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

May 14, 2025

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

Pilgrim Nuclear Power Station
Renewed Facility Operating License No. DPR-35
Docket No. 50-293 and 72-1044

Subject: Annual Radioactive Effluent Release Report, January 1 through December 31, 2024 for Pilgrim Station.

In accordance with the requirements of the Pilgrim Station Defueled Safety Analysis Report, Appendix B-5.6.3, and 10 CFR 50.36a(a) 2, Holtec Decommissioning International LLC (HDI), on behalf of Pilgrim Nuclear Power Station, herby submits the Annual Radioactive Effluent Release Report for calendar year 2024. This report includes the Annual ISFSI Radiological Effluent Release Report required per Section 5.4.of Appendix A to the Cask Certificate of Compliance (CoC), Renewed Certificate No. 1014, Amendment 14, and NRC Approved Exemption dated January 31, 2023 (ML22356A070).

This letter contains no new regulatory commitments.

Should you have any questions or require further information, please contact Mark Lawson, Radiation Protection and Chemistry Manager, at (508) 830-7109 or me at (856) 797-0900, ext. 3578.

Respectfully,

William Noval

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Enclosure: Annual Radioactive Effluent Release Report, January 1st through December 31st 2024

cc:
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PILGRIM NUCLEAR POWER STATION

Facility Operating License DPR-35

Annual Radioactive Effluent Release Report

January 1 through December 31, 2024

HOLTEC
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INTERNATIONAL

PILGRIM NUCLEAR POWER STATION
Facility Operating License DPR-35

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY 01 THROUGH DECEMBER 31, 2024

Prepared by: _____ 5/12/25
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1.0 EXECUTIVE SUMMARY

INTRODUCTION

This report quantifies the radioactive gaseous, liquid, and radwaste releases, and summarizes the local meteorological data for the period from January 01 through December 31, 2024. This document has been prepared in accordance with the requirements set forth in the Pilgrim Nuclear Power Station (PNPS) Technical Specifications and Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Material in Liquid and Gaseous Effluents from Light Water-Cooled Nuclear Power Plants". This document has been prepared in accordance with the requirements of PNPS Facility Licensing Basis.

The quantity of radioactive material released from PNPS is determined from sample analyses and continuous in-line monitoring of gaseous releases from the reactor building vent, various decontamination facilities, open air demo activities, and liquid releases into the discharge canal, when executed.

The quantity and volume of radioactive waste shipped offsite from PNPS for processing and burial were determined from data contained on the radwaste shipping documentation. The meteorological 10-year data was obtained from monitoring instruments located on the 220-foot tower located at Pilgrim Station.

GASEOUS EFFLUENTS

Gaseous radioactive releases for the reporting period are quantified in Tables 2.2-A, 2.2-B, and 2.2-C. There are no longer Radioactive noble gases released from the plant due to the plant condition (shut down and defueled). Releases of radioactive particulates with half-life of greater than 8 days totaled 0.00030 Curies and tritium releases totaled 5.22 Curies. No gross alpha radioactivity was detected in gaseous effluents.

There were no noble gas releases during 2024, therefore all quarterly and annual Noble gas dose consequences are zero. The release of radioactive particulates and tritium in gaseous effluents from PNPS during the reporting period resulted in a total body dose and to any organ to the maximum-exposed hypothetical individual of approximately 0.00047 mrem.

The maximum individual doses from gaseous radioactive effluents were compared to the applicable Offsite Dose Calculation Manual (ODCM) dose limits. Noble gas doses were 0.00% of the corresponding 10CFR50 dose objectives. Maximum doses resulting from releases of particulates and tritium in gaseous effluents were less than 0.0031% of corresponding 10CFR50 objectives.

LIQUID EFFLUENTS

Liquid radioactive releases for the reporting period are quantified in Tables 2.3-A and 2.3-B. No discharges of liquid effluents occurred during the reporting period. The resulting maximum total body dose was 0.00 mrem, with a corresponding organ dose of 0.00 mrem. All doses from liquid discharges were less than 0.00% of corresponding 10CFR50 objectives.

METEOROLOGICAL DATA

Meteorological joint frequency distributions (JFDs) are no longer listed within this report as RG 1.21 rev 2, June 2009 does not require them to be included. The site adopted revision 2 in a previous revision of the ODCM. Historical meteorological data is retained on site for reference use. Data recovery for the annual period is no longer maintained for the 33-ft and 220-ft levels of the tower individually. A 10-year average data comparison was completed in June 2022 that showed the 2005 to 2014 meteorological data and 2012 to 2021 meteorological data were statistically similar with the predominant wind direction was from the south-southwest, which occurred approximately 14-15% of the time (with the differences in time periods being less than 1%). The predominant stability class was Class D and E (neutral), which occurred similarly within the two 10-year periods with less than 1% difference. The small differences demonstrate that the JFDs for both periods from a distribution of stability class are nearly identical.

Data recovery for both 10-year study periods was greater than 90%. The goal of the study was to determine if the previous 10-year meteorological data are representative of the long-term meteorological conditions and that they are corresponding 10-year JFDs can be used in future dose assessment calculations during the remainder of the PNPS decommissioning activities. Based on the analysis performed the resultant JFDs are representative of the long-term meteorological conditions at PNPS and can be used for future dose assessment during the remainder of decommissioning activities.

OFFSITE AMBIENT RADIATION MEASUREMENTS

Ambient radiation exposure was evaluated to complete the assessment of radiological impact on humans. In past reports the dose to the maximum-exposed member of the public at the PNPS Health Club was used showing a fraction (and sometimes less) of a mrem of exposure even though that TLD is within the owner-controlled area. As this dose value is calculated using the nearest TLD to the PNPS Health Club (TC) reading average over the 4 quarters of 2024 multiplied by 4. Then the Zone 4 (background) is subtracted from it. That annual average net value is then multiplied by 500/8760 to show the exposure per 500 hr period in mR/yr. In the past this area was accessible to the public and that dose would be an accurate calculation, but it is no longer the case.

To that effect there is no longer any area on the site proper that would be considered “recreational” or accessible to the general public. The entirety of the site proper (areas accessible through the three entrances off Rocky Hill Road) is considered “for business purposes only” and therefore not accessible through means of fencing (i.e. fences, jersey barriers, gates), signage, or security monitoring (i.e tours, cameras).

The more accurate dose to an actual MEMBER OF THE PUBLIC as defined in NUREG 1302 would be that calculated from ISF-1 TLD located on the public roadway across from the same parking lot entrance as the previously accessible health club. ISF-1 TLD dose calculated in the same manner as explained above to result in -0.29 mrem/year. The negative value is caused by the previously identified increased result at the East Weymouth (background) location due to re-pavement of an adjacent roadway. The background value was greater than the ISF-1 (indicator) value resulting in a negative number.

During the 2024 reporting period Pilgrim Station adopted the NRC endorsed ANSI N13.37 standard that no longer considers environmental TLD dose reporting as a function of geographical zone averages (Zone 4 being the furthest from the Reactor Building and acting as “background”), but instead compares the quarterly and annual results of each location to its own baseline at that location. This would alleviate issues experienced in the industry at individual TLD locations that may be masked by averaging a larger zone. Due to limitations within this standard for a quarter, year, and MEMBER OF THE PUBLIC, TLD values may now simply appear as “ND” Not Detected above quarterly Minimum

Detected Dose (MDD) of 5 mrem, annual facility MDD of 10 mrem and an annual MEMBER OF THE PUBLIC minimum reported dose (MRD) of 1 mrem.

With the ISF-1 baseline used instead of "Zone 4" in the calculation above a MEMBER OF THE PUBLIC at the ISF-1 TLD location would receive 0.62 mR/yr or "ND". There was no significant increase during 2024 in ambient radiation measurements at the location of the nearest resident 0.8 km southeast of PNPS.

COMBINED DOSE IMPACT

The collective total body dose to a maximum-exposed hypothetical member of the public from airborne radioactivity, liquid-borne radioactivity, and ambient radiation exposure resulting from PNPS operation during 2024 was calculated as being approximately 0.62 mrem. This amount is approximately 0.1% of the typical dose of 620 mrem received each year by an average person from other sources of natural and man-made radiation. Although this calculated collective dose occurs to a maximum-exposed hypothetical individual, it is also well below the NRC dose limit of 100 mrem/yr specified in 10CFR20.1301, as well as the EPA dose limit of 25 mrem/yr specified in 40CFR190. Both of these limits are to be applied to real members of the general public, so the fact that the dose to the hypothetical maximum-exposed individual is within the limits ensures that any dose received by a real member of the public would be smaller and well within any applicable limit.

RADIOACTIVE SOLID WASTE DISPOSAL

Solid radioactive wastes shipped offsite for processing and disposal during the reporting period are described in Table 7.0. A sum of all low-level waste of approximately 952 cubic meters of solid waste, containing 96.4 Curies of radioactivity, was shipped from the site during the 2024 reporting period.

