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

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MPS Lic/GJC	R0
Docket Nos.	50-245
	50-336
	50-423
License Nos.	DPR-21
	DPR-65
	NPF-49

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 1, 2, AND 3
2017 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

In accordance with 10 CFR 50.36a, this letter transmits the annual Radioactive Effluent Release Report (RERR) for the period January 2017 through December 2017. This report meets the provisions of Section 5.7.3 of the Millstone Power Station Unit 1 Permanently Defueled Technical Specifications (PDTS), and Sections 6.9.1.6b and 6.9.1.4 of the Millstone Power Station Units 2 and 3 Technical Specifications, respectively.

Attachment 1 transmits Volume 1 of the 2014 RERR, in accordance with Regulatory Guide 1.21. The RERR contains information regarding airborne, liquid, and solid radioactivity released from Millstone Power Station, including the off-site dose from airborne and liquid effluents.

Attachment 2 transmits Volume 2 of the report, which consists of a complete copy of the Radiological Effluent Monitoring and Off-Site Dose Calculation Manual (REMODCM) as of December 31, 2017. This satisfies the requirements of Sections 5.6.1c of the Millstone Power Station Unit 1 PDTS, and Sections 6.15c and 6.9.13c of the Millstone Power Station Units 2 and 3 Technical Specifications, respectively.

If you have any questions or require additional information, please contact Mr. Jeffry A. Langan at (860) 444-5544.

Sincerely,

M. J. O'Connor
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IE48

NRR

Attachments: 2

Commitments made in this letter:

1. None.

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ATTACHMENT 1

2017 RADIOACTIVE EFFLUENTS RELEASE REPORT
VOLUME 1

MILLSTONE POWER STATION UNITS 1, 2, AND 3
DOMINION ENERGY NUCLEAR CONNECTICUT, INC. (DENC)

Millstone Power Station
2017
Radioactive Effluents Release Report
Volume One

Dominion Energy Nuclear Connecticut, Inc.

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Dominion Energy

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List of Acronyms

ABD-TK-2 Auxiliary Boiler Drains Tank 2
BOP – Balance of plant
CFR – Code of Federal Regulations
CPF – Condensate polishing facility
DENC – Dominion Energy Nuclear Conncticut
DOT – Department of Transportation
DSN – Discharge serial number
EBFS – Enclosure building filtration system
EDAN- Environmental Data Acquisition Network
ESF – Engineering safeguards facility
GI - Gastrointestinal
GWPP – Groundwater protection program
HPGe – High purity germanium
ISFSI – Independent spent fuel storage installation
MPS – Millstone Power Station
MPS1 – Millstone Power Station Unit 1
MPS2 – Millstone Power Station Unit 2
MPS3 – Millstone Power Station Unit 3
MDA – Minimum Detectable Activity
NCRP- National Council on Radiation Protection and Measurements
NEI- Nuclear Energy Institute
NPP – Nuclear power plant
NRC – Nuclear Regulatory Commission
RBCCW – Reactor building closed cooling water
REMODCM - Radiological Effluent Monitoring and Offsite Dose Calculation Manual
RWST – Reactor water storage tank
SFPI – Spent Fuel Pool Island
SG – Steam generator
SGBD – Steam generator blowdown
SLCRS – Secondary Leakage Collection and Recovery System
SW – Service water
TB – Turbine building
WGDT – Waste gas decay tank
WRGM – Wide range gas monitor
WTT – Waste test tank

Introduction

This report, for the period of January through December of 2017, is being submitted by DENC, Inc. for MPS1, 2, and 3, in accordance with 10 CFR 50.36a, the Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM), the MPS1 Permanently Defueled Technical Specifications, and the MPS2 and 3 Technical Specifications. This report contains radiological and volumetric information on gaseous and liquid effluents, doses to the public from these effluents, shipments of solid waste & irradiated components, onsite well water results, information on effluent instrumentation which was nonfunctional for more than 30 consecutive days and operating history.

Radioactive materials may be disposed of in solid waste shipments sent to licensed disposal sites or released in liquid or gas form in effluents to the local environment. The two basic characteristics used to describe radioactive effluents are radioactivity and radiation dose. The radioactivity of any given radionuclide increases in direct proportion to the amount of the radionuclide present. This report lists the amounts of various radionuclides present in radioactive effluents. For this report, activity can be thought of as the amount of radioactive material present in radioactive effluents. Section 2.0 of this report gives the activity released from MPS in 2017.

Although radioactivity is an important, inherent characteristic that helps to describe radioactive effluents, it is not—by itself—a good indicator of the potential health effects from exposure to radiation. Health effects are dependent on many factors, such as the radionuclide, the type of radiation emitted by the radionuclide, the energy of the radiation, the uptake of the radionuclide into the human body, and the metabolism of the radionuclide by the human body. To properly describe the potential health effects from exposure to radioactive materials, a measure that accounts for all of these differences is needed. Dose is a measure of how much radiation energy is absorbed by organs or tissues of the body. Dose is a good indicator of the potential health effects from exposure to radiation. Section 1.0 of this report gives the dose from activity released from MPS in 2017.

1.0 Off-Site Doses

This report provides a summary of the 2017 off-site radiation doses from releases of radioactive materials in gaseous and liquid effluents and from direct radiation from MPS1, 2 and 3. This includes the annual maximum dose in millirem (mrem) to any real member of the public as well the maximum gamma and beta air doses. To provide perspective, these doses are compared to the regulatory limits (in Table 1-3) and to the annual average dose that a member of the public could receive from natural background and other sources (in Table 1-4). The doses from radioactive effluents were much less than the doses from other sources of natural radiation that are commonly considered safe. This indicates radioactive effluents from MPS in 2017 had no significant impact on the health and safety of the public or the environment.

1.1 Dose Calculations

Dose from radioactive effluents are calculated to ensure compliance with NRC requirements in 10 CFR Part 50, Appendix I (Ref. 7). The dose calculations are based on the measurements and computer models listed below:

- measurements of the radioactive materials released to the environment,
- models of how radionuclides are dispersed and diluted in the environment,
- models of how radionuclides are incorporated into animals, plants, and soil, and
- models of the biokinetic of human uptake and metabolism of radioactive materials.

The models are designed to calculate the dose to a real (or hypothetical) individual closest to MPS or to an individual who may be exposed to the highest concentrations of radioactive materials from radioactive effluents. This person is often referred to as the maximum exposed individual. The parameters and assumptions used in these dose calculations include conservative assumptions that tend to overestimate the calculated exposures. Although the location of the maximum individual may vary each quarterly period, the annual dose is the sum of these quarterly doses. This conservatively assumes that the individual is at the location of maximum dose each quarter. As a result, the actual doses received by real individuals are often much less than those calculated.

The off-site dose to humans from radioactive material in liquid and gaseous effluents have been calculated using measured radioactive effluent data and the dose computation algorithm in OpenEMS, an effluent tracking program (Ref. 9). For liquid dose OpenEMS uses equations which yield the same result as the methodology given in NRC Regulatory Guide 1.109 (Ref. 3). For airborne dose OpenEMS uses an algorithm equivalent to the NRC code, GASPAR II (Ref. 1), which uses a semi-infinite cloud model to implement the NRC Regulatory Guide 1.109 (Ref. 3) dose models. The values of average relative effluent concentration (X/Q) and average relative deposition (D/Q) used in OpenEMS were generated using EDAN, a meteorological computer code. The annual summary of hourly meteorological data (in 15-minute increments), which includes wind speed, direction, atmospheric stability, and joint frequency distribution, is not provided in the report but are available. Doses are based upon exposure to radioactivity in gaseous and liquid effluents over a one-year period and an associated dose commitment over a 50-year period from initial exposure. The portion of the doses due to inhalation and ingestion take into account radioactive decay and biological elimination of the radioactive materials.

The dose calculations are based upon three types of input: radioactive source term, site-specific data, and generic factors. The radioactive source terms (Curies) are given in Section 2, Effluent Radioactivity, of this report. The site-specific data includes: meteorological data (e.g. wind speed, wind direction, atmospheric stability) to calculate the transport and dispersion of gaseous effluents, average annual milk consumption rates and dilution factors for liquid effluents. The generic factors include the average annual consumption rates (for ingestion of vegetables, produce, meat, fish, and shellfish), shielding factor for air submersion and ground irradiation and occupancy factors for shoreline activity, swimming and boating.

1.1.1 Gaseous Effluents

The following release points are considered ground level:

- MPS1 SFPI Vent (73 foot)
- MPS1 BOP Vent (80 foot)
- MPS2 and 3 Refueling Water Storage Tank (RWST) Vents
- MPS3 Engineered Safety Features Building (ESF) Ventilation
- Auxiliary Boiler Drains Tank 2 (ABD TK-2) Vent
- MPS2 & 3 Containment Equipment Hatch
- MPS3 Containment Drawdowns

Doses for releases from these points were calculated using the 33 foot meteorology. For each unit, doses from their respective release points were summed to determine the total unit gaseous effluent ground level dose.

The following release points are considered mixed mode (partially elevated and partially ground) releases:

- MPS2 Auxiliary Building Ventilation (159 foot elevation)
- MPS3 Auxiliary Building Ventilation (133 foot elevation)

The doses for mixed mode releases are calculated using 142 foot meteorology for which the Pasquill stability classes are determined based upon the temperature gradient between the 33 foot and 142 foot meteorological tower levels.

The MPS Stack release point at 374 foot elevation is considered an elevated release. Doses for elevated releases are calculated using Pasquill stability classes determined based upon the temperature gradient between the 33 foot and 374 foot meteorological tower levels. Only MPS2 and MPS3 discharge to the MPS Stack. In March 2001, MPS1 was separated from the stack and two new release points were added to MPS1, the Spent Fuel Pool Island (SFPI) Vent and the Balance of Plant (BOP) Vent. The following are sources of radioactivity for releases from the stack:

- MPS2 Waste Gas Decay Tanks batch releases
- MPS2 Containment Vents batch releases
- MPS2 Containment Purge batch releases (only during outage in the second quarter)
- MPS3 Containment Vents batch releases
- MPS3 Gaseous Waste System continuous releases
- MPS3 Containment Purge batch releases (only during outage in fourth quarter)

1.1.2 Liquid Effluents

MPS discharges radioactivity in water through two release pathways – thru the MPS Quarry to the Long Island Sound and thru Discharge Point DSN-006 to Niantic Bay. Discharges to the MPS Quarry are from primary side water, primarily from liquid waste processing systems. Discharges to DSN-006 are from secondary side water, primarily turbine building sumps. MPS1 discharges only to the MPS Quarry from sumps and leakage collection systems. Discharges to both release pathways are considered either continuous or batch discharges. Sources of continuous and batch discharges are listed in Sections 2.2.1.1 and 2.2.1.2. Water containing radioactivity being discharged to the MPS Quarry is diluted mainly by circulating water and, to a minor extent, by service water. Water containing radioactivity being discharged to DSN-006 is diluted by storm drains runoff.

1.2 Dose Results

The calculated maximum off-site doses are presented in Table 1-1 for gaseous effluents and Table 1-2 for liquid effluents. The units 'mrad' and 'mrem' used in this report are units of radiation dose. The letter 'm' is for 'milli', or one-thousandth of a 'rad' or a 'rem.' The word 'rad' is an acronym for radiation absorbed dose. One rad is equal to the absorption of 100 ergs of energy per gram of tissue. The word 'rem' is an acronym for roentgen equivalent man. One rem is equal to a rad multiplied by factors to account for type of radiation and distribution within the body.

1.2.1 Gaseous Effluents

For the dose to the maximum individual, OpenEMS calculates the dose to the whole body, gastrointestinal (GI), bone, liver, kidney, thyroid, lung, and skin from each of the following pathways: direct exposure from submersion in noble gases in the plume, direct exposure from ground deposition of radioactivity, inhalation, and ingestion of vegetation, produce, cow or goat milk, and meat. A cloud shine dose component for releases of noble gas radioactivity from the elevated MPS Stack is calculated using Reference 13. This cloud shine pathway accounts for dose to the maximum individual from the plume at the site boundary while the plume is still elevated. The values presented are a total from all pathways. Only the whole body, skin, thyroid and maximum organ (other than thyroid) doses are presented.

For the plume and inhalation pathways, the maximum individual dose is calculated at the off-site location of the highest X/Q where a potential for dose exists.

