Environmental Monitoring Report

For 2020

Pilgrim and Seabrook

Nuclear Power Station

Emergency Planning Zones

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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 in nuclear power station Emergency Planning Zones (EPZs) within the Commonwealth. This monitoring is part of the Department's regulatory responsibility. It provides a system of watchfulness over environmental radiation in Massachusetts communities surrounding nuclear power plants. These EPZs include 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. Pilgrim ceased operations on May 31, 2019 and is undergoing decommissioning[1]. This report summarizes the 2020 monitoring activities and results for the Pilgrim and Seabrook nuclear plant EPZs.

Report Highlights

- Overall, no radiation indicators or radionuclides were detected at a level of health concern.
- Radiation monitoring results in 2020 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.

[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.

1. 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 EPZs 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 2020 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 Pilgrim and Seabrook EPZs 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.

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 2020 Radiological Environmental Operating Report.

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

A. 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.

B. 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).

2. ENVIRONMENTAL MONITORING AND SAMPLING

This section describes the two nuclear power station EPZs in Massachusetts and summarizes the environmental samples collected and analyzed in 2020.

A. PILGRIM NUCLEAR POWER STATION

The Pilgrim Nuclear Power Station (Pilgrim) is located in Plymouth, MA. Five Massachusetts communities are included in the 10-mile EPZ of Pilgrim: Carver, Duxbury, Kingston, Marshfield, and Plymouth, all shown below in Figure 1.

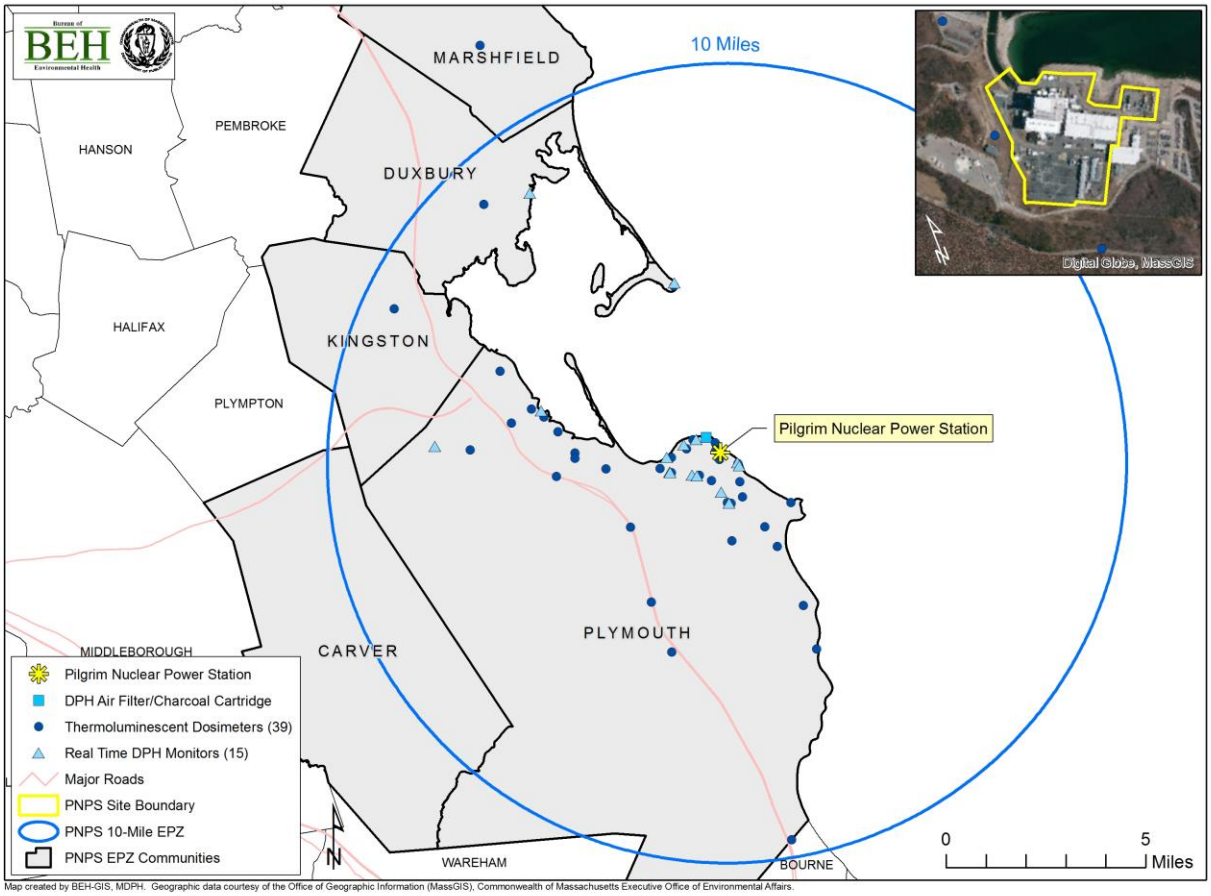

Figure 1. The MDPH/BEH Radiation -monitoring network at Pilgrim

In 2020, MDPH/BEH's radiation monitoring conducted within and outside the Pilgrim EPZ included a combination of independent direct monitoring of airborne radiation; air and cranberry sampling; and analysis of split samples provided by 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.