ONSITE GROUNDWATER MONITORING PROGRAM

In response to the Nuclear Energy Institute Groundwater Protection Initiative, Pilgrim Station instituted a groundwater monitoring program during 2007. Four monitoring wells were installed onsite during the fourth quarter of 2007, and the first samples were collected in late November 2007. Additional sampling wells were added in 2010, 2011, 2012, 2013, and 2014. As of the end of 2024, samples are being collected from a total of 23 monitoring wells. Low levels of tritium, a radioactive isotope of hydrogen, was detected in only one of these onsite wells. No other plant-related radioactivity was detected in the groundwater samples. The average concentration of tritium detected in these onsite monitoring wells during 2024 was well below the voluntary communications reporting level established by the EPA Drinking Water Standard of 20,000 pCi/L. Although the EPA Standard provides a standard for comparison, no drinking water sources are affected by this tritium. The maximum hypothetical dose resulting from tritium in groundwater presumed to enter Cape Cod Bay is calculated to be 0.0000035 mrem/yr. Results of the groundwater monitoring program are presented in Appendix B.

CONCLUSION

The PNPS Offsite Dose Calculation Manual contains effluent controls to limit doses resulting from releases of radioactivity to the environment. None of the effluent controls associated with liquid or gaseous effluents were exceeded during the reporting period, as confirmed by conservative dose assessments performed at weekly and monthly intervals. Conformance to the PNPS ODCM effluent control limits ensures that releases of radioactivity in liquid and gaseous effluents are kept as low as reasonably achievable in accordance with 10 CFR Part 50, Appendix I. Compliance with the ODCM also demonstrates that requirements of the Environmental Protection Agency's nuclear fuel cycle standard, 40CFR190.10, Subpart B, have been met. Based on the dose assessment results for 2024,

there was no significant radiological impact on the general public from PNPS decommissioning activities.

2.0 RADIOACTIVE EFFLUENT DATA

Radioactive gaseous and liquid releases for the reporting period are given in the standard format presented in Tables 1A, 1B, 1C, 2A, 2B, and Supplemental Information table from NRC Regulatory Guide 1.21 (Reference 1) format.

2.1 Supplemental Effluent Release Data

Supplemental information related to radioactive gaseous and liquid releases for the reporting period are given in the standard NRC Regulatory Guide 1.21 format in Table 2.1.

2.2 Gaseous Effluent Data

Gaseous radioactivity is released from Pilgrim Station to the atmosphere from the reactor building vent and various decontamination facilities. Combined gaseous effluent releases from all release points are summarized in Table 2.2-A. No alpha activity was detected on any of the particulate filters collected during the reporting period. The total gaseous releases for various categories of radionuclides, as well as the corresponding average release rates, can be summarized as follows:

- Particulates with half-life greater than 8 days: 0.000303 Ci, 0.00000961 μCi/sec
- Tritium: 5.22 Ci, 0.166 μCi/sec
- Noble gases: 0.00 Ci , no longer producing due to plant condition
- Carbon-14: 0.00 Ci, no longer producing due to plant condition

The main stack effluent was removed as a pathway at the end of 2019 and since removed from the ODCM. There are no longer any releases out of the main stack as detailed in Table 2.2-B

Ground-level effluent releases are detailed in Table 2.2-C. Data in this table include releases from the reactor building vent , open air demolition, and assorted equipment decontamination facilities (e.g., downdraft table, plastic media decon trailer, etc.) used during the period. Due to the close proximity of the reactor building, all of these release points are considered to be mixed-mode/ground level release points.

The use of supplemental heaters in the Spent Fuel Pool as well as the Reactor Cavity for heating and functionality of equipment purposes also increased the water volume evaporated from these bodies of water. Due to the increased evaporation, the total Curies of tritium released in 2024 also increased as shown above and in Table 2.2-A from the previous reporting period, though it is only roughly 10% of the release of tritium in the last operating period of the station.

Table 3.1-2 of the PNPS ODCM requires that if any of the gaseous effluent monitors are inoperable for more than 30-days, such events are to be reported in the Annual Radioactive Effluent Release Report with an explanation of why the affected monitor was not returned to operable status in a timely manner.

The RBV effluent process radiation monitor was removed from the ODCM in Revision 15. The effluent monitor and its surveillances became a part of the Emergency Planning (E-plan) program until such a time as the spent fuel was offloaded into canisters and placed onto the Independent Spent Fuel Storage Installation (ISFSI) II pad. That effort was completed in December of 2021. The reference to gaseous effluent monitoring includes only the particulate filter, effluent system flow rate measuring, and sample flow rate measuring at a single channel minimum.

Starting late in 2023 discrepancies were found with the RBV process flow readings from FR-8116 (RBV digital recorder). Due to the discrepancy in recorder readings the indication equipment was considered "unreliable". A compensatory action was put into place to check FT-8116 (physical gauge in the Control Room) twice a day. It was evaluated that the readings from the installed pitot tube were not well represented at lower decommissioning air flows. Flow was estimated by procedure using the capacities of in-service fans. As a parallel path the installation of hot wire anemometers was completed in June 2024. Thought originally as a back up to installed equipment for the estimation of flow, the hotwire anemometers became the primary RBV process flow indication. To demonstrate that flow measurement was accurate using the new equipment, compensatory measures continued to be credited until early September 2024.

Subsequently, additional inconsistencies were noted between estimated flow based on fan configuration and measured flow using anemometers. The cause turned out to be an anemometer model purchased and installed that differed from the model used to calibrate the recorder. The condition was corrected in the beginning of 2025 and the 2024 values Sept-Dec taken from the anemometer were calculated with a correction factor to account for the difference between the two models.

2.3 Liquid Effluent Data

Liquid radioactivity (when discharged) is released from PNPS to Cape Cod Bay via the site discharge canal. These permitted effluents enter Cape Cod Bay at the outfall of the canal, which is located approximately 1100 feet north of the reactor building.

Liquid effluent releases are summarized in Table 2.3-A. Detailed breakdowns for individual radionuclides are listed in Table 2.3-B. There were no discharges of liquid effluents containing radioactivity during the reporting period. Total releases for the various categories of radionuclides, as well as their corresponding mean concentrations, can be summarized as follows:

- Total Effluent Volume: 0 Liters
- Total Dilution Volume: 0 Liters
- Fission/Activation products: 0.00 Ci, 0.00 μCi/mL
- Tritium: 0.00 Ci, 0.00 μCi/mL
- Dissolved/entrained noble gases: 0.00 Ci, 0.00 μCi/mL

Table 2.1
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Supplemental Information
January-December 2024

FACILITY: PILGRIM NUCLEAR POWER STATION **LICENSE: DPR-35**

1. REGULATORY LIMITS					
a. Fission and activation gases:	500 mrem/yr total body and 3000 mrem/yr for skin at site boundary				
b,c. Iodines, particulates with half-life: >8 days, tritium	1500 mrem/yr to any organ at site boundary				
d. Liquid effluents:	0.06 mrem/month for whole body and 0.2 mrem/month for any organ (without radwaste treatment) 1.5 mrem/qtr, 3 mrem/yr TB and 5 mrem/qtr, 10 mrem/yr Max Organ				
2. EFFLUENT CONCENTRATION LIMITS					
a. Fission and activation gases:	10CFR20 Appendix B Table II				
b. Iodines:	Not Applicable				
c. Particulates with half-life > 8 days:	10CFR20 Appendix B Table II				
d. Liquid effluents:	2E-04 μCi/mL for entrained noble gases; 10CFR20 Appendix B Table II values for all other radionuclides				
3. AVERAGE ENERGY	Not Applicable				
4. MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY					
a. Fission and activation gases: b. Iodines: c. Particulates: d. Liquid effluents:	High purity germanium gamma spectroscopy for all gamma emitters; radiochemistry analysis for H-3, Fe-55 (liquid effluents), Sr-89, and Sr-90				
5. BATCH RELEASES	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024
a. Liquid Effluents					
1. Total number of releases:	N/A	N/A	N/A	N/A	N/A
2. Total time period (minutes):	N/A	N/A	N/A	N/A	N/A
3. Maximum time period (minutes):	N/A	N/A	N/A	N/A	N/A
4. Average time period (minutes):	N/A	N/A	N/A	N/A	N/A
5. Minimum time period (minutes):	N/A	N/A	N/A	N/A	N/A
6. Average stream flow during periods of release of effluents into a flowing stream (Liters/min):	N/A	N/A	N/A	N/A	N/A
b. Gaseous Effluents	None	None	None	None	None
6. ABNORMAL RELEASES					
a. Liquid Effluents	None	None	None	None	None
b. Gaseous Effluents	None	None	None	None	None

Table 2.2-A
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents - Summation of All Releases
January-December 2024

RELEASE PERIOD	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024	Est. Total Error
A. FISSION AND ACTIVATION GASES						
Total Release: Ci	N/A	N/A	N/A	N/A	N/A	±22%
Average Release Rate: μCi/sec	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Control Limit*	*	*	*	*	*	
B. IODINE-131						
Total Iodine-131 Release: Ci	N/A	N/A	N/A	N/A	N/A	±20%
Average Release Rate: μCi/sec	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Control Limit*	*	*	*	*	*	
C. PARTICULATES WITH HALF-LIVES > 8 DAYS						
Total Release: Ci	2.70E-04	3.27E-05	0.00E+00	0.00E+00	3.03E-04	±21%
Average Release Rate: μCi/sec	3.43E-05	4.15E-06	0.00E+00	0.00E+00	9.61E-06	
Percent of Effluent Control Limit*	*	*	*	*	*	
Gross Alpha Radioactivity: Ci	NDA	NDA	NDA	NDA	NDA	
D. TRITIUM						
Total Release: Ci	1.97E+00	8.27E-01	8.78E-01	1.55E+00	5.22E+00	±20%
Average Release Rate: μCi/sec	2.50E-01	1.05E-01	1.11E-01	1.96E-01	1.66E-01	
Percent of Effluent Control Limit*	*	*	*	*	*	
E. CARBON-14						
Total Release: Ci	N/A	N/A	N/A	N/A	N/A	N/A
Average Release Rate: μCi/sec	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Control Limit*	*	*	*	*	*	

Notes for Table 2.2-A:

* Percent of Effluent Control Limit values based on dose assessments are provided in Section 6 of this report.