For ground deposition and ingestion pathways (vegetation, meat and milk), the maximum individual dose is calculated at the location of the highest D/Q. For the milk pathways (cow and goat), the calculated dose is included in the maximum individual's dose only at locations and times where these pathways actually exist.

To determine compliance with 10 CFR 50, Appendix I (Reference 7), the maximum individual whole body and organ doses include all applicable external pathways (i.e., plume and ground exposure) as well as the internal pathways (inhalation and ingestion).

1.2.2 Liquid Effluents

Maximum individual doses from the release of radioactive liquid effluents were calculated using OpenEMS which gives dose results equal to dose results calculated using NRC Regulatory Guide 1.109. OpenEMS performs calculations for the following pathways: fish, shellfish, shoreline activity, swimming, and boating. Doses are calculated for the whole body, skin, thyroid, and maximum organ (GI, bone, liver, kidney, and lung).

1.2.3 Analysis of Results

Table 1-3 provides a quantitative dose comparison with the limits specified in the REMODCM. Gaseous and liquid effluent doses are compared to limits required by technical specifications and contained in Appendix I of 10 CFR 50. Total offsite doses are compared to limits in 40 CFR 190 (Reference 8). The data indicates that the total whole body and organ doses to the maximum offsite individual from MPS including all sources of the

fuel cycle are well within the limits. On-site radioactive waste and spent fuel storage during this year was within storage criteria and the maximum dose to a member of the public from these sources was approximately 0.13 mrem. The doses from gaseous and liquid effluents were added to the estimated dose from on-site radioactive waste storage to show compliance compared to 40 CFR 190.

The Offsite Dose Comparison, Table 1-4, provides a perspective on the maximum offsite individual dose received from MPS with the natural background radiation dose received by the average Connecticut resident (Reference 4). The total dose to the maximum individual received from MPS is small (< 0.3%) in comparison to the dose received from natural background radiation.

Table 1-1
2017 Off-Site Dose Commitments from Gaseous Effluents
MPS1, 2, 3

MPS1	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Air	mrad	mrad	mrad	mrad	mrad
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Max Individual	mrem	mrem	mrem	mrem	mrem
Whole Body	9.28E-06	3.60E-04	1.12E-05	5.75E-04	9.55E-04
Skin	9.14E-06	2.50E-04	4.65E-06	4.61E-04	7.25E-04
Thyroid	9.14E-06	3.60E-04	1.12E-05	5.75E-04	9.55E-04
Max organ[1]	9.53E-06	3.60E-04	1.12E-05	5.75E-04	9.56E-04

MPS2	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Air	mrad	mrad	mrad	mrad	mrad
Beta	5.66E-06	3.18E-05	5.77E-07	3.27E-06	4.13E-05
Gamma	1.23E-05	6.04E-05	1.37E-06	8.15E-06	8.22E-05
Max Individual	mrem	mrem	mrem	mrem	mrem
Whole Body	2.42E-03	1.79E-02	1.18E-02	4.03E-02	7.24E-02
Skin	2.81E-04	5.58E-04	3.07E-04	1.04E-03	2.19E-03
Thyroid	2.55E-03	1.80E-02	1.18E-02	4.05E-02	7.29E-02
Max organ[1]	1.17E-02	1.06E-01	6.98E-02	2.25E-01	4.13E-01

MPS3	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Air	mrad	mrad	mrad	mrad	mrad
Beta	4.21E-05	1.07E-06	2.02E-06	2.38E-05	6.90E-05
Gamma	2.82E-06	1.93E-07	3.34E-07	4.34E-05	4.67E-05
Max Individual	mrem	mrem	mrem	mrem	mrem
Whole Body	4.81E-03	1.88E-02	9.92E-03	5.88E-02	9.23E-02
Skin	2.35E-03	1.79E-03	3.79E-04	2.94E-03	7.46E-03
Thyroid	4.81E-03	1.88E-02	9.40E-03	5.71E-02	9.01E-02
Max organ[1]	1.47E-02	9.83E-02	5.76E-02	2.88E-01	4.59E-01

NOTES:
1- Maximum of the following organs (not including thyroid): Bone, GI-LLI, Kidney Liver Lung

Table 1-2
2017 Off-Site Commitments from Liquid Effluents MPS1, 2, 3

MPS1	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	1.37E-05	3.00E-05	0.00E+00	3.34E-06	4.71E-05
Thyroid	3.79E-06	8.32E-06	0.00E+00	9.69E-07	1.31E-05
Max Organ[1]	2.19E-05	4.58E-05	0.00E+00	4.74E-06	7.25E-05

MPS2	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	1.77E-04	1.96E-05	2.38E-06	3.03E-05	2.29E-04
Thyroid	1.12E-04	1.48E-05	2.38E-06	2.80E-05	1.57E-04
Max Organ[1]	6.32E-04	1.49E-03	2.38E-06	3.79E-05	2.16E-03

MPS3	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	6.19E-05	7.56E-05	2.09E-04	2.76E-04	6.22E-04
Thyroid	6.19E-05	4.34E-05	2.09E-04	2.75E-04	5.90E-04
Max Organ[1]	6.19E-05	2.80E-04	2.09E-04	2.79E-04	8.31E-04

NOTES:
1- Maximum of the following organs (not including thyroid): Bone, GI-LLI, Kidney Liver Lung

Table 1- 3
2017 Off-Site Dose Comparison to Limits MPS1, 2, 3

Gaseous Effluents Dose

	Whole Body (mrem)	Thyroid (mrem)	Max Organ* (mrem)	Skin (mrem)	Beta Air (mrad)	Gamma Air (mrad)
MPS1	9.55E-04	9.55E-04	9.56E-04	7.25E-04	0.00E+00	0.00E+00
MPS2	7.24E-02	7.29E-02	4.13E-01	2.19E-03	4.13E-05	8.22E-05
MPS3	9.23E-02	9.01E-02	4.59E-01	7.46E-03	6.90E-05	4.67E-05
MPS	**1.66E-01**	**1.64E-01**	**8.73E-01**	**1.04E-02**	**1.10E-04**	**1.29E-04**
Limits	***5***	***15***	***15***	***15***	***20***	***10***

Liquid Effluents Dose

	Whole Body (mrem)	Thyroid (mrem)	Max Organ* (mrem)
MPS1	4.71E-05	1.31E-05	7.25E-05
MPS2	2.29E-04	1.57E-04	2.16E-03
MPS3	6.22E-04	5.90E-04	8.31E-04
MPS	**8.98E-04**	**7.60E-04**	**3.06E-03**
Limits	***3***	***10***	***10***

Total Off-Site Dose from MPS

	Whole Body (mrem)	Thyroid (mrem)	Max Organ * (mrem)
Gaseous	1.66E-01	1.64E-01	8.73E-01
Liquid	8.98E-04	1.57E-04	2.16E-03
Direct Shine**	1.40E-01	1.40E-01	1.40E-01
MPS	**3.07E-01**	**3.04E-01**	**1.01E+00**
Limits	***25***	***75***	***25***

* Maximum of the following organs (not including Thyroid): Bone, GI-LLI, Kidney, Liver, Lung

** Direct shine is radiation exposure from onsite storage of radwaste and spent fuel.

Table 1- 4
2017 Off-Site Dose Comparison
Natural Background vs MPS

Average Resident	Natural Background Radiation Dose	
Cosmic	30 -100	mrem
Terrestrial (Atlantic and Gulf Coastal Plain)	30 - 60	mrem
Inhaled	20 - 1,000	mrem
In the Body	20 - 80	mrem
	100 - 1,240	mrem

Courtesy UNSCEAR Report 2000

Maximum Off-Site Individual	MPS Whole Body Dose	
Gaseous Effluents	0.166	mrem
Liquid Effluents	0.001	mrem
Direct Shine	0.140	mrem
	0.307	mrem

1.3 Other Sources of Radiation Dose to the Public (from Ref. 12)

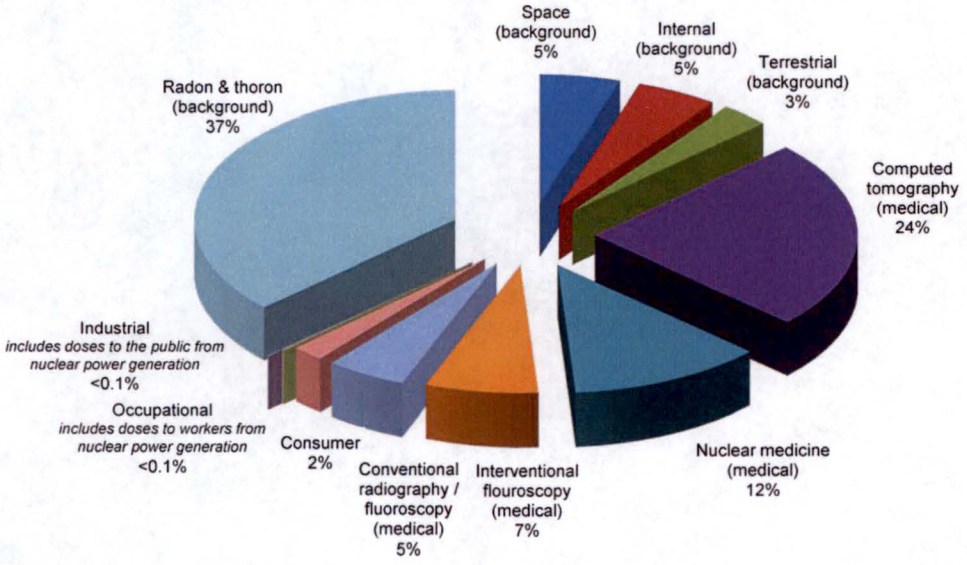
This section discusses the doses that the average American typically receives each year from naturally occurring background radiation and all other sources of radiation. The reader can compare the doses received

from MPS effluents with the doses received from natural, medical, and other sources of radiation. This comparison provides some context to the concept of radiation dose effects. In March 2009, the National Council on Radiation Protection and Measurements (NCRP) published Report No. 160 as an update to the 1987 NCRP Report No. 93, Ionizing Radiation Exposure of the Population of the United States. Report No. 160 describes the doses to the U.S. population from all sources of ionizing radiation for 2006, the most recent data available at the time the NCRP report was written. The NCRP report also includes information on the variability of those doses from one individual to another. The NCRP estimated that the average person in the United States receives about 620 mrem of radiation dose each year. NCRP Report No. 160 describes each of the sources of radiation that contribute to this dose, including:

- Naturally occurring sources (natural background) such as cosmic radiation from space, terrestrial radiation from radioactive materials in the earth, and naturally occurring radioactive materials in the food people eat and in the air people breathe;
- medical sources from diagnosis and treatment of health disorders using radioactive pharmaceuticals and radiation-producing equipment;
- consumer products (such as household smoke detectors);
- industrial processes, security devices, educational tools, and research activities; and
- exposures of workers that result from their occupations.

Below is a pie chart showing the relative contributions of these sources of radiation to the dose received by the average American. Larger contributors to dose are represented by proportionally larger slices of the pie. Doses to the public from nuclear power plants are included in the industrial category; doses to workers from nuclear power generation are included in the category of occupational dose. Doses to the public due to effluents from nuclear power plants are less than 0.1% (one-tenth of one percent) of what the average person receives each year from all sources of radiation. Doses to workers from occupational exposures, including those received from work at NPPs, also are less than 0.1% of the average dose to a member of the public from all sources.

Sources of Radiation Exposure to the U.S. Population



2.0 Effluent Radioactivity

2.1 Gaseous Effluents

2.1.1 Measurement of Radioactivity in Gaseous Effluents

2.1.1.1 Continuous Releases

The following pathways have continuous radiation monitors which monitor gaseous radioactivity and collect radioactive particulates on filters and radioactive halogens (iodine's, etc.) on charcoal cartridges except where noted on the list.

MPS1 SFPI Island (no charcoal cartridge)
MPS1 BOP Vent (no charcoal cartridge)
MPS2 Ventilation Vent
MPS2 Wide Range Gas Monitor (WRGM) to Site Stack
MPS2 Equipment Hatch Opening (no gaseous monitoring)
MPS3 Ventilation Vent
MPS3 SLCRS to Site Stack
MPS3 ESF Building Vent
MPS3 Containment Equipment Hatch Openings (no gaseous monitoring)

Most releases are based on results of sample analyses. Charcoal cartridges and particulate filters are replaced weekly (except every two weeks for MPS1) and analyzed for isotopic content using a gamma spectrometer. Particulate filters are also analyzed for Strontium-89 (Sr-89) (except for MPS1), Strontium-90 (Sr-90) and gross alpha. At least monthly, gaseous grab samples are taken and analyzed for noble gasses and H-3. The gas washing bottle (bubbler) method is utilized for H-3 collection. This sample is counted on a liquid scintillation detector. Isotopic concentrations at the release point are multiplied by the total flow to obtain the total activity released for each isotope.