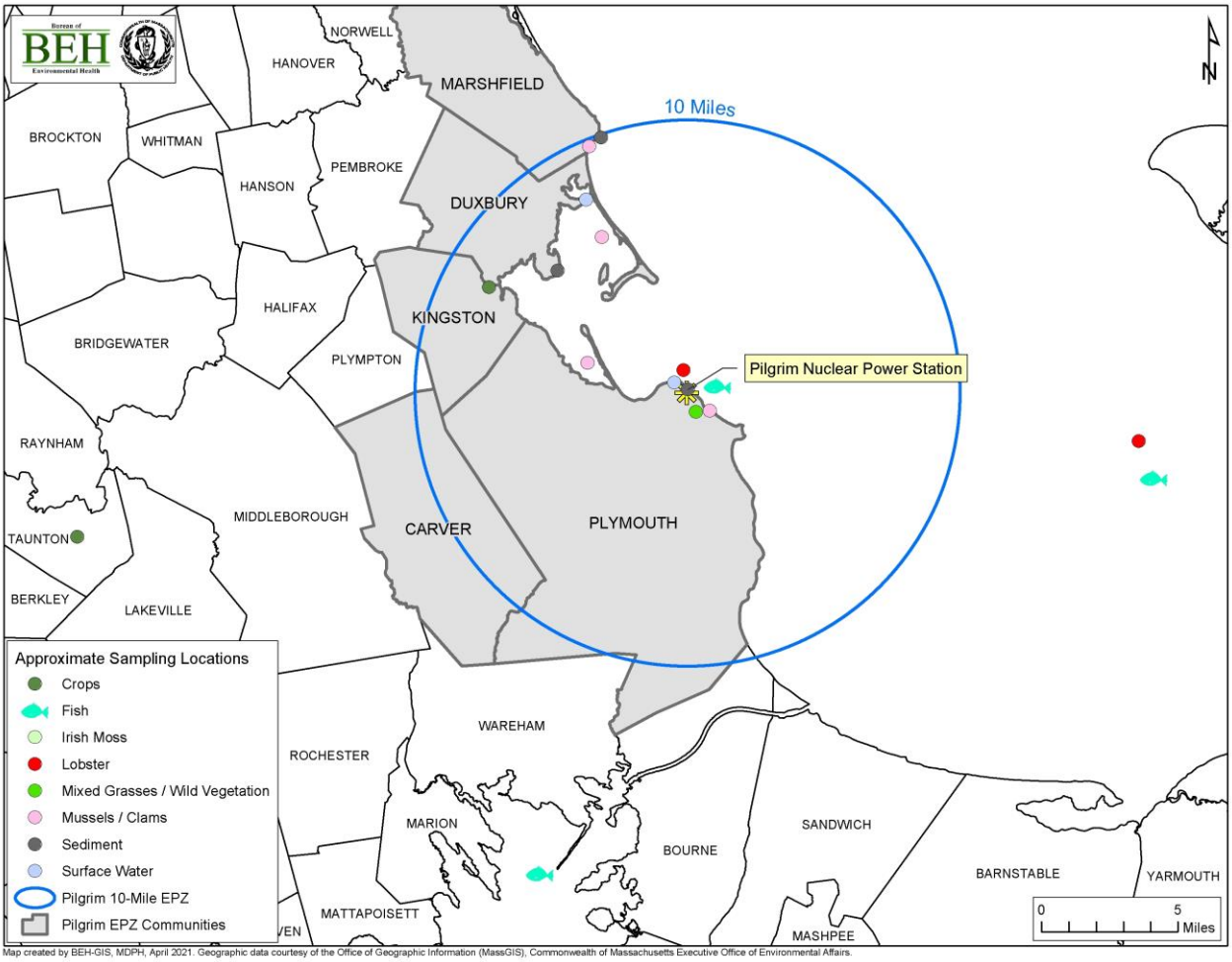

Figure 2. Pilgrim EPZ and sampling locations

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 within the 10-mile EPZ 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 EPZ and surrounding communities, which measure total gamma radiation in milliroentgen (mR). The majority of the TLDs are located in the inner region of the EPZ, 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 monthly basis from the Pilgrim discharge canal and the Powder Point Bridge in Duxbury and provides split samples 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 2020 Holtec also provided MERL with split samples of background fish from Buzzards Bay and Cape Cod Bay, and background lobster from Cape Cod Bay.

In 2020, 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 the 10-mile EPZ. MERL analyzes the split samples for gamma-emitting radionuclides.

Sediment

In 2020 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 2020 MDPH collected samples of strawberries, tomatoes, and zucchini during the growing season, from a farm in Kingston.

Mixed Grasses/Wild Vegetation

In 2020 MERL analyzed two split samples of mixed grasses/wild vegetation, collected by Holtec from the beach area at Pilgrim.

Irish moss

In previous years, Holtec collected samples of Irish moss from the Pilgrim discharge canal and a background location at Brant Rock in Marshfield semiannually; split samples were analyzed by MERL. Holtec did not collect Irish Moss samples in 2020[2].

Milk

MDPH/BEH previously collected samples of cow's milk monthly from a farm in Duxbury. The milk was analyzed for gamma-emitting radionuclides, including Iodine-131. Although this farm is located just

[2] Holtec's sampling contractor reported that no permits were issued by the Town of Plymouth to harvest Irish moss as a food crop, thus this pathway of exposure was not considered as part of the radionuclides surveillance at PNPS in 2020.

outside the EPZ (11 miles from Pilgrim), it has been the closest dairy farm to Pilgrim with available milk samples. In January, 2020, this farm discontinued commercial milk production. MDPH/BEH determined there are no other commercial dairies either in or near the Pilgrim EPZ. As such, there are no milk samples for 2020.

B. 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 in the 10-mile EPZ of Seabrook: Amesbury, Merrimac, Newbury, Newburyport, Salisbury, and West Newbury as shown in Figure 3.

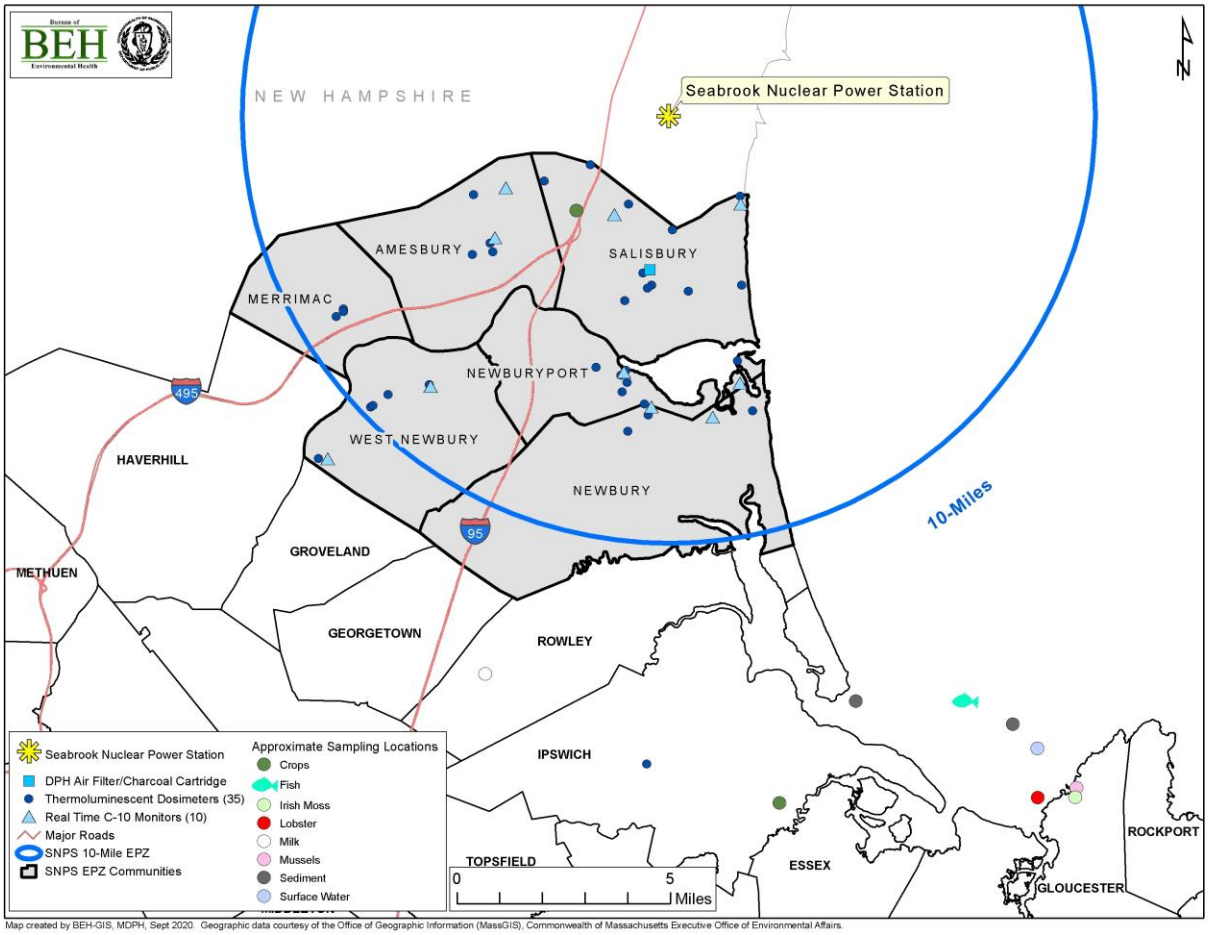

Figure 3. Seabrook EPZ and sampling locations within Massachusetts

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 2020 MDPH collected strawberries, tomatoes, and zucchini, from a farm located within the Seabrook EPZ in Salisbury, and also collected blueberries, strawberries, and tomatoes from a farm in Ipswich, which is outside the Seabrook EPZ.