1. NDA stands for No Detectable Activity.
2. LLD for airborne gross alpha activity listed as NDA is 1E-11 μCi/cc.
3. N/A stands for not applicable.

Table 2.2-B
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Elevated Release
January-December 2024

There was no elevated release during 2024. The elevated release through the PNPS Main Stack was secured in 2019 and is no longer a pathway.

Table 2.2-C
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Ground-Level Release
January-December 2024

CONTINUOUS MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	N/A	N/A	N/A	N/A	N/A
Kr-85	N/A	N/A	N/A	N/A	N/A
Kr-85m	N/A	N/A	N/A	N/A	N/A
Kr-87	N/A	N/A	N/A	N/A	N/A
Kr-88	N/A	N/A	N/A	N/A	N/A
Xe-131m	N/A	N/A	N/A	N/A	N/A
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-133m	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Xe-135m	N/A	N/A	N/A	N/A	N/A
Xe-137	N/A	N/A	N/A	N/A	N/A
Xe-138	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. IODINES: Ci					
I-131	N/A	N/A	N/A	N/A	N/A
I-133	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	3.27E-05	0.00E+00	0.00E+00	3.27E-05
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	2.70E-04	0.00E+00	0.00E+00	0.00E+00	2.70E-04
Ba/La-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total for period	2.70E-04	3.27E-05	0.00E+00	0.00E+00	3.03E-04
4. TRITIUM: Ci					
H-3	1.97E+00	8.27E-01	8.78E-01	1.55E+00	5.22E+00
5. CARBON-14: Ci					
C-14	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.2-C:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.2-C (continued)
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Ground-Level Release
January-December 2024

BATCH MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	N/A	N/A	N/A	N/A	N/A
Kr-85	N/A	N/A	N/A	N/A	N/A
Kr-85m	N/A	N/A	N/A	N/A	N/A
Kr-87	N/A	N/A	N/A	N/A	N/A
Kr-88	N/A	N/A	N/A	N/A	N/A
Xe-131m	N/A	N/A	N/A	N/A	N/A
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-133m	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Xe-135m	N/A	N/A	N/A	N/A	N/A
Xe-137	N/A	N/A	N/A	N/A	N/A
Xe-138	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. IODINES: Ci					
I-131	N/A	N/A	N/A	N/A	N/A
I-133	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Ru-103	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
4. TRITIUM: Ci					
H-3	N/A	N/A	N/A	N/A	N/A
5. CARBON-14: Ci					
C-14	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.2-C:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.3-A
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents - Summation of All Releases
January-December 2024

RELEASE PERIOD	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024	Est. Total Error
A. FISSION AND ACTIVATION PRODUCTS						
Total Release (not including tritium, gases, alpha): Ci	N/A	N/A	N/A	N/A	N/A	±12%
Average Diluted Concentration During Period: μCi/mL	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Concentration Limit*	N/A	N/A	N/A	N/A	N/A	
B. TRITIUM						
Total Release: Ci	N/A	N/A	N/A	N/A	N/A	±9.4%
Average Diluted Concentration During Period: μCi/mL	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Concentration Limit*	N/A	N/A	N/A	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES						
Total Release: Ci	N/A	N/A	N/A	N/A	N/A	±16%
Average Diluted Concentration During Period: μCi/mL	N/A	N/A	N/A	N/A	N/A	
Percent of Effluent Concentration Limit*	N/A	N/A	N/A	N/A	N/A	
D. GROSS ALPHA RADIOACTIVITY						
Total Release: Ci	N/A	N/A	N/A	N/A	N/A	±34%
E. VOLUME OF WASTE RELEASED PRIOR TO DILUTION						
Waste Volume: Liters	N/A	N/A	N/A	N/A	N/A	±5.7%
F. VOLUME OF DILUTION WATER USED DURING PERIOD						
Dilution Volume: Liters	N/A	N/A	N/A	N/A	N/A	±10%

Notes for Table 2.3-A:

* Additional percent of Effluent Control Limit values based on dose assessments are provided in Section 6 of this report.

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLD for dissolved and entrained gases listed as NDA is 1E-05 μCi/mL.
4. LLD for liquid gross alpha activity listed as NDA is 1E-07 μCi/mL.

Table 2.3-B
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents
January-December 2024

CONTINUOUS MODE RELEASES					
Nuclide Released	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024
1. FISSION AND ACTIVATION PRODUCTS: Ci					
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-55	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Zn-69m	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Zr/Nb-95	N/A	N/A	N/A	N/A	N/A
Mo/Tc-99	N/A	N/A	N/A	N/A	N/A
Ag-110m	N/A	N/A	N/A	N/A	N/A
Sb-124	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Ce-141	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. DISSOLVED AND ENTRAINED GASES: Ci					
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.3-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for liquid radionuclides listed as NDA are as follows:
   - Strontium: 5E-08 μCi/mL
   - Noble Gases: 1E-05 μCi/mL
   - All Others: 5E-07 μCi/mL

Table 2.3-B (continued)
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents
January-December 2024

BATCH MODE RELEASES					
Nuclide Released	Jan-Mar 2024	Apr-Jun 2024	Jul-Sep 2024	Oct-Dec 2024	Jan-Dec 2024
1. FISSION AND ACTIVATION PRODUCTS: Ci					
Na-24	N/A	N/A	N/A	N/A	N/A
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-55	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Zn-69m	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Zr/Nb-95	N/A	N/A	N/A	N/A	N/A
Mo/Tc-99	N/A	N/A	N/A	N/A	N/A
Ag-110m	N/A	N/A	N/A	N/A	N/A
Sb-124	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Ce-141	N/A	N/A	N/A	N/A	N/A
Ce-144	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. DISSOLVED AND ENTRAINED GASES: Ci					
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.3-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for liquid radionuclides listed as NDA are as follows:
   - Strontium: 5E-08 μCi/mL
   - Noble Gases: 1E-05 μCi/mL
   - All Others: 5E-07 μCi/mL

3.0 METEOROLOGICAL DATA

Meteorological data are summarized for the reporting period in Appendix A, in the standard joint frequency distribution format as given in NRC Regulatory Guide 1.21.

The predominant meteorological conditions, as mentioned previously, are no longer being observed continuously during the normal annual reporting period. An evaluation was performed in June of 2022 that looked closely at two 10-yr periods (2005-2014 and 2012-2021, excluding 2015 due to equipment failures) to assess if the last 10 years were comparable to the previous 10 years in terms of meteorological data. As a result, the evaluation determined the two 10-yr periods differed less than 1% and therefore the meteorological data could be used as a 10-yr average for determining calculations during future decommissioning activities. The last 10-year period averages are as follows:

- Stability Class: Class D, 43.89%
- 33-ft Wind Direction (from): South-southwest, 14.25%
- 33-ft Wind Speed: 3.5-7.5 mph, 55.77%
- 220-ft Wind Direction (from): South-southwest, 13.4%
- 220-ft Wind Speed: 12.5-18.5 mph, 35.6%

Joint data recovery for the 33-ft level and 220-ft level of the tower was over 90% (with more than half the years over 95%, both of which meet the 90% annual data recovery goal specified by the NRC.

4.0 MAXIMUM INDIVIDUAL DOSES

Doses to the maximum exposed individual resulting from radionuclides in effluents released offsite were calculated using methods presented in the PNPS Offsite Dose Calculation Manual (ODCM, Reference 2), NRC Regulatory Guide 1.109 (Reference 3), NRC Regulatory Guide 1.111 (Reference 4), and the Pilgrim Station Unit 1 Appendix I Evaluation (Reference 5). Maximum individual doses are calculated separately for: (1) particulates and tritium in gaseous effluents; and (2) liquid effluents. Maximum consumption and use factors for various pathways from Table E-5 of the PNPS ODCM are used for calculating the doses to the maximum exposed individual.

Information related to liquid and gaseous effluent releases are summarized in Section 2 of this report. These effluent release data were used as input to computer programs to calculate the resulting doses. PNPS ODCM methodologies were used to calculate the dose contributions to the various organs in each age class from major exposure pathways.

4.1 Doses From Noble Gas Releases

Gaseous effluent release data presented in Tables 2.2-A, 2.2-B, and 2.2-C from this effluent release report are no longer used as input to a dose assessment computer program to calculate radiation doses. Though data from gaseous releases from the PNPS reactor building vent are still used for particulate results and tritium (as seen in the next section), they no longer contain any Noble Gases due to current plant condition and therefore the table sections listed above are not applicable (NA). All noble gas inventory on site has decayed away. The only Noble Gas is Kr-85 within the spent fuel assembly gaps that has been sealed in dry casks and moved to the Independent Spent Fuel Storage Installation (ISFSI) II pad. ISFSI monitoring is discussed in Appendix D.

