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April 28, 2022

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

Oyster Creek Nuclear Generating Station
Renewed Facility Operating License No. DPR-16
Docket No. 50-219

Subject: Annual Radioactive Environmental Operating Report for 2021

Enclosed with this cover letter is the Annual Radioactive Environmental Operating Report for calendar year 2021 for Oyster Creek Nuclear Generating Station. This submittal is made in accordance with the Oyster Creek Nuclear Generating Station's Defueled Safety Analysis Report (DSAR) Appendix B, paragraph B.2.1.b, "Annual Radiological Environmental Operating Report."

This letter contains no new regulatory commitments.

Should you have any questions or require further information, please contact Kevin Wolf, Radiation Protection and Chemistry Manager, at (609) 971-4051 or me at (856) 797-0900, ext. 3578.

Sincerely,

Jean A. Fleming
Digitally signed by Jean A. Fleming
Date: 2022.04.28 12:46:13 -04'00'

Jean A. Fleming
Vice President, Licensing, Regulatory Affairs, & PSA
Corporate Engineering Division
Holtec International, LLC

cc: USNRC Regional Administrator, Region I
USNRC Project Manager, NMSS - Oyster Creek Nuclear Generating Station
USNRC Region I, Lead Inspector - Oyster Creek Nuclear Generating Station
Assistant Commissioner, Air Quality, Energy and Sustainability, NJ DEP
Principal Engineer, American Nuclear Insurers
Assistant Director Radiation Protection Element, NJ Bureau of Nuclear Engineering

Docket No: 50-219

OYSTER CREEK GENERATING STATION
UNIT 1

Annual Radiological
Environmental Operating Report

1 January through 31 December 2021

Prepared By
Teledyne Brown Engineering
Environmental Services

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INTERNATIONAL

Oyster Creek Generating Station
Forked River, NJ 08731

April 2022

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Preface

The nuclear power industry uses terms and concepts that may be unfamiliar to all readers of this report. This section of the report is intended to help the reader better understand some of these terms and concepts. In this section, we will discuss radiation and exposure pathways. This section is intended only to give a basic understanding of these subjects to hopefully allow the reader to better understand the data provided within the report.

Every nuclear power station is required to submit two reports annually, the Annual Radioactive Effluents Release Report (ARERR) and the Annual Radiological Environmental Operating Report (AREOR). The following information is provided in both reports for Oyster Creek Generating Station.

Understanding Radiation

Radiation is simply defined as the process of emitting radiant energy in the form of waves or particles. Radiation can be categorized as ionizing or non-ionizing radiation. If the radiation has enough energy to displace electrons from an atom it is termed ionizing radiation. Typically you will see a warning sign where there is a potential to be exposed to man-made ionizing radiation. These signs normally have the trefoil symbol on a yellow background.

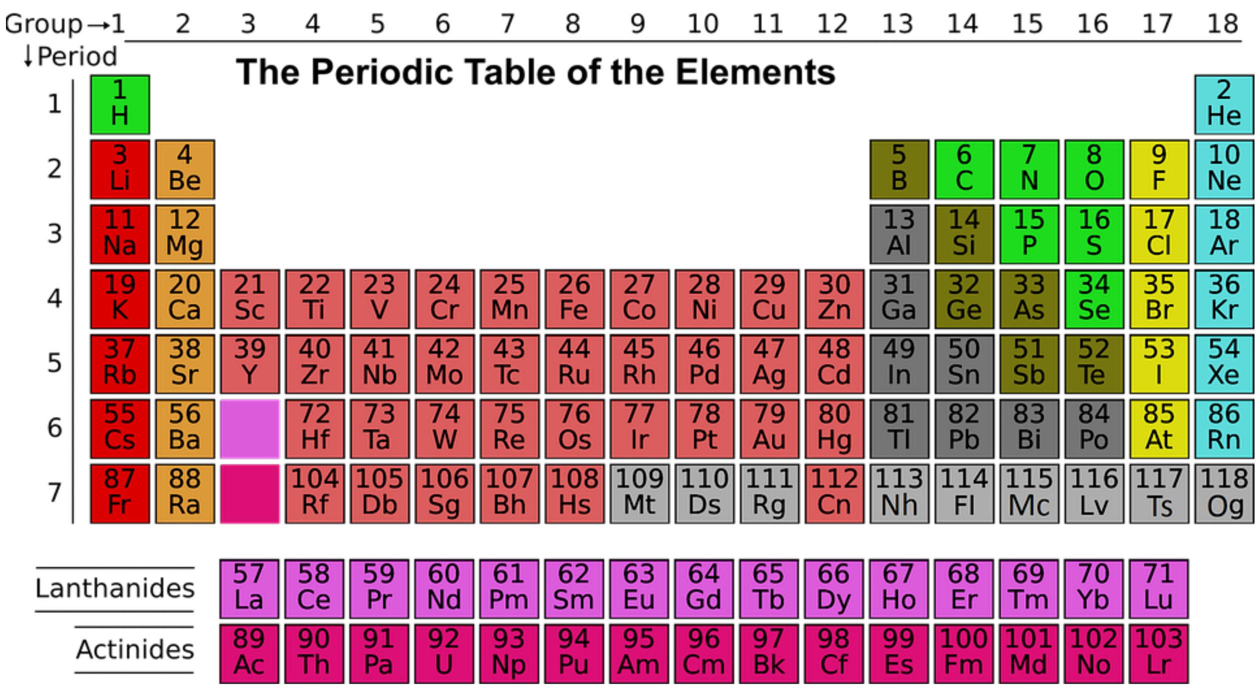
Example Radiological warning signs

People do not always recognize non-ionizing radiation as a form of radiation, such as light, heat given off from a stove, radiowaves and microwaves. In our report we focus on the ionizing radiation that is produced at a nuclear power plant though it is important to note that ionizing radiation comes from many sources. In fact, the amount of ionizing radiation an average person is exposed to due to operation of a nuclear power plant is a very small fraction of the total ionizing radiation they will be exposed to in their lifetime and will be discussed later.

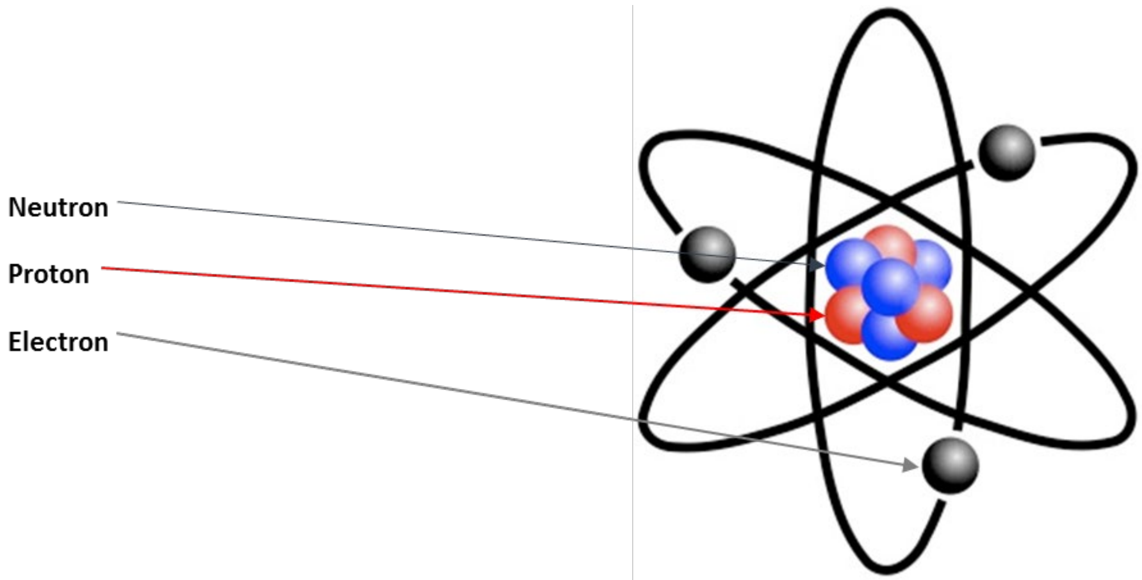
From this point forward we will only be discussing ionizing radiation but we will just use the term radiation.

Since this report discusses radiation in different forms and different pathways we first need to understand where the radiation comes from that we report. Radiation comes from atoms. So, what are atoms and how does radiation come from atoms?

You may have seen a Periodic Table of the Elements



This table lists all the elements found on earth. An atom is the smallest part of an element that maintains the characteristics of that element. An atom is made up of three parts, protons, neutrons and electrons.