3. 2020 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.

A. PILGRIM NUCLEAR POWER STATION

Sampling results for Pilgrim are provided in Tables 2, 3 and 4. Only two radionuclides –, Beryllium-7 and Potassium-40, were detected in samples collected either within or outside the Pilgrim EPZ. Naturally occurring Potassium-40 was detected in all samples of environmental media analyzed for Potassium-40 from both within and outside of the Pilgrim EPZ, with the exception of the Pilgrim station quarterly composite air samples for the 2nd, 3rd, and 4th quarters. Beryllium-7, which is also naturally occurring, was detected in: 1) Pilgrim station quarterly composite air samples for the 2nd, 3rd, and 4th quarters; 2) fish from the background location in Buzzards Bay; 3) clams from Duxbury and Plymouth Harbor; 3) mussels from the Pilgrim discharge canal; 4) cranberries, which are collected outside the EPZ; and 5) mixed grasses/wild vegetation collected at Pilgrim station. For both Potassium-40 and Beryllium-7, levels detected in samples collected within the EPZ 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 in the Pilgrim EPZ ranged from 0.003 – 0.025 and 0.021 – 0.147 pico curies (pCi)/m^3, respectively. These levels are consistent with those measured at the background location in Boston, of 0.005 – 0.017 and 0.036 – 0.093 pCi/m^3, 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 12.0 to 22.2 mRoentgen/quarter (i.e., 0.005 – 0.010 mRoentgen/hour) with an average of 15.6 mRoentgen/quarter (0.007 mRoentgen/hour). This value is compared to an average value of 16.7 mRoentgen/quarter measured at a background location in Boston, and corresponds to an average gamma exposure of 1.1 mRoentgen/quarter below background.

B. 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 mussels (i.e., modiolus and mytilus) collected from the background sampling location in Ipswich Bay, and in the composite air samples collected at the Salisbury Fire Station for the 2nd, 3rd and 4th 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 (0.005 – 0.022 pCi/m^3) and gross beta (0.041 – 0.130 pCi/m^3) radiation, consistent with levels measured at the background location in Boston (0.005 – 0.017 pCi/m^3 and 0.036 – 0.093 pCi/m^3, for gross alpha and gross beta radiation, respectively). No gamma radionuclides of concern were detected in quarterly composite air samples.

In 2020, 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.

TLD results for total gamma exposure ranged from 11.4 to 21.6 mRoentgen/quarter (0.005 – 0.010 mRoentgen/hour) with an average exposure of 17.6 mRoentgen/quarter (0.008 mRoentgen/hour), compared to an average of 17.9 mRoentgen/quarter at the background location in Boston. The result is an average gamma exposure level of 0.3 mRoentgen/quarter below background.

C. SUMMARY

Radiation monitoring results in 2020 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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D. RESULTS TABLES

Table 2. Pilgrim Nuclear Power Station 2020 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	01/03/2020	<0.0132	-	-	-	-	-	-	-	0.00840	0.0464
Air	Pilgrim Station	01/08/2020	<0.0259	-	-	-	-	-	-	-	0.01120	0.0705
Air	Pilgrim Station	01/22/2020	<0.0086	-	-	-	-	-	-	-	0.00597	0.0285
Air	Pilgrim Station	01/31/2020	<0.0127	-	-	-	-	-	-	-	0.00570	0.0354
Air	Pilgrim Station	02/05/2020	<0.0223	-	-	-	-	-	-	-	0.01320	0.0703
Air	Pilgrim Station	02/12/2020	<0.0213	-	-	-	-	-	-	-	0.00954	0.0610
Air	Pilgrim Station Quarterly Composite	2/15/2020	-	<0.162	0.085	<0.001	<0.061	<0.001	<0.002	<0.001	-	-
Air	Pilgrim Station	02/20/2020	<0.0131	-	-	-	-	-	-	-	0.00755	0.0416
Air	Pilgrim Station	02/28/2020	<0.0143	-	-	-	-	-	-	-	0.01120	0.0592
Air	Pilgrim Station	03/06/2020	<0.0138	-	-	-	-	-	-	-	0.00978	0.0539
Air	Pilgrim Station	03/11/2020	<0.0296	-	-	-	-	-	-	-	0.00769	0.0484
Air	Pilgrim Station	03/30/2020	<0.0070	-	-	-	-	-	-	-	0.00435	0.0221
Air	Pilgrim Station	04/11/2020	<0.0068	-	-	-	-	-	-	-	0.00327	0.0205
Air	Pilgrim Station	04/15/2020	<0.0293	-	-	-	-	-	-	-	0.01050	0.0731
Air	Pilgrim Station	04/22/2020	<0.0114	-	-	-	-	-	-	-	0.00960	0.0508
Air	Pilgrim Station	04/29/2020	<0.0185	-	-	-	-	-	-	-	0.00861	0.0477
Air	Pilgrim Station	05/06/2020	<0.0176	-	-	-	-	-	-	-	0.00651	0.0378
Air	Pilgrim Station	05/12/2020	<0.0209	-	-	-	-	-	-	-	0.00781	0.0422
Air	Pilgrim Station Quarterly Composite	5/15/2020	-	0.116	<0.025	<0.001	<0.022	<0.001	<0.002	<0.001	-	-
Air	Pilgrim Station	05/21/2020	<0.0105	-	-	-	-	-	-	-	0.00711	0.0382
Air	Pilgrim Station	05/28/2020	<0.0168	-	-	-	-	-	-	-	0.00546	0.0309
Air	Pilgrim Station	06/02/2020	<0.0216	-	-	-	-	-	-	-	0.00610	0.0459
Air	Pilgrim Station	06/10/2020	<0.0135	-	-	-	-	-	-	-	0.00853	0.0438
Air	Pilgrim Station	06/18/2020	<0.0105								0.00779	0.0345
Air	Pilgrim Station	06/24/2020	<0.0208	-	-	-	-	-	-	-	0.01160	0.0525
Air	Pilgrim Station	07/01/2020	<0.0142	-	-	-	-	-	-	-	0.00753	0.0599
Air	Pilgrim Station	07/08/2020	<0.0140	-	-	-	-	-	-	-	0.00541	0.0382
Air	Pilgrim Station	07/14/2020	<0.0236	-	-	-	-	-	-	-	0.01160	0.0673
Air	Pilgrim Station	07/22/2020	<0.0127	-	-	-	-	-	-	-	0.00854	0.0578
Air	Pilgrim Station	07/29/2020	<0.0186	-	-	-	-	-	-	-	0.01250	0.0832
Air	Pilgrim Station	08/12/2020	<0.0160	-	-	-	-	-	-	-	0.00666	0.0510

