Environmental Monitoring Report

For 2021

Pilgrim and Seabrook

Nuclear Power Stations

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May 2023

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# Executive Summary

The Massachusetts Department of Public Health (MDPH) Bureau of Environmental Health’s (MDPH/BEH) Environmental Toxicology and Radiation Control Programs collaborate to conduct routine environmental monitoring for Massachusetts communities within a 10-mile radius of nuclear power stations that are currently operating, or undergoing decommissioning. This monitoring provides a system of watchfulness over environmental radiation in Massachusetts communities surrounding nuclear power plants. The monitoring areas include Massachusetts communities located within a 10-mile radius of Pilgrim Nuclear Power Station (Pilgrim) in Plymouth, MA and Seabrook Nuclear Power Station (Seabrook) in Seabrook, NH. The 10-mile radius surrounding Seabrook corresponds with Seabrook’s Emergency Planning Zone (EPZ); as such environmental radiation monitoring is part of the MDPH’s regulatory responsibility. Pilgrim ceased operations on May 31, 2019 and is undergoing decommissioning[[1]](#footnote-1). Although the 10-mile EPZ for Pilgrim has been eliminated[[2]](#footnote-2), MDPH continues to conduct environmental monitoring while the power plant is being decommissioned. This report summarizes the 2021 monitoring activities and results for the Pilgrim and Seabrook nuclear plants.

**Report Highlights**

* Overall, no radiation indicators or radionuclides were detected at a level of health concern.
* Radiation monitoring results in 2021 for areas surrounding the two nuclear power stations -- Pilgrim and Seabrook -- have been either non-detect, naturally occurring, or at levels expected to be present in the environment from background fallout from historic bomb testing and past nuclear accidents.

# Introduction

The MDPH/BEH radiation environmental monitoring program is designed to monitor radiation levels and to protect residents in the Commonwealth from exposure to radiation. Samples of environmental media, collected within and just outside the 10-mile radius surrounding nuclear power plants by MDPH/BEH or provided by the utilities that operate the nuclear power plants, are analyzed for radiation by the MDPH/BEH Massachusetts Environmental Radiation Laboratory (MERL). Environmental media analyzed in 2021 include: air, surface water, milk, fish, shellfish, sediment, vegetation and food crops. In addition to the samples analyzed for radiation by MERL, MDPH/BEH has a network of stationary monitors surrounding Pilgrim that measures gamma radiation in real-time. This network is monitored online by MDPH/BEH staff. The C-l0 Research & Education Foundation, Inc., a non-profit organization under contract to MDPH/BEH, conducts direct radiation monitoring in Massachusetts communities within the Seabrook EPZ and provides summary reports to MDPH/BEH.

The radiation environmental monitoring of the areas around the Pilgrim and Seabrook plants has been in place since the 1980s. A focused investigation of tritium in groundwater on the Pilgrim Nuclear Power Plant property is ongoing and not part of this report. Updates on this monitoring effort are posted on the MDPH website: [Tritium investigation update reports](https://www.mass.gov/lists/environmental-monitoring-data-for-tritium-in-groundwater-at-pilgrim-nuclear-power-station).

The NRC requires specific environmental monitoring and annual reporting by operating nuclear power plants. The NRC reports summarizing Seabrook’s environmental monitoring can be found on its website: [Seabrook's 2021 Radiological Environmental Operating Report.](https://www.nrc.gov/docs/ML2211/ML22119A279.pdf)

This report contains background information regarding environmental radiation and laboratory methods used to analyze samples for radiation; sample location and analyses for the areas around the Pilgrim and Seabrook plants; and a summary of the monitoring results.

## Environmental Radiation

Background radiation in the environment comes from three general sources: naturally occurring radiation, radioactive fallout from past weapons testing or nuclear accidents, and man-made sources.

Naturally occurring radionuclides, such as Potassium-40 and Beryllium-7, are present in most environmental media. Potassium-40 is a radioactive form of potassium, which is an essential nutrient. Beryllium-7 is produced when cosmic energy collides with nitrogen and oxygen in the atmosphere (Delaygue et al., 2015). Additional natural sources of radiation, including cosmic radiation, radon, and carbon-14, contribute to an annual background radiation dose of approximately 310 mrems/year (US NRC, 2017a, b). Man-made sources include medical procedures (e.g., diagnostic x-rays) and various consumer products (e.g., certain construction material, combustible fuels, televisions, smoke detectors) (US NRC 2017c). Background and man-made sources contribute to the estimated 620 mrem annual dose of environmental radiation for average U.S. residents (US NRC, 2017b).

#### 

#### **Table 1**. Background Radiation Dose for Average U.S. Resident

|  |  |
| --- | --- |
| Source | Millirems/year |
| Natural background radiation | 310 |
| Man-made sources | 310 |
| Total of all sources | 620 |

Source: US NRC, 2017c

Background radiation includes fallout radiation from historical weapons testing, which occurred primarily in the 1950s and 1960s, and from nuclear power plant accidents such as Chernobyl and Fukushima. This fallout includes radioisotopes such as Cesium-137 (Cs-137) and Strontium-90 (Sr-90), which persist in the environment due to their 28-30 year half-lives.

During active operation, nuclear power plants emit direct gamma radiation from nuclear reactor systems; noble gases, tritium, Iodine-131, Carbon-14, and particulates from the station’s air stack; and discharge water containing tritium as well as other radionuclides that emit alpha, beta and gamma radiation (Luykx and Fraser, 1983; UNSCEAR, 2008). Noble gases are chemically inert, have short half-lives, disperse quickly in the environment, and do not bioconcentrate or easily incorporate into biological tissue. Tritium is created when water passes through the reactor core; the hydrogen atoms in the water molecules and other trace elements like boron absorb neutrons from the fission of the reactor fuel. Tritium is lighter and more mobile in water than other radionuclides and is a sentinel indicator of radionuclides in water bodies. Both Iodine-131 and particulates (notably Cesium-137, Cobalt-60, Iron-59, Magnesium-54, Stontium-90 and Zinc-65) have environmental and public health significance: their half-lives range from weeks to years, they are readily incorporated into biological tissue, and they will bioconcentrate. Iodine-131 is usually the first radioactive element detected in the event of an accidental release of power plant radiation (ATSDR, 2002). Carbon-14 is a naturally occurring radionuclide, which can also be released in relatively small amounts from nuclear power plants, primarily due to its formation in the coolant system (Yim and Caron, 2006).

Exposure to radiation from nuclear power plants may occur from permitted air or liquid discharges or from unmonitored releases or leaks. MDPH/BEH evaluates possible routes of exposure for radionuclides, particularly those that accumulate in the food chain, and samples environmental media along these routes to measure potential exposure to radiation.

## Laboratory Methods

The MDPH/BEH Radiation Control Program’s Massachusetts Environmental Radiation Laboratory (MERL) analyzes samples for a suite of more than 30 radioactive isotopes (e.g., radioisotopes, or radionuclides). Gamma spectroscopy is used to identify and detect environmentally significant and naturally occurring radioisotopes; gas proportion counters measure gross beta and alpha radiation; and liquid scintillation counters measure tritium. Environmental media sample results are compared to typical background levels. In the event that gamma emitters are present above typical background, the MERL protocol calls for additional testing at an outside laboratory for alpha emitters, such as transuranic (high atomic number) elements, and beta emitters, such as Strontium-90. MERL maintains its standard of excellence in analytical capability through participation with several federal agencies in inter-laboratory quality assurance measures.

Analysis methods by media are summarized below:

### Air

Air filters are collected weekly and analyzed for gross alpha and gross beta radioactivity using a gas proportion counter. Gross alpha and beta analysis is a screening-level tool that does not identify individual radionuclides; therefore, air filters are also analyzed quarterly for gamma emitting radionuclides using gamma spectroscopy. Results are compared to results from a background monitor located in Boston.

Air cartridges are analyzed weekly for iodine-131 using gamma spectroscopy.

Direct gamma radiation in air is measured with thermoluminescent dosimeters (TLDs) and analyzed using gamma spectroscopy.

### Water

Surface water samples are tested for total alpha and beta radioactivity with a gas proportional counter, and for gamma-emitting radionuclides with a gamma spectrometer. Water samples are also tested for tritium with a liquid scintillation counter.

### MILK

Milk is a good indicator media for radioactive elements, particularly iodine-131, which can be detected in milk soon after cows graze on contaminated pastures or feed. Hence, cow’s milk is tested for gamma radionuclides, including iodine-131, using gamma spectroscopy.

### seafood, SEDIMENT, VEGETATION, AND FOOD Crops

Seafood, sediment, vegetation and food crops were chosen to represent various stages of the food chain where radionuclides may be identified. Mollusks (such as clams and mussels) filter-feed sediment and sand where heavy and sediment-bound radionuclides may accumulate; lobsters eat clams, mussels and small fish; and radionuclides biomagnify from smaller to larger surface-dwelling fish.

Analyses of vegetation and crop samples aim to identify radionuclides that may settle on surfaces or be absorbed through the roots. Samples are tested for gamma-emitting radionuclides using a gamma spectrometer.