All noble gas detector instruments and surveillance requirements were removed from the ODCM in revision 15. All spent fuel was transferred in December of 2021. As explained above, the majority of noble gases have decayed away. The remaining gas (Kr-85) is a beta emitter with one gamma released for every 250 decays, the detectors would not have detected it even in a Designed Basis Accident (DBA) scenario. Furthermore, Pilgrim Engineering DBA Calculation No. M1422, “Radiological Consequences of a Design Basis Fuel Handling Accident Based on the Alternate Source

Term Methodology – Update for Permanent Shutdown", June 5, 2018 assessed the offsite dose impact of a dropped fuel canister with a damaged fuel assembly assumed to contain 150 fuel rods. The LPZ TEDE dose at 30 days is 92 mrem. The dose proportionally projected out to one year is 0.18 mrem (assuming the DBA occurred one year post permanent shutdown, which the site is beyond after shutting down permanently on May 31, 2019).

The maximum individual doses resulting from radioactive noble gases released in gaseous effluents are presented in Table 4.1 no longer apply, therefore the table has been removed.

4.2 Doses From Gaseous Effluent Releases

Gaseous effluent release data presented in Tables 2.2-A, 2.2-B, and 2.2-C from this effluent release report were used as input to a dose assessment computer program to calculate radiation doses. These data include gaseous releases from the PNPS reactor building vent. Meteorological data obtained from the PNPS 220-foot meteorological tower during the 10-year period from 2005 through 2014 were used as input to the NRC XOQDOQ computer program (Reference 7). This program was used to calculate the annual average atmospheric dispersion and deposition factors used in the dose assessment computer program to calculate maximum individual doses from airborne effluents. As stated in earlier sections the 2012-2021 10-year period was evaluated to be less than 1% difference in meteorological data compared to the 2005-2014 period and therefore the dose assessment computer program did not need to be updated in order to complete the calculations for this reporting period.

The maximum individual doses resulting from radioactive particulates and tritium released in gaseous effluents are presented in Tables 4.2-A through 4.2-E. These tables cover the individual calendar quarters and the total calendar year, respectively.

Tables 4.2-A through 4.2-E summarize the maximum total body and organ doses for the adult, teen, child, and infant age classes resulting from the major gaseous exposure pathways. These tables present the dose data according to specific receptor location and the exposure pathways assumed to occur at that location. For example, the second column of the tables presents the information for the hypothetical maximum-exposed at the most restrictive site boundary location, where only inhalation and ground deposition exposure pathways are assumed to occur. Since this is a shoreline location controlled by Holtec, the other pathways of garden vegetable production, milk production, and meat production are assumed not to occur. Doses for other offsite locations not under Holtec control, where other exposure pathways can and do occur, are presented in subsequent columns of the tables, and represent the potential maximum doses to individuals at these locations. For consistency, all distances listed in the first row of Tables 4.2-A through 4.2-E are measured from the Reactor Building Vent. However, doses at the specific receptor locations are calculated based on the actual distances from the applicable release points (PNPS reactor building vent).

Radioactivity (particulates and tritium) released in gaseous effluents from PNPS during 2024 resulted in a maximum total body and organ dose of 0.00047 mrem (child age class at nearest cow-goat for max organ of the liver) Carbon-14 contributed 0% of dose for 2024 as Carbon-14 is only generated during the operation of the plant.

Table 4.2-A

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jan-Mar 2024

Receptor: Direction: Distance[1]: Pathway[2]:	Bound WNW 0.24km DI	Resident S 2.22 km DI	Garden S 3.44 km DIV[3]	Cow/Goat W 3.75 km DIVCG[3]	Cow/Meat W 5.17 km DIVCM[3]	Meat S 3.82 km DIVM[3]
Age Class: Adult						
Bone	6.45E-07	2.42E-07	3.30E-05	3.23E-05	6.67E-05	1.70E-07
GI-LLI	1.68E-05	6.37E-06	6.34E-05	6.08E-05	7.64E-05	4.56E-06
Kidney	1.70E-05	6.45E-06	7.56E-05	7.19E-05	1.04E-04	4.63E-06
Liver	1.75E-05	6.64E-06	1.06E-04	1.01E-04	1.64E-04	4.77E-06
Lung	1.79E-05	6.80E-06	6.65E-05	6.29E-05	8.44E-05	4.88E-06
Thyroid	1.67E-05	6.34E-06	6.03E-05	5.69E-05	7.30E-05	4.55E-06
T.Body	1.73E-05	6.55E-06	9.01E-05	8.62E-05	1.33E-04	4.70E-06
Age Class: Teen						
Bone	9.01E-07	3.35E-07	5.25E-05	4.77E-05	1.16E-04	2.38E-07
GI-LLI	1.69E-05	6.42E-06	6.99E-05	6.36E-05	8.79E-05	4.60E-06
Kidney	1.73E-05	6.55E-06	9.04E-05	8.18E-05	1.36E-04	4.70E-06
Liver	1.80E-05	6.81E-06	1.37E-04	1.24E-04	2.38E-04	4.89E-06
Lung	1.87E-05	7.07E-06	7.75E-05	7.00E-05	1.06E-04	5.07E-06
Thyroid	1.68E-05	6.40E-06	6.66E-05	6.02E-05	8.40E-05	4.59E-06
T.Body	1.73E-05	6.55E-06	9.13E-05	8.27E-05	1.38E-04	4.70E-06
Age Class: Child						
Bone	1.22E-06	4.50E-07	1.23E-04	1.10E-04	2.77E-04	3.21E-07
GI-LLI	1.49E-05	5.66E-06	9.42E-05	8.48E-05	1.23E-04	4.06E-06
Kidney	1.53E-05	5.79E-06	1.30E-04	1.17E-04	2.07E-04	4.15E-06
Liver	1.60E-05	6.05E-06	2.10E-04	1.88E-04	3.85E-04	4.34E-06
Lung	1.64E-05	6.20E-06	1.07E-04	9.60E-05	1.53E-04	4.45E-06
Thyroid	1.49E-05	5.65E-06	9.20E-05	8.26E-05	1.20E-04	4.05E-06
T.Body	1.51E-05	5.72E-06	1.10E-04	9.89E-05	1.60E-04	4.10E-06
Age Class: Infant						
Bone	7.39E-07	2.76E-07	7.25E-07	6.15E-07	3.11E-04	1.95E-07
GI-LLI	8.57E-06	3.26E-06	8.73E-06	7.47E-06	6.14E-05	2.33E-06
Kidney	8.79E-06	3.34E-06	8.95E-06	7.65E-06	1.58E-04	2.39E-06
Liver	9.38E-06	3.55E-06	9.52E-06	8.14E-06	4.24E-04	2.55E-06
Lung	9.52E-06	3.60E-06	9.66E-06	8.26E-06	1.01E-04	2.59E-06
Thyroid	8.56E-06	3.25E-06	8.72E-06	7.46E-06	6.02E-05	2.33E-06
T.Body	8.63E-06	3.28E-06	8.78E-06	7.51E-06	8.61E-05	2.35E-06

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows, note not all these pathways exist at Pilgrim Station:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

Table 4.2-B

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Apr-Jun 2024

Receptor: Direction: Distance[1]: Pathway[2]:	Bound WNW 0.24km DI	Resident S 2.22 km DI	Garden S 3.44 km DIV[3]	Cow/Goat W 3.75 km DIVCG[3]	Cow/Meat W 5.17 km DIVCM[3]	Meat S 3.82 km DIVM[3]
Age Class: Adult						
Bone	1.30E-08	2.29E-09	1.36E-09	1.07E-09	6.18E-10	1.34E-09
GI-LLI	4.60E-06	3.54E-06	1.18E-05	1.55E-05	1.07E-05	1.36E-05
Kidney	4.53E-06	3.49E-06	1.00E-05	1.40E-05	9.35E-06	1.09E-05
Liver	4.54E-06	3.49E-06	1.01E-05	1.41E-05	9.42E-06	1.11E-05
Lung	5.96E-06	4.61E-06	1.09E-05	1.50E-05	9.97E-06	1.18E-05
Thyroid	4.53E-06	3.49E-06	1.00E-05	1.40E-05	9.35E-06	1.09E-05
T.Body	4.54E-06	3.49E-06	1.02E-05	1.42E-05	9.51E-06	1.12E-05
Age Class: Teen						
Bone	1.30E-08	2.29E-09	1.36E-09	1.07E-09	6.18E-10	1.34E-09
GI-LLI	4.64E-06	3.57E-06	1.29E-05	1.77E-05	1.15E-05	1.39E-05
Kidney	4.57E-06	3.52E-06	1.11E-05	1.61E-05	1.03E-05	1.15E-05
Liver	4.58E-06	3.52E-06	1.12E-05	1.62E-05	1.04E-05	1.17E-05
Lung	6.65E-06	5.16E-06	1.24E-05	1.75E-05	1.12E-05	1.28E-05
Thyroid	4.57E-06	3.52E-06	1.11E-05	1.61E-05	1.03E-05	1.15E-05
T.Body	4.58E-06	3.53E-06	1.14E-05	1.64E-05	1.05E-05	1.19E-05
Age Class: Child						
Bone	1.30E-08	2.29E-09	1.36E-09	1.07E-09	6.18E-10	1.34E-09
GI-LLI	4.06E-06	3.13E-06	1.65E-05	2.41E-05	1.53E-05	1.72E-05
Kidney	4.04E-06	3.11E-06	1.53E-05	2.31E-05	1.46E-05	1.58E-05
Liver	4.04E-06	3.11E-06	1.55E-05	2.33E-05	1.47E-05	1.61E-05
Lung	5.73E-06	4.44E-06	1.64E-05	2.42E-05	1.53E-05	1.69E-05
Thyroid	4.04E-06	3.11E-06	1.53E-05	2.31E-05	1.46E-05	1.58E-05
T.Body	4.05E-06	3.11E-06	1.59E-05	2.36E-05	1.50E-05	1.66E-05
Age Class: Infant						
Bone	1.30E-08	2.29E-09	1.36E-09	1.07E-09	6.18E-10	1.34E-09
GI-LLI	2.34E-06	1.80E-06	1.46E-06	1.16E-05	6.37E-06	1.44E-06
Kidney	2.33E-06	1.79E-06	1.45E-06	1.15E-05	6.30E-06	1.43E-06
Liver	2.33E-06	1.79E-06	1.45E-06	1.16E-05	6.33E-06	1.43E-06
Lung	3.40E-06	2.64E-06	2.12E-06	1.23E-05	6.77E-06	2.09E-06
Thyroid	2.33E-06	1.79E-06	1.45E-06	1.15E-05	6.30E-06	1.43E-06
T.Body	2.33E-06	1.79E-06	1.45E-06	1.16E-05	6.37E-06	1.43E-06