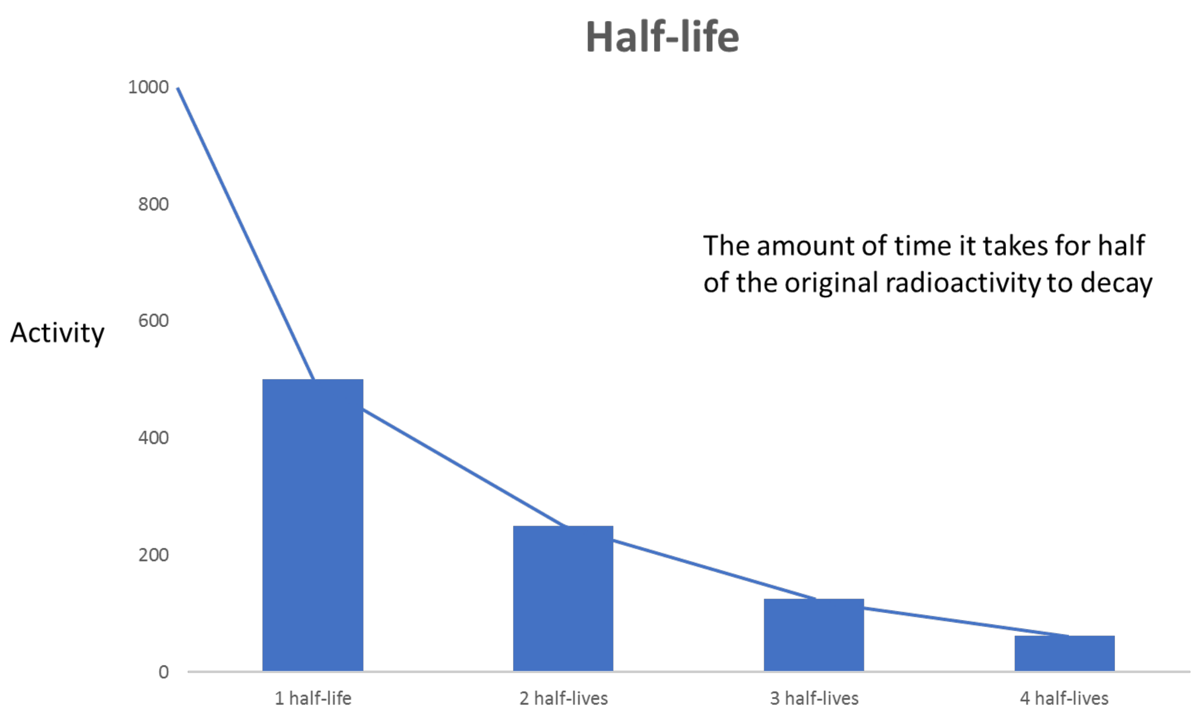
The number of protons in an atom determines the element. A hydrogen atom will always have one proton while an oxygen atom will always have eight protons. The protons are clustered with the neutrons at the center of the atom and this is called the nucleus. Orbiting around the nucleus are the relatively small electrons. Neutrons do not have an electrical charge, protons have a positive charge while electrons have a negative charge. In an electrically neutral atom, the negative and positive charges are balanced. Atoms of the same element that have a different number of neutrons in their nucleus are called isotopes.

Isotopes are atoms that have the same number of protons but different number of neutrons. They all have the same chemical properties and many isotopes are nonradioactive or stable while other isotopes may be unstable and are radioactive. Radioactive isotopes can be called a radionuclide, a radioisotope or simply called a radioactive atom. A radionuclide usually contains an excess amount of energy in the nucleus usually due to a deficit or excess of neutrons in the nucleus.

There are two basic ways radionuclides are produced at a nuclear power plant. The first way is a direct result of the fission process and the radionuclides created through this process are termed fission products. Fission occurs when a very large atom, such as U-235 (Uranium-235) and Pu-239 (Plutonium-239), absorbs a neutron into its nucleus making the atom unstable. In this instance the atom can actually split into smaller atoms, this splitting of the atom is called fission. When fission occurs there is also a large amount of energy released from the atom in the form of heat which is what is used to produce the steam that will spin the turbines to produce electricity at a nuclear power plant.

The second way a radionuclide is produced at a nuclear power plant is through a process called activation and the radionuclides produced in this method are termed activation products. Water passes through the core where the fission process is occurring. This water is used to both produce the steam to turn the turbines and to cool the reactor. Though the water passing through the core is considered to be very pure water, there is always some other material within the water. This material typically comes from the material used in the plant's construction. As the water passes through the core, the material is exposed to the fission process and the radiation within the core can react with the material causing it to become unstable, creating a radionuclide. The atoms in the water itself can become activated and create radionuclides.

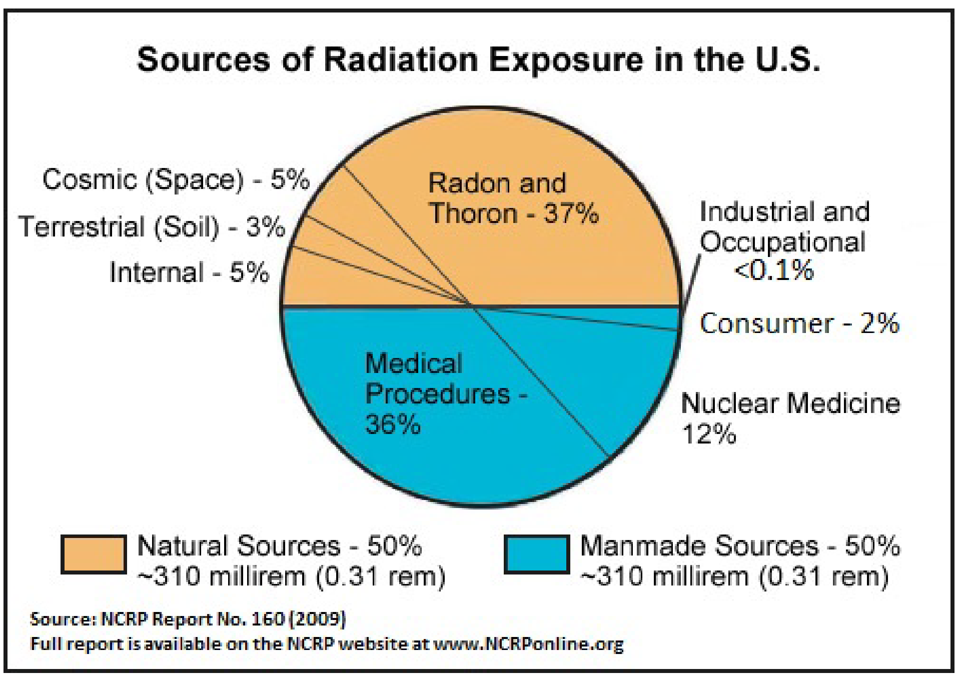
Over time, radioactive atoms will reach a stable state and no longer be radioactive. To do this they must release the excess energy. The release of excess energy can be in different forms and is called radioactive decay and the energy released is called radiation. The time it takes for a radionuclide to become stable is measured in units called half-lives. A half-life is the amount of time it takes for half of the original radioactivity to decay. Each radionuclide has a specific half-life. Some half-lives can be very long and are measured in years while others may be very short and are measured in seconds.



In this report, you will see radionuclides listed such as K-40 (potassium-40) and Co-60 (cobalt-60). The letter(s) represents the element and the number represents the specific isotope of that element and is the number of protons and neutrons in the nucleus of that radionuclide. You may hear the term naturally occurring radionuclide which refers to radionuclides that naturally occur in nature such as K-40. There are man-made radionuclides such as Co-60 that we are concerned with since these man-made radionuclides result as a by-product when generating electricity at a nuclear power plant. There are other ways man-made radionuclides are produced, such as detonating nuclear weapons, and this is important to note since nuclear weapons testing deposited these man-made radionuclides into the environment and some are still present today. There is a discussion in the AREOR for the radionculides Cs-137, Sr-89 and Sr-90. The reason we only see some of the radionuclides today is due to the fact that some of the radionuclides released into the environment had relatively short half-lives and all the atoms have decayed to a stable state while other radionuclides have relatively long half-lives and will be measurable in the environment for years to come.