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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 Quarterly Composite	08/15/2020	-	0.114	<0.019	<0.001	<0.005	<0.001	<0.002	<0.001	-	-
Air	Pilgrim Station	08/19/2020	<0.0192	-	-	-	-	-	-	-	0.00759	0.0580
Air	Pilgrim Station	08/26/2020	<0.0137	-	-	-	-	-	-	-	0.00873	0.0691
Air	Pilgrim Station	09/02/2020	<0.0134	-	-	-	-	-	-	-	0.00579	0.0456
Air	Pilgrim Station	09/09/2020	<0.0164	-	-	-	-	-	-	-	0.00542	0.0573
Air	Pilgrim Station	09/23/2020	<0.0143	-	-	-	-	-	-	-	0.00366	0.0455
Air	Pilgrim Station	10/01/2020	<0.0109	-	-	-	-	-	-	-	0.01310	0.0854
Air	Pilgrim Station	10/06/2020	<0.0206	-	-	-	-	-	-	-	0.01190	0.0777
Air	Pilgrim Station	10/14/2020	<0.0145	-	-	-	-	-	-	-	0.00841	0.0479
Air	Pilgrim Station	10/20/2020	<0.0179	-	-	-	-	-	-	-	0.01040	0.0685
Air	Pilgrim Station	10/27/2020	<0.0159	-	-	-	-	-	-	-	0.00719	0.0476
Air	Pilgrim Station	11/03/2020	<0.0181	-	-	-	-	-	-	-	0.00755	0.0472
Air	Pilgrim Station	11/13/2020	<0.0143	-	-	-	-	-	-	-	0.01020	0.0825
Air	Pilgrim Station Quarterly Composite	11/15/2020	-	0.113	<0.018	<0.001	<0.004	<0.001	<0.002	<0.001	-	-
Air	Pilgrim Station	11/19/2020	<0.0200	-	-	-	-	-	-	-	0.01080	0.0768
Air	Pilgrim Station	11/24/2020	<0.0421	-	-	-	-	-	-	-	0.00875	0.0712
Air	Pilgrim Station	12/02/2020	<0.0161	-	-	-	-	-	-	-	0.00906	0.0671
Air	Pilgrim Station	12/09/2020	<0.0218	-	-	-	-	-	-	-	0.00969	0.0603
Air	Pilgrim Station	12/15/2020	<0.0157	-	-	-	-	-	-	-	0.00989	0.0848
Air	Pilgrim Station	12/23/2020	<0.1400	-	-	-	-	-	-	-	0.02550	0.1470
Air	Pilgrim Station	12/29/2020	<0.0657	-	-	-	-	-	-	-	0.01590	0.1160
Air	Background	01/06/2020	<0.0174	-	-	-	-	-	-	-	0.00832	0.0494
Air	Background	01/13/2020	<0.0172	-	-	-	-	-	-	-	0.00690	0.0435
Air	Background	01/21/2020	<0.0152	-	-	-	-	-	-	-	0.01040	0.0532
Air	Background	01/27/2020	<0.0182	-	-	-	-	-	-	-	0.01050	0.0540
Air	Background	02/03/2020	<0.0157	-	-	-	-	-	-	-	0.00797	0.0461
Air	Background	02/10/2020	<0.0179	-	-	-	-	-	-	-	0.00821	0.0454
Air	Background Quarterly Composite	02/15/2020	-	<0.167	<0.026	<0.001	<0.075	<0.001	<0.003	<0.001	-	-
Air	Background	02/18/2020	<0.0148	-	-	-	-	-	-	-	0.00850	0.0486
Air	Background	02/24/2020	<0.0213	-	-	-	-	-	-	-	0.00992	0.0565
Air	Background	03/02/2020	<0.0130	-	-	-	-	-	-	-	0.01040	0.0601

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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	Background	03/09/2020	<0.0139	-	-	-	-	-	-	-	0.00661	0.0364
Air	Background	03/18/2020	<0.0127	-	-	-	-	-	-	-	0.00901	0.0420
Air	Background	03/23/2020	<0.0198	-	-	-	-	-	-	-	0.01710	0.0687
Air	Background	03/30/2020	<0.0200	-	-	-	-	-	-	-	0.01600	0.0650
Air	Background	04/28/2020	<0.0208	-	-	-	-	-	-	-	0.00959	0.0598
Air	Background	05/06/2020	<0.0124	-	-	-	-	-	-	-	0.00533	0.0407
Air	Background	05/11/2020	<0.0260	-	-	-	-	-	-	-	0.00730	0.0559
Air	Background Quarterly Composite	5/15/2020	-	<0.102	0.486	<0.002	<0.039	<0.001	<0.004	<0.001	-	-
Air	Background	05/19/2020	<0.0155	-	-	-	-	-	-	-	0.00788	0.0432
Air	Background	05/26/2020	<0.0170	-	-	-	-	-	-	-	0.00566	0.0407
Air	Background	06/02/2020	<0.0125	-	-	-	-	-	-	-	0.00510	0.0378
Air	Background	06/09/2020	<0.0185	-	-	-	-	-	-	-	0.00893	0.0570
Air	Background	06/16/2020	-	-	-	-	-	-	-	-	0.00729	0.0544
Air	Background	07/07/2020	<0.0166	-	-	-	-	-	-	-	0.00635	0.0538
Air	Background	07/13/2020	<0.0193	-	-	-	-	-	-	-	0.00857	0.0557
Air	Background	07/21/2020	<0.0144	-	-	-	-	-	-	-	0.00809	0.0542
Air	Background	07/27/2020	<0.0185	-	-	-	-	-	-	-	0.01050	0.0615
Air	Background	08/03/2020	<0.0167	-	-	-	-	-	-	-	0.01060	0.0716
Air	Background	08/10/2020	<0.0145	-	-	-	-	-	-	-	0.00770	0.0526
Air	Background Quarterly Composite	08/15/2020	-	0.118	<0.023	<0.001	<0.005	<0.001	<0.002	<0.001	-	-
Air	Background	08/17/2020	<0.0195	-	-	-	-	-	-	-	0.00757	0.0580
Air	Background	08/25/2020	<0.0111	-	-	-	-	-	-	-	0.00953	0.0574
Air	Background	09/01/2020	<0.0167	-	-	-	-	-	-	-	0.00697	0.0533
Air	Background	09/08/2020	<0.0161	-	-	-	-	-	-	-	0.00634	0.0519
Air	Background	09/15/2020	<0.0131	-	-	-	-	-	-	-	0.00507	0.0404
Air	Background	09/22/2020	<0.0168	-	-	-	-	-	-	-	0.00557	0.0459
Air	Background	09/29/2020	<0.0169	-	-	-	-	-	-	-	0.00659	0.0858
Air	Background	10/05/2020	<0.0161	-	-	-	-	-	-	-	0.01080	0.0565
Air	Background	10/14/2020	<0.00957	-	-	-	-	-	-	-	0.00778	0.0472
Air	Background	10/19/2020	<0.0247	-	-	-	-	-	-	-	0.00979	0.0662
Air	Background	10/26/2020	<0.0162	-	-	-	-	-	-	-	0.00990	0.0565
Air	Background	11/02/2020	<0.0165	-	-	-	-	-	-	-	0.00886	0.0560