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows, note not all these pathways exist at Pilgrim Station:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

Table 4.2-C

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jul-Sep 2024

Receptor: Direction: Distance[1]: Pathway[2]:	Bound WNW 0.24km DI	Resident S 2.22 km DI	Garden S 3.44 km DIV[3]	Cow/Goat W 3.75 km DIVCG[3]	Cow/Meat W 5.17 km DIVCM[3]	Meat S 3.82 km DIVM[3]
Age Class: Adult						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
Kidney	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
Liver	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
Lung	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
Thyroid	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
T.Body	4.80E-06	3.70E-06	1.07E-05	1.49E-05	9.93E-06	1.16E-05
Age Class: Teen						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
Kidney	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
Liver	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
Lung	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
Thyroid	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
T.Body	4.84E-06	3.74E-06	1.18E-05	1.71E-05	1.09E-05	1.23E-05
Age Class: Child						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
Kidney	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
Liver	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
Lung	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
Thyroid	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
T.Body	4.28E-06	3.30E-06	1.63E-05	2.45E-05	1.55E-05	1.68E-05
Age Class: Infant						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06
Kidney	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06
Liver	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06
Lung	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06
Thyroid	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06
T.Body	2.46E-06	1.90E-06	1.54E-06	1.23E-05	6.69E-06	1.52E-06

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows, note not all these pathways exist at Pilgrim Station:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

Table 4.2-D

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Oct-Dec 2024

Receptor: Direction: Distance[1]: Pathway[2]:	Bound WNW 0.24km DI	Resident S 2.22 km DI	Garden S 3.44 km DIV[3]	Cow/Goat W 3.75 km DIVCG[3]	Cow/Meat W 5.17 km DIVCM[3]	Meat S 3.82 km DIVM[3]
Age Class: Adult						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
Kidney	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
Liver	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
Lung	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
Thyroid	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
T.Body	8.45E-06	6.52E-06	1.88E-05	2.62E-05	1.75E-05	2.04E-05
Age Class: Teen						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
Kidney	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
Liver	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
Lung	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
Thyroid	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
T.Body	8.52E-06	6.58E-06	2.07E-05	3.01E-05	1.92E-05	2.16E-05
Age Class: Child						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
Kidney	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
Liver	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
Lung	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
Thyroid	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
T.Body	7.53E-06	5.81E-06	2.86E-05	4.31E-05	2.73E-05	2.96E-05
Age Class: Infant						
Bone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GI-LLI	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06
Kidney	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06
Liver	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06
Lung	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06
Thyroid	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06
T.Body	4.33E-06	3.34E-06	2.71E-06	2.16E-05	1.18E-05	2.67E-06

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows, note not all these pathways exist at Pilgrim Station:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

Table 4.2-E

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jan-Dec 2024

Receptor: Direction: Distance[1]: Pathway[2]:	Bound WNW 0.24km DI	Resident S 2.22 km DI	Garden S 3.44 km DIV[3]	Cow/Goat W 3.75 km DIVCG[3]	Cow/Meat W 5.17 km DIVCM[3]	Meat S 3.82 km DIVM[3]
Age Class: Adult						
Bone	1.01E-06	7.54E-07	3.06E-05	7.29E-05	3.66E-05	3.53E-05
GI-LLI	2.87E-05	2.21E-05	6.59E-05	9.19E-05	6.14E-05	7.26E-05
Kidney	2.90E-05	2.24E-05	7.76E-05	1.22E-04	7.60E-05	8.53E-05
Liver	2.98E-05	2.30E-05	1.05E-04	1.88E-04	1.09E-04	1.17E-04
Lung	3.02E-05	2.33E-05	6.90E-05	1.01E-04	6.53E-05	7.53E-05
Thyroid	2.86E-05	2.20E-05	6.34E-05	8.84E-05	5.90E-05	6.89E-05
T.Body	2.94E-05	2.27E-05	9.10E-05	1.54E-04	9.19E-05	1.01E-04
Age Class: Teen						
Bone	1.39E-06	1.05E-06	4.87E-05	1.27E-04	6.08E-05	5.22E-05
GI-LLI	2.89E-05	2.23E-05	7.28E-05	1.06E-04	6.74E-05	7.62E-05
Kidney	2.95E-05	2.27E-05	9.21E-05	1.59E-04	9.25E-05	9.65E-05
Liver	3.05E-05	2.35E-05	1.35E-04	2.70E-04	1.46E-04	1.42E-04
Lung	3.12E-05	2.41E-05	7.99E-05	1.25E-04	7.66E-05	8.34E-05
Thyroid	2.89E-05	2.22E-05	7.01E-05	1.02E-04	6.50E-05	7.29E-05
T.Body	2.95E-05	2.27E-05	9.29E-05	1.61E-04	9.34E-05	9.75E-05
Age Class: Child						
Bone	1.85E-06	1.42E-06	1.14E-04	3.02E-04	1.44E-04	1.20E-04
GI-LLI	2.55E-05	1.97E-05	9.85E-05	1.49E-04	9.37E-05	1.02E-04
Kidney	2.60E-05	2.01E-05	1.32E-04	2.40E-04	1.37E-04	1.37E-04
Liver	2.71E-05	2.09E-05	2.06E-04	4.35E-04	2.30E-04	2.15E-04
Lung	2.74E-05	2.11E-05	1.11E-04	1.81E-04	1.09E-04	1.15E-04
Thyroid	2.55E-05	1.96E-05	9.67E-05	1.46E-04	9.21E-05	1.00E-04
T.Body	2.57E-05	1.98E-05	1.13E-04	1.89E-04	1.13E-04	1.18E-04
Age Class: Infant						
Bone	1.15E-06	8.63E-07	6.82E-07	3.40E-04	1.41E-04	6.72E-07
GI-LLI	1.47E-05	1.13E-05	9.17E-06	7.42E-05	4.04E-05	9.04E-06
Kidney	1.50E-05	1.16E-05	9.38E-06	1.80E-04	8.40E-05	9.24E-06
Liver	1.59E-05	1.22E-05	9.92E-06	4.71E-04	2.05E-04	9.78E-06
Lung	1.59E-05	1.23E-05	9.93E-06	1.17E-04	5.82E-05	9.78E-06
Thyroid	1.47E-05	1.13E-05	9.17E-06	7.29E-05	3.98E-05	9.03E-06
T.Body	1.48E-05	1.14E-05	9.22E-06	1.01E-04	5.15E-05	9.09E-06

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows, note not all these pathways exist at Pilgrim Station:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

4.3 Doses From Liquid Effluent Releases

Liquid effluent release data presented in Tables 2.3-A and 2.3-B were used as input to the dose assessment computer program to calculate radiation doses. The maximum individual doses resulting from radionuclides released in liquid effluents are presented in Tables 4.3-A through 4.3-E. These tables cover the individual calendar quarters and the total calendar year, respectively.

Tables 4.3-A through 4.3-E summarize the maximum total body and organ doses for the adult, teen, and child age classes resulting from the major liquid exposure pathways. NRC Regulatory Guide 1.109 does not recognize the infant age class as being exposed to the liquid effluent pathways. Therefore, doses for this age class are not included in any of the tables.

It should be noted that doses calculated for the entire year might not equal the sum of the doses for the individual quarters. Doses from liquid effluents are based on the concentration (activity divided by volume) of radionuclides released in the effluent, as prescribed by the NRC in Regulatory Guide 1.109. If a larger proportion of activity is released with a relatively smaller volume of dilution water during a given quarter, the resulting concentration for that quarter will be higher than concentrations from other quarters. This will result in a proportionally higher dose for that quarter. However, when that quarter's activity values are included in the annual sum, and divided by the total annual dilution flow, the resulting dose contribution will be smaller. In such a situation, the annual dose will actually be less than the sum of the individual quarterly doses.