Some releases are based on calculation. These include tritium from spent fuel pools, Carbon 14 (C-14) and RWST vent releases.

Spent fuel pool tritium release is calculated using concentrations of tritium in the water and evaporation determined by change in pool levels. Grab samples from the MPS1 SFPI Vent and the MPS2 and MPS3 Vents are compared to the measured evaporation technique and the higher amount from either the vent or the measured evaporation technique is used to determine the amount of H-3 released.

C-14 releases are calculated using the methodology in Reference 11. Based on Reference 2, it was conservatively assumed that 30% of the C-14 exists as carbon dioxide (CO_2) which may be deposited on surfaces. Thus only 30% of C-14 released yielded dose via ingestion pathways of milk, meat, produce and vegetation. C-14 has always been released from the plant but, previous to 2010, was not reported because it was not a significant release relative to other radioactive releases. Since the overall quantity of other radioactive releases has steadily decreased due to improvements in power plant operations, C-14 now qualifies as a principle radionuclide. For each Unit, it is assumed that half of the C-14 is released from the MPS and half from each unit's main ventilation vent.

When water is transferred to the RWST there is a potential for a release of radioactivity through the tank vent. Releases of particulates and H-3 from the MPS2 and MPS3 RWSTs were estimated using factors for release from water to air. For H-3 the release factor is based on the ratio of mass of water vapor to mass of dry air and adjusted for difference between water and air densities. For particulates the release factor is based on an assumed partitioning factor of 10,000. RWST vent releases are calculated using concentration of tritium in water, particulate radioactivity added to the RWST during outages and volumes of air exhaled based on observed changes in water level and on thermal fluctuations of the water. During 2017 MP-CHEM-17-07, "Reporting of Radioactivity Released from RWST Vents" was written to establish threshold values for determining releases. The threshold value eliminated the monthly tracking tritium released through the RWST vent, but ensures that major level changes resulting significant release are tracked.

Any releases from the spent fuel pool area in the reactor building at MPS1 are released through the SFPI Vent. Releases from other parts of the MPS1 reactor building and other buildings are continuously discharged to the BOP Vent.

Samples of air near the containment equipment hatch openings are analyzed for particulates and iodines, during refueling outages for the period that the equipment hatch is open. An estimated flow out of the hatch and sample results are used to determine the radioactivity released. Containment equipment hatch and containment drawdown releases at MPS3 occurred only during the MPS3 outage during the second quarter.

2.1.1.2 Batch Releases

The following sources of radioactivity releases are considered batch releases:

MPS2 Waste Gas Decay Tanks (WGDT) (via MPS2 WRGM to MPS Stack)
MPS3 Containment Purges (via Ventilation Vents)
MPS2 and MPS3 Containment Vents (via EBFS to MPS Stack for MPS2 and via SLCRS to MPS Stack for MPS3)
MPS3 Containment Drawdown (ground level release at containment)

Waste Gases from the MPS2 Gaseous Waste Processing System are held for decay in waste gas decay tanks prior to discharge through the MPS Site Stack. Each gas decay tank is analyzed prior to discharge for noble gas and H-3. Calculated volume discharged is multiplied by the isotopic concentrations (noble gas and H-3) from the analysis of grab samples to determine the total activity released.

Containment air is sampled periodically for gamma and H-3 to determine the activity released from containment venting. The measured concentrations are multiplied by the containment vent volume to obtain the total activity released. MPS2 typically performs this process of discharging air from containment to maintain pressure approximately once per week and MPS3 vents containment about 15 times per month. Any iodines and particulates discharged would be detected by the continuous monitoring discussed in Section 2.1.1.1.

Containment air is sampled prior to each purge for gamma and H-3 to determine the activity released from containment purging. Similar to containment venting, the measured concentrations are multiplied by the containment purge volume to obtain the total activity released. Any iodines and particulates discharged would be detected by the continuous monitoring discussed in section 2.1.1.1.

MPS3 containment is initially drawn down prior to startup. This is accomplished by using the containment vacuum steam jet ejector which releases through an unmonitored vent on the roof of the Auxiliary Building. Grab samples are performed prior to drawdown to document the amount of radioactivity released during these evolutions.

2.1.2 Estimate of Errors

Estimates of errors associated with radioactivity measurements were made using the following guidelines:

Radioactivity Measurement Calibration	10%	Calibration to NIST* standards
Sampling/Data Collection	10% - 20%	Variation in sample collection
Sample Line Loss	20% - 40%	Deposition of some nuclides
Sample Counting	10% - 30%	Error for counting statistics
Flow & Level Measurements	10% - 20%	Error for release volumes

*National Institute of Standards and Technology

2.1.3 Gaseous Batch Release Statistics

MPS1 – None

MPS2	CTMT Vents	WGDT	CTMT Purge
Number of Batches	34	4	1
Total Time (min)	4780	714	1612
Maximum Time (min)	199	205	1612
Average Time (min)	141	179	1612
Minimum Time (min)	29	146	1612

MPS3	CTMT Vents	CTMT Purge
Number of Batches	168	1
Total Time (min)	48596	240
Maximum Time (min)	439	240
Average Time (min)	289	240
Minimum Time (min)	119	240

2.1.4 Abnormal Gaseous Releases

An abnormal gaseous release of radioactivity is defined as radioactive material released in gaseous effluents to the environment that was unplanned or uncontrolled due to an unanticipated event. These do not include normal routine effluent releases from anticipated operational and maintenance occurrences such as power level changes, reactor trip, opening primary system loops, degassing, letdown of reactor coolant or transferring spent resin and do not include non-routine events such as minor leakages from piping, valves, pump seals, tank vents, etc.

2.1.4.1 MPS1 – None

2.1.4.2 MPS2 – None

2.1.4.3 MPS3 - None

2.1.5 Gaseous Release Tables

The following tables provide the details of the gaseous radioactivity released from each of the MPS units. They are categorized by type of release, source(s), and by release point of discharge to the environment.

Table 2.1-A1
MPS1
Gaseous Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
1. Total Activity Released	Ci	-	-	-	-	-
2. Average Period Release Rate	uCi/sec	-	-	-	-	-
B. Iodines / Halogens						
1. Total Activity Released	Ci	na	na	na	na	na
2. Average Period Release Rate	uCi/sec	na	na	na	na	na
C. Particulates						
1. Total Activity Released	Ci	4.46E-07	9.85E-06	-	-	1.03E-05
2. Average Period Release Rate	uCi/sec	5.73E-08	1.25E-06	-	-	3.26E-07
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Tritium						
1. Total Activity Released	Ci	1.21E-02	4.33E-01	1.14E-02	6.11E-01	1.07E+00
2. Average Period Release Rate	uCi/sec	1.56E-03	5.51E-02	1.44E-03	7.69E-02	3.39E-02

"-" denotes less than Minimum Detectable Activity (MDA)
"na" denotes not required to be analyzed

Table 2.1-A2

MPS1

Gaseous Effluents - Ground Continuous - BOP Vent & SFPI Vent

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Kr-85	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines / Halogens						
I-131	Ci	na	na	na	na	na
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Be-7	Ci	-	9.85E-06	-	-	9.85E-06
Cs-137	Ci	4.46E-07	-	-	-	4.46E-07
Other γ Emitters	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Total Activity	Ci	4.46E-07	9.85E-06	-	-	1.03E-05
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	1.21E-02	4.33E-01	1.14E-02	6.11E-01	1.07E+00

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes not required to be analyzed

Table 2.2-A1
MPS2
Gaseous Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
1. Total Activity Released	Ci	8.72E-02	8.95E-02	5.77E-02	4.38E-02	2.78E-01
2. Average Period Release Rate	uCi/sec	1.12E-02	1.14E-02	7.26E-03	5.52E-03	8.82E-03
B. Iodines / Halogens						
1. Total Activity Released	Ci	8.12E-05	5.37E-05	6.12E-07	1.75E-06	1.37E-04
2. Average Period Release Rate	uCi/sec	1.04E-05	6.83E-06	7.70E-08	2.20E-07	4.35E-06
C. Particulates						
1. Total Activity Released	Ci	-	3.45E-05	-	-	3.45E-05
2. Average Period Release Rate	uCi/sec	-	4.38E-06	-	-	1.09E-06
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Tritium						
1. Total Activity Released	Ci	9.39E-01	2.03E+00	2.07E+00	5.39E+00	1.04E+01
2. Average Period Release Rate	uCi/sec	1.21E-01	2.59E-01	2.60E-01	6.78E-01	3.31E-01
F. C-14						
1. Total Activity Released**	Ci	2.26E+00	2.26E+00	2.26E+00	2.26E+00	9.04E+00
2. Average Period Release Rate	uCi/sec	2.91E-01	2.87E-01	2.84E-01	2.84E-01	2.87E-01

"-" denotes less than Minimum Detectable Activity (MDA)

** Calculated value per "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents" EPRI Final Report, 12/2010.

Table 2.2-A2

MPS2

Gaseous Effluents - Ground Level Release - Batch Mode

Release Point - No Releases

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Total Activity	Ci	*	*	*	*	*
B. Iodines / Halogens						
Total Activity	Ci	*	*	*	*	*
C. Particulates						
Total Activity	Ci	*	*	*	*	*
D. Gross Alpha						
Gross Alpha	Ci	*	*	*	*	*
E. Tritium						
H-3	Ci	*	*	*	*	*

* No activity released

Table 2.2-A3

MPS2

Gaseous Effluents - Ground Level Release - Continuous Mode

Release Point - Refuel Water Storage Tank Vent, Equipment Hatch

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Xe-133	Ci	-	6.20E-04	-	-	6.20E-04
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci					6.20E-04
B. Iodines / Halogens						
I-131	Ci	-	5.94E-08	-	-	5.94E-08
I-133	Ci	-	-	-	-	
Other γ Emitters	Ci	-	-	-	-	
Total Activity	Ci		5.94E-08			5.94E-08
C. Particulates						
Cr-51	Ci		7.07E-06			7.07E-06
Mn-54	Ci		2.21E-07			2.21E-07
Fe-59	Ci		7.51E-08			7.51E-08
Co-58	Ci		1.57E-05			1.57E-05
Co-60	Ci		2.27E-06			2.27E-06
Zr-95	Ci		1.58E-06			1.58E-06
Nb-95	Ci		2.25E-06			2.25E-06
Ag-110m	Ci		2.78E-06			2.78E-06
Sn-113	Ci		2.03E-07			2.03E-07
Sn-117m	Ci		5.45E-08			5.45E-08
Sb-124	Ci		3.98E-07			3.98E-07
Sb-125	Ci		1.22E-06			1.22E-06
Sb-126	Ci		6.92E-09			6.92E-09
Cs-136	Ci		2.25E-08			2.25E-08
Cs-137	Ci		5.77E-07			5.77E-07
Ce-141	Ci		3.37E-09			3.37E-09
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci		3.44E-05			3.44E-05
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	1.42E-04	4.04E-03	-	-	4.18E-03

"na" denotes Not Required to be Analyzed

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.2-A4

MPS2

Gaseous Effluents - Elevated Release - Batch Mode

Release Point – MPS Stack

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Ar-41	Ci	4.54E-02	2.01E-02	3.47E-02	3.04E-02	1.31E-01
Kr-85	Ci	6.79E-03	3.94E-03	1.19E-03	9.96E-04	1.29E-02
Xe-133	Ci	3.43E-02	9.92E-03	2.11E-02	1.19E-02	7.73E-02
Xe-135	Ci	6.93E-04	3.55E-04	7.63E-04	5.63E-04	2.37E-03
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	8.72E-02	3.43E-02	5.78E-02	4.39E-02	2.23E-01
B. Iodines / Halogens						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	1.43E-01	2.90E-02	1.39E-01	1.69E-01	4.80E-01

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes not required to be analyzed

Table 2.2-A5

MPS2

Gaseous Effluents - Elevated Release - Continuous Mode

Release Point - MPS Stack

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines / Halogens						
I-131	Ci	-	-	-	-	-
I-133	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	-	-	1.79E-01	1.27E-01	3.06E-01
F. C-14						
C-14	Ci	1.13E+00	1.13E+00	1.13E+00	1.13E+00	4.52E+00