### IRISH MOSS

Irish moss (i.e., Chondrus) is a type of seaweed that readily absorbs iodine and is thus a good reference indicator of iodine-131 in the environment.

### Quality Assurance

Laboratory sample detection levels are affected by sample size, time between collection and analysis, and equipment processing and counting time. Where detection levels fall outside our analytic sensitivity guidelines they are noted in the tables as “NR” (Result is not reported for quality control reason).

# Environmental monitoring and Sampling

This section summarizes the environmental samples collected and analyzed in 2021 for the Pilgrim and Seabrook nuclear power stations.

## Pilgrim Nuclear Power Station

The Pilgrim Nuclear Power Station (Pilgrim) is located in Plymouth, MA. There are five Massachusetts communities within a 10-mile radius of Pilgrim: Carver, Duxbury, Kingston, Marshfield, and Plymouth, all shown below in Figure 1.

Diagram

Description automatically generatedFigure 1. The MDPH/BEH Radiation -monitoring network at Pilgrim

In 2021, MDPH/BEH’s radiation monitoring conducted in the areas surrounding Pilgrim included a combination of independent direct monitoring of airborne radiation; air and cranberry sampling; and analysis of split samples provided by the current owner of the Pilgrim site (Holtec). Holtec provided samples of water, fish, shellfish, sediment, food crops, and mixed grasses/wild vegetation. Figure 1 shows locations of the air monitors for Pilgrim. Sample locations for water, fish, shellfish, sediment, food crops, and mixed grasses/wild vegetation are shown in Figure 2.

Diagram

Description automatically generated

Figure 2. Pilgrim 10-mile radius and sampling locations

#### Air/Direct Radiation

MDPH/BEH’s direct radiation monitoring at Pilgrim is comprised of three systems operating on real-time, weekly, and quarterly bases. The redundant systems are designed to independently monitor the land areas surrounding Pilgrim and to verify the utility’s radiation monitoring.

MDPH/BEH maintains a network of 15 stationary radiation monitoring stations that detects gamma radiation in real-time and transmits data to a computer which is remotely accessed by staff. Emergency alerts are sent to MDPH and Massachusetts Emergency Management Agency (MEMA) officials if radiation is detected at levels greater than three times the typical background level. In 2016, MDPH/BEH completely replaced the older system with new monitors and servers and installed an internet-based communication system.

MDPH/BEH analyzes samples collected from an air particulate filter and a charcoal air cartridge located just outside the Pilgrim utility’s fence. Filters are analyzed for gross beta and gross alpha radioactivity and cartridges are analyzed for iodine-131. A filter composite sample is also analyzed quarterly for additional gamma-emitting radionuclides. The same analyses are done for an air particulate filter and charcoal cartridge collected from a background location in Boston.

MDPH/BEH also has a network of 39 TLDs placed throughout the Pilgrim 10-mile radius and surrounding communities, which measure total gamma radiation in milliroentgen (mR). The majority of the TLDs are located in the inner region of the 10-mile radius, and three are near the plant border. These TLDs are collected and analyzed quarterly, and the results are compared to those of a background location in Boston.

#### Surface Water

Holtec collects seawater on a weekly basis from the Pilgrim discharge canal and the Powder Point Bridge in Duxbury and provides split samples of monthly composites to MDPH/BEH for analysis of gamma-emitting radionuclides. MERL also analyzes monthly composites of weekly surface water samples from both locations for tritium.

#### Fish and Shellfish

Holtec provides annual split samples of fish and lobster collected from the Pilgrim discharge canal to MERL for analysis. In 2021 Holtec also provided MERL with split samples of background fish and lobster from Cape Cod Bay.

In 2021, Holtec collected Mytilus (i.e., blue or common mussels) from Green Harbor in Marshfield and the Pilgrim discharge canal; and collected soft shell clams from Duxbury Bay and Plymouth Harbor. Duxbury Bay, Green Harbor, and Plymouth Harbor are reported to be background locations by Holtec for federal reporting requirements but are considered to be “indicator” locations by MDPH/BEH because they fall within 10 miles of the plant. MERL analyzes the split samples for gamma-emitting radionuclides.

#### Sediment

In 2021 Holtec collected sediment samples from Green Harbor in Marshfield, Duxbury and the Pilgrim discharge canal; MERL analyzed the split samples.

#### Crops

MDPH/BEH collects and analyzes background cranberry samples from a bog in East Taunton annually.

In 2021 MDPH collected samples of strawberries, tomatoes, and zucchini during the growing season, from a farm in Kingston.

#### Mixed Grasses/Wild Vegetation

In 2021 MERL analyzed two split samples of mixed grasses/wild vegetation, collected by Holtec from the beach area at Pilgrim.

## Seabrook Nuclear Power Station

The Seabrook Nuclear Power Station (Seabrook) is located in Seabrook, New Hampshire, approximately two miles north of the Massachusetts border. Six Massachusetts communities are included within 10 miles of Seabrook: Amesbury, Merrimac, Newbury, Newburyport, Salisbury, and West Newbury as shown in Figure 3. Because the Seabrook plant is still operating, areas within the 10-mile radius are referred to as an Emergency Planning Zone (EPZ).

Diagram

Description automatically generatedFigure 3. Seabrook EPZ and sampling locations within Massachusetts

Radiation monitoring conducted within and outside the Seabrook EPZ includes the following environmental media: air, surface water, fish, shellfish, sediment, Irish moss, crops, and milk. MDPH/BEH receives split samples from Nextera, the utility that owns Seabrook, for all media except milk and air. Sampling locations and activities within Massachusetts are described below. Sampling locations are shown in Figure 3.

#### Air/Direct Radiation

MDPH/BEH collects air particulate filters and charcoal cartridges weekly at the Salisbury Fire Station. Filters are analyzed for gross beta and alpha radioactivity, and cartridges for iodine-131. Additionally, a filter composite is analyzed quarterly for gamma-emitting radionuclides. The same analyses are done for air particulate filters and charcoal cartridges collected at the background location in Boston.

MDPH/BEH measures total ambient gamma radiation using a network of 34 TLDs placed at locations throughout the Seabrook EPZ in Massachusetts. These are collected and analyzed quarterly and results are compared to those of a background location in Boston.

MDPH/BEH contracts with the C-l0 Research & Education Foundation, Inc. to conduct radiation monitoring in Massachusetts communities located in the Seabrook EPZ. The C-10 system consists of a network of 10 real-time radiation sensors and weather probes located in Massachusetts within a 10-mile radius of Seabrook station. Beta, gamma, and weather data are collected and uploaded every 15 minutes to a secure web-based central repository. C-10 compiles and graphs the data monthly and sends reports to MDPH/BEH. The 10 Massachusetts monitoring sites within the Seabrook 10-mile EPZ are located at private homes, schools, and businesses. MDPH and MEMA officials receive text alerts from C-10 if levels are greater than three times the typical background readings.

#### Surface Water

Seawater samples are typically collected monthly by Nextera from a background location in Ipswich Bay. MERL analyzes split samples for gamma-emitting radionuclides. MERL also analyzes surface water samples for tritium.

#### Milk

MDPH/BEH collects samples of cow’s milk monthly from a farm located in Rowley and MERL analyzes the samples for gamma-emitting radionuclides, including iodine-131.

#### Fish and Shellfish

Nextera semi-annually collects samples of fish and shellfish, including lobster, Modiolus (i.e, Atlantic ribbed mussels) and Mytilus (i.e., blue or common mussels), from Ipswich Bay, which is considered a background location; MERL analyzes the split samples for gamma-emitting radionuclides.

#### Sediment

Nextera semi-annually collects sediment samples from Ipswich Bay and the tidal flats on Plum Island, both background locations; MERL analyzes the split samples for gamma-emitting radionuclides.

#### Irish moss

As noted earlier, Irish moss readily absorbs iodine and is a sentinel indicator of environmental iodine-131. Nextera collects samples of Irish moss semiannually from a background location in Ipswich Bay, and split samples are analyzed by MERL for gamma-emitting radionuclides.

#### Crops

In 2021 MDPH collected cucumber, sugar snap peas, and zucchini, from a farm located within the Seabrook EPZ in Salisbury, and also collected cucumber, sugar snap peas, and tomatoes from a farm in Ipswich, which is outside the Seabrook EPZ.

# 2021 Environmental Monitoring Results

Results of environmental monitoring conducted by MDPH/BEH in the Massachusetts communities in the vicinity of the Pilgrim and Seabrook nuclear power stations are discussed below and presented in Tables 2-7. The tables are organized by nuclear power station and by sample media.

## Pilgrim Nuclear Power Station

Sampling results for Pilgrim are provided in Tables 2, 3 and 4. Only two radionuclides – Beryllium-7 and Potassium-40, both of which are naturally occurring -- were detected in samples collected and consistent with levels detected in background samples.. Naturally occurring Potassium-40 was detected in all samples of environmental media analyzed for Potassium-40, except for the first quarter composite air sample. Naturally occurring Beryllium-7 was detected in: 1) all quarterly composite air samples; 2) clams from Duxbury; 3) mussels from the Pilgrim discharge canal; 4) strawberries; 5) mixed grass; and 6) cranberries. Except for the cranberries, all samples in which Beryllium-7 was detected were collected within 10-miles of Pilgrim; the cranberries were collected in Taunton, which is more than 10 miles from Pilgrim. For both Potassium-40 and Beryllium-7, levels detected in all samples collected in the vicinity of Pilgrim (including the cranberries) are generally consistent with levels detected in background samples.