There were no liquid Effluent releases from PNPS during 2024, therefore the Radioactivity released in liquid effluents from PNPS during the reporting period resulted in a maximum total body dose (teen age class) of 0.00 mrem. The maximum organ dose (teen age class, Liver) was 0.00 mrem.

Table 4.3-A

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jan-Mar 2024

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	N/A	N/A	N/A
GI-LLI	N/A	N/A	N/A
Kidney	N/A	N/A	N/A
Liver	N/A	N/A	N/A
Lung	N/A	N/A	N/A
Thyroid	N/A	N/A	N/A
T.Body	N/A	N/A	N/A

Table 4.3-B

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Apr-Jun 2024

Organ	Age Class Organ Dose – mrem		
	Adult	Teen	Child
Bone	N/A	N/A	N/A
GI-LLI	N/A	N/A	N/A
Kidney	N/A	N/A	N/A
Liver	N/A	N/A	N/A
Lung	N/A	N/A	N/A
Thyroid	N/A	N/A	N/A
T.Body	N/A	N/A	N/A

Table 4.3-C

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jul-Sep 2024

Organ	Age Class Organ Dose – mrem		
	Adult	Teen	Child
Bone	N/A	N/A	N/A
GI-LLI	N/A	N/A	N/A
Kidney	N/A	N/A	N/A
Liver	N/A	N/A	N/A
Lung	N/A	N/A	N/A
Thyroid	N/A	N/A	N/A
T.Body	N/A	N/A	N/A

Table 4.3-D

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Oct-Dec 2024

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	N/A	N/A	N/A
GI-LLI	N/A	N/A	N/A
Kidney	N/A	N/A	N/A
Liver	N/A	N/A	N/A
Lung	N/A	N/A	N/A
Thyroid	N/A	N/A	N/A
T.Body	N/A	N/A	N/A

Table 4.3-E

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jan-Dec 2024

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	N/A	N/A	N/A
GI-LLI	N/A	N/A	N/A
Kidney	N/A	N/A	N/A
Liver	N/A	N/A	N/A
Lung	N/A	N/A	N/A
Thyroid	N/A	N/A	N/A
T.Body	N/A	N/A	N/A

5.0 OFFSITE AMBIENT RADIATION MEASUREMENTS

The PNPS ODCM does not contain control limits related specifically to offsite ambient radiation exposure. However, Regulatory Guide 1.21 (Reference 1) recommends calculation of ambient radiation exposure as part of the overall assessment of radiological impact on man.

Thermoluminescent dosimeters (TLDs) are posted at 46 locations both inside and beyond the PNPS site boundary. A number of these TLDs located within the site boundary, on Holtec property, are in close proximity to the restricted area. The TLDs are collected on a quarterly basis and used to calculate the ambient radiation exposure in milliRoentgen (mR) over the exposure period.

In addition to responding to ambient radiation exposure, TLDs will also record radiation resulting from noble gases (plume and immersion exposure), particulate materials deposited on the ground, cosmic rays from outer space, and from naturally occurring radioactivity in the soil and air. Typically, the exposure from cosmic rays and other natural radioactivity components is approximately 40 to 70 mR/year. As calculated in Sections 4.1 and 4.2 of this report, the ambient radiation component of doses from PNPS effluent emissions are below 1 mrem/yr and would not be discernible above the natural radiation exposure levels.

These TLDs are no longer geographically grouped into four zones of increasing distance from the station with their average exposure values for each zone calculated. Pilgrim has now adopted the NRC endorsed ANSI N13.37 standard. In this standard instead of zone averages that had the potential to mask an increase or decrease at one particular location, the values at each location are compared in its own baseline. The difference the dose difference between the result and baseline is the extraneous dose (facility dose). That does is then calculated with the occupancy factor to determine the dose to a MEMBER OF THE PUBLIC (MOP). If the dose is less than the minimum detected dose (MDD) of 5 mrem for a quarter, 10 mrem for the year or 1 mrem for a MOP, then it is considered Non-detectable (ND). All of 2024 TLD results based on these standard calculations were ND.

The major source of ambient radiation exposure from PNPS include radiation emitted from contained radioactive materials and/or radwaste at the facility. Despite these sources of ambient radiation exposure at PNPS, increases in exposure from ambient radiation are typically not observable above background levels at locations beyond station-controlled property.

It must be emphasized that the projected ambient exposures discussed and calculated as examples for understanding occur to a maximum-exposed hypothetical individual. Even though conservative assumptions are made in the projection of these dose consequences, all of the projected doses are well below the NRC dose limit of 100 mrem/yr specified in 10CFR20.1301, as well as the EPA dose limit of 25 mrem/yr specified in 40CFR190. Both of these limits are to be applied to real members of the general public, so the fact that the dose to the hypothetical maximum-exposed individual is within the limits ensures that any dose received by a real member of the public would be smaller and well within any applicable limit.

As stated previously the station no longer calculates the TLD result as a factor of geographic zones. The results of all TLD locations can be found in the station's Annual Radiological Environmental Operating Report (AREOR) for 2024 in Table 2.4-1 and Table 2.4-2. Table 5.0 of this report which previously showed the "Average TLD Exposures By Distance Zone" for the reporting period is no longer included.

6.0 PERCENT OF ODCM EFFLUENT CONTROL LIMITS

The PNPS ODCM contains dose and concentration limits for radioactive effluents. In addition, the effluent controls specified ensure that radioactive releases are maintained as low as reasonably achievable. The percentage of the PNPS ODCM Control limit values were determined from doses calculated in Section 4, the effluent releases summarized in Section 2, and the ODCM Control limits/objectives listed in Tables 6.1 and 6.2.

The percent of applicable control limit values are provided to supplement the information provided in the Section 2 of this report. The format for the percent of applicable limits is modified from that prescribed in Regulatory Guide 1.21 (Reference 1) to accommodate the Radioactive Effluents Technical Specifications (RETS) that became effective March 01, 1986. The percentages have been grouped according to whether the releases were via liquid or gaseous effluent pathways.

6.1 Gaseous Effluent Releases

Dose-based effluent controls related to exposures arising from gaseous effluent releases are presented in Table 6.1. The maximum quarterly air doses and annual whole-body doses listed in Table 4.1 were used to calculate the percentage values shown in Table 6.1.

Organ dose limits for the maximum-exposed individual from radioactive particulates and tritium from the PNPS ODCM are also shown in Table 6.1. The maximum quarterly and annual organ doses from Tables 4.2-A through 4.2-E were used to calculate the percentages shown in Table 6.1. The resulting organ doses from Pilgrim Station's gaseous releases during 2024 were a small percentage of the corresponding effluent control. As stated in previous sections there are no longer any monitored Noble Gases released from PNPS. The 3.3.1 and 3.3.2 sections in the ODCM that listed the dose controls for Noble Gas releases have been removed and therefore have also been removed from this report. Gaseous Effluent releases consist of particulates and tritium as seen in the table below.

Table 6.1

Percent of ODCM Effluent Control Limits
for Gaseous Effluent Releases During 2024

A. Instantaneous Dose Rate Limit - Particulates & Tritium
PNPS ODCM Control 3.3.1.b
Limit: 1500 mrem/yr Organ Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	4.71E-04	3.14E-03%

H. Quarterly Dose Objective - Particulates & Tritium
PNPS ODCM Control 3.3.3.a
Objective: 7.5 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	4.24E-04	5.66E-03%
Apr-Jun	2.42E-05	3.23E-04%
Jul-Sep	2.45E-05	3.27E-04%
Oct-Dec	4.31E-05	5.75E-04%

I. Annual Dose Objective – Particulates & Tritium
PNPS ODCM Control 3.3.3.b
Objective: 15 mrem Organ Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	4.71E-04	3.14E-03%

6.2 Liquid Effluent Releases

Liquid effluent concentration limits and dose objectives from the PNPS ODCM are shown in Table 6.2. The quarterly average concentrations from Table 2.3-A were used to calculate the percent concentration limits. The maximum quarterly and annual whole body and organ doses from Tables 4.3-A through 4.3-E were used to calculate the percentages shown in Table 6.2. The resulting concentrations, as well as organ and total body doses from Pilgrim Station's liquid releases during the reporting period were zero as there were no radioactive liquid discharges in 2024.