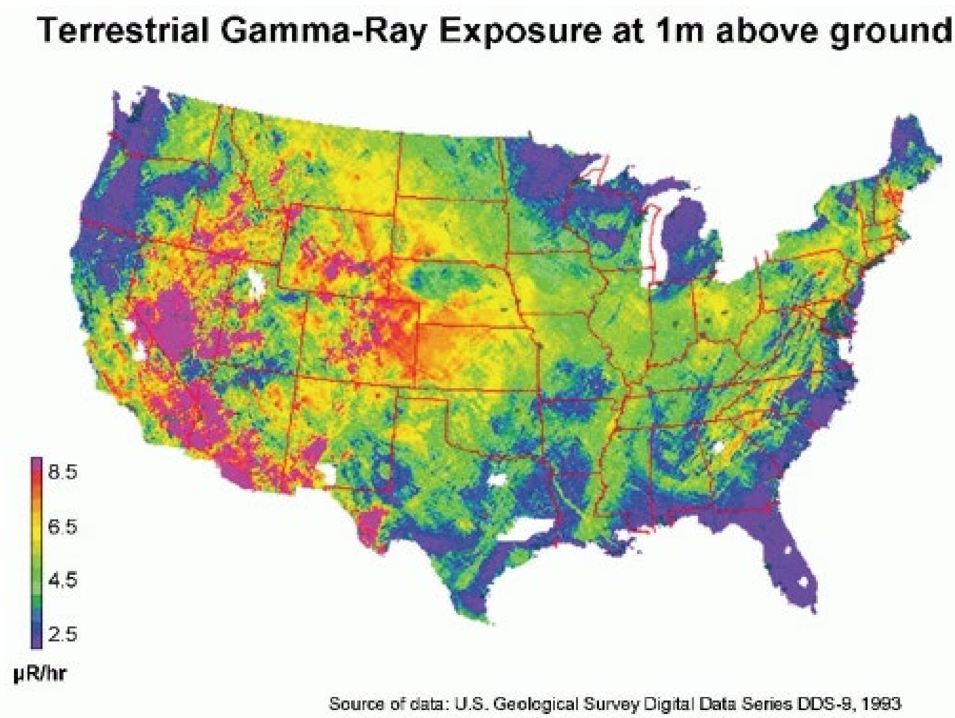
Sources of Radiation

People are exposed to radiation every day of their lives and have been since the dawn of mankind. Some of this radiation is naturally occurring while some is man-made. There are many factors that will determine the amount of radiation an individual will be exposed to such as where you live, medical treatments, etc. Below are examples of some of the typical sources of radiation an individual is exposed to in a year.



Adapted with permission of the National Council on Radiation Protection and Measurements, http://NCRPonline.org

As you can see from the graph, the largest natural source of radiation is due to Radon. That is because essentially all air contains Radon. Cosmic and Internal make up the next largest natural sources of radiation. Cosmic radiation comes from the sun and stars and there are multiple factors which can impact the amount of cosmic radiation you are exposed to such as the elevation at which you live and the amount of air travel you take a year. The internal natural source of radiation mainly comes from two sources. Technically, all organic material is slightly radioactive due to C-14 (carbon-14), including humans and the food we eat. C-14 makes up a percentage of the carbon in all organic material. Another contributor to the internal natural source is K-40 (potassium-40). Potassium is present in many of the foods we eat, such as brazil nuts, bananas, carrots and red meat. The smallest natural source listed is terrestrial. Soil and rocks contain radioactive materials such as Radium and Uranium. The amount of terrestrial radiation you are exposed to depends on where you live. The map below shows terrestrial exposure levels across the United States. The radiation released from nuclear power plants is included in the Industrial and Occupational slice and is listed as <0.1%.

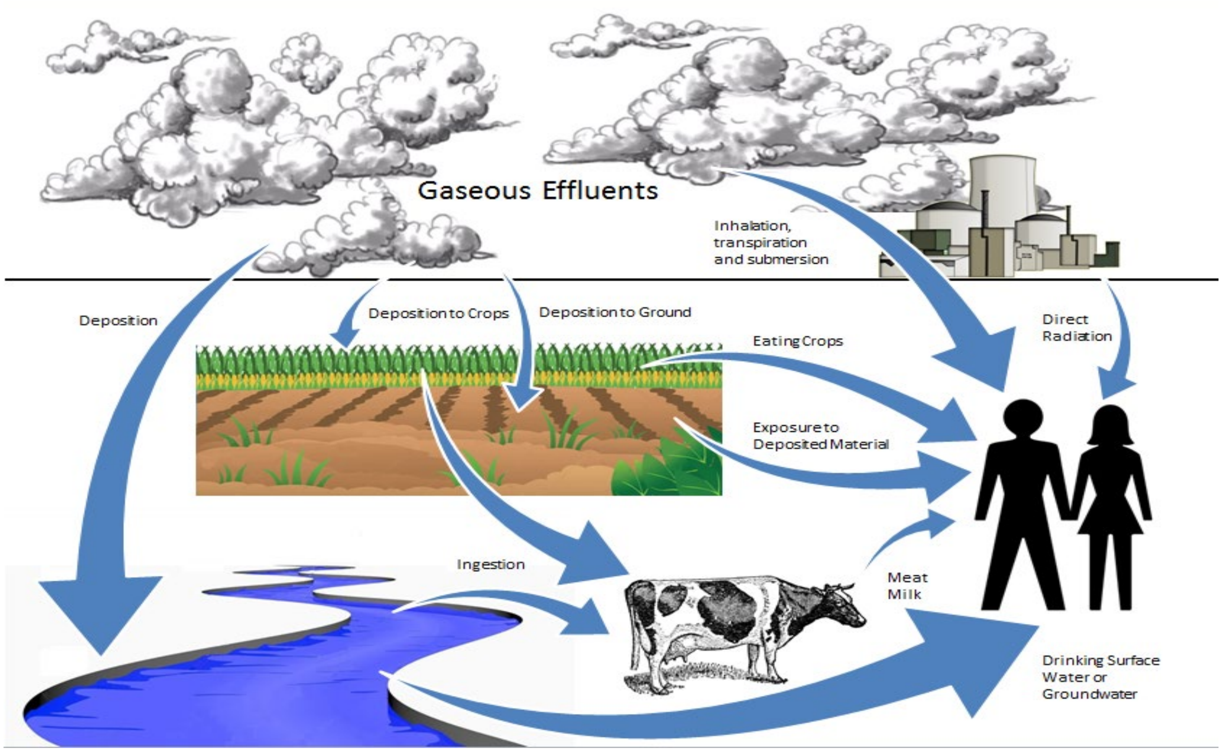


Exposure Pathways

Radiological exposure pathways define the methods by which people may become exposed to radioactive material. The major pathways of concern are those which could cause the highest calculated radiation dose. These projected pathways are determined from the type and amount of radioactive material released into the environment and how the environment is used. The way radioactive material is transported in the environment includes consideration of physical factors, such as the hydrological (water) and meteorological (weather) characteristics of the area. An annual average of the water flow, wind speed, and wind direction are used to evaluate how the radionuclides will be distributed in an area for gaseous or liquid releases. An important factor in evaluating the exposure pathways is the use of the environment. Many factors are considered such as dietary intake of residents, recreational use of the area, and the locations of homes and farms in the area.

The external and internal exposure pathways considered are shown in Figure 2.1. The release of radioactive gaseous effluents involves pathways such as external whole-body exposure, deposition of radioactive material on plants, deposition on soil, inhalation by animals destined for human consumption, and inhalation by humans. The release of radioactive material in liquid effluents involves pathways such as drinking water, fish, and direct exposure from the water at the shoreline while swimming. Although radionuclides can reach humans by many different pathways, some result in more dose than others. The critical pathway is the exposure route that will provide, for a specific radionuclide, the greatest dose to a population, or to a specific group of the population called the critical group. The critical group may vary depending on the radionuclides involved, the age and diet of the group, or other cultural factors. The dose may be delivered to the whole body or to a specific organ. The organ receiving the greatest fraction of the dose is called the critical organ.

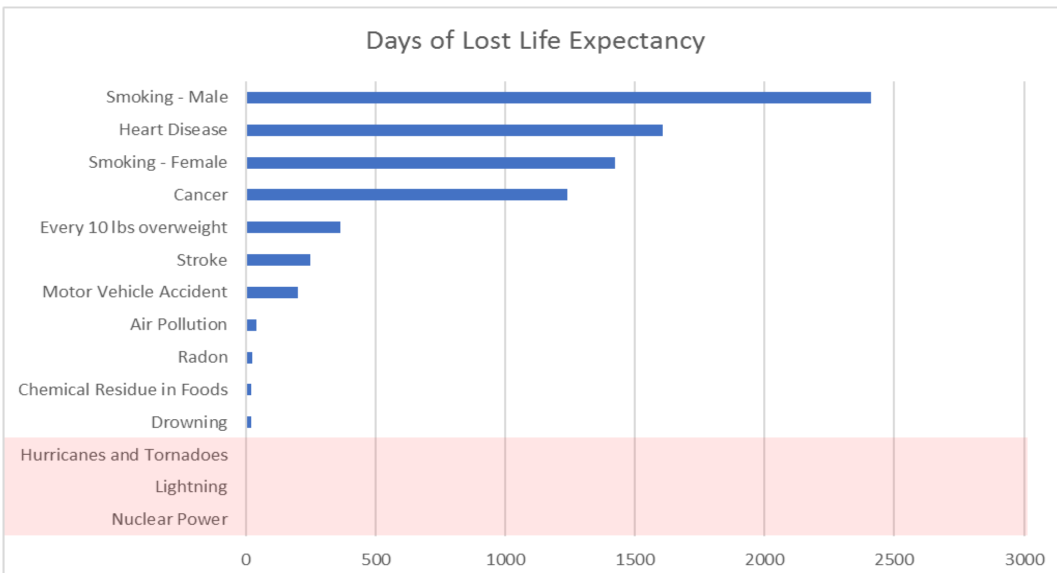
Figure 2.1 External and Internal Exposure Pathways