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.2-A6

MPS2

Gaseous Effluents - Mixed Mode Release - Batch Mode

Release Point – MPS2 Main Exhaust Vent

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Ar-41	Ci	*	1.98E-02	*	*	1.98E-02
Xe-133	Ci	*	3.36E-02	*	*	3.36E-02
Xe-135	Ci	*	1.19E-03	*	*	1.19E-03
Other γ Emitters	Ci	*	-	*	*	-
Total Activity	Ci	*	5.46E-02	*	*	5.46E-02
B. Iodines / Halogens						
Br-82	Ci	*	1.30E-05	*	*	1.30E-05
Other γ Emitters	Ci	*	-	*	*	-
Total Activity	Ci	*	1.30E-05	*	*	1.30E-05
C. Particulates						
	Ci	*	*	*	*	*
Other γ Emitters	Ci	*	*	*	*	*
Total Activity	Ci	*	*	*	*	*
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	-	1.79E-01	-	-	1.79E-01

* No activity released

"na" denotes not required to be analyzed

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.2-A7

MPS2

Gaseous Effluents - Mixed Mode Release - Continuous Mode

Release Point - MPS 2 Main Exhaust Vent

Nuclides Released	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines / Halogens						
Br-85	Ci	5.41E-06	-	-	-	5.41E-06
I-131	Ci	1.82E-05	1.00E-06	6.12E-07	1.75E-06	2.16E-05
I-133	Ci	5.75E-05	5.11E-06	-	-	6.26E-05
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	8.11E-05	6.11E-06	6.12E-07	1.75E-06	8.96E-05
C. Particulates						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	7.96E-01	1.82E+00	1.75E+00	5.09E+00	9.46E+00
F. C-14						
C-14	Ci	1.13E+00	1.13E+00	1.13E+00	1.13E+00	4.52E+00

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.3-A1
MPS3
Gaseous Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
1. Total Activity Released	Ci	2.23E-01	2.22E-01	2.46E-01	3.04E-01	9.96E-01
2. Average Period Release Rate	uCi/sec	2.87E-02	2.83E-02	3.10E-02	3.82E-02	3.16E-02
B. Iodines / Halogens						
1. Total Activity Released	Ci	2.75E-06	1.28E-05	1.81E-06	1.60E-06	1.90E-05
2. Average Period Release Rate	uCi/sec	3.53E-07	1.63E-06	2.27E-07	2.01E-07	6.02E-07
C. Particulates						
1. Total Activity Released	Ci	5.89E-08	-	-	1.42E-03	1.42E-03
2. Average Period Release Rate	uCi/sec	7.58E-09	-	-	1.79E-04	4.52E-05
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Tritium						
1. Total Activity Released	Ci	1.34E+01	1.04E+01	4.39E+00	1.35E+01	4.17E+01
2. Average Period Release Rate	uCi/sec	1.73E+00	1.32E+00	5.53E-01	1.70E+00	1.32E+00
F. C-14						
1. Total Activity Released**	Ci	2.88E+00	2.88E+00	2.88E+00	2.88E+00	1.15E+01
2. Average Period Release Rate	uCi/sec	3.70E-01	3.66E-01	3.62E-01	3.62E-01	3.65E-01

"-" denotes less than Minimum Detectable Activity (MDA)

** Calculated value per "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents" EPRI Final Report, 12/2010.

Table 2.3-A2

MPS3

Gaseous Effluents - Ground Level Release - Batch Mode

Release Point -ESF Building Rooftop

Nuclides Released	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
γ Emitters	Ci	*	-	*	*	-
Total Activity	Ci	*	-	*	*	-
B. Iodines / Halogens						
I-131	Ci	*	-	*	*	-
I-133	Ci	*	-	*	*	-
Other γ Emitters	Ci	*	-	*	*	-
Total Activity	Ci	*	-	*	*	-
C. Particulates						
γ Emitters	Ci	*	-	*	*	-
Total Activity	Ci	*	-	*	*	-
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	*	-	*	*	-

* No activity released

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes Not Required to be Analyzed

Table 2.3-A3

MPS3

Gaseous Effluents - Ground Level Release - Continuous Mode

Release Point - ESF Building Vent, Containment Equipment Hatch, RWST Vent, ABD TK-2 Vent

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines / Halogens						
I-131	Ci	-	-	-	-	-
I-133	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Cr-51	Ci	*	*	*	5.72E-04	5.72E-04
Mn-54	Ci	*	*	*	4.16E-05	4.16E-05
Fe-59	Ci	*	*	*	1.62E-05	1.62E-05
Co-57	Ci	*	*	*	2.84E-08	2.84E-08
Co-58	Ci	*	*	*	4.31E-04	4.31E-04
Co-60	Ci	*	*	*	1.10E-03	1.10E-03
Zr-95	Ci	*	*	*	4.32E-05	4.32E-05
Nb-95	Ci	*	*	*	6.97E-05	6.97E-05
Sb-125	Ci	*	*	*	4.76E-07	4.76E-07
Cs-137	Ci	*	*	*	6.01E-06	6.01E-06
Total Activity	Ci	*	*	*	2.28E-03	2.28E-03
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	4.81E-02	1.13E-01	3.89E-02	4.55E-02	2.45E-01

"-" denotes less than Minimum Detectable Activity (MDA)

* No activity released

Table 2.3-A4

MPS3

Gaseous Effluents - Elevated Release - Batch Mode

Release Point - MPS Stack

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Ar-41	Ci	7.83E-03	8.14E-03	8.20E-04	3.55E-03	2.77E-02
Xe-133	Ci	5.61E-04	1.88E-04	8.40E-04	4.34E-05	1.63E-03
Xe-135	Ci	2.60E-04	1.19E-04	2.77E-04	-	6.57E-04
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	8.65E-03	8.45E-03	9.31E-03	3.60E-03	3.00E-02
B. Iodines / Halogens						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	2.05E-01	6.36E-02	5.56E-02	2.56E-02	3.50E-01

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes Not Required to be Analyzed

Table 2.3-A5

MPS3

Gaseous Effluents - Elevated Release - Continuous Mode

Release Point - MPS Stack

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Ar-41	Ci	1.00E-04	-	-	1.40E-01	1.40E-01
Kr-85	Ci	1.46E-01	2.14E-01	2.37E-01	1.26E-01	7.23E-01
Kr-85m	Ci	8.80E-05	-	-	1.68E-03	1.77E-03
Kr-87	Ci	1.80E-04	-	-	2.00E-03	2.18E-03
Kr-88	Ci	1.90E-04	-	-	2.50E-03	2.69E-03
Xe-133	Ci	1.90E-04	-	-	3.20E-03	3.39E-03
Xe-135	Ci	5.50E-04	-	-	3.20E-03	3.75E-03
Xe-135m	Ci	1.70E-04	-	-	1.01E-02	1.03E-02
Xe-138	Ci	7.00E-04	-	-	8.90E-03	9.60E-03
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	1.48E-01	2.14E-01	2.37E-01	2.98E-01	8.97E-01
B. Iodines / Halogens						
Br-82	Ci	2.75E-06	1.28E-05	1.81E-06	1.60E-06	1.90E-05
I-131	Ci	-	-	-	-	-
I-133	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	2.75E-06	1.28E-05	1.81E-06	1.60E-06	1.90E-05
C. Particulates						
Mn-54	Ci	-	-	-	3.08E-08	3.08E-08
Co-58	Ci	-	-	-	4.42E-07	4.42E-07
Co-60	Ci	-	-	-	1.96E-07	1.96E-07
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Ba-131	Ci	5.89E-08	-	-	-	5.89E-08
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	5.89E-08	-	-	6.69E-07	7.28E-07
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	1.20E+00	2.04E+00	6.39E-01	2.15E-01	4.09E+00
F. C-14						
C-14	Ci	1.44E+00	1.44E+00	1.44E+00	1.44E+00	5.76E+00

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.3-A6

MPS3

Gaseous Effluents - Mixed Mode Release - Batch Mode

Release Point - MPS3 Ventilation Vent

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Xe-133	Ci	*	*	*	1.78E-03	1.78E-03
Xe-135	Ci	*	*	*	6.26E-04	6.26E-04
Other γ Emitters	Ci	*	*	*	-	-
Total Activity	Ci	*	*	*	2.41E-03	2.41E-03
B. Iodines / Halogens						
	Ci	*	*	*	-	-
Other γ Emitters	Ci	*	*	*	-	-
Total Activity	Ci	*	*	*	-	-
C. Particulates						
	Ci	*	*	*	-	-
Other γ Emitters	Ci	*	*	*	-	-
Total Activity	Ci	*	*	*	-	-
D. Gross Alpha						
Gross Alpha	Ci	na	na	na	na	na
E. Tritium						
H-3	Ci	-	-	-	4.13E-02	4.13E-02

* No activity released

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes Not Required to be Analyzed

Table 2.3-A7

MPS3

Gaseous Effluents - Mixed Mode Release - Continuous Mode

Release Point - MPS3 Ventilation Vent

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Kr-85	Ci	6.60E-02	-	-	-	6.60E-02
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	6.60E-02	-	-	-	6.60E-02
B. Iodines / Halogens						
I-131	Ci	-	-	-	-	-
I-133	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Cr-51	Ci	-	-	-	3.53E-05	3.53E-05
Co-58	Ci	-	-	-	7.80E-05	7.80E-05
Co-60	Ci	-	-	-	1.39E-05	1.39E-05
Nb-95	Ci	-	-	-	3.72E-06	3.72E-06
Other γ Emitters	Ci	-	-	-	-	-
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	1.31E-04	1.31E-04
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	1.20E+01	8.18E+00	3.66E+00	1.32E+00	3.70E+01
F. C-14						
C-14	Ci	1.44E+00	1.44E+00	1.44E+00	1.44E+00	5.76E+00

"-" denotes less than Minimum Detectable Activity (MDA)

2.2 Liquid Effluents

2.2.1 Measurement of Radioactivity in Liquid Effluents

2.2.1.1 Continuous Liquid Releases

Water containing radioactivity is continuously released through one of two pathways – the MPS Quarry or DSN006. DSN006 is next to the MPS3 intake structure (DSN is acronym for Discharge Serial Number.) Grab samples are taken for continuous liquid release pathways and analyzed on the gamma spectrometer and liquid scintillation detector (for H-3) if required by the conditional action requirements of the REMODCM. Total estimated volume is multiplied by the isotopic concentrations (if any) to determine the total activity released. A proportional aliquot of each discharge is retained for composite analysis for Sr-89, Sr-90, Fe-55 and gross alpha if required by the conditional action requirements of the REMODCM. Sources for continuous liquid effluent releases via the MPS Quarry include Steam Generator Blowdown for MPS2 & MPS3, Service Water Effluent for MPS2 & MPS3 and Reactor Building Closed Cooling Water (RBCCW) Sump for MPS2. Sources for continuous liquid effluent releases via DSN006 include Turbine Building Sump discharge from MPS2 & MPS3, CPF TK2 from MPS3 and SRW Sump 3 from MPS3.

2.2.1.2 Batch Liquid Releases from Tanks and Sumps

Batch liquid releases are made via both the MPS Quarry and DSN006. There are numerous sources from which batches of liquids containing radioactivity are discharged to the environs. Except for two sources from MPS3 to DSN006 they are discharged via the MPS Quarry. The sources are:

MPS1 Radwaste Processing System – Includes sources from:

1. Reactor Building Sumps
2. Underground Ventilation Duct
3. Site Stack Sump

MPS2 Radwaste Processing System:

1. Clean Waste Monitor Tanks (2)
2. Aerated Waste Monitor Tanks

Other Radwaste Sources:

1. CPF Waste Neutralization Sump
2. Steam Generator Bulk
3. Other Systems' Bulk Discharges

MPS3 Radwaste Processing

1. Waste Test Tanks (2)
2. Low Level Waste Test Tanks (2)
3. Boron Test Tanks (2)

Other Radwaste Sources:

1. CPF Waste Neutralization Sump
2. Steam Generator Bulk
3. Other systems' Bulk Discharges (via Quarry or DSN006)
4. Boron and Waste Test Tanks Berm (via DSN006)

Prior to release, a tank is re-circulated for two equivalent tank volumes, a sample is drawn and then analyzed on the HPGe gamma spectrometer and liquid scintillation detector (H-3) for individual radionuclide composition. Isotopic concentrations are multiplied by the volume released to obtain the total activity released. For bulk releases, several samples are taken during the discharge to verify the amount of radioactivity released. A proportional aliquot of each discharge is retained for composite analysis for Sr-89, Sr-90, Fe-55, and gross alpha.

