within the controlled areas are generally sufficiently low to compensate for increase in the atmospheric dispersion factor above the site boundary. Groups of concern include fishermen, visitors, and daily contractors. Use of a conservative assumption for fishermen is 8 hours per week for 39-weeks spent inside the site boundary by these groups conservatively represents the most-exposed individual.

Table 3, Onsite Doses (Within Site Boundary)

Effluent Source	Sector	Approx. Distance (Meters)	X/Q s/m^3 (Vent)	X/Q s/m^3 (Stack)	Total Body Dose		External Dose	Total
					Noble Gas (mrem)	Iodine, Particulate, C-14 & H-3 (mrem)	TLD and Gamma	
Combined	W	805	2.80e-06	9.60E-07	4.21E-04	1.81E+00	6.60E-01	2.47E+00
Note: combined refers to the combined dose from the stack and reactor building and radwaste.								

5.0 SUPPLEMENTAL INFORMATION

5.1 Gaseous Batch Releases

5.1.1 NMP Unit 2

Number of batch releases	4
Total time period for a batch release	354 minutes
Maximum time period for a batch release	127 minutes
Average time period for a batch release	89 minutes
Minimum time period for a batch release	50 minutes

5.2 Liquid Batch Releases

5.2.1 NMP Unit 2

Number of batch releases	0
Total time period for a batch release	0 minutes
Maximum time period for a batch release	0 minutes
Average time period for a batch release	0 minutes
Minimum time period for a batch release	0 minutes
Average total flow during period of release	0 gpm

5.3 Abnormal Releases

5.3.1 Gaseous Abnormal Releases

Number of releases	0
Total activity released	0 Ci

5.3.2 Liquid Abnormal Releases

Number of releases	0
Total activity released	0 Ci

5.4 Land Use Census Changes

There were no significant changes to the Land Use Census in 2022. On site gardens were not operational for routine sampling in 2022.

5.5 Meteorological Data

Meteorology data provided via Murray and Trettel, Inc. report. The Nine Mile Point meteorology tower was used to collect meteorology for both the JAF and NMP power plants. Accordingly, NMP meteorological monitoring program produced 77,447 hours of valid data out of 78,840 parameter hours during 2022. Data recovery was 98.2%. Calibrations were performed in May, August, and October. Specific sensor and data collection errors are available upon request.

5.6 Effluent Radiation Monitors Out of Service Greater Than 30 Days

Radiation effluent monitoring equipment was operational throughout the year and there were no periods where radiation monitoring equipment was not operational for longer than 30-days.

5.7 Offsite Dose Calculation Manual (ODCM) Changes

NMP Unit 2 ODCM, CY-AA-170-3100 Revision 37 was valid January to December 2022 with no changes required.

5.8 Process Control Program (PCP) Changes

There were no changes to PCP in 2022.

5.9 Radioactive Waste Treatment System Changes

There were no changes to the radioactive waste treatment system in 2022.

5.10 Other Supplemental Information

a. During 2022, Nine Mile Point Units 1 and 2 had two non-emergency notifications to the NRC:

   1. Event 55821 was completed on April 5, 2022.

   2. Event 56089 was completed on September 4, 2022.

b. At the time of this report development, an anomaly was identified with gaseous effluent results for isotopes Sr-89, Sr-90, and Fe-55 from ground and elevated releases and integration with dose calculation software. NMP acknowledges these results and conservatively reports these isotopes. Future amendments to the 2022 NMP Unit 2 ARERR may occur, if the results for these three isotopes were identified as errors in accordance with RG 1.21 rev 3, section 7.0.

5.10.1 Outside Tanks

During 2022, there were no external water storage tanks containing radioactive material that leaked onto the ground or storm drain.

5.10.2 Independent Spent Fuel Storage Installation (ISFSI) Monitoring Program

Information concerning the ISFSI monitoring program and 2022 annual dose can be found in the 2022 John A. FitzPatrick Nuclear Power Plant and Nine Mile Point Nuclear Station Annual Radiological Environmental Operating Report published on the Nuclear Regulatory Commission website: https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-specific-reports/nmp1-2.html.

5.10.3 Carbon-14

Carbon-14 (C-14) is a naturally occurring radionuclide with a 5730-year half-life. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. Nuclear power plants also produce C-14, but the amount is infinitesimal compared to what has been distributed in the environment due to weapons testing and what is produced by natural cosmic ray interactions.