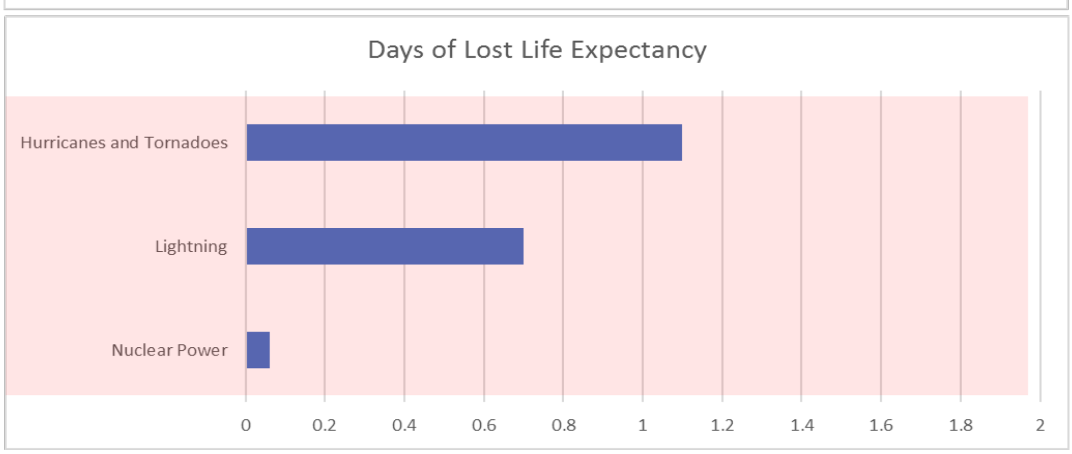


This simple diagram demonstrates some potential exposure pathways from Oyster Creek Generating Station.

Radiation Risk

U.S. radiation protection standards are based on the premise that any radiation exposure carries some risk. There is a risk whether the radiation exposure is due to man-made sources or natural sources. There have been many studies performed trying to determine the level of risk. The following graph is an example of one study that tries to relate risk from many different factors. This graph represents risk as "Days of Lost Life Expectancy." All the categories are averaged over the entire population except Male Smokers, Female Smokers and individuals that are overweight. Those risks are only for people that fall into those categories. The category for Nuclear Power is a government estimate based on all radioactivity releases from nuclear power, including accidents and wastes.





Adapted from the article by Bernard L. Cohen, Ph.D. in the Journal of American Physicians and Surgeons Volume 8 Number 2 Summer 2003. The full article can be found at [*http://www.jpands.org/vol8no2/cohen.pdf*](http://www.jpands.org/vol8no2/cohen.pdf)

Annual Reports

All nuclear power plants are required to perform sampling of both the potential release paths from the plant and the potential exposure pathways in the environment. The results of this sampling are required to be reported annually to the Nuclear Regulatory Commission (NRC) and made available to the public. There are two reports generated annually, the Annual Radioactive Effluents Release Report (ARERR) and the Annual Radiological Environmental Operating Report (AREOR). The ARERR summarizes all of the effluents released from the plant and quantifies the doses to the public from these effluents. The AREOR summarizes the results of the samples obtained in the environment looking at all the potential exposure pathways by sampling different media such as air, vegetation, direct radiation, etc. These two reports are related in that the results should be aligned. The AREOR should validate that the effluent program is accurate. The ARERR and AREOR together ensure Nuclear Power Plants are operating in a manner that adequately protects the public and the environment.

In the reports, there are four different but interrelated units for measuring radioactivity, exposure, absorbed dose, and dose equivalent. Together, they are used to properly capture both the amount of radiation and its effects on humans.

- Radioactivity refers to the amount of ionizing radiation released by a material. The units of measure for radioactivity used within the AREOR and ARERR are the curie (Ci). Small fractions of the Ci often have a prefix, such as microCurie (μCi) that means 1/1,000,000. That means there are 1,000,000 μCi in one Ci. Due to the extremely low levels of radioactivity in the environment, the unit commonly used for these samples is the picocurie (pCi). A pCi is 1/1,000,000 of a μCi; there are 1,000,000 pCi in a μCi. There are 1,000,000,000,000 pCi in a Ci.

- Exposure describes the amount of radiation traveling through the air. The units of measure for exposure used within the AREOR and ARERR are the roentgen (R). Traditionally direct radiation monitors placed around the site are measured in milliroentgen (mR), 1/1,000 of one R.

- Absorbed dose describes the amount of radiation absorbed by an object or person. The units of measure for absorbed dose used within the AREOR and ARERR are the rad. Noble gas air doses are reported by the site are measured in millirad (mrad), 1/1,000 of one rad.

- Dose equivalent (or effective dose) combines the amount of radiation absorbed and the health effects of that type of radiation. The units used within the AREOR and ARERR are the roentgen equivalent man (rem). Regulations require doses to the whole body, specific organ, and direct radiation to be reported in millirem (mrem), 1/1,000 of one rem.

Typically releases from nuclear power plants are so low that the samples taken in the environment are below the detection levels required to be met by all nuclear power plants. There are some radionuclides identified in the environment during the routine sampling, but this is typically background radiation from nuclear weapons testing and events such as Chernobyl and these radionuclides are discussed in the AREOR.

Each report lists the types of samples that are collected and the analyses performed. Different types of media may be used at one sample location looking for specific radionuclides. There are also examples where a sample collected on one media is analyzed differently depending on the radionuclide for which the sample is being analyzed.

These annual reports, and much more information related to nuclear power, are available on the NRC website at www.nrc.gov.

I. Summary and Conclusions

On July 1st, 2019, ownership of the Oyster Creek Nuclear Power Station and transfer of the station and decommissioning license from Exelon Generation Company, LLC to Oyster Creek Environmental Protection, LLC (OCEP) as the licensed owner and Holtec Decommissioning International, LLC (HDI) as the licensed operator, was completed. Exelon had determined that transitioning operational nuclear plants to decommissioning nuclear plants targeted for permanent shutdown was not aligned with its core objectives and actively sought buyers who would assume ownership and complete decommissioning and license termination.

This report on the Radiological Environmental Monitoring Program (REMP) conducted for the Oyster Creek Generating Station (OCGS) by Holtec Decommissioning International, LLC (HDI) covers the period 01 January 2021 through 31 December 2021. During that time period, a total of 919 analyses were performed on 691 samples. In assessing all the data gathered for this report and comparing these results with historical data, it was concluded that the decommissioning of OCGS had no adverse radiological impact on the environment.

REMP-designated surface water samples were analyzed for concentrations of tritium and gamma emitting nuclides. No tritium, fission or activation products were detected in any of the surface water samples collected as part of the Radiological Environmental Monitoring Program during 2021.

REMP-designated drinking water samples were analyzed for concentrations of gross beta, tritium, and gamma emitting nuclides. The preoperational environmental monitoring program did not include analysis of drinking water for gross beta. No tritium or fission or activation products were detected in any of the drinking water samples collected.

REMP-designated groundwater samples were analyzed for concentrations of tritium and gamma emitting nuclides. No tritium and no fission or activation products were detected in REMP groundwater samples.

Fish (predator), clams, crabs, and sediment samples were analyzed for concentrations of gamma emitting nuclides. No OCGS-produced fission or activation products were detected in fish, clams, crabs or sediment samples.

Air particulate samples were analyzed for concentrations of gross beta, gamma emitting nuclides, strontium-89 (Sr-89), and strontium-90 (Sr-90). Gross beta and cosmogenic beryllium-7 (Be-7) were detected at levels consistent with those detected in previous years. No fission or activation products were detected. Sr-89 and Sr-90 analyses were performed on quarterly composites of air particulate samples. All Sr-89 and Sr-90 results were below the MDC.

Vegetation samples were analyzed for gamma emitting nuclides, Sr-89, and Sr-90. Concentrations of naturally occurring potassium-40 (K-40) were consistent with those detected in previous years. No fission or activation products were detected. All Sr-89 results were below the minimum detectable activity. Sr-90 activity was at levels consistent with those detected in previous years at both control and indicator stations and can be attributed to historical nuclear weapons testing and the Chernobyl accident.

Environmental gamma radiation measurements were performed quarterly using Optically Stimulated Luminescence Dosimeters (OSLD). Beginning in calendar year 2012, Exelon (the previous plant owner) began using OSLDs and discontinued the use of Thermoluminescent Dosimetry (TLD). There were two main reasons for this change. First, OSLDs have minimal “fade” over a quarterly time period. Fade is where the dose on the dosimeter drifts lower over time. Second, OSLDs may be re-read if necessary. TLDs are reset to zero after they are read. Levels detected were consistent with those observed in previous years. The maximum dose to any member of the public attributable to radioactive effluents and direct radiation from the OCGS was less than the 25 mRem/year limit established by the United States Environmental Protection Agency (EPA).