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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	Background	11/09/2020	<0.0164	-	-	-	-	-	-	-	0.01410	0.0931
Air	Background Quarterly Composite	11/15/2020	-	0.085	<0.027	<0.001	<0.004	<0.001	<0.002	<0.001	-	-
Air	Background	11/18/2020	<0.0152	-	-	-	-	-	-	-	0.00918	0.0638
Air	Background	11/23/2020	<0.0248	-	-	-	-	-	-	-	0.01310	0.0633
Air	Background	12/01/2020	<0.0118	-	-	-	-	-	-	-	0.00925	0.0661
Air	Background	12/08/2020	<0.0145	-	-	-	-	-	-	-	0.00715	0.0507
Air	Background	12/16/2020	<0.0135	-	-	-	-	-	-	-	0.00885	0.0734
Air	Background	12/23/2020	<0.0186	-	-	-	-	-	-	-	0.00743	0.0700
Air	Background	12/30/2020	<0.0263	-	-	-	-	-	-	-	0.00601	0.0619

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

Table 3. Pilgrim Nuclear Power Station 2020 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	Discharge Canal	01/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	01/29/2020	1510	<2.9	<6.6	<2.7	<6.4	<6.4	-	<3.0	-	-
Surface water	Discharge Canal	02/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	03/03/2020	283	<2.5	<6.1	<2.6	<5.1	<9.5	-	<2.7	-	-
Surface water	Discharge Canal	03/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	03/31/2020	327	<2.5	<11.5	<2.8	<6.2	NR	-	<2.4	-	-
Surface water	Discharge Canal	04/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	04/28/2020	1450	<3.1	<9.5	<3.0	<6.7	NR	-	<3.0	-	-
Surface water	Discharge Canal	05/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	06/02/2020	278	<3.5	<17.4	<2.9	<7.5	NR	-	<3.0	-	-
Surface water	Discharge Canal	06/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	06/30/2020	267	<3.1	<6.0	<2.9	<6.6	<6.2	-	<2.9	-	-
Surface water	Discharge Canal	07/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	08/04/2020	300	<3.2	<8.2	<3.0	<6.7	<24.0	-	<2.8	-	-
Surface water	Discharge Canal	08/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	09/01/2020	324	<2.5	<5.9	<2.5	<5.7	<8.3	-	<2.6	-	-
Surface water	Discharge Canal	09/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	09/29/2020	384	<2.8	<7.1	<2.8	<6.5	<12.9	-	<3.0	-	-
Surface water	Discharge Canal	10/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	11/04/2020	323	<3.5	<11.4	<3.2	<7.8	NR	-	<3.1	-	-
Surface water	Discharge Canal	11/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	12/01/2020	262	<3.2	<10.7	<2.8	<7.0	NR	-	<3.1	-	-
Surface water	Discharge Canal	12/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Discharge Canal	12/29/2020	298	<2.5	<7.3	<2.7	<5.7	NR	-	<2.6	-	-
Surface water	Powder Point Bridge[1]	01/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	01/29/2020	1460	<3.1	<6.4	<3.0	<6.4	<6.9	-	<2.9	-	-
Surface water	Powder Point Bridge[1]	02/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	03/03/2020	1460	<3.0	<7.3	<2.7	<6.0	<12.8	-	<3.0	-	-
Surface water	Powder Point Bridge[1]	03/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	03/31/2020	1450	<3.3	<12.7	<2.9	<7.2	NR	-	<3.0	-	-
Surface water	Powder Point Bridge[1]	04/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	04/28/2020	274	<2.6	<8.2	<2.7	<5.4	NR	-	<2.5	-	-
Surface water	Powder Point Bridge[1]	05/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	06/02/2020	279	<3.7	<16.0	<2.9	<8.0	<7.8	-	<3.1	-	-

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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	Powder Point Bridge[1]	06/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	06/30/2020	302	<3.1	<6.2	<2.9	<6.4	<6.3	-	<2.8	-	-
Surface water	Powder Point Bridge[1]	07/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	08/04/2020	340	<2.8	<6.7	<2.8	<5.4	<17.5	-	<2.8	-	-
Surface water	Powder Point Bridge[1]	08/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	09/01/2020	324	<3.1	<7.3	<3.0	<6.5	<11.5	-	<3.1	-	-
Surface water	Powder Point Bridge[1]	09/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	09/29/2020	302	<2.5	<6.3	<2.5	<5.2	<8.6	-	<2.6	-	-
Surface water	Powder Point Bridge[1]	10/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	11/04/2020	294	<2.7	<10.2	<3.0	<6.3	NR	-	<2.8	-	-
Surface water	Powder Point Bridge[1]	11/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	12/01/2020	245	<2.8	<8.1	<2.7	<5.6	NR	-	<2.6	-	-
Surface water	Powder Point Bridge[1]	12/15/2020	-	-	-	-	-	-	-	-	-	<300
Surface water	Powder Point Bridge[1]	12/28/2020	308	<3.2	<9.1	<2.8	<6.6	NR	-	<2.9	-	-

[1]Sample considered "background" for the purpose of NRC regulations, but considered "indicator" by MDPH because it falls within the 10-mile EPZ.

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

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Table 4. Pilgrim Nuclear Power Station 2020 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)	I-131* (pCi/kg)
Atlantic Cod	Cape Cod Bay (background)	10/09/2020	<476	3890	<31.9	<126.0	<25.0	<62.2	<26.0	-
Atlantic Menhaden	Buzzards Bay (background)	10/21/2020	136	3170	<4.8	<19.2	<4.9	<12.2	<4.7	-
Blue Fish	Pilgrim Discharge Canal	10/18/2020	<1250	4650	NR	<357.0	<43.5	<105.0	<43.3	-
Striped Bass	Buzzards Bay (background)	10/21/2020	<721	4380	<28.5	<233.0	<22.8	<67.1	<24.5	-
Striped Bass	Pilgrim Discharge	10/09/2020	<1100	3790	<43.0	<341.0	<31.7	<95.7	<32.1	-
Winter Flounder	Cape Cod Bay (background)	05/13/2020	<67	4370	<5.7	<20.7	<5.3	<13.5	<5.0	-
Lobster	Cape Cod Bay (background)	07/22/2020	<69	2930	<6.4	<20.3	<5.9	<14.6	<5.8	-
Lobster	PNPS Discharge Canal	07/22/2020	<66	2980	<6.0	<18.9	<6.0	<13.3	<5.1	-
Mytilus[1]	Green Harbor, Marshfield[2]	10/19/2020	<81	1450	<5.6	<22.9	<5.3	<12.2	<5.5	-
Mytilus[1]	Pilgrim Discharge Canal	06/02/2020	70	2570	<3.6	<9.0	<3.5	<7.9	<3.5	-
Mytilus[1]	Pilgrim Discharge Canal	11/12/2020	<47	1160	<4.4	<12.9	<4.1	<9.8	<4.0	
Softshell Clams	Duxbury[2]	05/09/2020	105	2240	<5.3	<23.0	<5.6	<12.1	<5.0	-
Softshell Clams	Duxbury[2]	11/20/2020	<51	1800	<4.4	<10.6	<3.9	<9.6	<4.0	-
Softshell Clams	Plymouth Harbor	05/08/2020	56.4	1990	<5.5	<21.2	<4.9	<12.3	<4.7	-
Softshell Clams	Plymouth Harbor	10/19/2020	<81	1450	<5.6	<22.9	<5.3	<12.2	<5.5	-
Sediment	Green Harbor, Marshfield[2]	05/09/2020	-	10100	-	-	<21.1	-	<21.3	-
Sediment	Duxbury[2]	11/20/2020	-	13900	-	-	<24.5	-	<26.8	-
Sediment	PNPS Discharge Canal	06/02/2020	-	13900	-	-	<25.2	-	<25.2	-
Sediment	PNPS Discharge Canal	11/12/2020	-	8990	-	-	<16.7	-	<18.4	-
Cranberries	E. Taunton (background)	10/16/2020	59.2	938	<2.7	<4.7	<2.9	<6.1	<2.9	-
Strawberries	Cretinon's Farm, Kingston	06/24/2020	<36.8	1950	<4.7	<8.3	<5.1	<9.6	<4.7	-
Tomatoes	Cretinon's Farm, Kingston	08/26/2020	<27.0	2090	<3.3	<7.0	<3.5	<8.0	<3.3	-
Zucchini	Cretinon's Farm, Kingston	07/22/2020	<27.7	2360	<3.6	<7.1	<3.4	<7.6	<3.5	
Mixed Grasses/Wild Vegetation	Pilgrim Beach[3]	10/06/2020	928	3120	<12.2	<24.1	<13.2	<26.9	<13.1	
Mixed Grasses/Wild Vegetation	Pilgrim Beach[4]	10/06/2020	2540	3580	<27.0	<53.1	<27.8	<58.7	<25.3	