In addition to naturally occurring Beryllium-7 and Potassium-40, which were detected at levels consistent with background levels, air filter and cartridge analyses indicated low levels of gross alpha and gross beta radiation. Levels of gross alpha and beta radiation measured ranged from 0.003 – 0.020 and 0.031 – 0.161 pico curies (pCi)/m3, respectively. These levels are consistent with those measured at the background location in Boston, of 0.004 – 0.012 and 0.029 – 0.080 pCi/m3, respectively. No gamma-emitting radionuclides of concern were detected in quarterly composite air samples.

Real-time monitoring did not detect radiation greater than typical background levels of approximately 0.007 - 0.009 mRoentgen/hour with the exception of brief increases up to approximately 0.02 mRoentgen/hour. Brief increases are expected due to rainfall washout from naturally occurring radionuclides such as airborne radon daughters and cosmic radiation events. No alerts at three times background were recorded.

TLD total gamma exposure results ranged from 12.3 to 161 mRoentgen/quarter (i.e., 0.006 – 0.074 mRoentgen/hour) with an average of 17.0 mRoentgen/quarter (0.007 mRoentgen/hour). This value is compared to an average value of 18.2 mRoentgen/quarter measured at a background location in Boston and corresponds to an average gamma exposure of 1.2 mRoentgen/quarter below background. The maximum quarterly value of 161 mRoentgen/quarter was measured at an onsite TLD monitor located inside the PNPS property, near the dry fuel storage pad, and covers a period when spent fuel was being moved to the storage pad. Because the TLD monitor is onsite, gamma levels measured at the monitor do not represent potential exposure to the general public. At a nearby TLD monitor located on Rocky Hill Rd (approximately 400 meters southeast of the onsite TLD), the total gamma exposure was 19.2 mRoentgen/quarter for the same period. Excluding the quarterly value of 161 mRoentgen/quarter, the next highest value was 32.3 mRoentgen/quarter, measured at the onsite TLD.

## Seabrook Nuclear Power Station

Seabrook sampling results are provided in Tables 5, 6 and 7. As with Pilgrim, the only radionuclides detected either within or outside the Seabrook EPZ were Potassium-40 and Beryllium-7.

Naturally occurring Potassium-40 was detected in all samples of environmental media from both within and outside the Seabrook EPZ except for the first quarterly composite air sample. Naturally occurring Beryllium-7 was detected in Irish moss (i.e., chondrus) and mytilus mussels collected in May, from the background sampling location in Ipswich Bay, and in the composite air samples collected at the Salisbury Fire Station for all 4 quarters. As with Pilgrim, levels of Potassium-40 and Beryllium-7 detected within the Seabrook EPZ are consistent with background levels.

In addition to naturally occurring Beryllium-7 and Potassium-40, detected at levels consistent with background, analyses of air filter and cartridge samples found low levels of gross alpha (0.003 – 0.056 pCi/m3) and gross beta (0.027 – 0.485 pCi/m3) radiation. The maximum levels are greater than levels measured at the background location in Boston, where gross alpha ranged from 0.004 – 0.012 pCi/m3 and gross beta ranged from 0.029 – 0.080 pCi/m3. The elevated levels measured within the Seabrook EPZ are due to low sample collection volumes for three samples, resulting in falsely high readings. Excluding the low volume samples, levels of gross alpha and beta within the Seabrook EPZ ranged from 0.003 – 0.015 pCi/m3, and 0.027 – 0.086 pCi/m3, respectively, consistent with background levels. No gamma radionuclides of concern were detected in quarterly composite air samples.

In 2021, real-time monitoring for the Seabrook EPZ did not show gamma radiation levels above typical background levels at most stations (approximately 0.010 mRoentgen/hour) with the exception of brief increases (typically up to approximately 0.02 mRoentgen/hour). Brief increases are expected due to rainfall washout from naturally occurring radionuclides such as airborne radon daughters and cosmic radiation events. Beta readings ranged from approximately 35 to 55 counts per minute with the exception of brief increases similar to the gamma results. These beta levels are comparable to levels from previous years, and also to levels from the background location in Somerville, MA.

TLD results for total gamma exposure ranged from 11.2 to 21.6 mRoentgen/quarter (0.005 – 0.010 mRoentgen/hour) with an average exposure of 17.3 mRoentgen/quarter (0.008 mRoentgen/hour), compared to an average of 18.2 mRoentgen/quarter at the background location in Boston. The result for the TLDs near Seabrook is an average gamma exposure level of 0.9 mRoentgen/quarter below background.

## c. summary

Radiation monitoring results in 2021 for Massachusetts have been either non-detect or naturally occurring (i.e., Potassium-40, Beryllium-7). No detectible radionuclides were at levels of health concern or were indicative of an unintentional release of radiation at Pilgrim or Seabrook.