II. Introduction

The Oyster Creek Generating Station (OCGS) is a non-operational single unit nuclear power plant owned and operated by HDI. OCGS is located on the Atlantic Coastal Plain Physiographic Province in Ocean County, New Jersey, about 60 miles south of Newark, 9 miles south of Toms River, and 35 miles north of Atlantic City. It lies approximately 2 miles inland from the Barnegat Bay. The Oyster Creek Site is approximately 152 acres located west of U.S. Highway Route 9 between the south branch of the Forked River and the Oyster Creek. Most of the Site is identified as Block 100, Lot 4.02 in Lacey Township according to a 2018 American Land Title Association (ALTA)/National Society of Professional Surveyors (NSPS) land title survey. The site includes a small land area south of the Discharge Canal identified as Block 4, Lot 43 in Ocean Township. A perimeter security fence surrounds the restricted /protected area of the site. The site description is changed to reflect the current decommissioning site boundaries. The site location is part of the New Jersey shore area with its relatively flat topography and extensive freshwater and saltwater marshlands. The South Branch of Forked River runs across the northern side of the site and Oyster Creek partly borders the southern side.

A preoperational Radiological Environmental Monitoring Program (REMP) for OCGS was established in 1966 and continued prior to the plant becoming operational in 1969. This report covers those analyses performed by Teledyne Brown Engineering (TBE), Landauer and Environmental Inc. (Midwest Labs) on samples collected during the period 01 January 2021 through 31 December 2021.

A. Objectives of the REMP

The objectives of the REMP are to:

1. Provide data on measurable levels of radiation and radioactive materials in and beyond the site environs
2. Evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure
3. Validate the effluent computer model that predicts radioactive material concentrations at populated off-site locations
4. Fulfill the obligations of the radiological surveillance sections of Oyster Creek's Offsite Dose Calculation Manual (ODCM)

B. Implementation of the Objectives

The implementation of the objectives is accomplished by:

1. Identifying significant exposure pathways
2. Establishing baseline radiological data for media within those pathways
3. Continuously monitoring those media before, during and after terminating Station operation to assess Station radiological effects (if any) on the public, plant workers and the environment

C. Discussion

1. General Program

The Radiological Environmental Monitoring Program (REMP) was established in 1966, before the plant became operational. This preoperational surveillance program was established to describe and quantify the radioactivity, and its variability, in the area prior to the operation of OCGS. After OCGS became operational in 1969, the operational surveillance program continued to measure radiation and radioactivity in the surrounding areas.

A variety of environmental samples are collected as part of the REMP at OCGS. The selection of sample types is based on the established pathways for the transfer of radionuclides through the environment to humans. The selection of sampling locations is based on sample availability, local meteorological and hydrological characteristics, local population characteristics, and land usage in the area of interest. The selection of sampling frequencies for the various environmental media is based on the radionuclides of interest, their respective half-lives, and their behavior in both the biological and physical environment.

2. Preoperational Surveillance Program

The federal government requires nuclear facilities to conduct radiological environmental monitoring prior to constructing the facility. This preoperational surveillance program is aimed at collecting the data needed to identify pathways, including selection of the radioisotope and sample media combinations to be included in the environmental surveillance program conducted after facility operation begins. Radiochemical analyses performed on the environmental samples should include not only those nuclides expected to be released during facility operation but should also include typical radionuclides from nuclear weapons testing and natural background radioactivity. All environmental media with a potential to be affected by facility operation as well as those media directly in the major pathways, should be sampled on at least an annual basis during the preoperational phase of the environmental surveillance program.

The preoperational surveillance design, including nuclide/media combinations, sampling frequencies and locations, collection techniques, and radioanalyses performed, should be carefully considered and incorporated in the design of the operational surveillance program. In this manner, data can be compared in a variety of ways (for example, from year to year, location to location, etc.) in order to detect any radiological impact the facility has on the surrounding environment. Data collection during the preoperational phase should be planned to provide a comprehensive database for evaluating any future changes in the environment surrounding the nuclear facility.

OCGS began its preoperational environmental surveillance program three years before the plant began operating in 1969. Data accumulated during those early years provide an extensive database from which environmental monitoring personnel are able to identify trends in the radiological characteristics of the local environment. The environmental surveillance program at OCGS will continue after the plant has reached the end of its economically useful life and decommissioning has begun.

3. Consideration of Plant Effluents

Effluents are strictly monitored to ensure that radioactivity released to the environment is as low as reasonably achievable (ALARA) and does not exceed regulatory limits. Effluent control includes the operation of monitoring systems, in-plant and environmental sampling and analyses programs, quality assurance programs for effluent and environmental programs, and procedures covering all aspects of effluent and environmental monitoring.

Both radiological environmental and effluent monitoring indicate that the operation of OCGS does not result in significant radiation exposure of the people or the environment surrounding OCGS and is well below the applicable levels set by the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA).

Environmental sampling of airborne particulates showed no radioactivity attributable to the operation of OCGS.

III. Program Description

A. Sample Collection

Samples for the OCGS REMP were collected for HDI by on-site personnel and Normandeau Associates, Incorporated. This section describes the general collection methods used to obtain environmental samples for the OCGS REMP in 2021. Sample locations and descriptions can be found in Tables B-1 and B-2, and Figures B-1, B-2, and B-3, Appendix B. The collection procedures are listed in Table B-3.

Aquatic Environment

The aquatic environment was evaluated by performing radiological analyses on samples of surface water, drinking water, groundwater, fish, clams, crabs, and sediment. One gallon water samples were collected monthly from two surface water locations (33 and 94), semiannually at two surface water locations (23 and 24), monthly from four drinking water wells (1N, 1S, 37, and 38) and quarterly from 2 groundwater stations (MW-24-3A and W-3C). Control locations were 94 and 37. All samples were collected in plastic bottles, which were rinsed at least twice with source water prior to collection. Fish samples comprised of the flesh of predators were collected semiannually at two locations (33 and 93) and annually at control location 94. Clams were collected semiannually from three locations (23, 24, and 94 [control]). Two annual crab samples were collected from two locations (33 and 93). Sediment samples were collected at four locations semiannually (23, 24, 33, and 94 [control]).

Atmospheric Environment

The atmospheric environment was evaluated by performing radiological analyses on air particulate samples. Air particulate samples were collected and analyzed bi-weekly at seven locations (C, 20, 66, 71, 72, 73, and 111). The control location was C. The samples were obtained at each location, using a vacuum pump with glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The filters were replaced weekly and sent to the laboratory for analysis.

Terrestrial Environment

The terrestrial environment was evaluated by performing radiological analyses on samples of garden vegetation. No commercial dairy operations and no dairy animals producing milk for human consumption are located within a 5-mile radius of the plant. Therefore, vegetation samples were collected in lieu of milk. Vegetation samples were collected, when available, at four locations (35, 36, 66 and 115). Station 36 is the control location as it is 24 miles northwest of the plant in the lowest X/Q sector, beyond any influence of the plant when the plant was operating, and while it is permanently shut down for decommissioning. All samples were collected in 18” x 24” new unused plastic bags and shipped promptly to the laboratory.

Ambient Gamma Radiation

Direct radiation measurements were made using Al_2O_3:C Optically Stimulated Luminescence Dosimetry (OSLD). Exelon Nuclear (the previous plant owner) changed the dosimetry used for environmental monitoring. Beginning in calendar year 2012, Exelon began using OSLDs and discontinued the use of Thermoluminescent Dosimetry (TLD). There were two main reasons for this change. First, OSLDs are subject to minimal fade. Fade is where the dose on the dosimeter drifts lower over time. Second, OSLDs may be re-read if necessary. TLDs are reset to zero after they are read. The OSLDs were placed on and around the OCGS site and were categorized as follows:

An inner ring consisting of 19 locations (1, T1, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 112 and 113) near the site boundary.

An outer ring consisting of 21 locations (6, 8, 9, 22, 68, 73, 74, 75, 78, 79, 98, 99, 100, 101, 102, 103, 104, 106, 107, 109 and 110) extending to approximately 5 miles from the site designed to measure possible exposures to close-in population.

Special interest stations consisting of 3 locations (71, 72 and 81) representing special interest areas such as population centers, state parks, etc.

Background (Control) stations consisting of one location (C) greater than 20 miles distant from the site.

Indicator OSLDs were placed systematically, with at least one station in each of 16 meteorological compass sectors in the general area of the site boundary. OSLDs were also placed in each meteorological sector in the 1 to 5 mile range, where reasonable highway access would permit, in areas of public interest and population centers. Background locations were located greater than twenty miles distant from the OCGS and generally in an upwind direction from the OCGS.

Two OSLDs were placed at each location approximately three to eight feet above ground level. The OSLDs were exchanged quarterly and sent to a vendor for analysis.