Table 6.2

Percent of ODCM Effluent Control Limits
for Liquid Effluent Releases During 2024

A. Fission and Activation Product Effluent Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 10CFR20 Appendix B, Table 2, Column 2 Value

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	N/A	N/A
Apr-Jun	N/A	N/A
Jul-Sep	N/A	N/A
Oct-Dec	N/A	N/A
Jan-Dec	N/A	N/A

B. Tritium Average Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 1.0E-03 μCi/mL

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	N/A	N/A
Apr-Jun	N/A	N/A
Jul-Sep	N/A	N/A
Oct-Dec	N/A	N/A
Jan-Dec	N/A	N/A

C. Dissolved and Entrained Noble Gases Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 2.0E-04 μCi/mL

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	N/A	N/A
Apr-Jun	N/A	N/A
Jul-Sep	N/A	N/A
Oct-Dec	N/A	N/A
Jan-Dec	N/A	N/A

Table 6.2 (continued)

Percent of ODCM Effluent Control Limits
for Liquid Effluent Releases During
2024

D. Quarterly Total Body Dose Objective
PNPS ODCM Control 3.2.2.a
Objective: 1.5 mrem Total Body Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	N/A	N/A
Apr-Jun	N/A	N/A
Jul-Sep	N/A	N/A
Oct-Dec	N/A	N/A

E. Annual Total Body Dose Objective
PNPS ODCM Control 3.2.2.b
Objective: 3 mrem Total Body Dose

Period	Value - mrem	Fraction of Limit
Jan-Dec	N/A	N/A

F. Quarterly Organ Dose Objective
PNPS ODCM Control 3.2.2.a
Objective: 5 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	N/A	N/A
Apr-Jun	N/A	N/A
Jul-Sep	N/A	N/A
Oct-Dec	N/A	N/A

G. Annual Organ Dose Objective
PNPS ODCM Control 3.2.2.b
Objective: 10 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Dec	N/A	N/A

7.0 RADIOACTIVE WASTE DISPOSAL DATA

Radioactive wastes that were shipped offsite for processing and disposal during the reporting period are described in Table 7.0, in the standard NRC Regulatory Guide 1.21 format.

The total quantity of radioactivity in Curies and the total volume in cubic meters are summarized in Table 7.0 for the following waste categories:

- Spent resins, filter sludges, and evaporator bottoms;
- Dry activated wastes, contaminated equipment, etc.;
- Irradiated components, control rods, etc.; and,
- Other.

During the reporting period approximately 20.2 cubic meters of spent resins, filter sludges, etc., containing a total activity of approximately 66.6 Curies were shipped from PNPS for processing and disposal. Dry activated wastes and contaminated equipment shipped during the period totaled 893 cubic meters and contained 2.35 Curies of radioactivity. Shipments of irradiated components during the reporting period contained 1.73 cubic meters and contained 27.5 Curies of radioactivity. Shipments of “Other wastes” during the reporting period included 37.2 cubic meters and contained 0.019 Curies of radioactivity. There were no shipments of irradiated fuel during the reporting period.

Estimates of principal radionuclides, those comprising greater than 1% of the total activity in each waste category shipped, are listed in Table 7.0. There were 14 shipments to Waste Control Specialists, Compact Waste Disposal Facility and 30 shipments to Waste Control Specialists, TSD Facility.

Table 7.0
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Solid Waste and Irradiated Fuel Shipments
January-December 2024

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not irradiated fuel)

1. Estimate of volume and activity content by type of waste

Type of waste	Jan-Dec 2021		
	Volume - m^3	Curies	Total Error
a. Spent resins, filters, filter sludges, evaporator bottoms, etc.	8.35E+01	1.65E+02	± 25%
b. Dry activated waste, contaminated equipment, etc.	9.03E+02	6.29E+00	± 25%
c. Irradiated components, control rods, etc.	5.47E+01	1.54E+02	± 25%
d. Other (describe):	8.84E+02	3.20E+00	± 25%

2. Estimate of major nuclide composition by type of waste

Type of waste	Radionuclide	Abundance	Total Error
a. Spent resins, filters, filter sludge's, evaporator bottoms, etc.	Mn-54	1.85%	± 25%
	Fe-55	86.08%	± 25%
	Co-60	11.2%	± 25%
b. Dry activated waste, contaminated equipment, etc.	Mn-54	1.47%	± 25%
	Fe-55	74.48%	± 25%
	Co-60	11.86%	± 25%
	Cs-137	10.65%	± 25%
c. Irradiated components, control rods, etc.	Mn-54	3.06%	± 25%
	Fe-55	50.43%	± 25%
	Co-60	36.73%	± 25%
	Ni-63	9.44%	± 25%
d. Other (describe): Contaminated oil and water	Fe-55	79.55%	± 25%
	Co-60	18.29%	± 25%
	Ni-63	1.87%	± 25%

[1] *"Major" is defined as any radionuclide comprising >1% of the total activity in the waste category.*

3. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
27	Goulet Trucking, Inc	Waste Control Specialists, LLC TSD Facility
13	INTERSTATE VENTURES	Waste Control Specialists, LLC Compact Waste Disposal Facility
1	INTERSTATE VENTURES	Waste Control Specialists, LLC TSD Facility
1	Landstar Ranger	Waste Control Specialists, LLC (CWF) Compact Waste Disposal Facility
2	Landstar Ranger	Waste Control Specialists, LLC (TSDF) TSD Facility

B. IRRADIATED FUEL SHIPMENTS & DISPOSITION

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/A

8.0 OFFSITE DOSE CALCULATION MANUAL REVISIONS

The PNPS Offsite Dose Calculation Manual (ODCM) was not revised during the calendar year of 2024.

9.0 PROCESS CONTROL PROGRAM REVISIONS

The following list summarizes changes made during 2024 to various procedures related to the Process Control Program (PCP). Any changes made to EN procedures were not adopted by PNPS following the shutdown of the plant at the end of May 2019.

EN-RW-102, "Radioactive Shipping Procedure", Rev. 24:

- Add load logs Attachment 18 - DAW example form, CWF example form
- Repurpose Attachment 18 – "Shipping requests" to Load Logs
- Added inputs at Precautions and Limitations to address Corrective actions iaw PIL-07975 (04,05,06,07)
- Description of non-standard or custom packaging
- Documentation requirements for non-standard packaging
- Adds to Documents & Trailer inspection checklists for trailer bed conditions and payload protections required

EN-RW-101, "Radioactive Waste Management" Rev 4:

- No changes

EN-RW-104, "Scaling Factors" Rev 15:

- No changes

EN-RW-105, "Process Control Program" Rev 7:

- No changes

EN-RW-106, "Integrated Transportation Security Plan" Rev 7:

- No changes

EN-RW-108, "Radioactive Shipment Accident Response" Rev 4:

- No changes

10.0 REFERENCES

1. U.S. Nuclear Regulatory Commission, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants”, Regulatory Guide 1.21, Revision 1, June 1974.

2. “Pilgrim Nuclear Power Station Offsite Dose Calculation Manual”.

3. U.S. Nuclear Regulatory Commission, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50 Appendix I”, Regulatory Guide 1.109, Revision 1, October 1977.

4. U.S. Nuclear Regulatory Commission, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors”, Regulatory Guide 1.111, July 1977.

5. Boston Edison Company, “Pilgrim Station Unit 1 Appendix I Evaluation”, April 1977.

6. Entech Engineering Inc., P100-R19, "AEOLUS-3 - A Computer Code for the Determination of Atmospheric Dispersion and Deposition of Nuclear Power Plant Effluents During Continuous, Intermittent and Accident Conditions in Open-Terrain Sites, Coastal Sites and Deep-River Valleys".

7. U.S. Nuclear Regulatory Commission, “XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations”, NUREG/CR2919, September 1982.

APPENDIX A

Results of Onsite Groundwater Monitoring Program

In response to the Nuclear Energy Institute (NEI) Groundwater Protection Initiative, Pilgrim Station instituted a groundwater monitoring program during 2007. Four monitoring wells were installed inside the protected area fence during the fourth quarter of 2007. The first samples were collected in November 2007. Since these are onsite wells, they are not considered part of the Radiological Environmental Monitoring Program (REMP), and data from these wells are being reported in the annual Radiological Effluent Release Report. Two pre-existing wells were incorporated into the groundwater monitoring program in early 2008. Additional wells were added to the program in 2010 (12 wells), 2011 (2 wells), 2012 (1 well), 2013 (3 wells), and 2014 (1 well). A total of 23 wells are being sampled on a routine basis.

In addition to sampling the onsite monitoring wells, samples of surface water are collected from a location in the PNPS Intake Canal. These locations are along the shoreline in the same direction as the groundwater flow gradient.

All samples collected are analyzed for tritium, a radioactive isotope of hydrogen, and also for gamma emitting radionuclides. In accordance with industry practice established under the NEI initiative, lower limits of detection (LLDs) used for analysis of REMP samples were used when assessing these samples for the presence of radioactivity. Low levels of tritium were detected in only 1 of the 23 onsite wells. Although gamma spectroscopy indicated the presence of naturally occurring radioactivity, such as Potassium-40 and radon daughters from the uranium/thorium decay chains, there was no indication of any plant-related radioactivity in the groundwater samples, other than tritium. Such levels of natural radioactivity are expected as these radionuclides are dissolved into the groundwater from the rocks and soil. The fact that these low levels of naturally occurring radioactivity can be detected demonstrates the ability of the gamma spectroscopy analyses to detect radioactivity in groundwater. Analyses are also performed for hard-to-detect radionuclides, including Iron-55, Nickel-63, Strontium-89, and Strontium-90 on a less frequent basis. These hard-to-detect radionuclides were also non-detectable in all of the wells sampled and analyzed during 2024.

A summary of the results of the tritium analyses conducted in 2024 are presented in the following table. In this table, a value of “NDA < xx” in the columns indicates that no activity was detected in the sample when analyzed to the minimum-detectable level following the “<” sign. For example, if a sample collected from MW201 contained no detectable tritium, and a minimum detectable concentration of 508 pCi/L was achieved on that sample. The achieved sensitivity of 508 pCi/L is well below the required REMP LLD of 3000 pCi/L, and no tritium was detected even when counted to this more sensitive level of detection. No plant-related radioactivity (other than tritium) was detected in any of the monitoring wells, and no tritium or plant-related radioactivity was detected in surface water samples collected from the intake canal.