2.2.2 Estimate of Errors

Estimates of errors associated with radioactivity measurements were made using the following guidelines:

Radioactivity Measurement Calibration	10%	Calibration to NIST* standards
Sampling/Data Collection	10% - 20%	Variation in sample collection
Sample Counting	10% - 30%	Error for counting statistics
Flow & Level Measurements	10% - 20%	Error for release volumes

* National Institute of Standards and Technology

2.2.3 Liquid Batch Release Statistics

	MPS1	MPS2	MPS3
Radwaste Processing System:			
Number of Batches	6	24	82
Total Time (min)	260	3762	8372
Maximum Time (min)	60	281	123
Average Time (min)	43	157	201
Minimum Time (min)	34	60	48
	MPS1	**MPS2**	**MPS3**
Other Radwaste Sources:			
Number of Batches	NA	5	167
Total Time (min)	NA	572	19800
Maximum Time (min)	NA	283	194
Average Time (min)	NA	58	125
Minimum Time (min)	NA	17	30

2.2.4 Abnormal Liquid Releases

An abnormal release of radioactivity is the discharge of a volume of liquid radioactive material to the environment that was unplanned or uncontrolled. In 2017, the following abnormal liquid releases occurred:

2.2.4.1 MPS1 – None

2.2.4.2 MPS2 – None

2.2.4.3 MPS3 - None

2.2.5 Liquid Release Tables

The following tables provide the details of the liquid radioactivity released from each of the MPS units. They are categorized by type of release, source(s), and by release point of discharge to the environment.

Table 2.1-L1
MPS1
Liquid Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission and Activation Products						
1. Total Activity Released	Ci	9.72E-04	1.87E-03	*		2.95E-03
2. Average Period Diluted Activity+	uCi/ml	4.10E-12	1.10E-11	*		4.30E-12
B. Tritium						
1. Total Activity Released	Ci	1.53E-03	2.56E-03	*	1.79E-02	2.20E-02
2. Average Period Diluted Activity+	uCi/ml	6.44E-12	1.51E-11	*	6.43E-11	3.21E-11
C. Dissolved and Entrained Gases						
1. Total Activity Released	Ci	-	-	*	-	-
2. Average Period Diluted Activity+	uCi/ml	-	-	*	-	-
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	*	-	-
E. Volume						
1. Released Waste Volume	Liters	6.11E+04	6.40E+04	*	6.26E+04	1.88E+05
2. Dilution Volume During Releases	Liters	4.62E+08	3.24E+08	*	3.83E+08	1.17E+09
3. Dilution Volume During Period++	Liters	2.37E+11	1.70E+11	*	2.78E+11	6.85E+11

* No activity released

"-" denotes less than Minimum Detectable Activity (MDA)

\+ "Total Activity Released" ÷ ("Released Waste Volume" + "Dilution Volume During Period")

++ MPS2 Dilution Volume During Period used because there is no MPS1 dilution

Table 2.1-L2

MPS1

Liquid Effluents - Batch

Release to Quarry: Liquid Radwaste Processing System

Nuclides Released	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Cs-137	Ci	9.06E-04	1.78E-03	*	2.62E-04	2.95E-03
Other γ Emitters	Ci	-	-	*	-	-
Sr-89	Ci	4.33E-06	-			
Sr-90	Ci	-	3.90E-06	*	-	-
Fe-55	Ci	6.11E-05	9.03E-05	*	-	-
Total Activity	Ci	9.72E-04	1.87E-03	*		2.95E-03
B. Tritium						
H-3	Ci	1.53E-03	2.56E-03	*	1.79E-02	2.20E-02
C. Dissolved & Entrained Gases						
Kr-85	Ci	-	-	*	-	-
Other γ Emitters	Ci	-	-	*	-	-
Total Activity	Ci	-	-	*	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	*	-	-

* No activity released

"-" denotes less than Minimum Detectable Activity (MDA)

"na" denotes not required to be analyzed

Table 2.2-L1

MPS2

Liquid Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission and Activation Products						
1. Total Activity Released	Ci	1.06E-02	6.36E-04	-	9.39E-05	1.13E-02
2. Average Period Diluted Activity *	uCi/ml	4.47E-11	3.74E-12	-	3.37E-13	4.88E-11
B. Tritium						
1. Total Activity Released	Ci	3.09E+02	3.17E+01	6.98E+00	3.28E+01	3.80E+02
2. Average Period Diluted Activity *	uCi/ml	1.30E-06	1.87E-07	2.50E-08	1.18E-07	3.94E-07
C. Dissolved and Entrained Gases						
1. Total Activity Released	Ci	1.74E-02	7.19E-04	-	-	1.81E-02
2. Average Period Diluted Activity *	uCi/ml	7.34E-11	4.23E-12	-	-	7.76E-11
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Volume						
1. Released Waste Volume						
Primary	Liters	8.62E+05	4.77E+05	8.66E+04	1.59E+05	1.58E+06
Secondary	Liters	2.40E+06	1.61E+05	1.08E+04	3.46E+05	2.92E+06
2. Dilution Volume During Releases						
Primary	Liters	9.80E+09	1.13E+10	9.35E+08	3.46E+09	2.55E+10
Secondary (DSN006)	Liters	6.53E+07	2.42E+05	4.61E+05	8.46E+06	7.45E+07
Secondary (Quarry)	Liters	2.41E+09	3.16E+09	Note	8.88E+08	6.46E+09
3. Dilution Volume During Period						
Quarry	Liters	2.37E+11	1.70E+11	2.79E+11	2.78E+11	9.64E+11
DSN006	Liters	6.38E+07	4.76E+07	6.17E+07	5.72E+07	2.30E+08

* "Total Activity Released" ÷ ("Released Waste Volume" + "Dilution Volume During Period")

"-" denotes less than Minimum Detectable Activity (MDA)

Note: No secondary releases to DSN006 in 2nd and 3rd quarters.

Table 2.2-L2

MPS2

Liquid Effluents - Continuous

1. **Release to Quarry: Steam Generator Blowdown, Service Water and Reactor Building Closed Cooling Water**
2. **Release to DSN006: Turbine Building Sumps and Tendon Gallery**

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
γ Emitters	Ci	-	-	*	-	-
Sr-89	Ci	-	-	*	-	-
Sr-90	Ci	-	-	*	-	-
Ni-63	Ci	-	-	*	-	-
Total Activity	Ci	-	-	*	-	-
B. Tritium						
H-3	Ci	2.02E+03	1.50E-03	8.30E-04	1.14E-03	2.02E+03
C. Dissolved & Entrained Gases						
γ Emitters	Ci	-	-	*	-	-
Total Activity	Ci	-	-	*	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	*	-	-

"-" denotes less than Minimum Detectable Activity (MDA)

* No activity released

Table 2.2-L3

MPS2

Liquid Effluents - Batch

Release to Quarry: Liquid Radwaste Processing System

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Be-7	Ci	-	-	-	-	-
Mn-54	Ci	-	3.89E-06	-	-	3.89E-06
Co-58	Ci	-	7.00E-05	-	-	7.00E-05
Co-60	Ci	1.55E-04	2.00E-04	-	-	3.55E-04
Nb-97	Ci	-	-	-	-	-
Ag-110m	Ci	3.01E-05	2.97E-04	-	-	3.27E-04
Sb-125	Ci	1.83E-04	2.44E-05	-	-	2.07E-04
I-131	Ci	-	-	-	-	-
Cs-137	Ci	2.98E-05	-	-	-	2.98E-05
Other γ Emitters	Ci	-	-	-	-	-
Fe-55	Ci	6.03E-03	4.06E-05	-	9.39E-05	6.16E-03
Ni-63	Ci	6.98E-04	-	-	-	6.98E-04
Sr-89	Ci	3.50E-03	-	-	-	3.50E-03
Sr-90	Ci	-	-	-	-	-
Total Activity	Ci	1.06E-02	6.36E-04	-	9.39E-05	1.14E-02
B. Tritium						
H-3	Ci	3.09E+02	3.17E+01	6.98E+00	3.28E+01	3.80E+02
C. Dissolved & Entrained Gases						
Xe-133	Ci	1.70E-02	7.19E-04	-	-	1.77E-02
Xe-133m	Ci	1.29E-04	-	-	-	1.29E-04
Xe-135	Ci	2.93E-04	-	-	-	2.93E-04
Other γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	1.74E-02	7.19E-04	-	-	1.81E-02
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.3-L1

MPS3

Liquid Effluents - Release Summary

	Units	2017 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission and Activation Products						
1. Total Activity Released	Ci	-	1.91E-03	-	3.02E-04	2.21E-03
2. Average Period Diluted Activity *	uCi/ml	-	4.77E-12	-	9.49E-13	1.36E-12
B. Tritium						
1. Total Activity Released	Ci	1.51E+02	6.86E+01	6.26E+02	5.30E+02	1.38E+03
2. Average Period Diluted Activity *	uCi/ml	3.49E-07	1.71E-07	1.32E-06	1.67E-06	8.47E-07
C. Dissolved and Entrained Gases						
1. Total Activity Released	Ci	-	-	-	-	-
2. Average Period Diluted Activity *	uCi/ml	-	-	-	-	-
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Volume						
1. Released Waste Volume						
Primary	Liters	5.35E+05	1.31E+06	1.15E+06	1.07E+06	4.07E+06
Secondary	Liters	2.60E+07	2.16E+07	1.84E+07	1.47E+07	8.07E+07
2. Dilution Volume During Releases						
Primary	Liters	4.51E+09	1.19E+10	1.07E+10	8.09E+09	3.52E+10
Secondary (DSN006)	Liters	1.25E+08	4.71E+07	1.20E+08	3.37E+04	2.92E+08
Secondary (Quarry)	Liters	1.08E+12	9.00E+11	1.10E+12	7.43E+11	3.82E+12
3. Dilution Volume During Period						
Quarry	Liters	4.31E+11	4.01E+11	4.73E+11	3.18E+11	1.62E+12
DSN006	Liters	6.38E+07	4.76E+07	6.17E+07	5.72E+07	2.30E+08

"-" denotes less than Minimum Detectable Activity (MDA)

* "Total Activity Released" ÷ (Primary "Released Waste Volume" + "Dilution Volume During Period")

Table 2.3-L2

MPS3

Liquid Effluents - Continuous

1. **Release to Quarry: Steam Generator Blowdown, Service Water, ABD TK-2**
2. **Release to DSN006: Turbine Building Sump and SRW Sump 3**

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
γ Emitters	Ci	-	-	-	-	-
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Fe-55	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Tritium						
H-3	Ci	6.51E-01	5.06E-01	3.24E-01	8.60E-02	1.57E+00
C. Dissolved & Entrained Gases						
γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-

"-" denotes less than Minimum Detectable Activity (MDA)

Table 2.3-L3

MPS3

Liquid Effluents - Batch

1. **Release to Quarry: Liquid Radwaste Processing System, CPF Waste Neutralization Sumps, Hotwell and Steam Generator Bulk, ABD TK-2**
2. **Release to DSN006: Waste Test Tank Berm**

Nuclides Released	Units	2017				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Mn-54	Ci	-	-	-	-	-
Co-58	Ci	-	-	-	3.02E-04	3.02E-04
Co-60	Ci	-	-	-	-	-
Zr-95	Ci	-	-	-	-	-
Nb-95	Ci	-	-	-	-	-
Sb-125	Ci	-	-	-	-	-
Cs-134	Ci	-	-	-	-	-
Cs-137	Ci	-	-	-	-	-
Other γ Emitters	Ci	-	-	-	-	-
Fe-55	Ci	-	1.91E-03	-	-	1.91E-03
Ni-63	Ci	-	-	-	-	-
Sr-89	Ci	-	-	-	-	-
Sr-90	Ci	-	-	-	-	-
Total Activity	Ci	-	1.91E-03	-	3.02E-04	2.21E-03
B. Tritium						
H-3	Ci	1.50E+02	6.81E+01	6.26E+02	5.30E+02	1.37E+03
C. Dissolved & Entrained Gases						
γ Emitters	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-

"-" denotes less than Minimum Detectable Activity (MDA)

2.3 Solid Waste

Solid waste shipment summaries for each unit are given in the following tables:

Table 2.1-S MPS1 Solid Waste and Irradiated Component Shipments
Table 2.2-S MPS2 Solid Waste and Irradiated Component Shipments
Table 2.3-S MPS3 Solid Waste and Irradiated Component Shipments

The principal radionuclides in these tables were from shipping manifests.