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# RESULTS Tables

#### Table 2. Pilgrim Nuclear Power Station 2021 Environmental Monitoring Data - Air Samples

| **Sample Type** | **Location** | **Date** | **I-131\***  (pCi/m3) | **Be-7\***  (pCi/m3) | **K-40\***  (pCi/m3) | **Mn-54\***  (pCi/m3) | **Fe-59\***  (pCi/m3) | **Co-60\***  (pCi/m3) | **Zn-65\***  (pCi/m3) | **Cs-137\***  (pCi/m3) | **Gross Alpha**  (pCi/m3) | **Gross Beta**  (pCi/m3) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Air | Pilgrim Station | 01/05/2021 | <0.0166 | - | - | - | - | - | - | - | 0.0086 | 0.0493 |
| Air | Pilgrim Station | 01/13/2021 | <0.0136 | - | - | - | - | - | - | - | 0.0064 | 0.0478 |
| Air | Pilgrim Station | 01/21/2021 | <0.0238 | - | - | - | - | - | - | - | 0.0155 | 0.0971 |
| Air | Pilgrim Station | 01/29/2021 | <0.0228 | - | - | - | - | - | - | - | 0.0053 | 0.0446 |
| Air | Pilgrim Station | 02/02/2021 | <0.0324 | - | - | - | - | - | - | - | 0.0088 | 0.0600 |
| Air | Pilgrim Station | 02/08/2021 | <0.0397 | - | - | - | - | - | - | - | 0.0151 | 0.0924 |
| Air | Pilgrim Station Quarterly Composite | 2/15/2021 | - | 0.129 | <0.028 | <0.001 | <0.005 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Pilgrim Station | 02/17/2021 | <0.0108 | - | - | - | - | - | - | - | 0.0060 | 0.0604 |
| Air | Pilgrim Station | 02/25/2021 | <0.0157 | - | - | - | - | - | - | - | 0.0081 | 0.0639 |
| Air | Pilgrim Station | 03/03/2021 | <0.0184 | - | - | - | - | - | - | - | 0.0090 | 0.0653 |
| Air | Pilgrim Station | 03/11/2021 | <0.0150 | - | - | - | - | - | - | - | 0.0085 | 0.0620 |
| Air | Pilgrim Station | 03/16/2021 | <0.0611 a | - | - | - | - | - | - | - | 0.0201a | 0.1610a |
| Air | Pilgrim Station | 03/24/2021 | <0.0569 | - | - | - | - | - | - | - | 0.0095 | 0.0860 |
| Air | Pilgrim Station | 03/31/2021 | <0.0155 | - | - | - | - | - | - | - | 0.0052 | 0.0454 |
| Air | Pilgrim Station | 04/06/2021 | <0.0150 | - | - | - | - | - | - | - | 0.0055 | 0.0454 |
| Air | Pilgrim Station | 04/14/2021 | <0.0149 | - | - | - | - | - | - | - | 0.0033 | 0.0307 |
| Air | Pilgrim Station | 04/21/2021 | <0.0128 | - | - | - | - | - | - | - | 0.0045 | 0.0314 |
| Air | Pilgrim Station | 04/28/2021 | <0.0204 | - | - | - | - | - | - | - | 0.0090 | 0.0666 |
| Air | Pilgrim Station | 05/05/2021 | <0.0138 | - | - | - | - | - | - | - | 0.0065 | 0.0537 |
| Air | Pilgrim Station | 05/12/2021 | <0.0153 | - | - | - | - | - | - | - | 0.0045 | 0.0365 |
| Air | Pilgrim Station Quarterly Composite | 5/15/2021 | - | 0.143 | 0.128 | <0.001 | <0.005 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Pilgrim Station | 05/19/2021 | <0.0179 | - | - | - | - | - | - | - | 0.0058 | 0.0615 |
| Air | Pilgrim Station | 05/26/2021 | <0.0130 | - | - | - | - | - | - | - | 0.0044 | 0.0481 |
| Air | Pilgrim Station | 06/02/2021 | <0.0131 | - | - | - | - | - | - | - | 0.0051 | 0.0425 |
| Air | Pilgrim Station | 06/10/2021 | <0.0150 | - | - | - | - | - | - | - | 0.0050 | 0.0572 |
| Air | Pilgrim Station | 06/16/2021 | <0.0174 | - | - | - | - | - | - | - | 0.0047 | 0.0476 |
| Air | Pilgrim Station | 06/23/2021 | <0.0198 | - | - | - | - | - | - | - | 0.0045 | 0.0610 |
| Air | Pilgrim Station | 06/29/2021 | <0.0178 | - | - | - | - | - | - | - | 0.0038 | 0.0533 |
| Air | Pilgrim Station | 07/07/2021 | <0.0140 | - | - | - | - | - | - | - | 0.0065 | 0.0364 |
| Air | Pilgrim Station | 07/14/2021 | <0.0125 | - | - | - | - | - | - | - | 0.0070 | 0.0390 |
| Air | Pilgrim Station | 07/21/2021 | <0.0184 | - | - | - | - | - | - | - | 0.0096 | 0.0629 |
| Air | Pilgrim Station | 07/27/2021 | <0.0190 | - | - | - | - | - | - | - | 0.0102 | 0.0628 |
| Air | Pilgrim Station | 08/04/2021 | <0.0157 | - | - | - | - | - | - | - | 0.0079 | 0.0497 |
| Air | Pilgrim Station | 08/10/2021 | <0.0189 | - | - | - | - | - | - | - | 0.0106 | 0.0752 |
| Air | Pilgrim Station Quarterly Composite | 08/15/2021 | - | 0.132 | 0.155 | <0.001 | <0.011 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Pilgrim Station | 08/18/2021 | <0.0132 | - | - | - | - | - | - | - | 0.0066 | 0.0572 |
| Air | Pilgrim Station | 08/25/2021 | <0.0175 | - | - | - | - | - | - | - | 0.0081 | 0.0475 |
| Air | Pilgrim Station | 08/31/2021 | <0.0214 | - | - | - | - | - | - | - | 0.0106 | 0.0829 |
| Air | Pilgrim Station | 09/08/2021 | <0.0147 | - | - | - | - | - | - | - | 0.0068 | 0.0542 |
| Air | Pilgrim Station | 09/15/2021 | <0.0165 | - | - | - | - | - | - | - | 0.0089 | 0.0787 |
| Air | Pilgrim Station | 09/22/2021 | <0.0276 | - | - | - | - | - | - | - | 0.0074 | 0.0611 |
| Air | Pilgrim Station | 09/29/2021 | <0.0134 | - | - | - | - | - | - | - | 0.0055 | 0.0645 |
| Air | Pilgrim Station | 10/06/2021 | <0.0172 | - | - | - | - | - | - | - | 0.0078 | 0.0510 |
| Air | Pilgrim Station | 10/13/2021 | <0.0179 | - | - | - | - | - | - | - | 0.0060 | 0.0477 |
| Air | Pilgrim Station | 10/20/2021 | <0.0197 | - | - | - | - | - | - | - | 0.0090 | 0.0708 |
| Air | Pilgrim Station | 10/27/2021 | <0.0174 | - | - | - | - | - | - | - | 0.0114 | 0.0789 |
| Air | Pilgrim Station | 11/03/2021 | <0.0172 | - | - | - | - | - | - | - | 0.0094 | 0.0612 |
| Air | Pilgrim Station | 11/10/2021 | <0.0262 | - | - | - | - | - | - | - | 0.0122 | 0.0778 |
| Air | Pilgrim Station Quarterly Composite | 11/15/2021 | - | 0.090 | 0.159 | <0.001 | <0.006 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Pilgrim Station | 11/17/2021 | <0.0174 | - | - | - | - | - | - | - | 0.0119 | 0.0684 |
| Air | Pilgrim Station | 11/23/2021 | <0.0204 | - | - | - | - | - | - | - | 0.0144 | 0.0739 |
| Air | Pilgrim Station | 12/01/2021 | <0.0148 | - | - | - | - | - | - | - | 0.0108 | 0.0689 |
| Air | Pilgrim Station | 12/09/2021 | <0.0213 | - | - | - | - | - | - | - | 0.0095 | 0.0738 |
| Air | Pilgrim Station | 12/14/2021 | <0.0275 | - | - | - | - | - | - | - | 0.0167 | 0.1020 |
| Air | Pilgrim Station | 12/22/2021 | <0.0259 | - | - | - | - | - | - | - | 0.0093 | 0.0685 |
| Air | Pilgrim Station | 12/29/2021 | <0.0178 | - | - | - | - | - | - | - | 0.0117 | 0.0845 |
| Air | Background | 01/04/2021 | <0.0237 | - | - | - | - | - | - | - | 0.0092 | 0.0629 |
| Air | Background | 01/11/2021 | <0.0164 | - | - | - | - | - | - | - | 0.0072 | 0.0502 |
| Air | Background | 01/19/2021 | <0.0134 | - | - | - | - | - | - | - | 0.0091 | 0.0713 |
| Air | Background | 01/25/2021 | <0.0193 | - | - | - | - | - | - | - | 0.0083 | 0.0563 |
| Air | Background | 02/03/2021 | <0.0098 | - | - | - | - | - | - | - | 0.0042 | 0.0349 |
| Air | Background | 02/09/2021 | <0.0154 | - | - | - | - | - | - | - | 0.0101 | 0.0632 |
| Air | Background  Quarterly Composite | 02/15/2021 | - | 0.135 | 0.088 | <0.001 | <0.004 | <0.001 | <0.002 | <0.0006 | - | - |
| Air | Background | 02/16/2021 | <0.0169 | - | - | - | - | - | - | - | 0.0079 | 0.0700 |
| Air | Background | 02/22/2021 | <0.0200 | - | - | - | - | - | - | - | 0.0086 | 0.0685 |
| Air | Background | 03/03/2021 | <0.0100 | - | - | - | - | - | - | - | 0.0075 | 0.0573 |
| Air | Background | 03/10/2021 | <0.0168 | - | - | - | - | - | - | - | 0.0086 | 0.0583 |
| Air | Background | 03/16/2021 | <0.0195 | - | - | - | - | - | - | - | 0.0087 | 0.0621 |
| Air | Background | 03/23/2021 | <0.0141 | - | - | - | - | - | - | - | 0.0071 | 0.0604 |
| Air | Background | 03/30/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0052 | 0.0487 |
| Air | Background | 04/07/2021 | <0.0141 | - | - | - | - | - | - | - | 0.0069 | 0.0450 |
| Air | Background | 04/12/2021 | <0.0233 | - | - | - | - | - | - | - | 0.0059 | 0.0415 |
| Air | Background | 04/20/2021 | <0.0134 | - | - | - | - | - | - | - | 0.0046 | 0.0287 |
| Air | Background | 04/27/2021 | <0.0127 | - | - | - | - | - | - | - | 0.0065 | 0.0506 |
| Air | Background | 05/04/2021 | <0.0132 | - | - | - | - | - | - | - | 0.0062 | 0.0468 |
| Air | Background | 05/12/2021 | <0.0159 | - | - | - | - | - | - | - | 0.0051 | 0.0306 |
| Air | Background  Quarterly Composite | 5/15/2021 | - | 0.117 | 0.094 | <0.001 | <0.003 | <0.001 | <0.001 | <0.0005 | - | - |
| Air | Background | 05/18/2021 | <0.0156 | - | - | - | - | - | - | - | 0.0085 | 0.0565 |
| Air | Background | 05/25/2021 | <0.0147 | - | - | - | - | - | - | - | 0.0069 | 0.0494 |
| Air | Background | 06/01/2021 | <0.0148 | - | - | - | - | - | - | - | 0.0070 | 0.0379 |
| Air | Background | 06/08/2021 | <0.0166 | - | - | - | - | - | - | - | 0.0063 | 0.0647 |
| Air | Background | 06/16/2021 | <0.0131 | - | - | - | - | - | - | - | 0.0050 | 0.0462 |
| Air | Background | 06/22/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0056 | 0.0535 |
| Air | Background | 06/29/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0062 | 0.0473 |
| Air | Background | 07/06/2021 | <0.0122 | - | - | - | - | - | - | - | 0.0054 | 0.0358 |
| Air | Background | 07/13/2021 | <0.0170 | - | - | - | - | - | - | - | 0.0068 | 0.0485 |
| Air | Background | 07/20/2021 | <0.0156 | - | - | - | - | - | - | - | 0.0059 | 0.0440 |
| Air | Background | 07/27/2021 | <0.0144 | - | - | - | - | - | - | - | 0.0081 | 0.0437 |
| Air | Background | 08/03/2021 | <0.0177 | - | - | - | - | - | - | - | 0.0075 | 0.0587 |
| Air | Background | 08/10/2021 | <0.0193 | - | - | - | - | - | - | - | 0.0084 | 0.0607 |
| Air | Background  Quarterly Composite | 08/15/2021 | - | 0.113 | <0.016 | <0.001 | <0.004 | <0.001 | <0.001 | <0.0006 | - | - |
| Air | Background | 08/17/2021 | <0.0139 | - | - | - | - | - | - | - | 0.0086 | 0.0572 |
| Air | Background | 08/24/2021 | <0.0175 | - | - | - | - | - | - | - | 0.0071 | 0.0487 |
| Air | Background | 08/31/2021 | <0.0169 | - | - | - | - | - | - | - | 0.0099 | 0.0762 |
| Air | Background | 09/07/2021 | <0.0184 | - | - | - | - | - | - | - | 0.0084 | 0.0541 |
| Air | Background | 09/14/2021 | <0.0138 | - | - | - | - | - | - | - | 0.0083 | 0.0753 |
| Air | Background | 09/21/2021 | <0.0148 | - | - | - | - | - | - | - | 0.0075 | 0.0723 |
| Air | Background | 09/29/2021 | <0.0142 | - | - | - | - | - | - | - | 0.0062 | 0.0606 |
| Air | Background | 10/06/2021 | <0.0163 | - | - | - | - | - | - | - | 0.0092 | 0.0521 |
| Air | Background | 10/12/2021 | <0.0190 | - | - | - | - | - | - | - | 0.0095 | 0.0546 |
| Air | Background | 10/19/2021 | <0.0167 | - | - | - | - | - | - | - | 0.0123 | 0.0637 |
| Air | Background | 10/26/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0120 | 0.0800 |
| Air | Background | 11/02/2021 | <0.0172 | - | - | - | - | - | - | - | 0.0088 | 0.0516 |
| Air | Background | 11/09/2021 | <0.0132 | - | - | - | - | - | - | - | 0.0089 | 0.0657 |
| Air | Background  Quarterly Composite | 11/15/2021 | - | 0.082 | 0.156 | <0.001 | <0.006 | <0.001 | <0.002 | <0.0005 | - | - |
| Air | Background | 11/16/2021 | <0.0158 | - | - | - | - | - | - | - | 0.0107 | 0.0743 |
| Air | Background | 11/23/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0084 | 0.0620 |
| Air | Background | 11/30/2021 | <0.0157 | - | - | - | - | - | - | - | 0.0093 | 0.0572 |
| Air | Background | 12/07/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0086 | 0.0613 |
| Air | Background | 12/16/2021 | <0.0190 | - | - | - | - | - | - | - | 0.0059 | 0.0565 |
| Air | Background | 12/21/2021 | <0.0207 | - | - | - | - | - | - | - | 0.0084 | 0.0725 |
| Air | Background | 12/28/2021 | <0.0189 | - | - | - | - | - | - | - | 0.0072 | 0.0698 |