In accordance with Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," the NRC recommended re-evaluating "principal radionuclides" and reporting C-14 as appropriate. Carbon-14 production and release estimates were calculated using EPRI Report 1021106, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents". This calculation uses active core coolant mass, average neutron flux by energy and reactor coolant nitrogen concentrations to determine Carbon-14 generation based upon an effective full power year. The estimated generation for unit 2 during 2022 was 1.68E+01 curies.

Public dose estimates were performed using methodology from the ODCM which is based on Regulatory Guide 1.109 methodology. Carbon dioxide is assumed to make up 20-30% of the Carbon-14 gaseous emissions from the station based upon available references and on-site testing.

5.10.4 Errata/Corrections to Previous ARERRs

There are no corrections to prior ARERRs.

6.0 NEI 07-07 ONSITE RADIOLOGICAL GROUNDWATER MONITORING PROGRAM

Nine Mile Point has developed a Groundwater Protection Initiative (GPI) program in accordance with NEI 07-07, Industry Ground Water Protection Initiative – Final Guidance Document [9]. The purpose of the GPI is to ensure timely detection and an effective response to situations involving inadvertent radiological releases to groundwater in order to prevent migration of licensed radioactive material off-site and to quantify impacts on decommissioning. During 2022, NMP Unit 1 and 2 collected and analyzed groundwater samples in accordance with the site requirements.

This section is included in this report to communicate results of NEI 07-07 Radiological Groundwater Monitoring Program. Monitoring wells installed as part of GPI program are sampled and analyzed annually and quarterly. In addition to reporting results from NEI 07-07 monitoring wells, new voluntary communications made for onsite leaks or spills per NEI 07-07 Objective 2.2, are also reported as part of this report. It is important to note, samples and results taken in support of NEI 07-07 groundwater monitoring program are not part of the Radiological Environmental Monitoring Program (REMP) but should be reported as part of AREOR or ARERR.

- Number of positive detections for Tritium: 6
- Number of analyses: 49
- Number of samples below lower level of detection: 43
- Maximum concentration identified: 381 pCi/L

Table 4, Groundwater Protection Program Monitoring Well Results

Well Name	Type of Analysis	Number of Positive Detections	Number of Analyses	Average Concentration[2] (pCi/L)	Maximum Concentration (pCi/L)
GMX-MW1 (control)	Tritium	0	1	<191	<191
MW-1	Tritium	0	1	<173	<173
MW-5	Tritum	0	4	<182	<194
MW-6	Tritium	0	1	<188	<188
MW-7	Tritium	0	1	<185	<185
MW-8	Tritium	0	4	<184	<184
MW-9 (sentinel well)	Tritium	0	4	<182	<182
MW-10 (sentinel well)	Tritium	1	1	227	227
MW-11	Tritium	0	1	<194	<194
MW-12	Tritium	0	1	<191	<191
MW-13	Tritium	0	1	<189	<189
MW-14 (control)	Tritium	0	1	<181	<181
MW-15	Tritium	1	4	<176	204
MW-16	Tritium	1	1	264	264

[2] Results <MDA should not be included in the average concentration calculation.

Table 4, Groundwater Protection Program Monitoring Well Results

Well Name	Type of Analysis	Number of Positive Detections	Number of Analyses	Average Concentration[2] (pCi/L)	Maximum Concentration (pCi/L)
MW-17	Tritium	0	4	<176	<194
MW-18	Tritium	0	4	<180	<197
MW-19	Tritium	0	1	<179	<179
MW-20	Tritium	0	1	<194	<194
MW-21	Tritium	0	1	<189	<189
NMP2 MAT[1]	Tritium	3	4	<184	**381**
PZ-7	Tritium	0	4	<177	<203
PZ-8	Tritium	0	4	<180	<191

Note 1: NMP2 MAT is the groundwater depression cone. Samples collected from storm drain system, which includes precipitation; likely atmospheric recapture.

6.1 Voluntary Notification

During 2022, Nine Mile Point Units 1 and 2 did not make a voluntary NEI 07-07 notification to State/Local officials, NRC, and to other stakeholders required by site procedures.

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[15] "NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors,"," Nuclear Regulatory Commission, April 1991.

[16] "40 CFR Part 141, "National Primary Drinking Water Regulations,"," US Environmental Protection Agency, Washington, DC..