[1]Blue, or common mussel
[2]Sample considered "background" for the purpose of NRC regulations, but considered "indicator" by MDPH because it falls within the 10-mile EPZ.
[3]Sample collected near doghouse
[4]Sample collected near TLD 21

-" = Not analyzed
* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65
"<" = value is less than the listed MDA (Minimum Detectable Activity) value
"NR"= result not reported for quality control reasons.

Table 5. Seabrook Nuclear Power Station 2020 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	02/12/2020	<0.0210	-	-	-	-	-	-	-	0.00838	0.0491
Air	Salisbury Fire Station Quarterly Composite	02/15/2020	-	<0.438	<0.050	<0.003	<0.204	<0.002	<0.007	<0.002	-	-
Air	Salisbury Fire Station	02/19/2020	<0.0244	-	-	-	-	-	-	-	0.00800	0.0543
Air	Salisbury Fire Station	02/25/2020	<0.0368	-	-	-	-	-	-	-	0.01550	0.0909
Air	Salisbury Fire Station	03/03/2020	<0.0266	-	-	-	-	-	-	-	0.00946	0.0754
Air	Salisbury Fire Station	03/11/2020	<0.0273	-	-	-	-	-	-	-	0.00807	0.0500
Air	Salisbury Fire Station	03/26/2020	<0.0200	-	-	-	-	-	-	-	0.00714	0.0506
Air	Salisbury Fire Station	04/01/2020	<0.0408	-	-	-	-	-	-	-	0.01140	0.0672
Air	Salisbury Fire Station	04/08/2020	<0.0566	-	-	-	-	-	-	-	0.00551	0.0446
Air	Salisbury Fire Station	04/15/2020	<0.0584	-	-	-	-	-	-	-	0.01100	0.0659
Air	Salisbury Fire Station	04/22/2020	<0.0451	-	-	-	-	-	-	-	0.01140	0.0820
Air	Salisbury Fire Station	04/29/2020	<0.0527	-	-	-	-	-	-	-	0.00985	0.0767
Air	Salisbury Fire Station	05/06/2020	<0.0309	-	-	-	-	-	-	-	0.01050	0.0557
Air	Salisbury Fire Station	05/13/2020	<0.0751	-	-	-	-	-	-	-	0.01180	0.0780
Air	Salisbury Fire Station Quarterly Composite	05/15/2020	-	0.129	0.203	<0.002	<0.036	<0.001	<0.004	<0.001	-	-
Air	Salisbury Fire Station	05/20/2020	<0.0567	-	-	-	-	-	-	-	0.00755	0.0599
Air	Salisbury Fire Station	05/27/2020	<0.0480	-	-	-	-	-	-	-	0.00893	0.0634
Air	Salisbury Fire Station	06/03/2020	<0.0383	-	-	-	-	-	-	-	0.00700	0.0616
Air	Salisbury Fire Station	06/10/2020	<0.0594	-	-	-	-	-	-	-	0.01090	0.0758
Air	Salisbury Fire Station	06/18/2020	<0.0509	-	-	-	-	-	-	-	0.00802	0.0678
Air	Salisbury Fire Station	06/24/2020	<0.0491	-	-	-	-	-	-	-	0.01320	0.0868
Air	Salisbury Fire Station	07/01/2020	<0.0370	-	-	-	-	-	-	-	0.01580	0.0910
Air	Salisbury Fire Station	07/07/2020	<0.0544	-	-	-	-	-	-	-	0.01330	0.0743
Air	Salisbury Fire Station	07/14/2020	<0.0389	-	-	-	-	-	-	-	0.01840	0.0975
Air	Salisbury Fire Station	07/21/2020	<0.0336	-	-	-	-	-	-	-	0.01760	0.1070
Air	Salisbury Fire Station	07/28/2020	<0.0431	-	-	-	-	-	-	-	0.01740	0.1180
Air	Salisbury Fire Station	08/05/2020	<0.0619	-	-	-	-	-	-	-	0.01480	0.0922
Air	Salisbury Fire Station	08/11/2020	<0.0400	-	-	-	-	-	-	-	0.02170	0.1300