Monitoring Well ID	Installation Date	Number of Samples	Number of Positive Results	Minimum Concentration pCi/L	Maximum Concentration pCi/L
MW201	Nov-2007	4	0	NDA < 300	NDA< 596
MW202	Nov-2007	4	0	NDA<488	NDA<602
MW202-I	Apr-2010	4	0	NDA < 484	NDA< 599
MW203	Nov-2007	Well decommissioned in 2013 during construction of ISFSI pad			
MW204	Nov-2007	4	0	NDA< 480	NDA<596
MW205	Apr-2010	4	0	NDA< 369	NDA<581
MW206	Apr-2010	4	0	NDA < 483	NDA<622
MW207	Apr-2010	4	0	NDA < 496	NDA< 610
MW208-S	Apr-2010	4	0	NDA < 519	NDA < 622
MW208-I	Apr-2010	4	0	NDA < 544	NDA < 625
MW209	Aug-2010	4	0	NDA< 476	NDA<606
MW210	Aug-2010	4	0	NDA< 474	NDA<590
MW211	Aug-2010	4	0	NDA<506	NDA<622
MW212	Aug-2010	4	0	NDA< 503	NDA< 626
MW213	Aug-2010	4	0	NDA< 476	NDA<595
MW214	Aug-2010	4	0	NDA< 500	NDA<622
MW215	Dec-2011	4	0	NDA<500	NDA<594
MW216	Sep-2012	4	1	NDA<581	744
MW217	Dec-2011	4	0	NDA< 497	NDA< 619
MW218	Nov-2013	4	0	NDA<508	NDA<627
MW219	Dec-2013	4	0	NDA< 496	NDA<619
MW220	Dec-2014	4	0	NDA< 501	NDA<629
MW3	Jul-1987	4	0	NDA< 481	NDA< 563
MW4	Jul-1997	Well decommissioned in 2013 during installation of MW4R			
MW4-R	Nov-2013	4	0	NDA< 528	NDA<632
All Wells	--	92	1	NDA < 300	744
Intake Canal West	--	4	0	NDA < 485	NDA <597
Intake Canal East	--	Discontinued sampling in 2016 for sampling safety concerns			

Concentrations of tritium detected in the onsite wells ranged from non-detectable at less than 300 pCi/L, up to a maximum concentration of 744 pCi/L. The average quarterly concentrations from these onsite wells are well below the voluntary communication reporting level of 20,000 pCi/L as established by the EPA Drinking Water Standard. Although the EPA Standard provides a baseline for comparison, no drinking water sources are affected by this tritium. All of the affected wells are onsite, and the general groundwater flow pathway is under Pilgrim Station and out into the salt water of Cape Cod Bay. As such, there is no potential to influence any off-site drinking water wells. Even if worst-case assumptions were made and the water from monitoring well with an average concentration of 3,246 pCi/L for example was consumed as drinking water for an entire year, the maximum dose consequence would be less than 0.25 mrem/yr. In actuality, any dose consequence would be much less than this, as any tritium-laden water potentially leaving the site would be diluted into the seawater of Cape Cod Bay before being incorporated into any ingestion pathways. No drinking water ingestion pathway exists at the Pilgrim Station site.

Although there are no indications that the groundwater containing detectable tritium is actually migrating offsite, a bounding calculation was performed to assess the potential dose impact of such a scenario. Based on the tritium concentrations detected during 2024 (as actual values instead of less than MDA values), the annual average concentrations of tritium in groundwater in the four monitoring wells most closely adjacent to the shoreline (MW204, MW205, MW202, and MW201) were used to estimate potential tritium migration into the intake bay. Hydrological characteristics of the compacted backfill in the vicinity of these wells were measured in 2010 and indicate the hydraulic conductivity ranges from 0.002 cm/sec to approximately 0.006 cm/sec. When coupled with the hydraulic slope of 0.014 and average porosity of 0.3, the flow velocity was calculated as being between 0.08 and 0.23 meters per day. Using an assumed horizontal shoreline interface area 236 meters long by 3 meters deep that could potentially transmit groundwater into the intake bay, the annual discharge of groundwater would be approximately 12.5 million liters of water per year. Assuming this volume of 12.5 million liters contained the segment-weighted average concentration of 468 pCi/L, the annual discharge of tritium into the intake bay under this hypothetical scenario would be 0.00585 Curies. This activity represents less than 0.11% of the annual airborne effluent of tritium released from the reactor building vent (see Table 2.2-C). Such airborne effluents can be washed down to the ground surface during precipitation events and infiltrate into the ground, thereby introducing tritium into the groundwater.

In the hypothetical scenario described above, the 0.00585 Curies of tritium entering the intake bay would be further diluted into the cooling water flow of the plant. As documented in Table 2.3-A, the total volume of cooling water flow during 2024 was 1.18 billion Liters, yielding an effective concentration of tritium in the intake bay of approximately 5.45 pCi/L. Such a concentration would be well below the detection sensitivity of approximately 450 pCi/L used to analyze water collected from the discharge canal as part of the radiological environmental monitoring program (REMP). The calculated dose to the maximum-exposed member of the public from such a hypothetical release would be 0.0000031 millirem, resulting from ingestion of tritium incorporated into fish and shellfish. Since the tritium would be incorporated into seawater, there is no drinking water ingestion pathway in the described scenario.

The following table lists the hydrological characteristics in the vicinity of each of the monitoring wells used to estimate tritium migration. Predicted flow velocities, annual discharge volumes, average tritium concentrations, and hypothetical tritium discharges are listed for each shoreline segment represented by each monitoring well.

Shoreline Segment Number	1	2	3	4
Monitoring Well Number	MW204	MW205	MW202	MW201
Hydraulic Conductivity - cm/sec	1.99E-03	4.27E-03	3.13E-03	5.64E-03
Hydraulic Slope	0.014	0.014	0.014	0.014
Porosity	0.300	0.300	0.300	0.300
Flow Velocity - m/day	8.02E-02	1.72E-01	1.26E-01	2.27E-01
Flow Velocity - ft/yr	9.61E+01	2.06E+02	1.51E+02	2.72E+02
Length of Shoreline Segment – m	61.0	38.1	45.7	91.4
Thickness of Water Layer – m	3.0	3.0	3.0	3.0
Volumetric Discharge - m^3/day	4.40E+00	5.90E+00	5.19E+00	1.87E+01
Volumetric Discharge - Liter/yr	1.61E+06	2.16E+06	1.90E+06	6.84E+06
Annual Average H-3 Concentration - pCi/L	5.55E+02	5.16E+02	5.61E+02	5.02E+02
Annual Segment Tritium Discharge - Ci/yr	8.92E-04	1.11E-03	1.06E-03	3.43E-03
Total Volumetric Discharge - L/yr	1.25E+07			
Total H-3 Discharge - Ci/yr	6.06E-03			
Annual Circulating Water Flow - Liter/yr	1.18E+09			
Discharge Canal H-3 Concentration - Ci/L	5.45E-12			
Discharge Canal H-3 Concentration - pCi/L	5.45E+00			
Max. Indiv. Dose Factor - mrem/yr per Ci/L	5.73E+05			
Maximum Individual Dose - mrem/yr	3.12E-06			

In conclusion, the only radionuclide detected in groundwater during the 2024 monitoring effort that is attributable to Pilgrim Station decommissioning activities is tritium. Although some previous soil samples near the separation in the underground discharge line from the neutralizing sump years ago indicated the presence of low-level gamma radioactivity, such activity has not been detected in the groundwater and indicates the radioactivity is immobile and confined to the soil. Even in the case of the three reportable events that occurred in 2013 and subsequent sample results in 2016, the total dose impact to a maximally exposed member of the public would have been much less than 1 mrem/yr.

APPENDIX B

CORRECTIONS TO PREVIOUS EFFLUENT REPORTS

At the end of 2023 RBV flow calculations were performed using corrected flow values to demonstrate equipment reliability. Though there was a slight difference in release and dose values from the submitted 2023 report, it was insignificant and did not warrant corrections to the submitted 2023 ARERR. There were no corrections made to the previous effluent (ARERR) report during the calendar-year of 2024.

APPENDIX C

CHANGES TO PNPS
OFFSITE DOSE CALCULATION MANUAL

The PNPS Offsite Dose Calculation Manual (ODCM) was not revised during calendar year 2024.

APPENDIX D

ISFSI Radiological Effluent Reporting

This section of the report until 2024 was reported and submitted to the NRC in a separate effort. Like many other sites, the spent fuel storage facility onsite at PNPS required its own effluent reporting. The information is now and will remain a part of the Annual Radiological Effluent Release Report (ARERR).

The HI-STORM 100 Cask system that holds spent fuel and other irradiated parts does not create radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. The HI-STORM 100 Cask System is designed and fabricated with a totally sealed-welded pressure vessel such that leakage from the confinement boundary is not considered to be a credible occurrence.

Therefore, there were no radionuclides released to the environment in liquid or gaseous effluents from the Independent Spent Fuel Storage Installation (ISFSI) at PNPS during 2024. Without a release there is no dose consequence.