[a] Low volume sample due to power outage

#### Table 3. Pilgrim Nuclear Power Station 2021 Environmental Monitoring Data – Liquid Matrices

| **Sample Type** | **Location** | **Date** | **K-40\*** (pCi/L) | **Mn-54\*** (pCi/L) | **Fe-59\*** (pCi/L) | **Co-60\*** (pCi/L) | **Zn-65\*** (pCi/L) | **I-131\*** (pCi/L) | **Cs-137\*** (pCi/L) | **H-3\*** (pCi/L) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Surface water | Discharge Canal | 01/15/2021 | 304 | <2.7 | <7.6 | <2.7 | <5.5 | NR | <2.6 | <300 |
| Surface water | Discharge Canal | 02/15/2021 | 287 | <3.7 | <18.8 | <2.7 | <7.6 | NR | <3.1 | <300 |
| Surface water | Discharge Canal | 03/15/2021 | 382 | <3.2 | <13.5 | <2.8 | <7.3 | NR | <3.0 | <300 |
| Surface water | Discharge Canal | 04/15/2021 | 1590 | <3.3 | <12.0 | <3.1 | <6.8 | NR | <2.9 | <300 |
| Surface water | Discharge Canal | 05/15/2021 | 701 | <2.5 | <7.9 | <2.7 | <5.9 | NR | <2.5 | <300 |
| Surface water | Discharge Canal | 06/15/2021 | 1560 | <3.2 | <8.6 | <2.8 | <7.2 | NR | <3.0 | <300 |
| Surface water | Discharge Canal | 07/15/2021 | 1480 | <3.1 | <8.3 | <2.8 | <6.8 | <19.0 | <2.9 | <300 |
| Surface water | Discharge Canal | 08/15/2021 | 270 | <2.9 | <10.8 | <3.0 | <6.3 | NR | <2.8 | <300 |
| Surface water | Discharge Canal | 09/15/2021 | 698 | <2.6 | <8.9 | <2.7 | <6.0 | NR | <2.7 | <300 |
| Surface water | Discharge Canal | 10/15/2021 | 1030 | <3.9 | NR | <3.5 | <8.4 | NR | <3.6 | <300 |
| Surface water | Discharge Canal | 11/15/2021 | 860 | <3.0 | <13.0 | <2.8 | <6.5 | NR | <2.7 | <300 |
| Surface water | Discharge Canal | 12/15/2021 | 909 | <2.8 | <9.9 | <2.6 | <6.6 | NR | <2.6 | <300 |
| Surface water | Powder Point Bridge1 | 01/15/2021 | 299 | <3.2 | <10.3 | <2.9 | <6.4 | NR | <2.9 | <300 |
| Surface water | Powder Point Bridge1 | 02/15/2021 | 298 | <2.6 | <15.2 | <2.8 | <6.5 | NR | <2.5 | <300 |
| Surface water | Powder Point Bridge1 | 03/15/2021 | 1490 | <3.3 | <13.1 | <3.0 | <7.1 | NR | <3.0 | <300 |
| Surface water | Powder Point Bridge1 | 04/15/2021 | 356 | <2.8 | <10.5 | <2.8 | <5.4 | NR | <2.6 | <300 |
| Surface water | Powder Point Bridge1 | 05/15/2021 | 1510 | <3.0 | <9.8 | <2.8 | <7.0 | NR | <3.0 | <300 |
| Surface water | Powder Point Bridge1 | 06/15/2021 | 700 | <2.6 | <8.1 | <2.7 | <5.8 | NR | <2.8 | <300 |
| Surface water | Powder Point Bridge1 | 07/15/2021 | 675 | <2.6 | <6.4 | <2.7 | <5.3 | <13.5 | <2.8 | <300 |
| Surface water | Powder Point Bridge1 | 08/15/2021 | 256 | <2.5 | <9.2 | <2.6 | <6.1 | NR | <2.7 | <300 |
| Surface water | Powder Point Bridge1 | 09/15/2021 | 718 | <2.7 | <8.2 | <2.8 | <5.9 | NR | <2.6 | <300 |
| Surface water | Powder Point Bridge1 | 10/15/2021 | 954 | <3.0 | <19.6 | <2.9 | <6.8 | NR | <2.7 | <300 |
| Surface water | Powder Point Bridge1 | 11/15/2021 | 1040 | <3.7 | <16.9 | <3.2 | <7.9 | NR | <3.6 | <300 |
| Surface water | Powder Point Bridge1 | 12/15/2021 | 1230 | <3.8 | <14.5 | <3.5 | <8.2 | NR | <3.7 | <300 |

1Sample considered “background” for the purpose of NRC regulations, but considered “indicator” by MDPH because it falls within 10-miles of the PNPS plant