B. Sample Analysis

This section describes the general analytical methodologies used by TBE and Environmental Inc. (Midwest Labs) to analyze the environmental samples for radioactivity for the OCGS REMP in 2021. The analytical procedures used by the laboratories are listed in Table B–3.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of beta emitters in air particulates and drinking water

2. Concentrations of gamma emitters in surface water, drinking water, groundwater, fish, clams, crabs, sediment, air particulates and vegetation

3. Concentrations of tritium in REMP-designated surface water, drinking water and groundwater

4. Concentrations of I-131 in air iodine cartridges

5. Concentrations of strontium in air particulates and vegetation

Iodine analysis was discontinued beginning with the second calendar quarter of 2020. The iodine isotopes of interest (I-131, I-132, I-133, I-134, & I-135) have short half-lives and are generated by the nuclear fission process. No iodines were produced after permanent cessation of operation in September 2018. After they have undergone radioactive decay, there is no basis for sampling to detect them.

C. Data Interpretation

For trending purposes, the radiological and direct radiation data collected during 2021 were compared with data from past years. The results of environmental sampling show that radioactivity levels have not increased from the background radioactivity detected prior to the operation of OCGS. The operation of OCGS continues to have no measurable radiological impact upon the environment.

Several factors were important in the interpretation of the data:

1. <u>Lower Limit of Detection and Minimum Detectable Concentration</u>

   The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as a before the fact (*a priori)* estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact (*a posteriori*) criterion for the presence of activity. All analyses were designed to achieve the required OCGS detection capabilities for environmental sample analysis.

   The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an after the fact estimate of the presence of activity.

2. Net Activity Calculation and Reporting of Results

Net activity for a sample was calculated by subtracting background activity from the sample activity. Since the REMP measures extremely small changes in radioactivity in the environment, background variations may result in sample activity being lower than the background activity, which results in a negative number. A less-than MDC was reported in all cases where positive activity was not detected.

Gamma spectroscopy results for each type of sample were grouped as follows:

For surface, drinking water, and groundwater - six nuclides: Mn-54, Co-60, Zn-65, Zr-95, Cs-134 and Cs-137 were reported.

For fish - six nuclides: K-40, Mn-54, Co-60, Zn-65, Cs-134, and Cs-137 were reported.

For clams - six nuclides: K-40, Mn-54, Co-60, Zn-65, Cs-134, and Cs-137 were reported.

For crabs - six nuclides: K-40, Mn-54, Co-60, Zn-65, Cs-134, and Cs-137 were reported.

For sediment - eight nuclides: Be-7, K-40, Mn-54, Co-60, Cs-134, Cs-137, Ra-226, and Th-228 were reported.

For air particulates - five nuclides: Be-7, Mn-54, Co-60, Cs-134, and Cs-137 were reported.

For vegetation - four nuclides: Be-7, K-40, Cs-134 and Cs-137 were reported.

Means and standard deviations of the results were calculated. The standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

For 2021, the OCGS REMP had a sample recovery rate in excess of 97%. Exceptions are listed below:

Environmental Dosimetry

1. 1st & 2nd Quarters, 2021: Stations 61 & 63 - Samples not taken due to radiography nearby. See Appendix G for more information.

Air

1. 07/28/21 - 08/11/21: Station 111 - Pump not running; pump repaired and new sample collection started. (IR #OYS-02404)
2. 08/25/21 - 09/10/21: Stations 66 & 111 - No sample due to large hole in filter; likely caused by tropical storm early in sample period.

(IR #OYS-02405)

3. 09/10/21 - 09/22/21: Station 71 - No sample. Pump found not running with main breaker open. Breaker closed and pump started running. (IR #OYS-02406)

Drinking Water

Note: Stations 1S and 1N are on-site drinking water wells. Typically, only one well is in service at a time. They are only listed as deviations when there is not a sample for the monitoring period.

1. 2021: Station 1S was not operational for the entire year.
2. December 2021: Station 38 - Sample was missed because there was no one at the water plant and the technician could not enter to sample. We now have cell phone contact so sampling can be arranged ahead of time.

Fish

1. September 2021: Control Station 94 - no fish samples collected for fall sampling. Per procedure ER-OCGS-14, fish are to be collected if available.

Vegetation

1. 2021 Season: Station 66 - No crop was recovered from Station 66 for the entire season. (IR #OYS-02407)

Program exceptions are tracked by Oyster Creek staff and Normandeau and investigated to understand the causes of the program exception. Sampling and maintenance errors are reviewed with the personnel involved to prevent recurrence.

The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

E. Program Changes

There were no program changes in 2021.

IV. Results and Discussion

A. Aquatic Environment

1. Surface Water

Samples were taken via grab sample methodology at two locations (33 and 94) on a monthly schedule. In addition, grab samples were collected semi-annually at two locations (23 and 24). Of these locations 23, 24, and 33, located downstream, could be affected by Oyster Creek's effluent releases. The following analyses were performed:

Tritium

Surface water sampling began in 1966, and the samples were analyzed for tritium as well as other radioactivity. During this preoperational program, tritium was detected at an average concentration of 1,050 pCi/L. At that time, counting instrumentation was not as sensitive as it now, and the minimum detectable concentration (MDC) was 1,000 pCi/L versus 200 pCi/L used through October 2021. (The MDC was changed to 2,000 pCi/L in November 2020). By comparing the 2021 sampling results to the decay- corrected average preoperational concentration reported in the 2007 Annual Radiological Environmental Operating Report (111 pCi/L), it can be seen that the inventory of tritium in the environment is due to fallout from past atmospheric nuclear weapons testing and is decreasing with time.

Samples from all locations were analyzed for tritium activity. No tritium activity was detected. (Table C–I.1, Appendix C)

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides. All nuclides were less than the MDC. (Table C–I.2, Appendix C)

2. Drinking water

Monthly grab samples were taken from three drinking water wells (1N, 37 and 38). Station 1, because it is located on the OCGS site, could potentially be affected by radioactive releases from the plant. Station 1 was split into two separate locations, 1N and 1S. Station 38, the Ocean Township Municipal Utility Authority Well, could potentially be affected by effluent releases from the OCGS. Given its distance from the facility (1.6 miles) and depth (approximately 360 feet), however, the probability of any OCGS-related impact is very small. Stations 37, a Lacey Township Municipal Utility Authority well, is not likely to be impacted by effluents from the OCGS. This well is located generally up-gradient of the regional groundwater flow direction (southeast). In addition, because of the depth (> 200 feet) and distance from the site (2.2 miles), it is unlikely to be affected by OCGS operations.

The following analyses were performed:

Tritium

Monthly samples from all locations were analyzed for tritium activity. No tritium activity was detected. Drinking water was sampled during the preoperational program and throughout the almost 50 years of the plant's operational program. Tritium sampling results during the preoperational years, yielded results all less than the minimum detectable concentration of 1000 pCi/L. The 2021 results are all less than the MDC. (Table C–II.1, Appendix C)

Gross Beta

Monthly samples from all locations were analyzed for concentrations of total gross beta activity. Gross beta was detected in 11 of 35 samples and is attributed to natural sources and fallout residual from previous bomb testing. The values ranged from 1.5 to 6.9 pCi/L. (Table C-II.2, Appendix C)

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides. All nuclides were less than the MDC. (Table C–II.3, Appendix C)

3. Groundwater

The following analyses were performed:

Tritium

Samples from all locations were analyzed for tritium activity. No tritium activity was detected. (Table C–III.1, Appendix C)

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C–III.2, Appendix C). All nuclides were less than the MDC.

4. Fish

Fish samples comprised of predators (striped bass, white perch, American eel and weakfish) were collected at three locations (33, 93, and 94) semiannually when available. Locations 93 and 33 could be affected by Oyster Creek's effluent releases. The following analysis was performed:

Gamma Spectrometry

The edible portions of fish samples from three locations were analyzed for gamma emitting nuclides. Naturally occurring K-40 was found at all stations and ranged from 2,831 to 4,475 pCi/kg wet and was consistent with levels detected in previous years. No fission or activation products were found. (Table C–IV.1, Appendix C)

No fish were sampled during the preoperational sampling program for OCGS.

5. Clams and Crabs

Clams were collected at three locations (23, 24, and 94) semiannually when available. Crabs were collected at two locations (33 and 93) annually when available. Locations 23, 24, 33, and 93 could be affected by Oyster Creek's effluent releases. The following analysis was performed:

<u>Gamma Spectrometry</u>

The edible portions of clam samples from all three locations were analyzed for gamma emitting nuclides. Naturally occurring K-40 was found at all stations and ranged from 1,222 to 1,644 pCi/kg wet and was consistent with levels detected in previous years. No fission or activation products were found. (Table C–IV.2, Appendix C) Historical levels of Co-60 in clams are shown in Figure C–1, Appendix C. After 1986, all results were less than the Lower Limit of Detection (LLD).