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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 Quarterly Composite	08/15/2020	-	0.105	0.120	<0.001	<0.007	<0.001	<0.002	<0.001	-	-
Air	Salisbury Fire Station	08/21/2020	<0.0480	-	-	-	-	-	-	-	0.01610	0.0926
Air	Salisbury Fire Station	08/26/2020	<0.0261	-	-	-	-	-	-	-	0.01500	0.0835
Air	Salisbury Fire Station	09/08/2020	<0.0093	-	-	-	-	-	-	-	0.00499	0.0421
Air	Salisbury Fire Station	09/17/2020	<0.0130	-	-	-	-	-	-	-	0.00802	0.0563
Air	Salisbury Fire Station	09/22/2020	<0.0168	-	-	-	-	-	-	-	0.01010	0.0503
Air	Salisbury Fire Station	09/30/2020	<0.0140	-	-	-	-	-	-	-	0.01350	0.0985
Air	Salisbury Fire Station	10/06/2020	<0.0190	-	-	-	-	-	-	-	0.00746	0.0414
Air	Salisbury Fire Station	10/13/2020	<0.0227	-	-	-	-	-	-	-	0.00677	0.0448
Air	Salisbury Fire Station	10/19/2020	<0.0241	-	-	-	-	-	-	-	0.00793	0.0545
Air	Salisbury Fire Station	10/27/2020	<0.0425	-	-	-	-	-	-	-	0.01230	0.0787
Air	Salisbury Fire Station	11/05/2020	<0.0135	-	-	-	-	-	-	-	0.00732	0.0445
Air	Salisbury Fire Station	11/11/2020	<0.0327	-	-	-	-	-	-	-	0.01230	0.0979
Air	Salisbury Fire Station Quarterly Composite	11/15/2020	-	0.091	<0.018	<0.001	<0.005	<0.001	<0.002	<0.001	-	-
Air	Salisbury Fire Station	11/17/2020	<0.0161	-	-	-	-	-	-	-	0.00935	0.0590
Air	Salisbury Fire Station	11/25/2020	<0.0378	-	-	-	-	-	-	-	0.01090	0.0725
Air	Salisbury Fire Station	12/01/2020	<0.0193	-	-	-	-	-	-	-	0.01050	0.0686
Air	Salisbury Fire Station	12/08/2020	<0.0427	-	-	-	-	-	-	-	0.00781	0.0547
Air	Salisbury Fire Station	12/15/2020	<0.0440	-	-	-	-	-	-	-	0.01250	0.0840
Air	Salisbury Fire Station	12/22/2020	<0.0187	-	-	-	-	-	-	-	0.01080	0.0716
Air	Salisbury Fire Station	12/30/2020	<0.0222	-	-	-	-	-	-	-	0.00829	0.0636
Air	Background	01/06/2020	<0.0174	-	-	-	-	-	-	-	0.00832	0.0494
Air	Background	01/13/2020	<0.0172	-	-	-	-	-	-	-	0.00690	0.0435
Air	Background	01/21/2020	<0.0152	-	-	-	-	-	-	-	0.01040	0.0532
Air	Background	01/27/2020	<0.0182	-	-	-	-	-	-	-	0.01050	0.0540
Air	Background	02/03/2020	<0.0157	-	-	-	-	-	-	-	0.00797	0.0461
Air	Background	02/10/2020	<0.0179	-	-	-	-	-	-	-	0.00821	0.0454
Air	Background Quarterly Composite	02/15/2020	-	<0.167	<0.026	<0.001	<0.075	<0.001	<0.003	<0.001	-	-
Air	Background	02/18/2020	<0.0148	-	-	-	-	-	-	-	0.00850	0.0486
Air	Background	02/24/2020	<0.0213	-	-	-	-	-	-	-	0.00992	0.0565
Air	Background	03/02/2020	<0.0130	-	-	-	-	-	-	-	0.01040	0.0601

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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	Background	03/09/2020	<0.0139	-	-	-	-	-	-	-	0.00661	0.0364
Air	Background	03/18/2020	<0.0127	-	-	-	-	-	-	-	0.00901	0.0420
Air	Background	03/23/2020	<0.0198	-	-	-	-	-	-	-	0.01710	0.0687
Air	Background	03/30/2020	<0.0200	-	-	-	-	-	-	-	0.01600	0.0650
Air	Background	04/28/2020	<0.0208	-	-	-	-	-	-	-	0.00959	0.0598
Air	Background	05/06/2020	<0.0124	-	-	-	-	-	-	-	0.00533	0.0407
Air	Background	05/11/2020	<0.0260	-	-	-	-	-	-	-	0.00730	0.0559
Air	Background Quarterly Composite	5/15/2020	-	<0.102	0.486	<0.002	<0.039	<0.001	<0.004	<0.001	-	-
Air	Background	05/19/2020	<0.0155	-	-	-	-	-	-	-	0.00788	0.0432
Air	Background	05/26/2020	<0.0170	-	-	-	-	-	-	-	0.00566	0.0407
Air	Background	06/02/2020	<0.0125	-	-	-	-	-	-	-	0.00510	0.0378
Air	Background	06/09/2020	<0.0185	-	-	-	-	-	-	-	0.00893	0.0570
Air	Background	06/16/2020	-	-	-	-	-	-	-	-	0.00729	0.0544
Air	Background	07/07/2020	<0.0166	-	-	-	-	-	-	-	0.00635	0.0538
Air	Background	07/13/2020	<0.0193	-	-	-	-	-	-	-	0.00857	0.0557
Air	Background	07/21/2020	<0.0144	-	-	-	-	-	-	-	0.00809	0.0542
Air	Background	07/27/2020	<0.0185	-	-	-	-	-	-	-	0.01050	0.0615
Air	Background	08/03/2020	<0.0167	-	-	-	-	-	-	-	0.01060	0.0716
Air	Background	08/10/2020	<0.0145	-	-	-	-	-	-	-	0.00770	0.0526
Air	Background Quarterly Composite	08/15/2020	-	0.118	<0.023	<0.001	<0.005	<0.001	<0.002	<0.001	-	-
Air	Background	08/17/2020	<0.0195	-	-	-	-	-	-	-	0.00757	0.0580
Air	Background	08/25/2020	<0.0111	-	-	-	-	-	-	-	0.00953	0.0574
Air	Background	09/01/2020	<0.0167	-	-	-	-	-	-	-	0.00697	0.0533
Air	Background	09/08/2020	<0.0161	-	-	-	-	-	-	-	0.00634	0.0519
Air	Background	09/15/2020	<0.0131	-	-	-	-	-	-	-	0.00507	0.0404
Air	Background	09/22/2020	<0.0168	-	-	-	-	-	-	-	0.00557	0.0459
Air	Background	09/29/2020	<0.0169	-	-	-	-	-	-	-	0.00659	0.0858
Air	Background	10/05/2020	<0.0161	-	-	-	-	-	-	-	0.01080	0.0565
Air	Background	10/14/2020	<0.00957	-	-	-	-	-	-	-	0.00778	0.0472
Air	Background	10/19/2020	<0.0247	-	-	-	-	-	-	-	0.00979	0.0662
Air	Background	10/26/2020	<0.0162	-	-	-	-	-	-	-	0.00990	0.0565
Air	Background	11/02/2020	<0.0165	-	-	-	-	-	-	-	0.00886	0.0560

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

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	Background	11/09/2020	<0.0164	-	-	-	-	-	-	-	0.01410	0.0931
Air	Background Quarterly Composite	11/15/2020	-	0.085	<0.027	<0.001	<0.004	<0.001	<0.002	<0.001	-	-
Air	Background	11/18/2020	<0.0152	-	-	-	-	-	-	-	0.00918	0.0638
Air	Background	11/23/2020	<0.0248	-	-	-	-	-	-	-	0.01310	0.0633
Air	Background	12/01/2020	<0.0118	-	-	-	-	-	-	-	0.00925	0.0661
Air	Background	12/08/2020	<0.0145	-	-	-	-	-	-	-	0.00715	0.0507
Air	Background	12/16/2020	<0.0135	-	-	-	-	-	-	-	0.00885	0.0734
Air	Background	12/23/2020	<0.0186	-	-	-	-	-	-	-	0.00743	0.0700
Air	Background	12/30/2020	<0.0263	-	-	-	-	-	-	-	0.00601	0.0619