#### Table 4. Pilgrim Nuclear Power Station 2021 Environmental Monitoring Data – Solid matrices

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Location** | **Date** | **Be-7\*** (pCi/kg) | **K-40\*** (pCi/kg) | **Mn-54\*** (pCi/kg) | **Fe-59\***  (pCi/kg) | **Co-60\*** (pCi/kg) | **Zn-65\***  (pCi/kg) | **Cs-137\***  (pCi/kg) |
|
| Atlantic Menhaden | Cape Cod Bay (background) | 11/16/2021 | <882 | 10300 | <38.1 | NR | <34.9 | <88.6 | <30.8 |
| Flounder | Cape Cod Bay (background) | 11/09/2021 | <936 | 12700 | <34.7 | <269 | <29.8 | <82.1 | <30.7 |
| Lobster | Cape Cod Bay (background) | 07/24/2021 | <39.3 | 2250 | <4.0 | <11.2 | <4.5 | <9.1 | <4.2 |
| Lobster | PNPS Discharge Canal | 07/24/2021 | <46.4 | 4420 | <5.1 | <13.1 | <4.8 | <11.1 | <4.7 |
| Mytilus1 | Green Harbor, Marshfield2 | 04/30/2021 | <71 | 1700 | <5.3 | <21.5 | <4.8 | <12.0 | <4.5 |
| Mytilus1 | Green Harbor, Marshfield2 | 11/08/2021 | <162 | 2640 | <7.2 | <49.0 | <5.7 | <16.0 | <5.3 |
| Mytilus1 | PNPS Discharge Canal | 06/08/2021 | <48 | 1510 | <4.8 | <11.3 | <4.9 | <11.0 | <4.7 |
| Mytilus1 | PNPS Discharge Canal | 11/10/2021 | <138 | 2390 | <6.6 | <41.0 | <6.3 | <15.6 | <5.2 |
| Softshell Clams | Duxbury2 | 04/30/2021 | 81.9 | 1830 | <3.8 | <16.8 | <4.1 | <10.3 | <3.9 |
| Softshell Clams | Duxbury2 | 12/03/2021 | 177 | 3120 | <7.2 | <35.3 | <6.9 | <15.7 | <7.1 |
| Softshell Clams | Plymouth Harbor | 04/29/2021 | <72 | 1570 | <4.6 | <18.9 | <4.7 | <11.5 | <4.5 |
| Softshell Clams | Plymouth Harbor | 11/04/2021 | <152 | 2500 | <6.0 | <48.8 | <5.0 | <13.8 | <4.8 |
| Sediment | Green Harbor, Marshfield2 | 04/30/2021 | - | 13800 | - | - | <237 | - | NR |
| Sediment | Green Harbor, Marshfield2 | 11/08/2021 | - | 15100 | - | - | <23.5 | - | <22.4 |
| Sediment | PNPS Discharge Canal | 06/08/2021 | - | 8980 | - | - | <17.1 | - | <17.0 |
| Sediment | PNPS Discharge Canal | 11/10/2021 | - | 14100 | - | - | <19.0 | - | <17.8 |
| Cranberries | E. Taunton (background) | 10/04/2021 | 453 | 12000 | <38.0 | <77.6 | <42.7 | <78.3 | <41.0 |
| Strawberries | Cretinon's Farm, Kingston | 06/10/2021 | 16.0 | 1530 | <4.5 | <9.4 | <4.68 | <10.1 | <4.2 |
| Tomatoes | Cretinon's Farm, Kingston | 08/10/2021 | <25.7 | 3320 | <3.3 | <6.5 | <3.16 | <7.1 | <3.3 |
| Zucchini | Cretinon's Farm, Kingston | 07/07/2021 | <37.3 | 3550 | <4.1 | <6.2 | <4.73 | <10.0 | <4.7 |
| Mixed Grasses | Pilgrim Beach3 | 10/20/2021 | 3290 | 2440 | <14.4 | <28.8 | <15.7 | <33.2 | <14.9 |
| Mixed Grasses | Pilgrim Beach4 | 10/20/2021 | 6700 | 8440 | <25.8 | <58.1 | <28.9 | <59.1 | <28.4 |

1Blue, or common mussel

2Sample considered “background” for the purpose of NRC regulations, but considered “indicator” by MDPH because it falls within 10-miles of the PNPS plant