Solidification Agent(s): No solidification on site

Containers routinely used for radioactive waste shipment include:

55-gal Steel Drum DOT* 17-H container	7.5 ft^3
Steel Boxes	45 ft^3
	87 ft^3
	95 ft^3
Steel Container	202.1 ft^3
Steel "Sea Van"	1280 ft^3
Polyethylene High Integrity Containers	120.3 ft^3
	132.4 ft^3
	173.4 ft^3
	202.1 ft^3

* United States Department of Transportation

Table 2.1-S
Solid Waste and Irradiated Component Shipments
MPS1

January 1, 2017 through December 31, 2017

Resins, Filters, and Evaporator Bottoms	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	N/A	N/A	N/A
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**N/A**	**N/A**	**N/A**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
CURIES (TOTAL)		0

Table 2.1-S (continued)
Solid Waste and Irradiated Component Shipments
MPS1

January 1, 2017 through December 31, 2017

Dry Active Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	3.20E+02	9.05E+00	2.73E-02
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**3.20E+02**	**9.05E+00**	**2.73E-02**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
C-14	< 0.01%	1.06E-06
Fe-55	58.92%	1.61E-02
Co-60	21.70%	5.93E-03
Ni-63	7.16%	1.96E-03
Sr-90	0.04%	1.10E-05
Cs-137	8.86%	2.42E-03
Pu-238	< 0.01%	2.34E-07
Pu-239	< 0.01%	2.15E-07
Pu-241	0.05%	1.44E-05
Am-241	< 0.01%	8.10E-07
Cm-242	< 0.01%	6.92E-09
Cm-244	< 0.01%	3.51E-07
CURIES (TOTAL)		**2.73E-02**

Table 2.1-S (continued)
Solid Waste and Irradiated Component Shipments
MPS1

January 1, 2017 through December 31, 2017

Irradiated Components	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	N/A	N/A	N/A
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**N/A**	**N/A**	**N/A**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
CURIES (TOTAL)		0

Other Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	N/A	N/A	N/A
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**N/A**	**N/A**	**N/A**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
CURIES (TOTAL)		0

Table 2.1-S (continued)
Solid Waste and Irradiated Component Shipments
MPS1

January 1, 2017 through December 31, 2017

Sum of All Low-Level Waste Shipped from Site	Volume		Curies Shipped
Waste Class	ft^3	m^3	Curies
A	3.20E+02	9.05E+00	2.73E-02
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**3.20E+02**	**9.05E+00**	**2.73E-02**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
C-14	< 0.01%	1.06E-06
Fe-55	58.92%	1.61E-02
Co-60	21.70%	5.93E-03
Ni-63	7.16%	1.96E-03
Sr-90	0.04%	1.10E-05
Cs-137	8.86%	2.42E-03
Pu-238	< 0.01%	2.34E-07
Pu-239	< 0.01%	2.15E-07
Pu-241	0.05%	1.44E-05
Am-241	< 0.01%	8.10E-07
Cm-242	< 0.01%	6.92E-09
Cm-244	< 0.01%	3.51E-07
CURIES (TOTAL)		**2.73E-02**

Table 2.2-S
Solid Waste and Irradiated Component Shipments
MPS2

January 1, 2017 through December 31, 2017

Resins, Filters, and Evaporator Bottoms	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	8.87E+02	2.51E+01	1.04E+01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**8.87E+02**	**2.51E+01**	**1.04E+01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	0.13%	1.41E-02
C-14	2.41%	2.51E-01
Mn-54	10.70%	1.12E+00
Fe-55	28.58%	2.98E+00
Co-57	0.09%	9.36E-03
Co-58	0.73%	7.58E-02
Co-60	31.65%	3.30E+00
Ni-59	0.18%	1.92E-02
Ni-63	19.07%	1.99E+00
Sr-90	0.17%	1.78E-02
Tc-99	0.03%	3.26E-03
Ag-108m	< 0.01%	1.92E-04
Ag-110m	0.43%	4.52E-02
Sn-113	0.32%	3.33E-02
Sb-125	3.70%	3.86E-01
Cs-137	1.11%	1.16E-01
Ce-144	< 0.01%	8.73E-05
Pu-238	< 0.01%	2.24E-05
Pu-239	< 0.01%	5.60E-06
Pu-241	0.02%	1.91E-03
Am-241	< 0.01%	1.02E-05
Cm-242	< 0.01%	4.73E-06
Cm-244	< 0.01%	1.23E-05
CURIES (TOTAL)		**1.04E+01**

Table 2.2-S (continued)
Solid Waste and Irradiated Component Shipments
MPS2
January 1, 2017 through December 31, 2017

Dry Active Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	2.18E+04	6.16E+02	2.30E-01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**2.18E+04**	**6.16E+02**	**2.30E-01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	0.20%	4.67E-04
C-14	0.01%	2.37E-05
Cr-51	3.43%	7.88E-03
Mn-54	0.96%	2.21E-03
Fe-55	5.84%	1.34E-02
Co-57	0.03%	6.67E-05
Co-58	2.51%	5.78E-03
Co-60	49.43%	1.14E-01
Ni-59	0.25%	5.64E-04
Ni-63	15.52%	3.57E-02
Sr-89	< 0.01%	4.47E-06
Sr-90	< 0.01%	8.59E-06
Zr-95	5.17%	1.19E-02
Nb-94	0.08%	1.78E-04
Nb-95	9.52%	2.19E-02
Tc-99	0.02%	5.15E-05
Ag-110m	1.06%	2.44E-03
Sn-113	0.34%	7.75E-04
Sb-125	3.95%	9.07E-03
Cs-137	0.66%	1.52E-03
Ce-144	< 0.01%	8.34E-06
Pu-238	< 0.01%	2.44E-06
Pu-239	< 0.01%	2.06E-06
Pu-241	0.17%	3.84E-04
Am-241	< 0.01%	1.04E-05
Cm-242	< 0.01%	8.99E-07
Cm-244	< 0.01%	3.86E-06
CURIES (TOTAL)		**2.30E-01**

Table 2.2-S (continued)
Solid Waste and Irradiated Component Shipments
MPS2
January 1, 2017 through December 31, 2017

Irradiated Components	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	N/A	N/A	N/A
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**N/A**	**N/A**	**N/A**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
CURIES (TOTAL)		0

Table 2.2-S (continued)
Solid Waste and Irradiated Component Shipments
MPS2
January 1, 2017 through December 31, 2017

Other Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	8.28E+02	2.34E+01	1.84E-02
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**8.28E+02**	**2.34E+01**	**1.84E-02**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	76.47%	1.41E-02
C-14	< 0.01%	8.46E-09
Mn-54	0.01%	2.63E-06
Fe-55	0.04%	6.86E-06
Co-57	< 0.01%	1.93E-09
Co-58	0.14%	2.57E-05
Co-60	0.09%	1.69E-05
Ni-63	0.08%	1.39E-05
Zn-65	< 0.01%	2.62E-09
Sr-89	< 0.01%	4.61E-08
Sr-90	3.13%	5.76E-04
Tc-99	< 0.01%	7.81E-07
Sb-125	0.05%	9.43E-06
Cs-137	19.94%	3.66E-03
Pu-238	< 0.01%	1.83E-09
Pu-239	< 0.01%	1.17E-09
Pu-241	< 0.01%	4.55E-08
Am-241	< 0.01%	6.75E-09
Pu-240	< 0.01%	9.49E-10
Cm-242	< 0.01%	1.14E-10
Cm-243	< 0.01%	3.75E-09
Cm-244	< 0.01%	4.18E-09
CURIES (TOTAL)		**1.84E-02**

Table 2.2-S (continued)
Solid Waste and Irradiated Component Shipments
MPS2
January 1, 2017 through December 31, 2017

Sum of All Low-Level Waste Shipped from Site	Volume		Curies Shipped
Waste Class	ft^3	m^3	Curies
A	2.35E+04	6.65E+02	1.07E+01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**2.35E+04**	**6.65E+02**	**1.07E+01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	0.27%	2.86E-02
C-14	2.35%	2.51E-01
Cr-51	0.16%	1.68E-02
Mn-54	10.48%	1.12E+00
Fe-55	28.04%	2.99E+00
Co-57	0.09%	9.43E-03
Co-58	0.76%	8.16E-02
Co-60	31.97%	3.41E+00
Ni-59	0.19%	1.98E-02
Ni-63	18.96%	2.03E+00
Zn-65	0.15%	1.55E-02
Sr-89	0.06%	6.13E-03
Sr-90	0.17%	1.83E-02
Zr-95	0.16%	1.70E-02
Nb-94	< 0.01%	1.78E-04
Nb-95	0.31%	3.26E-02
Tc-99	0.03%	3.31E-03
Ag-108m	< 0.01%	1.92E-04
Ag-110m	0.45%	4.77E-02
Sn-113	0.32%	3.41E-02
Sb-125	3.70%	3.95E-01
Cs-137	1.13%	1.21E-01
Ce-144	< 0.01%	9.60E-05
Pu-238	< 0.01%	2.48E-05
Pu-239	< 0.01%	7.66E-06
Pu-241	0.02%	2.29E-03
Am-241	< 0.01%	2.06E-05
Pu-240	< 0.01%	9.49E-10
Cm-242	< 0.01%	5.63E-06
Cm-243	< 0.01%	3.75E-09
Cm-244	< 0.01%	1.61E-05
CURIES (TOTAL)		**1.07E+01**

Table 2.3-S
Solid Waste and Irradiated Component Shipments
MPS3

January 1, 2017 through December 31, 2017

Resins, Filters, and Evaporator Bottoms	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	1.52E+02	4.31E+00	1.07E+01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**1.52E+02**	**4.31E+00**	**1.07E+01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	1.06%	1.13E-01
C-14	1.96%	2.10E-01
Mn-54	0.83%	8.93E-02
Fe-55	3.24%	3.47E-01
Co-57	0.03%	3.16E-03
Co-58	0.23%	2.41E-02
Co-60	2.61%	2.79E-01
Ni-59	0.43%	4.59E-02
Ni-63	37.91%	4.06E+00
Zn-65	0.01%	6.69E-04
Sr-90	0.01%	1.51E-03
Nb-94	< 0.01%	1.94E-05
Tc-99	0.33%	3.57E-02
Ag-110m	0.02%	2.48E-03
Sb-125	50.45%	5.40E+00
Cs-134	0.10%	1.06E-02
Cs-137	0.78%	8.36E-02
Ce-144	< 0.01%	4.29E-06
Pu-238	< 0.01%	7.24E-06
Pu-239	< 0.01%	9.20E-08
Pu-241	< 0.01%	4.97E-04
Am-241	< 0.01%	1.75E-06
Cm-242	< 0.01%	3.06E-08
Cm-244	< 0.01%	5.04E-08
CURIES (TOTAL)		**1.07E+01**

Table 2.3-S (continued)
Solid Waste and Irradiated Component Shipments
MPS3

January 1, 2017 through December 31, 2017

Dry Active Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	1.23E+04	3.49E+02	4.99E-01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**1.23E+04**	**3.49E+02**	**4.99E-01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	0.33%	1.62E-03
Cr-51	1.14%	5.67E-03
Mn-54	2.52%	1.26E-02
Fe-55	62.15%	3.10E-01
Fe-59	0.15%	7.24E-04
Co-57	0.06%	2.91E-04
Co-58	2.58%	1.28E-02
Co-60	19.97%	9.96E-02
Ni-59	0.04%	2.23E-04
Ni-63	6.02%	3.00E-02
Sr-90	< 0.01%	1.86E-05
Zr-95	1.20%	5.99E-03
Nb-94	0.03%	1.63E-04
Nb-95	2.19%	1.09E-02
Sn-113	0.06%	2.96E-04
Sb-125	0.58%	2.89E-03
Cs-137	0.95%	4.73E-03
Pu-241	0.04%	2.12E-04
Am-241	< 0.01%	8.70E-07
Cm-242	< 0.01%	2.31E-07
Cm-244	< 0.01%	6.85E-07
CURIES (TOTAL)		**4.99E-01**