[17] "40 CFR 190 - Environmental Radiation Protection Standards for Nuclear Power Operation," US Environmental Protection Agency, Washington, DC.

[18] "10 CFR 20 - Standards for Protection Against Radiation," US Nuclear Regulatory Commission, Washington, DC.

[19] HPPOS-140 PDR-9111210378, NRC memorandum from D.R. Muller to T.M. Novak and G.C. Lainas dated March 10, 1983.

Attachment 1, ARERR Release Summary Tables (RG-1.21 Tables)

1.0 GASEOUS EFFLUENTS

Table 5, Gaseous Effluents Summation of All Releases NMP2

A.	Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1.	Total Release	Ci	*	*	2.82E+00	*	5.00E+01
2.	Average release rate for the period	µCi/sec	*	*	3.55E-01	*	
B.	Iodine						
1.	Total Iodine – 131	Ci	1.61E-06	2.61E-06	*	*	3.00E+01
2.	Average release rate for the period	µCi/sec	2.07E-07	3.32E-07	*	*	
C.	Particulates						
1.	Particulates with half-lives > 8 days	Ci	2.00E-04	2.59E-04	6.44E-02	5.87E-02	3.00E+01
2.	Average release rate for the period	µCi/sec	2.57E-05	3.29E-05	8.11E-03	7.39E-03	
D.	Tritium						
1.	Total Release	Ci	1.80E+01	2.08E+01	1.93E+01	1.93E+01	5.00E+01
2.	Average release rate for the period	µCi/sec	2.32E+00	2.64E+00	2.42E+00	2.43E+00	
E.	Gross Alpha						
1.	Total Release	Ci	*	*	*	*	2.50E+01
2.	Average release rate for the period	µCi/sec	*	*	*	*	
F.	Carbon-14						
1.	Total Release	Ci	3.34E+00	4.52E+00	4,15E+00	4.82E+00	5.00E+01
2.	Average release rate for the period	µCi/sec	3.18E-03	4.30E-03	3.95E-03	4.59E-03	

% of limit is on Table 1, Nine Mile Point Unit 2 Dose Summary

Table 6, Gaseous Effluents – Ground Level Release Batch Mode NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Tritium						
H-3	Ci	7.62E-02	*	*	*	**7.62E-02**
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 7, Gaseous Effluents – Ground Level Release Continuous Mode NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	4.24E-06	*	9.79E-06	*	1.40E-05
Co-60	Ci	1.21E-04	1.75E-04	2.90E-04	3.12E-04	8.98E-04
Sr-89	Ci	6.37E-06	*	*	*	6.37E-06
Sr-90	Ci	6.37E-06	*	*	*	6.37E-06
Cs-137	Ci	*	6.27E-06	*	*	6.27E-06
Fe-55	Ci	6.37E-06	*	*	*	6.37E-06
Mn-54	Ci	*	7.01E-06	*	*	7.01E-06
Total for Period	**Ci**	1.47E-04	1.88E-04	3.00E-04	3.12E-04	**9.47E-04**
Tritium						
H-3	Ci	5.93E+00	4.67E+00	5.74E+00	6.39E+00	**2.27E+01**
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 8, Gaseous Effluents – Elevated Level Release Batch Mode NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	*	*	*
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Iodines						
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	*	*	*	*	*
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	2.72E-12	*	*	2.72E-12
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Cs-137	Ci	*	1.20E-11	*	*	1.20E-11
Total for Period	**Ci**	*	*	*	*	**1.47E-11**
Tritium						
H-3	Ci	7.62E-02	3.00E-02	*	*	**1.06E-01**
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	*	*	*	*	*