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

Table 6. Seabrook Nuclear Power Station 2020 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 bay[1]	01/14/2020	258	<2.5	<6.6	<2.6	<5.0	<14.0	-	<2.5	-	<300
Surface water	Ipswich bay[1]	02/11/2020	1480	<3.3	<7.9	<2.8	<6.5	<25.4	-	<3.0	-	<300
Surface water	Ipswich bay[1]	03/18/2020	1480	<3.4	<13.1	<3.0	<7.4	NR	-	<2.9	-	<300
Surface water	Ipswich bay[1]	04/16/2020	249	<2.5	<7.8	<2.6	<5.6	NR	-	<2.6	-	<300
Surface water	Ipswich bay[1]	05/14/2020	1490	<3.0	<7.0	<2.6	<6.7	<15.6	-	<2.9	-	<300
Surface water	Ipswich bay[1]	06/17/2020	685	<2.6	<6.2	<2.6	<5.4	<13.5	-	<2.7	-	<300
Surface water	Ipswich bay[1]	07/15/2020	336	<3.1	<8.4	<2.9	<6.8	NR	-	<2.9	-	<300
Surface water	Ipswich bay[1]	08/11/2020	290	<2.6	<6.5	<2.7	<5.4	<13.2	-	<2.3	-	<300
Surface water	Ipswich bay[1]	09/17/2020	312	<3.7	<9.4	<3.1	<7.5	NR	-	<3.3	-	<300
Surface water	Ipswich bay[1]	10/15/2020	312	<3.2	<7.2	<2.8	<5.4	<15.0	-	<2.9	-	<300
Surface water	Ipswich bay[1]	11/18/2020	315	<3.4	<15.1	<2.9	<7.5	NR	-	<2.9	-	<300
Surface water	Ipswich bay[1]	12/09/2021	290	<2.7	<9.4	<2.6	<5.4	NR	-	<2.6	-	<300
Milk	Rowley	01/08/2020	2570	-	-	-	-	<3.3	<2.6	<3.0	<10.6	
Milk	Rowley	02/05/2020	2580	-	-	-	-	<3.4	<2.7	<3.1	<10.6	
Milk	Rowley	03/03/2020	1370	-	-	-	-	<3.3	<2.5	<3.0	<10.4	
Milk	Rowley	05/06/2020	1410	-	-	-	-	<2.2	<2.4	<2.8	<9.0	
Milk	Rowley	06/03/2020	1000	-	-	-	-	<2.8	<2.8	<3.5	<11.2	
Milk	Rowley	07/01/2020	1570	-	-	-	-	<3.3	<2.7	<3.0	<10.7	
Milk	Rowley	08/10/2020	1360	-	-	-	-	<2.4	<2.4	<2.9	<9.6	
Milk	Rowley	09/08/2020	1440	-	-	-	-	<2.4	<2.5	<2.8	<9.6	
Milk	Rowley	10/06/2020	1430	-	-	-	-	<3.6	<2.6	<2.9	<11.4	
Milk	Rowley	11/05/2020	1450	-	-	-	-	<2.5	<2.4	<2.9	<9.5	
Milk	Rowley	12/01/2020	1520	-	-	-	-	<3.5	<2.7	<3.0	<10.9	

[1]Background sample

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.

Table 7. Seabrook Nuclear Power Station 2020 Environmental Monitoring Data –Solid Matrices

Sample	Location[1]	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	02/19/2020	<38	3360	<4.3	<10.4	<4.3	<9.8	<3.9	-
Cod	Ipswich Bay	12/18/2020	<476	4550	<38.2	<118.0	<33.7	<88.1	<37.9	-
Flounder	Ipswich Bay	05/13/2020	<612	3940	<8.6	<272.0	<6.0	<23.0	<5.7	
Winter Fin Fish	Ipswich Bay	08/11/2020	<175	4180	<6.7	<65.2	<6.0	<17.4	<6.1	
Lobster	Ipswich Bay	05/15/2020	<47	4430	<4.8	<13.5	<4.7	<10.6	<4.3	-
Lobster	Ipswich Bay	11/21/2020	<93	2310	<5.7	<27.3	<6.2	<13.7	<5.1	-
Modiolus[2]	Ipswich Bay	05/14/2020	48	1520	<4.1	<9.2	<4.0	<8.6	<3.6	-
Modiolus[2]	Ipswich Bay	12/09/2020	39	1120	<4.2	<14.6	<4.4	<9.5	<3.7	-
Mytilus[2]	Ipswich Bay	05/18/2020	129	1790	<3.9	<8.3	<4.3	<8.7	<3.9	-
Mytilus[2]	Ipswich Bay	11/18/2020	<78	792	<4.7	<21.1	<3.7	<9.8	<3.9	-
Sediment	Ipswich Bay - subtidal[3]	11/18/2020	-	19200	-	-	<21.0	-	<19.6	-
Sediment	Ipswich Bay - subtidal[4]	11/18/2020	-	19900	-	-	<19.7		<18.9	
Sediment	Ipswich Bay - subtidal[3]	12/09/2020	-	12600	-	-	<24.4		<25.8	
Sediment	Ipswich Bay - subtidal [4]	12/09/2020	-	12500	-	-	<23.8	-	<25.3	
Sediment	Plum Island - beach	05/18/2020	-	27400	-	-	<19.1	-	<17.6	-
Sediment	Plum Island - beach[3]	05/14/2020	-	16900	-	-	<22.0	-	<22.8	-
Sediment	Plum Island - beach[4]	05/14/2020	-	11900	-	-	<23.8	-	<24.3	-
Irish Moss	Ipswich Bay	05/14/2020	128	6900	<6.2	<16.5	<7.2	<16.0	<15.1	<6.1
Irish Moss	Ipswich Bay	05/14/2020	159	7760	<4.8	<13.0	<5.1	<12.0	<13.7	<4.7
Irish Moss	Ipswich Bay	12/09/2020	1020	23000	<13.0	<51.6	<14.5	<34.9	NR	<13.8
Blueberries	Russell Orchards, Ipswich	07/14/2020	<30.2	685	<3.5	<7.1	<3.4	<7.9	<3.5	
Strawberries	Bartlett Farm, Salisbury[5]	06/18/2020	<29.9	1560	<3.4	<6.9	<3.5	<7.7	<3.5	-
Strawberries	Russell Orchards, Ipswich	06/18/2020	<37.5	2110	<4.5	<8.4	<4.6	<9.1	<4.6	-
Tomatoes	Bartlett Farm, Salisbury[5]	08/11/2020	<27.0	2230	<3.3	<6.8	<4.1	<8.3	<3.6	-
Tomatoes	Russell Orchards, Ipswich	08/11/2020	<30.8	2250	<3.7	<7.4	<3.7	<4.8	<3.7	-
Zucchini	Bartlett Farm, Salisbury[5]	07/14/2020	<24.3	2180	<2.9	<6.2	<3.3	<7.4	<2.8	

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

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

[3]Sample depth is 0-3"

[4]Sample depth is 3-6"

[5]Indicator sample

-" = Not analyzed

* I-131 = iodine 131; Ba-140 = Barium 140; Be-7 = Beryllium 7; Co-60 = Cobalt 60; Cs-134 = Cesium 134; Cs-137=Cesium 137; Fe-59=Iron 59; H-3* = Tritium; K-40 = Potassium-40; Mn-54=Manganese-54; Zn-65=Zinc 65

"<" = value is less than the listed MDA (Minimum Detectable Activity) value

"NR"= result not reported for quality control reasons.