Table 2.3-S (continued)
Solid Waste and Irradiated Component Shipments
MPS3

January 1, 2017 through December 31, 2017

Irradiated Components	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	N/A	N/A	N/A
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**N/A**	**N/A**	**N/A**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
CURIES (TOTAL)		0

Table 2.3-S (continued)
Solid Waste and Irradiated Component Shipments
MPS3

January 1, 2017 through December 31, 2017

Other Waste	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	4.50E+02	1.27E+01	8.91E-03
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**4.50E+02**	**1.27E+01**	**8.91E-03**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	89.22%	7.95E-03
C-14	< 0.01%	7.22E-09
Mn-54	0.02%	1.36E-06
Fe-55	0.03%	2.60E-06
Co-57	< 0.01%	2.10E-09
Co-58	0.06%	5.64E-06
Co-60	0.06%	5.39E-06
Ni-63	0.04%	3.60E-06
Zn-65	< 0.01%	2.85E-09
Sr-89	< 0.01%	3.15E-08
Sr-90	1.42%	1.26E-04
Tc-99	< 0.01%	3.47E-07
Sb-125	0.02%	2.07E-06
Cs-137	9.10%	8.11E-04
Pu-238	< 0.01%	1.78E-09
Pu-239	< 0.01%	1.11E-09
Pu-241	< 0.01%	1.48E-08
Am-241	< 0.01%	6.47E-09
Pu-240	< 0.01%	1.03E-09
Cm-242	< 0.01%	3.73E-11
Cm-243	< 0.01%	4.07E-09
Cm-244	< 0.01%	4.21E-09
CURIES (TOTAL)		**8.91E-03**

Table 2.3-S (continued)
Solid Waste and Irradiated Component Shipments
MPS3

January 1, 2017 through December 31, 2017

Sum of All Low-Level Waste Shipped from Site	Volume		Curies Shipped
Waste Class	**ft^3**	**m^3**	**Curies**
A	1.29E+04	3.66E+02	1.12E+01
B	N/A	N/A	N/A
C	N/A	N/A	N/A
ALL	**1.29E+04**	**3.66E+02**	**1.12E+01**

Nuclides for the Above Table:

Radionuclide	% of Total	Curies
H-3	1.09%	1.23E-01
C-14	1.87%	2.10E-01
Cr-51	0.05%	5.67E-03
Mn-54	0.91%	1.02E-01
Fe-55	5.86%	6.57E-01
Fe-59	< 0.01%	7.24E-04
Co-57	0.03%	3.45E-03
Co-58	0.33%	3.69E-02
Co-60	3.38%	3.79E-01
Ni-59	0.41%	4.62E-02
Ni-63	36.46%	4.09E+00
Zn-65	< 0.01%	6.69E-04
Sr-89	< 0.01%	3.61E-08
Sr-90	0.01%	1.66E-03
Zr-95	0.05%	5.99E-03
Nb-94	< 0.01%	1.83E-04
Nb-95	0.10%	1.09E-02
Tc-99	0.32%	3.57E-02
Sn-113	< 0.01%	2.96E-04
Sb-125	48.19%	5.41E+00
Cs-137	0.79%	8.91E-02
Pu-238	< 0.01%	7.39E-06
Pu-239	< 0.01%	2.33E-07
Pu-241	< 0.01%	7.10E-04
Am-241	< 0.01%	2.62E-06
Pu-240	< 0.01%	1.03E-09
Cm-242	< 0.01%	2.61E-07
Cm-243	< 0.01%	4.07E-09
Cm-244	< 0.01%	7.39E-07
CURIES (TOTAL)		**1.12E+01**

2.4 Groundwater Monitoring

With the Groundwater Protection Program (GWPP) MPS implements the actions cited in the Nuclear Energy's Institute's (NEI) Groundwater Protection Initiative (Reference 9). The purpose of the GWPP is to establish a program to assure timely and effective management of situations involving potential releases of radioactive material to groundwater. A key element in the GWPP is on-site groundwater monitoring. The results of the GWPP are documented in tables below.

Another key element in the GWPP is site hydrological characterization. The general trend of groundwater flow at the station is toward the Long Island Sound. The underdrain system effectively captures groundwater in the area around MPS3 and channels this water via the storm drain system to Long Island Sound.

Table 2.4-GW (p. 1 of 3)
Well Sample Results

Name	Date	H-3[1,2] (pCi/L)	Name	Date	H-3[1,2] (pCi/L)
MW-7C[3]	1/27/2017	4150	MW-7D[3]	6/12/2017	4230
	2/23/2017	7430	(cont.)	6/13/2017	3010
	3/21/2017	4420		6/26/2017	3590
	4/3/2017	2660		7/5/2017	4860
	5/3/2017	3880		7/25/2017	4680
	6/12/2017	4470		8/9/2017	6450
	9/25/2017	4950		8/21/2017	5150
	10/27/2017	<MDA		9/5/2017	7190
	11/8/2017	4530		9/6/2017	7830
	11/20/2017	3240		9/11/2017	7750
	12/6/2017	<MDA		9/18/2017	7520
MW-7D[3]	1/11/2017	8760		9/25/2017	8130
	1/13/2017	9960		10/2/2017	6980
	1/27/2017	8180		10/10/2017	9120
	2/6/2017	7910		10/18/2017	8240
	2/22/2017	6900		10/26/2017	6720
	3/6/2017	5200		10/31/2017	5020
	3/20/2017	4480		11/3/2017	4550
	4/3/2017	4110		11/7/2017	3350
	4/17/2017	2640		11/14/2017	3900
	5/3/2017	2690		11/20/2017	7220
	5/8/2017	2230		11/27/2017	5570
	5/18/2017	2290		12/5/2017	6160

Notes: 1 - There was no gamma radioactivity detected in these samples.
2 - MDA is approximately 1,760 pCi/L.
3 - These wells are located near the MPS3 RWST which is downwind direction from the MPS3 Ventilation Vent. All or some of the H-3 detected in these wells is from releases out of the RWST vent and Ventilation Vent. Gaseous releases from the Ventilation Vent are reported in Table 2.3-A7 and from the RWST vent in Table 2.3-A3. Any releases from RWST vent or Ventilation Vent which reach the groundwater are captured in sumps and underground vaults, and periodically monitored before release to the environment and reported in Table 2.3-L2. There has been no hydraulic communication with offsite groundwater.

Table 2.4-GW (p. 2 of 3)
Well Sample Results

Name	Date	H-3[1,2] (pCi/L)	Name	Date	H-3[1,2] (pCi/L)
DP-102[3]	1/4/2017	2400	MW-GPI-08	1/25/2017	<MDA
	4/11/2017	2960		5/23/2017	<MDA
	8/10/2017	dry		7/25/2017	<MDA
	9/5/2017	dry		12/11/2017	<MDA
	11/28/2017	4130	MW-GPI-09[4]	1/11/2017	2600
ME-2	7/19/2017	<MDA		1/25/2017	4200
ME-5	7/26/2017	<MDA		2/6/2017	3670
MW-6A	3/9/2017	<MDA		2/22/2017	3490
	5/4/2017	<MDA		3/6/2017	4270
	8/28/2017	<MDA		3/20/2017	2520
	11/15/2017	<MDA		4/5/2017	<MDA
MW-6B	3/8/2017	<MDA		4/17/2017	2510
	5/4/2017	<MDA		5/2/2017	2950
	8/25/2017	<MDA		5/23/2017	2980
	11/15/2017	<MDA		6/12/2017	<MDA
MW-GPI-02	2/2/2017	<MDA		6/26/2017	2600
	5/10/2017	<MDA		7/17/2017	2390
	7/17/2017	<MDA		8/9/2017	<MDA
	12/11/2017	<MDA		9/5/2017	<MDA
MW-GPI-03	7/26/2017	<MDA		9/18/2017	2070
MW-GPI-04	4/27/2017	<MDA		10/2/2017	<MDA
MW-GPI-06	1/4/2017	<MDA		10/27/2017	2440
	4/13/2017	<MDA		11/7/2017	<MDA
	8/10/2017	dry		11/10/2017	<MDA
	9/5/2017	dry		11/14/2017	<MDA
	11/28/2017	<MDA		11/20/2017	<MDA
				11/27/2017	2330
				12/5/2017	<MDA

Notes: 1 - There was no gamma radioactivity detected in these samples.
2 - MDA is approximately 1,760 pCi/L.
3 - These wells are located near the MPS3 RWST which is downwind direction from the MPS3 Ventilation Vent. All or some of the H-3 detected in these wells is from releases out of the RWST vent and Ventilation Vent. Gaseous releases from the Ventilation Vent are reported in Table 2.3-A7 and from the RWST vent in Table 2.3-A3. Any releases from RWST vent or Ventilation Vent which reach the groundwater are captured in sumps and underground vaults, and periodically monitored before release to the environment and reported in Table 2.3-L2. There has been no hydraulic communication with offsite groundwater.
4- Some results from MW-GPI-09 are positive. The source of tritium appears to be from the tritium being released via underground discharge tunnels. This tritium has been documented and the releases reported in another part of this report. No other leakage source has been identified.

Table 2.4-GW (p. 3 of 3)
Well Sample Results

Name	Date	H-3[1,2] (pCi/L)	Name	Date	H-3[1,2] (pCi/L)
MW-GPI-10	2/2/2017	<MDA	S12-MW-3	1/12/2017	<MDA
	5/8/2017	<MDA		5/10/2017	<MDA
	8/11/2017	<MDA		8/14/2017	<MDA
	10/10/2017	<MDA		11/20/2017	<MDA
MW-GPI-11	1/13/2017	<MDA	S13-MW-1	2/8/2017	<MDA
	4/10/2017	<MDA	S1-MW-1	1/19/2017	<MDA
	7/31/2017	<MDA	S3-MW-2	2/8/2017	<MDA
	11/17/2017	<MDA	T10-MW-5E	1/17/2017	<MDA
S11-MW-1	2/23/2017	<MDA	T10-MW-6A	3/8/2017	<MDA
	1/30/2017	<MDA	T10-MW-6B	6/20/2017	<MDA
	5/16/2017	<MDA	T1-MW-3	1/19/2017	<MDA
	8/14/2017	<MDA			
	12/7/2017	<MDA			

Notes: 1 - There was no gamma radioactivity from licensed radioactive material detected in these samples.
2 - MDA is approximately 1,760 pCi/L.

3.0 NONFUNCTIONAL Effluent Monitors

During the period January 1 through December 31, 2017, the following effluent instrumentation were NONFUNCTIONAL for more than 30 consecutive days:

3.1. **MPS1** - None

3.2. **MPS2** - None

3.3. **MPS3** -
3HVR-19B - On 03/20/2017 3HVR19B, SLCRS Gas Low Range flow transmitter failed SP 3449B32, Supplemental Leak Collection and Release Operational Test and Calibration, surveillance. Operations declared the radiation monitoring Non Functional based on the flow transmitter failing the surveillance.

As a result, condition report CR 1062683, HVR*FT19 unresponsive to M&TE mid-scale input signals and troubleshooting work order 53103060450 were initiated. The Maintenance Rule Functional Failure evaluation concluded that process flow indication is not required to support the gas channel indication. The troubleshooting work order required removal of the flow transmitter's circuit board, so that the vendor, FCI could repair the board. The time to develop a troubleshooting

work order coupled with the reliance on vendor repairs caused the 3HVR19B to be Non Functional for greater than 30 days.