Preoperational clam sample results for naturally occurring K-40 ranged from 600 to 9,800 pCi/kg wet, which are consistent with current sample results.

The edible portions of an annual crab sample were analyzed for gamma emitting nuclides. Naturally occurring K-40 was found at both stations with concentrations ranging from 1,883 to 2,717 pCi/kg wet, consistent with levels detected in previous years. No fission or activation products were found. (Table C–IV.2, Appendix C)

Crabs were not sampled during the preoperational years of the OCGS environmental monitoring program.

6. Sediment

Aquatic sediment samples were collected at four locations (23, 24, 33, and 94) semiannually. Of these locations, stations 23, 24, and 33 located downstream, could be affected by Oyster Creek's effluent releases. The following analysis was performed:

<u>Gamma Spectrometry</u>

Sediment samples from all four locations were analyzed for gamma emitting nuclides. Naturally occurring K-40 was found at all stations and ranged from 944 to 17,120 pCi/kg dry. Naturally occurring Ra-226 was found at one location at a concentration range of 1325 to 2,173 pCi/kg dry. Naturally occurring Th-228 was found at all 4 stations and ranged from 103 to 639 pCi/kg wet. Cs-137 was not detected in any of the samples. No fission or activation products were found.
(Table C–V.1, Appendix C)

The Figure C-3, Appendix C graph shows Cs-137 concentrations in sediment from 1984 through 2021 and Figure C–2, Appendix C graph shows Co-60 concentrations in sediment from 1984 through 2021.

The requirement for sampling sediment is a requirement of ODCM 3.12.1, Table 3.12.1-1.d. ODCM Table 3.12.1-2, "Reporting Levels for Radioactive Concentrations in Environmental Samples Reporting Levels" does not include requirements for sediment. CY-AA-170-1000, Radiological Environmental Monitoring Program and Meteorological Program Implementation, Attachment 1, Analytical Results Investigation Levels, includes sediment investigation level for Cs-137 of 1000E+00 pCi/kg dry.

While aquatic sediment sampling was part of the preoperational program, samples were not analyzed for gamma emitting nuclides until 1981.

In conclusion, the 2021 aquatic monitoring results for surface water, drinking water, groundwater, fish, clams, crabs, and sediment showed only naturally occurring radioactivity and were consistent with levels measured prior to the operation of OCGS, and with levels measured in past years. No radioactivity attributable to activities at OCGS was detected in any aquatic samples during 2021 and no adverse long-term trends are shown in the aquatic monitoring data.

B. Atmospheric Environment

1. Airborne (Air Particulates)

Continuous air particulate samples were collected from seven locations on a bi-weekly basis. The seven locations were separated into three groups: Group I represents locations near the OCGS site boundary (20, 66 and 111), Group II represents the locations at an intermediate distance from the OCGS site (71, 72, and 73), and Group III represents the control and locations at a remote distance from OCGS (C). The following analyses were performed:

<u>Gross Beta</u>

Samples were analyzed for concentrations of beta emitters. Detectable gross beta activity was observed at all locations. Comparison of results among the three groups aids in determining the effects, if any, resulting from the operation of OCGS. The results from the Site Boundary locations (Group I) ranged from 7E-03 to 28E–03 pCi/m^3 with a mean of 15E–03 pCi/m^3. The results from the Intermediate Distance locations (Group II) ranged from 5E-03 to 25E–03 pCi/m^3 with a mean of 14E–03 pCi/m^3. The results from the Distant locations (Group III) ranged from 8E-03 to 24E–03 pCi/m^3 with a mean of 17E–03 pCi/m^3. (Table C–VI.1 and C–VI.2, Appendix C)

The similarity of the results from the three groups indicates that there is no relationship between gross beta activity and distance from OCGS. These results are consistent with data from previous years and indicate no effects from the operation of OCGS. (Figures C-4 and C–5, Appendix C).

Air sample filters have been analyzed for gross beta activity since the inception of the preoperational environmental monitoring program in 1966. The preoperational data values ranged from 1.90E-02 to 2.77E-01 pCi/m3. The 2021 gross beta activity values ranged from <3E-03 to 28E-03 pCi/m3. The 2021 results are consistent with historical operational data (Figure C-5, Appendix C) and fall within the range of results observed during the preoperational period.

Strontium-90

Samples were composited quarterly and analyzed for Sr-90. No strontium was detected in any of the samples. (Table C–VI.3, Appendix C) These results are consistent with historical operational data. The preoperational environmental monitoring program did not include analysis of air samples for Sr-90.

Gamma Spectrometry

Samples were composited quarterly and analyzed for gamma emitting nuclides. Naturally occurring Be-7 due to cosmic ray activity was detected in 28 of 28 samples. The values ranged from 46E-03 to 94E–03 pCi/m^3. All other nuclides were less than the MDC. (Table C–VI.4, Appendix C) These results are consistent with historical operational data. The preoperational environmental monitoring program did not include analysis of air samples for gamma emitting nuclides.

2. Terrestrial

a. Vegetation

Samples were collected from four locations (35, 36, 66 and 115) when available. The following analyses were performed:

Strontium-89 and Strontium-90

Vegetation samples from all locations were analyzed for concentrations of Sr-89 and Sr-90. All Sr-89 results were less than the MDC. Sr-90 was detected in 16 of 32 samples. The values ranged from 5.9 to 15 pCi/kg wet, which is consistent with historical data. (Table C–VIII.1, Appendix C)

The following information on Sr-90 is available on the NRC web page under “Backgrounder Radiation Protection and the “Tooth Fairy” Issue” published in December of 2004:

> *The largest source of Sr-90 in the environment (~99%) is from weapons testing fallout. Approximately 16.8 million curies of Sr-90 were produced and globally dispersed in atmospheric nuclear weapons testing until 1980. As a result of the Chernobyl accident, approximately 216,000 curies of Sr-90 were released into the atmosphere. With a 28-year half-life, Sr-90 still remains in the environment at nominal levels.*

The total annual release of Sr-90 into the atmosphere from all 103 commercial nuclear power plants operating in the United States is typically 1/1000th of a curie. (NUREG/CR-2907 Vol.12). At an individual nuclear power plant, the amount of Sr-90 is so low that it is usually at or below the minimum detectable activity of sensitive detection equipment.

Oyster Creek did not report any Sr-90 released in the Annual Radioactive Effluent Release Report as all analyses for Sr-90 performed were less than the minimum detectable concentration.

<u>Gamma Spectrometry</u>

Vegetation samples from locations 35, 36, and 115 were analyzed for concentrations of gamma-emitting nuclides. Naturally occurring K-40 activity was found in all samples and ranged from 1,152 to 6,042 pCi/kg wet. Naturally occurring Be-7 was detected in 5 of 32 samples and ranged from 258 to 465 pCi/kg wet. All other nuclides were less than the MDC. (Table C–VIII.1, Appendix C)

Preoperational vegetation sample analyses did not include strontium analyses or gamma spectroscopy.

Oyster Creek conducted a Cs-137 study in 2006/2007. A report was generated titled "Evaluation of Cesium-137 in Environmental Samples from the Amergen Property East of the Oyster Creek Generating Station". Below is an excerpt from that report:

"The levels of Cs-137 observed in the soil and vegetation samples are consistent with environmental concentrations known to be attributable to fallout from historic nuclear weapons testing and the Chernobyl accident. In addition, the variability of Cs-137 concentrations in soil and vegetation on the farm property appears to be driven by a number of environmental factors. Cs-137 concentrations in soil were non-detectable. Vegetation samples exhibited Cs-137 concentrations from non-detectable to 0.130 pCi/g, with a mean concentration of 0.078 pCi/g. For comparison, in the year 2000, as part of the confirmatory release survey for the adjacent Forked River site to the west of OCGS, the NRC reported that the maximum observed soil concentration of 0.53 pCi/g was not distinguishable from the variation in Cs-137 in the environment due to these fallout sources. The NRC also reported background Cs-137 concentrations in New Jersey coastal plain soils as high as 1.5 and 2.8 pCi/g. In addition, decay-corrected historic REMP data from a predominantly upwind location, nearly four miles from the OCGS, yields present-day Cs-137 concentrations ranging from 0.862 to 1.68 pCi/g."

In 2021, there was no Cs-137 identified in any vegetation samples, but it is not unusual for Cs-137 to be identified given the known environmental levels of this radionuclide attributable to atmospheric nuclear weapons testing and the Chernobyl accident.

In conclusion, terrestrial monitoring results for vegetation samples during 2021 showed only naturally-occurring radioactivity and radioactivity associated with fallout from past atmospheric nuclear weapons testing and Chernobyl. The radioactivity levels detected were consistent with levels measured in past years, and no radioactivity attributable to activities at OCGS was detected in any terrestrial samples. The terrestrial monitoring data show no adverse long-term trends in the terrestrial environment.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured using Optically Stimulated Luminescence Dosimeters (OSLD). Forty-four OSLD locations were monitored around the site with all measurements below 25 mRem/yr. Results of background corrected OSLD measurements are summarized in Tables C-IX.1 to C-IX.3 and Figure C-6.