3Sample collected near doghouse

4Sample collected near TLD 21

#### Table 5. Seabrook Nuclear Power Station 2021 Environmental Monitoring Data - Air Samples

| **Sample Type** | **Location** | **Date** | **I-131\*** (pCi/m3) | **Be-7\*** (pCi/m3) | **K-40\*** (pCi/m3) | **Mn-54\*** (pCi/m3) | **Fe-59\*** (pCi/m3) | **Co-60\*** (pCi/m3) | **Zn-65\*** (pCi/m3) | **Cs-137\*** (pCi/m3) | **Gross Alpha** (pCi/m3) | **Gross Beta** (pCi/m3) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Air | Salisbury Fire Station | 01/05/2021 | <0.0384 | - | - | - | - | - | - | - | 0.0113 | 0.0673 |
| Air | Salisbury Fire Station | 01/12/2021 | <0.0258 | - | - | - | - | - | - | - | 0.0085 | 0.0516 |
| Air | Salisbury Fire Station | 01/19/2021 | <0.0205 | - | - | - | - | - | - | - | 0.0100 | 0.0647 |
| Air | Salisbury Fire Station | 01/26/2021 | <0.0344 | - | - | - | - | - | - | - | 0.0080 | 0.0503 |
| Air | Salisbury Fire Station | 02/02/2021 | <0.0237 | - | - | - | - | - | - | - | 0.0066 | 0.0390 |
| Air | Salisbury Fire Station | 02/11/2021 | <0.0172 | - | - | - | - | - | - | - | 0.0076 | 0.0504 |
| Air | Salisbury Fire Station Quarterly Composite | 02/15/2021 | - | 0.097 | <0.018 | <0.001 | <0.004 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Salisbury Fire Station | 02/16/2021 | <0.0287 | - | - | - | - | - | - | - | 0.0130 | 0.0807 |
| Air | Salisbury Fire Station | 02/23/2021 | <0.0186 | - | - | - | - | - | - | - | 0.0084 | 0.0858 |
| Air | Salisbury Fire Station | 03/03/2021 | <0.0355 | - | - | - | - | - | - | - | 0.0076 | 0.0587 |
| Air | Salisbury Fire Station | 03/09/2021 | <0.0202 | - | - | - | - | - | - | - | 0.0063 | 0.0680 |
| Air | Salisbury Fire Station | 03/15/2021 | <0.0273 | - | - | - | - | - | - | - | 0.0091 | 0.0708 |
| Air | Salisbury Fire Station | 03/23/2021 | <0.0176 | - | - | - | - | - | - | - | 0.0080 | 0.0559 |
| Air | Salisbury Fire Station | 03/30/2021 | <0.0218 | - | - | - | - | - | - | - | 0.0079 | 0.0545 |
| Air | Salisbury Fire Station | 04/05/2021 | <0.0223 | - | - | - | - | - | - | - | 0.0075 | 0.0690 |
| Air | Salisbury Fire Station | 04/13/2021 | <0.0329 | - | - | - | - | - | - | - | 0.0038 | 0.0265 |
| Air | Salisbury Fire Station | 04/23/2021 | <0.2330 | - | - | - | - | - | - | - | 0.0564a | 0.4850a |
| Air | Salisbury Fire Station | 04/28/2021 | <0.0198 | - | - | - | - | - | - | - | 0.0058 | 0.0368 |
| Air | Salisbury Fire Station | 05/12/2021 | <0.0105 | - | - | - | - | - | - | - | 0.0034 | 0.0334 |
| Air | Salisbury Fire Station Quarterly Composite | 05/15/2021 | - | 0.137 | 0.355 | <0.001 | <0.006 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Salisbury Fire Station | 05/18/2021 | <0.0218 | - | - | - | - | - | - | - | 0.0079 | 0.0651 |
| Air | Salisbury Fire Station | 05/26/2021 | <0.0164 | - | - | - | - | - | - | - | 0.0063 | 0.0557 |
| Air | Salisbury Fire Station | 06/01/2021 | <0.0163 | - | - | - | - | - | - | - | 0.0049 | 0.0675 |
| Air | Salisbury Fire Station | 06/09/2021 | <0.0125 | - | - | - | - | - | - | - | 0.0040 | 0.0658 |
| Air | Salisbury Fire Station | 06/15/2021 | <0.0193 | - | - | - | - | - | - | - | 0.0050 | 0.0493 |
| Air | Salisbury Fire Station | 06/24/2021 | <0.0147 | - | - | - | - | - | - | - | 0.0033 | 0.0477 |
| Air | Salisbury Fire Station | 06/29/2021 | <0.0184 | - | - | - | - | - | - | - | 0.0068 | 0.0723 |
| Air | Salisbury Fire Station | 07/8/2021 | <0.1030b | - | - | - | - | - | - | - | 0.0232b | 0.1550b |
| Air | Salisbury Fire Station | 07/16/2021 | <0.0211 | - | - | - | - | - | - | - | 0.0056 | 0.0464 |
| Air | Salisbury Fire Station | 07/22/2021 | <0.0320 | - | - | - | - | - | - | - | 0.0075 | 0.0643 |
| Air | Salisbury Fire Station | 07/27/2021 | <0.0466 | - | - | - | - | - | - | - | 0.0104 | 0.0768 |
| Air | Salisbury Fire Station | 08/4/2021 | <0.0730 | - | - | - | - | - | - | - | 0.0229b | 0.1310b |
| Air | Salisbury Fire Station Quarterly Composite | 08/15/2021 | - | 0.131 | 0.244 | <0.001 | <0.016 | <0.001 | <0.003 | <0.001 | - | - |
| Air | Salisbury Fire Station | 08/18/2021 | <0.0186 | - | - | - | - | - | - | - | 0.0073 | 0.0515 |
| Air | Salisbury Fire Station | 08/26/2021 | <0.0191 | - | - | - | - | - | - | - | 0.0066 | 0.0528 |
| Air | Salisbury Fire Station | 08/31/2021 | <0.0318 | - | - | - | - | - | - | - | 0.0071 | 0.0796 |
| Air | Salisbury Fire Station | 09/07/2021 | <0.0155 | - | - | - | - | - | - | - | 0.0057 | 0.0597 |
| Air | Salisbury Fire Station | 09/15/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0052 | 0.0713 |
| Air | Salisbury Fire Station | 09/21/2021 | <0.0200b | - | - | - | - | - | - | - | 0.0097 | 0.0729 |
| Air | Salisbury Fire Station | 09/29/2021 | <0.0145 | - | - | - | - | - | - | - | 0.0053 | 0.0650 |
| Air | Salisbury Fire Station | 10/04/2021 | <0.0259 | - | - | - | - | - | - | - | 0.0082 | 0.0556 |
| Air | Salisbury Fire Station | 10/13/2021 | <0.0157 | - | - | - | - | - | - | - | 0.0038 | 0.0398 |
| Air | Salisbury Fire Station | 10/22/2021 | <0.0337 | - | - | - | - | - | - | - | 0.0059 | 0.0647 |
| Air | Salisbury Fire Station | 10/27/2021 | <0.0254 | - | - | - | - | - | - | - | 0.0079 | 0.0602 |
| Air | Salisbury Fire Station | 11/01/2021 | <0.0269 |  |  |  |  |  |  |  | 0.0064 | 0.0641 |
| Air | Salisbury Fire Station | 11/10/2021 | <0.0198 | - | - | - | - | - | - | - | 0.0052 | 0.0604 |
| Air | Salisbury Fire Station Quarterly Composite | 11/15/2021 | - | 0.111 | 0.122 | <0.001 | <0.008 | <0.001 | <0.002 | <0.001 | - | - |
| Air | Salisbury Fire Station | 11/15/2021 | <0.0289 | - | - | - | - | - | - | - | 0.0077 | 0.0726 |
| Air | Salisbury Fire Station | 11/24/2021 | <0.0231 | - | - | - | - | - | - | - | 0.0053 | 0.0468 |
| Air | Salisbury Fire Station | 12/01/2021 | <0.0192 | - | - | - | - | - | - | - | 0.0091 | 0.0640 |
| Air | Salisbury Fire Station | 12/08/2021 | <0.0344 | - | - | - | - | - | - | - | 0.0110 | 0.0811 |
| Air | Salisbury Fire Station | 12/13/2021 | <0.0366 | - | - | - | - | - | - | - | 0.0147 | 0.0861 |
| Air | Salisbury Fire Station | 12/22/2021 | <0.0234 | - | - | - | - | - | - | - | 0.0069 | 0.0672 |
| Air | Salisbury Fire Station | 12/29/2021 | [c] | - | - | - | - | - | - | - | 0.0060 | 0.0593 |
| Air | Background | 01/04/2021 | <0.0237 | - | - | - | - | - | - | - | 0.0092 | 0.0629 |
| Air | Background | 01/11/2021 | <0.0164 | - | - | - | - | - | - | - | 0.0072 | 0.0502 |
| Air | Background | 01/19/2021 | <0.0134 | - | - | - | - | - | - | - | 0.0091 | 0.0713 |
| Air | Background | 01/25/2021 | <0.0193 | - | - | - | - | - | - | - | 0.0083 | 0.0563 |
| Air | Background | 02/03/2021 | <0.0098 | - | - | - | - | - | - | - | 0.0042 | 0.0349 |
| Air | Background | 02/09/2021 | <0.0154 | - | - | - | - | - | - | - | 0.0101 | 0.0632 |
| Air | Background  Quarterly Composite | 02/15/2021 | - | 0.135 | 0.088 | <0.001 | <0.004 | <0.001 | <0.002 | <0.0006 | - | - |
| Air | Background | 02/16/2021 | <0.0169 | - | - | - | - | - | - | - | 0.0079 | 0.0700 |
| Air | Background | 02/22/2021 | <0.0200 | - | - | - | - | - | - | - | 0.0086 | 0.0685 |
| Air | Background | 03/03/2021 | <0.0100 | - | - | - | - | - | - | - | 0.0075 | 0.0573 |
| Air | Background | 03/10/2021 | <0.0168 | - | - | - | - | - | - | - | 0.0086 | 0.0583 |
| Air | Background | 03/16/2021 | <0.0195 | - | - | - | - | - | - | - | 0.0087 | 0.0621 |
| Air | Background | 03/23/2021 | <0.0141 | - | - | - | - | - | - | - | 0.0071 | 0.0604 |
| Air | Background | 03/30/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0052 | 0.0487 |
| Air | Background | 04/07/2021 | <0.0141 | - | - | - | - | - | - | - | 0.0069 | 0.0450 |
| Air | Background | 04/12/2021 | <0.0233 | - | - | - | - | - | - | - | 0.0059 | 0.0415 |
| Air | Background | 04/20/2021 | <0.0134 | - | - | - | - | - | - | - | 0.0046 | 0.0287 |
| Air | Background | 04/27/2021 | <0.0127 | - | - | - | - | - | - | - | 0.0065 | 0.0506 |
| Air | Background | 05/04/2021 | <0.0132 | - | - | - | - | - | - | - | 0.0062 | 0.0468 |
| Air | Background | 05/12/2021 | <0.0159 | - | - | - | - | - | - | - | 0.0051 | 0.0306 |
| Air | Background  Quarterly Composite | 5/15/2021 | - | 0.117 | 0.094 | <0.001 | <0.003 | <0.001 | <0.001 | <0.0005 | - | - |
| Air | Background | 05/18/2021 | <0.0156 | - | - | - | - | - | - | - | 0.0085 | 0.0565 |
| Air | Background | 05/25/2021 | <0.0147 | - | - | - | - | - | - | - | 0.0069 | 0.0494 |
| Air | Background | 06/01/2021 | <0.0148 | - | - | - | - | - | - | - | 0.0070 | 0.0379 |
| Air | Background | 06/08/2021 | <0.0166 | - | - | - | - | - | - | - | 0.0063 | 0.0647 |
| Air | Background | 06/16/2021 | <0.0131 | - | - | - | - | - | - | - | 0.0050 | 0.0462 |
| Air | Background | 06/22/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0056 | 0.0535 |
| Air | Background | 06/29/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0062 | 0.0473 |
| Air | Background | 07/06/2021 | <0.0122 | - | - | - | - | - | - | - | 0.0054 | 0.0358 |
| Air | Background | 07/13/2021 | <0.0170 | - | - | - | - | - | - | - | 0.0068 | 0.0485 |
| Air | Background | 07/20/2021 | <0.0156 | - | - | - | - | - | - | - | 0.0059 | 0.0440 |
| Air | Background | 07/27/2021 | <0.0144 | - | - | - | - | - | - | - | 0.0081 | 0.0437 |
| Air | Background | 08/03/2021 | <0.0177 | - | - | - | - | - | - | - | 0.0075 | 0.0587 |
| Air | Background | 08/10/2021 | <0.0193 | - | - | - | - | - | - | - | 0.0084 | 0.0607 |
| Air | Background  Quarterly Composite | 08/15/2021 | - | 0.113 | <0.016 | <0.001 | <0.004 | <0.001 | <0.001 | <0.0006 | - | - |
| Air | Background | 08/17/2021 | <0.0139 | - | - | - | - | - | - | - | 0.0086 | 0.0572 |
| Air | Background | 08/24/2021 | <0.0175 | - | - | - | - | - | - | - | 0.0071 | 0.0487 |
| Air | Background | 08/31/2021 | <0.0169 | - | - | - | - | - | - | - | 0.0099 | 0.0762 |
| Air | Background | 09/07/2021 | <0.0184 | - | - | - | - | - | - | - | 0.0084 | 0.0541 |
| Air | Background | 09/14/2021 | <0.0138 | - | - | - | - | - | - | - | 0.0083 | 0.0753 |
| Air | Background | 09/21/2021 | <0.0148 | - | - | - | - | - | - | - | 0.0075 | 0.0723 |
| Air | Background | 09/29/2021 | <0.0142 | - | - | - | - | - | - | - | 0.0062 | 0.0606 |
| Air | Background | 10/06/2021 | <0.0163 | - | - | - | - | - | - | - | 0.0092 | 0.0521 |
| Air | Background | 10/12/2021 | <0.0190 | - | - | - | - | - | - | - | 0.0095 | 0.0546 |
| Air | Background | 10/19/2021 | <0.0167 | - | - | - | - | - | - | - | 0.0123 | 0.0637 |
| Air | Background | 10/26/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0120 | 0.0800 |
| Air | Background | 11/02/2021 | <0.0172 | - | - | - | - | - | - | - | 0.0088 | 0.0516 |
| Air | Background | 11/09/2021 | <0.0132 | - | - | - | - | - | - | - | 0.0089 | 0.0657 |
| Air | Background  Quarterly Composite | 11/15/2021 | - | 0.082 | 0.156 | <0.001 | <0.006 | <0.001 | <0.002 | <0.0005 | - | - |
| Air | Background | 11/16/2021 | <0.0158 | - | - | - | - | - | - | - | 0.0107 | 0.0743 |
| Air | Background | 11/23/2021 | <0.0162 | - | - | - | - | - | - | - | 0.0084 | 0.0620 |
| Air | Background | 11/30/2021 | <0.0157 | - | - | - | - | - | - | - | 0.0093 | 0.0572 |
| Air | Background | 12/07/2021 | <0.0160 | - | - | - | - | - | - | - | 0.0086 | 0.0613 |
| Air | Background | 12/16/2021 | <0.0190 | - | - | - | - | - | - | - | 0.0059 | 0.0565 |
| Air | Background | 12/21/2021 | <0.0207 | - | - | - | - | - | - | - | 0.0084 | 0.0725 |
| Air | Background | 12/28/2021 | <0.0189 | - | - | - | - | - | - | - | 0.0072 | 0.0698 |