Table 9, Gaseous Effluents – Elevated Level Release Continuous Mode NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission Gases						
Ar-41	Ci	*	*	2.40E+00	*	2.40E+00
Kr-85	Ci	*	*	*	*	*
Kr-85m	Ci	*	*	*	*	*
Kr-87	Ci	*	*	*	*	*
Kr-88	Ci	*	*	*	*	*
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Xe-135m	Ci	*	*	*	*	*
Xe-138	Ci	*	*	4.20E-01	*	4.20E-01
Total for Period	**Ci**	*	*	2.82E+00	*	**2.82E+00**
Iodines						
I-131	Ci	1.61E-06	2.61E-06	*	*	4.22E-06
I-133	Ci	8.70E-05	1.41E-04	*	*	2.28E-04
I-135	Ci	*	*	*	*	*
Total for Period	**Ci**	8.86E-05	1.44E-04	*	*	**2.32E-04**
Particulates						
Co-58	Ci	*	*	*	*	*
Co-60	Ci	3.38E-05	5.93E-05	6.41E-02	5.84E-02	1.23E-01
Sr-89	Ci	7.34E-06	2.73E-06	*	*	1.01E-05
Sr-90	Ci	7.34E-06	2.73E-06	*	*	1.01E-05
Cs-134	Ci	*	*	*	*	*
Mn-54	Ci	*	1.93E-06	*	2.35E-06	4.28E-06
Fe-55	Ci	7.34E-06	4.03E-06	4.24E-05	*	5.38E-05
Zn-65	Ci	*	*	*	*	*
Cs-137	Ci	*	*	*	1.84E-09	*
Ni-63	Ci	*	*	*	*	*
Ag-110m	Ci	*	*	*	*	*
Total for Period	**Ci**	5.58E-05	7.07E-05	6.41E-02	5.84E-02	**1.23E-01**
Tritium						
H-3	Ci	1.19E+01	1.61E+01	1.35E+01	1.29+01	**5.44E+01**
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Carbon-14						
C-14	Ci	3.34E+00	4.52E+00	4.15E+00	4.82E+00	**1.68E+01**

2.0 LIQUID EFFLUENTS

Table 10, Liquid Effluents – Summation of All Releases NMP2

A.	Fission & Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1.	Total Release	Ci	*	*	*	*	5.00E+01
2.	Average diluted concentration	µCi/mL	*	*	*	*	
B.	Tritium						
1.	Total Release	Ci	*	*	*	*	5.00E+01
2.	Average diluted concentration	µCi/mL	*	*	*	*	
C.	Dissolved & Entrained Gases						
1.	Total Release	Ci	*	*	*	*	5.00E+01
2.	Average diluted concentration	µCi/mL	*	*	*	*	
D.	Gross Alpha Activity						
1.	Total Release	Ci	*	*	*	*	5.00E+01
E.	Volume of Waste Released (prior to dilution)	Liters	*	*	*	*	
F.	Volume of Dilution Water Used During Period	Liters	1.08E+10	1.16E+10	1.27E+10	1.00E+10	

% of limit is on the Table 1, Nine Mile Point Unit 2 Dose Summary

Table 11, Batch Mode Liquid Effluents NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission and Activation Products						
Cr-51	Ci	*	*	*	*	*
Mn-54	Ci	*	*	*	*	*
Fe-55	Ci	*	*	*	*	*
Fe-59	Ci	*	*	*	*	*
Co-57	Ci	*	*	*	*	*
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Nb-95	Ci	*	*	*	*	*
Zn-65	Ci	*	*	*	*	*
Ag-110m	Ci	*	*	*	*	*
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Cs-137	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Entrained Gases						
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*

Table 12, Continuous Mode Liquid Effluents NMP2

Radionuclide Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for year
Fission and Activation Products						
Cr-51	Ci	*	*	*	*	*
Mn-54	Ci	*	*	*	*	*
Fe-55	Ci	*	*	*	*	*
Fe-59	Ci	*	*	*	*	*
Co-57	Ci	*	*	*	*	*
Co-58	Ci	*	*	*	*	*
Co-60	Ci	*	*	*	*	*
Sr-89	Ci	*	*	*	*	*
Sr-90	Ci	*	*	*	*	*
Nb-95	Ci	*	*	*	*	*
Zn-65	Ci	*	*	*	*	*
Ag-110m	Ci	*	*	*	*	*
I-131	Ci	*	*	*	*	*
I-133	Ci	*	*	*	*	*
Cs-134	Ci	*	*	*	*	*
Cs-137	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*
Tritium						
H-3	Ci	*	*	*	*	*
Gross Alpha						
Alpha	Ci	*	*	*	*	*
Entrained Gases						
Xe-133	Ci	*	*	*	*	*
Xe-135	Ci	*	*	*	*	*
(List Others)	Ci	*	*	*	*	*
Total for Period	Ci	*	*	*	*	*