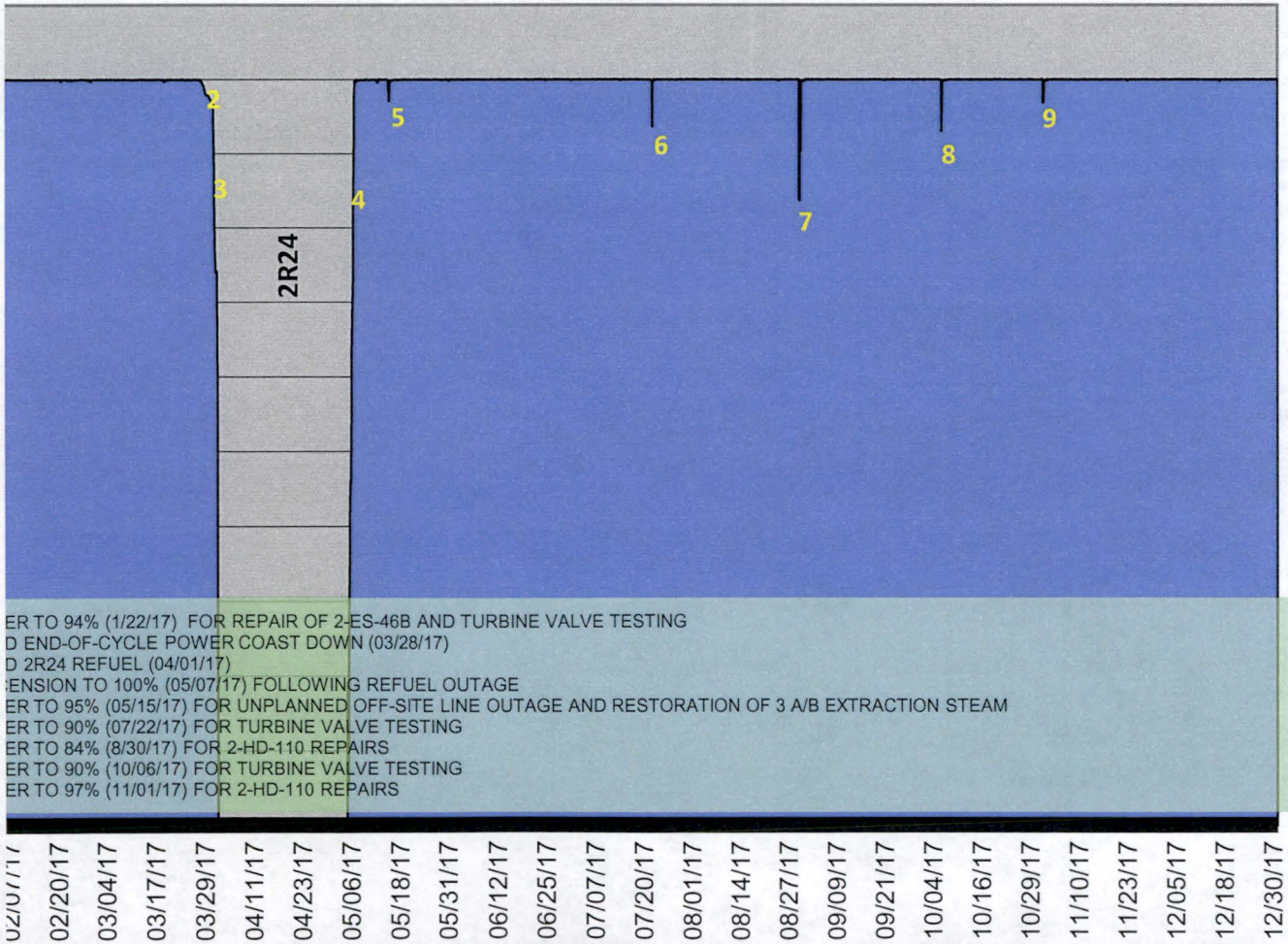
The flow transmitter retested successfully on 05/11/2017 and Functionality was restored to HVR19B. All compensatory samples were taken once every seven days while the HVR19B was declared Non Functional.

4.0 Operating History

The operating history of the MPS Units during this reporting period was as follows:
MPS1 was shut down November 11, 1995 with a cessation of operation declared in July 1998.
MPS2 operated with a capacity factor of 89%
MPS3 operated with a capacity factor of 91.7%
The power histograms for 2017 are on the following pages.

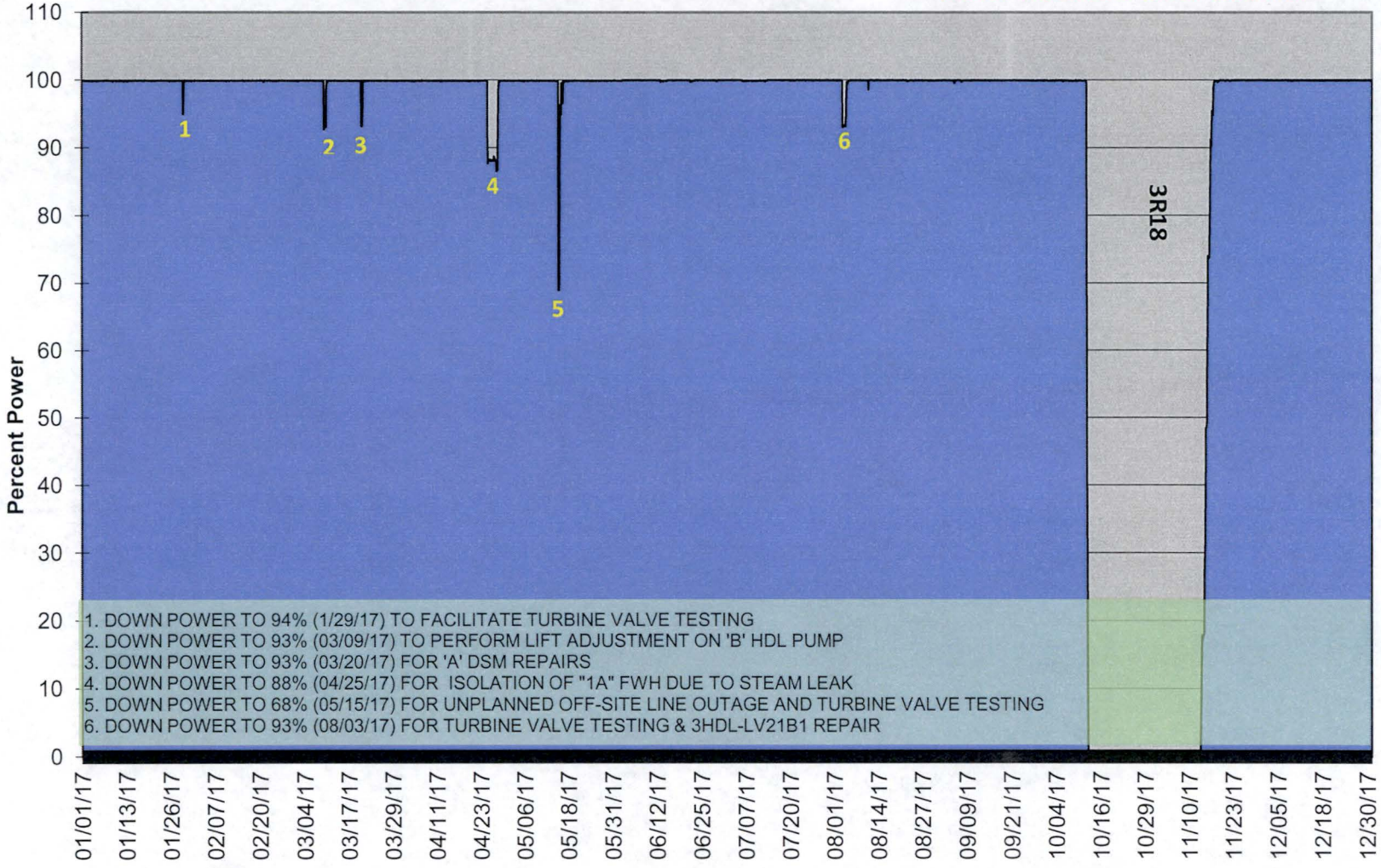
MP2 - CYCLE 24/25 POWER HISTORY
YEAR 2017

Note: Data at 3 Hour Intervals



MP3 - CYCLE 18/19 POWER HISTORY
YEAR 2017

Note: Data at 3 Hour Interval



5.0 ERRATA

Not Applicable

6.0 REMODCM Changes

The description and the bases of the change(s) for REMODCM Revision 29 (effective April 4, 2017) are included here in Volume II of the Radioactive Effluent Release Report. In addition, a complete copy of the REMODCM revision is provided to the Nuclear Regulatory Commission as Volume 2 of the Radioactive Effluent Release Report.

REMODCM Summary of Changes in Revision 29	
Pg.1	II.E changed from "MPS1 Liquid Discharge" to "Liquid Discharge Flow Rates and Monitoring Setpoints"
Table I.C.-1 Pg.8	MPS unit Radioactive Liquid Waste Sampling and Analysis Program Added Footnote C to obtain grab samples for alpha, Fe-55, and Sr-90.
Table I.C-2 Pg.12	MPS2 Radioactive Liquid Waste Sampling and Analysis Program. Added condensate as an alternate sample for steam generator in Footnotes H&I.
I.C-2 Pg.18	Liquid Radioactive Waste Treatment 1) Added ALPS/AIM Processing to MPS2 processing equipment. 2) In MPS2 clean liquid waste processing equipment deleted "Aerated Liquid" which was with secondary or equivalent demineralizer.
Figure I.C.-2 Pg. 21	Simplified Liquid Effluent Flow Diagram MPS2 Added ALPS processing
Table I.D-1 Pages 23-24	MPS1 Radioactive Gaseous Waste Sampling and Analysis Programs 1) Added new Footnote F to require monthly gas sample from BOP Vent when SFPI ventilation is shut down and ventilation of SFPI is exhausted to BOP vent. 2) Added new Footnote G to allow an alternative to tritium analysis of vent sample.
Table I.D-1 Pg. 28	MPS3 Radioactive Gaseous Waste Sampling and Analysis Program 1) In MPS3 table (I.D-3), deleted fuel building releases. 2) In Footnote F of Table I.D-3 changed numbered conditions from 3 and 4 to and 2, respectively.
Table I.E-4 Pg. 44 Continued...	Maximum Values for Lower Limit of Detection (LLD) 1) Made food products LLDs applicable to vegetation LLD. 2) Made sediment LLDs applicable to soil LLDs. Added a LLD of 0.093 pCi/g for fish and shellfish for I-131 analyses.
II.A Pg. 51	Section II - Offsite Dose Calculation Manual (ODCM) - Introduction Deleted 5th and 6th paragraphs.
II.D.I Pg. 55	Gaseous Dose Calculation –Site Release Rate Limit ("Instantaneous") revised wording in first paragraph as shown in attached markup.
Table III.C-3 Pg. 89	MPS1 Radioactive Gaseous Effluent Monitoring Instrumentation 1) Changed 2nd Footnote 1 to Footnote 2. 2) In ACTION B changed time requirement for analysis of filter collection from 24hrs to 48 hours. 3) In ACTION B added the word "duration" to "24 hour sample' to clarify length of sample versus time of sample.

Table IV. C-1 & V.C-1 Pages 104,122	MPS2 & MPS3 Radioactive liquid Effluent Monitoring Instrumentation Change required functionality of steam generator blowdown radiation monitors from Modes 1-4 to whenever the pathway is in use.
III.D, IV.D, V.D Pages. 91,111, 131	Radioactive Effluents Concentration and Dose Limitations In Surveillance Requirement changed reference to "Section II" to "Section II.E."

7.0 References

1. NUREG-0597, User Guide to GASPAR Code, KF Eckerman, FJ Congel, AK Roecklien, WJ Pasciak, Division of Site Safety and Environmental Analysis, Office of Nuclear Reactor Regulation, US Nuclear Regulatory Commission, Washington, DC 20555, manuscript completed January 1980, published June 1980.

2. EPRI Report 1021106, Estimation of Carbon-14 in Nuclear Power Plants Gaseous Effluents, December, 2010.

3. NRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, October 1977.

4. UNSCEAR 2000 Report Vol. I, Sources and Effects of Ionizing Radiation, United Nations Scientific Committee on the Effects of Atomic Radiation

5. NRC Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Revision 1, July 1977.

6. NUREG/CR-1276, ORNL/NUREG/TDMC-1, User's Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents, DB Simpson, BL McGill, prepared by Oak Ridge National Laboratory, Oak Ridge, TN 37830, for Office of Administration, US Nuclear Regulatory Commission, manuscript completed 17 March 1980.

7. 10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

8. 40 CFR Part 190, Environmental Radiation Protection Standard for Nuclear Power Operation.

9. NEI 07-07, Nuclear Energy Institute, Industry Ground Water Protection Initiative – Final Guidance Document, August 2007.

10. NRC Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, Revision 2, October 2008.

11. EPRI Report 1024827, Carbon-14 Dose Calculation Methods at Nuclear Power Plants, April, 2012.

12. NUREG/CR-2907, Vol. 15, Radioactive Effluents from Nuclear Power Plants Annual Report 2009, R. Conatser, US Nuclear Regulatory Commission and N. Daugherty, Oak Ridge Associated Universities, Aug., 2013.

13. Radiation Protection Calculation #16-18, "Isotopic Cloud Shine Doses For MPS Releases," Jan. 24, 2017.

14. MP-CHEM-17-07, "Reporting of Radioactivity Released from RWST Vents," May 26, 2016.