[a] Low volume sample due to equipment failure

[b] Low volume sample due to power interruption

[c] Sample not collected

#### Table 6. Seabrook Nuclear Power Station 2021 Environmental Monitoring Data – Liquid Matrices

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample Type** | **Location** | **Date** | **K-40\*** (pCi/L) | **Mn-54\*** (pCi/L) | **Fe-59\*** (pCi/L) | **Co-60\*** (pCi/L) | **Zn-65\*** (pCi/L) | **I-131\*** (pCi/L) | **Cs-134\*** (pCi/L) | **Cs-137\*** (pCi/L) | **Ba-140\*** (pCi/L) | **H-3\*** (pCi/L) |
| Surface water | Ipswich bay1 | 01/11/2021 | 278 | <2.5 | <6.7 | <2.6 | <5.5 | <16.1 | - | <2.6 | - | <300 |
| Surface water | Ipswich bay1 | 02/10/2021 | 341 | <3.1 | <7.1 | <2.7 | <6.4 | <19.5 | - | <3.1 | - | <300 |
| Surface water | Ipswich bay1 | 03/18/2021 | 365 | <3.3 | <14.4 | <2.9 | <7.2 | NR | - | <3.1 | - | <300 |
| Surface water | Ipswich bay1 | 04/21/2021 | 305 | <2.4 | <6.9 | <2.7 | <6.0 | <23.6 | - | <2.5 | - | <300 |
| Surface water | Ipswich bay1 | 05/11/2021 | 1480 | <3.2 | <12.6 | <2.8 | <7.3 | NR | - | <3.0 | - | <300 |
| Surface water | Ipswich bay1 | 06/14/2021 | 1490 | <3.3 | <10.6 | <3.1 | <7.2 | NR | - | <3.0 | - | <300 |
| Surface water | Ipswich bay1 | 07/14/2021 | 1280 | <3.3 | <10.7 | <3.0 | <7.0 | NR | - | <3.1 | - | <300 |
| Surface water | Ipswich bay1 | 08/09/2021 | 634 | <3.0 | <14.8 | <2.9 | <6.2 | NR | - | <2.8 | - | <300 |
| Surface water | Ipswich bay1 | 09/15/2021 | 308 | <2.7 | <9.5 | <2.7 | <6.1 | NR | - | <2.7 | - | <300 |
| Surface water | Ipswich bay1 | 10/12/2021 | 304 | <2.7 | <7.6 | <2.8 | <5.7 | <25.3 | - | <2.7 | - | <300 |
| Surface water | Ipswich bay1 | 11/17/2021 | 963 | <2.9 | <16.4 | <2.6 | <6.6 | NR | - | <2.6 | - | <300 |
| Surface water | Ipswich bay1 | 12/09/2021 | 1120 | <3.7 | <16.7 | <3.7 | <8.6 | NR | - | <3.6 | - | <300 |
| Milk | Rowley | 01/12/2021 | 1470 | - | - | - | - | <3.8 | <2.8 | <3.1 | <12.0 | - |
| Milk | Rowley | 02/16/2021 | 1450 | - | - | - | - | <3.5 | <2.7 | <3.0 | <11.0 | - |
| Milk | Rowley | 03/23/2021 | 1790 | - | - | - | - | <2.4 | <2.5 | <2.9 | <9.5 | - |
| Milk | Rowley | 04/06/2021 | 1410 | - | - | - | - | <3.4 | <2.7 | <3.2 | <11.1 | - |
| Milk | Rowley | 05/04/2021 | 1520 | - | - | - | - | <3.6 | <2.7 | <3.1 | <11.2 | - |
| Milk | Rowley | 06/09/2021 | 1420 | - | - | - | - | <4.5 | <2.4 | <2.8 | <13.3 | - |
| Milk | Rowley | 6/29/2021**a** | 1770 | - | - | - | - | <2.4 | <2.3 | <2.8 | <9.1 | - |
| Milk | Rowley | 08/04/2021 | 2630 | - | - | - | - | <3.4 | <2.7 | <3.0 | <10.9 | - |
| Milk | Rowley | 09/07/2021 | 2620 | - | - | - | - | <3.5 | <2.8 | <3.2 | <11.2 | - |
| Milk | Rowley | 10/04/2021 | 1780 | - | - | - | - | <2.7 | <2.5 | <3.0 | <10.9 | - |
| Milk | Rowley | 11/10/2021 | 1510 | - | - | - | - | NR | <2.7 | <2.7 | NR | - |
| Milk | Rowley | 12/01/2021 | 2090 | - | - | - | - | NR | <3.5 | <3.7 | NR | - |

1Background sample

[a] July sample, collected early due to holiday and staffing

#### Table 7. Seabrook Nuclear Power Station 2021 Environmental Monitoring Data –Solid Matrices

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Location1** | **Date** | **Be-7\*** (pCi/kg) | **K-40\*** (pCi/kg) | **Mn-54\*** (pCi/kg) | **Fe-59\***  (pCi/kg) | **Co-60\*** (pCi/kg) | **Zn-65\***  (pCi/kg) | **Cs-137\***  (pCi/kg) | **I-131\***  (pCi/kg) |
|
| Cod | Ipswich Bay | 02/08/2021 | <1020 | 13500 | <36.2 | <310 | <25.4 | <79.7 | <27.2 | - |
| Longhorn Sculpin | Ipswich Bay | 05/11/2021 | <716 | 3520 | <46.4 | <193 | <37.5 | <98.7 | <39.9 | - |
| Window Pane Flounder | Ipswich Bay | 11/11/2021 | <1170 | 12600 | <46.0 | <350 | <38.4 | <111 | <38.9 |  |
| Winter Flounder | Ipswich Bay | 08/25/2021 | <232 | 8140 | <26.8 | <50.8 | <27.2 | <56.0 | <28.1 |  |
| Lobster | Ipswich Bay | 05/23/2021 | <116 | 4610 | <5.9 | <36.7 | <5.2 | <14.7 | <4.9 | - |
| Lobster | Ipswich Bay | 11/15/2021 | <224 | 4620 | <8.9 | <73.4 | <8.3 | <21.6 | <8.0 | - |
| Modiolus2 | Ipswich Bay | 05/11/2021 | <72.2 | 1820 | <4.2 | <20.4 | <4.1 | <10.1 | <3.8 | - |
| Modiolus2 | Ipswich Bay | 11/17/2021 | <1.1 | 2820 | <3.1 | <0.1 | <6.0 | <5.7 | <6.3 | - |
| Mytilus2 | Ipswich Bay | 05/23/2021 | 66 | 1520 | <4.1 | <10.0 | <4.6 | <8.8 | <4.4 | - |
| Mytilus2 | Ipswich Bay | 11/15/2021 | <85.0 | 1080 | <4.9 | <25.3 | <4.1 | <10.5 | <4.0 | - |
| Sediment | Ipswich Bay - subtidal | 05/11/2021 | - | 8790 | - | - | <22.1 | - | <22.0 | - |
| Sediment | Ipswich Bay - subtidal | 11/17/2021 | - | 17600 | - | - | <30.1 | - | <32.9 | - |
| Sediment | Plum Island - beach | 05/11/2021 | - | 24500 | - | - | <18.7 | - | <17.0 | - |
| Sediment | Plum Island - beach | 11/15/2021 | - | 20300 | - | - | <29.3 | - | <28.9 | - |
| Irish Moss3 | Ipswich Bay | 5/11/2021 | 245 | 7800 | <8.2 | <23.2 | <8.1 | <20.2 | NR | <8.2 |
| Cucumber | Bartlett Farm, Salisbury4 | 08/18/2021 | <40.6 | 3190 | <4.8 | <9.0 | <4.8 | <10.7 | <4.7 | - |
| Cucumber | Russell Orchards, Ipswich | 08/18/2021 | <31.4 | 2160 | <4.2 | <8.1 | <4.4 | <9.7 | <4.2 | - |
| Sugar Snap Peas | Bartlett Farm, Salisbury4 | 06/24/2021 | <42.5 | 4230 | <4.7 | <9.8 | <4.6 | <10.2 | <4.6 | - |
| Sugar Snap Peas | Russell Orchards, Ipswich | 06/24/2021 | <42.3 | 2590 | <4.4 | <10.2 | <4.5 | <9.7 | <4.4 | - |
| Tomatoes | Russell Orchards, Ipswich | 07/07/2021 | <29.6 | 2290 | <3.5 | <7.5 | <3.7 | <7.7 | <3.8 | - |
| Zucchini | Bartlett Farm, Salisbury4 | 07/07/2021 | <32.1 | 385 | <4.0 | <8.5 | <3.8 | <8.4 | <3.7 |  |

1All samples are background, except for produce samples from Bartlett Farm in Salisbury

2Mytilus (i.e., blue or common mussel) samples collected on Plum Island; Modiolus (i.e., Atlantic ribbed mussel) samples collected offshore.

3Sample not dried prior to analysis

4Indicator sample

1. Pilgrim entered Phase I of plant decommissioning on June 11, 2019 when the nuclear fuel from the reactor was safely transferred into the spent fuel pool, and the site was certified by Federal regulators as having permanent cessation of operations and permanent removal of fuel. In August of 2019 Pilgrim was sold by the Entergy Corporation to Holtec International for completion of the remaining decommissioning steps. [↑](#footnote-ref-1)
2. <https://www.mass.gov/info-details/pilgrim-nuclear-power-station> [↑](#footnote-ref-2)