Attachment 2, Solid Waste Information

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

Table 13, Types of Solid Waste Summary NMP2

Types of Waste	Total Volume (m3)	Total Activity (Ci)	Est. Total Error (%)
a. Spent resins, filter sludges, evaporator bottoms, etc.	3.03E+01	1.45E+01	25
b. Dry compressible waste, contaminated equip, etc.	4.91E+02	1.95E-01	25
c. Irradiated components, control rods, etc.	0.00E+00	0.00E+00	25
d. Other	5.17E+01	4.17E+00	25
Total	**5.73E+02**	**1.89E+01**	25

2.0 ESTIMATE OF MAJOR NUCLIDE COMPOSITION (BY WASTE TYPE) ONLY >1% ARE REPORTED. [NOTE 1]

Table 14, Major Nuclides NMP2

Major Nuclide Composition	Isotope	%	Curies
a. Spent resins, filter sludges, evaporator bottoms, etc.	Co-60	78.1	1.13E+01
	Fe-55	18.0	2.61E+00
	Mn-54	2.25	3.26E-01
b. Dry compressible waste, contaminated equip, etc.	Co-60	86.48	1.68E-01
	Fe-55	8.96	1.75E-02
	Mn-54	2.66	5.17E-03
	Zn-65	1.17	2.28E-03
c. Other waste	Co-60	89.51	3.73E+00
	Fe-55	6.22	2.59E-01
	Mn-54	2.87	1.20E-01

Table 14, Major Nuclides NMP2

	Zn-65	1.02	4.23E-02
d. Irradiated components, control rods, etc.	*	0	00E+00

3.0 SOLID WASTE DISPOSITION

Table 15, Solid Waste Disposition NMP2

Number of Shipments	Mode of Transportation	Destination
7	NRC Class: A; DOT Type: A LSA-II	Energy Solutions Clive (CWF Containerized Waste Facility)
14	NRC Class: A; DOT Type: A LSA-II	Energy Solutions Bear Creek (CVRF)

4.0 IRRADIATED FUEL DISPOSITION

Table 16, Irradiated Fuel Shipments Disposition NMP2

Number of Shipments	Mode of Transportation	Destination
0	*	*

Attachment 3, Meteorological Data

1.0 METEOROLOGICAL DATA SUMMARY

1.1 Joint Frequency Distributions

1. Period of Record: 2022
2. Stability Class: All
   a. Periods of calm (hours): 12
   b. Hours of missing data: 155 hours
   c. Meteorological data quality 98.2% for all stability classes and parameters.
   d. Total annual precipitation: 27.32 inches
3. Elevation: 200 ft.

Wind Speed Range (m/s)												
Wind Direction	<0.5	0.5 1.0	1.1 1.5	1.6 2.0	2.1 3.0	3.1 4.0	4.1 5.0	5.1 6.0	6.1 8.0	8.1 10.0	>10.0	Total
N	0	4	12	17	40	58	43	27	54	19	44	318
NNE	1	2	8	9	38	67	34	47	99	50	116	471
NE	0	4	12	20	50	51	46	44	40	25	12	304
ENE	0	3	10	21	39	47	10	4	6	0	0	140
E	0	2	10	11	58	65	22	12	17	0	0	197
ESE	1	4	3	13	37	65	55	42	48	17	7	292
SE	0	3	9	10	35	96	103	113	303	116	38	826
SSE	0	1	6	10	27	114	80	132	355	125	44	894
S	0	5	3	11	25	95	109	132	344	108	45	877
SSW	1	3	6	6	31	76	109	133	210	21	1	597
SW	1	4	6	15	26	74	68	86	163	48	20	510
WSW	0	4	9	11	38	104	82	106	206	110	150	820
W	0	4	7	18	37	103	63	70	143	123	288	856
WNW	1	3	9	12	34	67	34	23	101	82	221	587
NW	1	5	4	9	38	42	40	41	116	84	141	521
NNW	1	3	12	13	43	44	34	26	82	45	46	349
Total	7	54	126	206	595	1168	932	1038	2287	973	1173	8559

1.2 Stability class

Table 17, Classification of Atmospheric Stability

Stability Condition	Pasquill Categories	Hours	Percentage
Extremely Unstable	A	969	11.3%
Moderately Stable	B	568	6.6%
Slightly Unstable	C	722	8.4%
Neutral	D	3306	38.6%
Slightly Stable	E	1865	21.8%
Moderately Stable	F	610	7.1%
Extremely Stable	G	519	6.1%

Note: Percentage is calculated based on the 200ft winds and 200ft-30ft stability hourly data for the year (8559 hours of valid data).