The non-background corrected OSLD measurements ranged from 19 to 31.1 mR/standard quarter. In order to correct these results for background radiation, the mean of the dose rates measured at the background OSLD station (C) was subtracted from the dose measured at each indicator station.

The preoperational environmental monitoring program utilized film badges, the results of which are not comparable with the doses measured using thermoluminescent dosimeters or optically stimulated dosimeters during the operational REMP. In conclusion, the 2021 OSLD results are consistent with past operational measurements of direct radiation and demonstrate that the OCGS continues to be in compliance with the 40 CFR 190 limit on maximum dose to the public.

D. Land Use Survey

A Land Use Survey, conducted in September 2021 around the Oyster Creek Generating Station (OCGS), was performed by Normandeau Associates, Inc. for HDI. The survey is conducted annually to identify any changes from the previous year. The purpose of the survey is to identify the nearest residence and garden larger than 500 square feet within each meteorological sector, at a distance of 5 miles from the plant. Additionally, as part of the survey, Normandeau also looked for evidence of milk-producing animals for human consumption in each of the 16 meteorological sectors out to a distance of 5 miles from the OCGS. None were observed. The distance and direction of all locations from the OCGS Reactor Building were determined using Global Positioning System (GPS) technology. Twenty-four gardens identified in the 2020 report were not viable or determined to be too small to be considered this year. However, eighteen new gardens, previously not identified, were noted within 3 miles of the facility during this year's survey. The results of this survey are summarized below:

Distance in Feet from the OCGS Reactor Building			
Sector		Residence (ft.)	Garden* (ft.)
1	N	5,655	6,077
2	NNE	3,240	4,557
3	NE	3,245	3,932
4	ENE	5,704	6,486
5	E	6,549	1,758
6	ESE	3,189	2,081
7	SE	3,073	2,321
8	SSE	4,666	4,872
9	S	7,971	9,034
10	SSW	8,260	8,290
11	SW	9,285	9,776
12	WSW	10,713	12,354
13	W	22,191	None
14	WNW	None	None
15	NW	27,985	None
16	NNW	7,506	8,918

**Greater than 500 ft² in size producing broad leaf vegetation*

E. Summary of Results – Inter-laboratory Comparison Program

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes. The PE samples supplied by Analytics Inc., Environmental Resource Associates (ERA) and Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

A. Analytics Evaluation Criteria

Analytics' evaluation report provides a ratio of TBE's result and Analytics' known value. Since flag values are not assigned by Analytics, TBE evaluates the reported ratios based on internal Quality Control (QC) requirements based on the DOE MAPEP criteria.

B. ERA Evaluation Criteria

ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the United States Environmental Protection Agency (USEPA), National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (PT) program requirements or ERA's standard operating procedure (SOP) for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

C. DOE Evaluation Criteria

MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

- Acceptable (flag = "A") - result within ± 20% of the reference value
- Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
- Not Acceptable (flag = "N") - bias is greater than 30% of the reference value

Note: The Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

For the TBE laboratory, 146 out of 154 analyses performed met the specified acceptance criteria. Seven analyses did not meet the specified acceptance criteria and were addressed through the TBE Corrective Action Program. *NOTE: One analysis (soil for Tc-99) that did not meet acceptance criteria was performed for TBE information and is not on the list of required ICP analyses.* A summary is found below:

1. The ERA MRAD March 2021 Water Fe-55 result was evaluated as *Not Acceptable*. The reported value for Fe-55 was 579 pCi/L and the known result was 275 pCi/L (acceptance range 162 - 400). When reviewing the original sample data, it was found that the carrier yield was 52.6% (lower than typical water samples). Looking at the etched plate that was counted, it appeared that some loss of sample could have occurred. The sample was logged for reanalysis and used as the workgroup duplicate. The results were acceptable at 197 and 221 respectively. Yields were 97.4% and 105.7% and the plated samples were centered with no apparent loss of sample. The loss of sample during plating resulted in a low yield which produced an artificially high sample result. (NCR 21-01)

2. The MAPEP February 2021 AP Gross Alpha result was evaluated as *Not Acceptable*. The reported value was 0.371 Bq/sample and the known result was 1.77 Bq/sample (acceptance range 0.53 - 3.01). A similar failure had occurred several years prior due to the filter being placed with the wrong side up on the detector. At that time, a small dot was placed on the top of

the filter prior to removal from the package to indicate the correct side for counting. The current sample was still in the detector when the result was received (dot side facing the detector). The sample was recounted with a similar result and was flipped and recounted. The flipped result was 0.661 Bq/sample, within the acceptable range. Because TBE cannot rely on receiving correct packaging from the provider, MAPEP AP cross-checks will be counted on both sides going forward. *NOTE: The August sample had the same packaging issue (upside down).* (NCR 21-02)

3. The MAPEP February 2021 soil Ni-63 was evaluated as *Not Acceptable*. The reported value was 310 Bq/kg and the known result was 689 (acceptance range 482 - 896). All workgroup QC was reviewed with no anomalies. The analytical procedure had been revised prior to this analysis to eliminate added interferences. The sample yield was >100%, indicative of incomplete separation from interferences, leading to a lower result. The procedure was again revised after acceptable results were obtained. (NCR 21-03)

4. The ERA October 2021 water Gross Beta result was evaluated as *Not Acceptable*. The reported value was 63.0 pCi/L and the known was 55.7 (acceptance range 38.1 - 62.6) or 113% of the known. The 2-sigma error was 6.8, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. A follow-up Quick Response cross-check was analyzed with a 120% ratio (see item 7). (NCR 21-10)

5. The ERA October 2021 water Tritium result was evaluated as *Not Acceptable*. The reported value was 13,800 pCi/L and the known was 17,200 (acceptance range 15,000 - 18,900). The 2-sigma error was 1,430, placing the result within the acceptable range. TBE's internal QC acceptance is 70% - 130%, while ERA's for this sample was 87% - 110%. All QA was reviewed with no anomalies. A Quick Response follow-up cross-check was analyzed with a result of 17,500 pCi/L (known 17,800 pCi/L). (NCR 21-11)

6. The MAPEP August 2021 soil Ni-63 result was evaluated as *Not Acceptable*. The reported value was 546 Bq/kg and the known result was 1,280 Bq/kg (acceptance range 896 - 1,664). All QC was reviewed and no anomalies found. The procedure revision to remove added MAPAP interferences was ineffective for this sample. No client soil matrix samples were analyzed for Ni-63 in 2020 or 2021. The root cause investigation is still ongoing at this time. (NCR 21-13)

7. The ERA December 2021 Quick Response water Gross Beta result was evaluated as *Not Acceptable*. The reported value was 47.6 pCi/L and the known was 39.8 pCi/L or 120% of the known (acceptance range of 26.4 - 47.3). The 2-sigma error was 6.1, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. The original sample was recounted on a different detector with a result of 40.3 ± 6.27

pCi/L. The “failure” of this sample and the RAD-127 was due to the narrow upper acceptance ranges assigned (119% and 112%) (NCR 21-14)

For secondary QC samples, Environmental Inc., Midwest Laboratories (EIML) analyzed samples for H-3, Sr-89/90 and gamma nuclides (REMP). In addition, EIML performed Gross Alpha analyses for the ARGPP (see Appendix H, Appendix B). For these nuclides, 29 out of 29 analyses performed met the specified acceptance criteria.

The Inter-Laboratory Comparison Program provides evidence of “in control” counting systems and methods, and that the laboratories are producing accurate and reliable data.

V. References

1. HDI Offsite Dose Calculation Manual for Oyster Creek Generating Station, Procedure CY-OC-170-301.

2. United States Nuclear Regulatory Commission Branch Technical Position, An Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

3 Pre-Operational Environmental Radiation Survey, Oyster Creek Nuclear Electric Generating Station, Jersey Central Power and Light Company, March 1968.

VI. Errata

There was no errata data for 2021.

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APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

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TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE OYSTER CREEK GENERATING STATION, 2021

NAME OF FACILITY: OYSTER CREEK GENERATING STATION **DOCKET NUMBER: 50-219**
LOCATION OF FACILITY: OCEAN COUNTY, NJ **REPORTING PERIOD: 2021**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER *(PCI/LITER)*	**H-3**	30	**2000**	<LLD	<LLD	-		0
	GAMMA	30						
	MN-54		**15**	<LLD	<LLD	-		0
	CO-60		**15**	<LLD	<LLD	-		0
	ZN-65		**30**	<LLD	<LLD	-		0
	ZR-95		**30**	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
DRINKING WATER *(PCI/LITER)*	**H-3**	35	**2000**	<LLD	<LLD	-		0
	GR-B	35	**4**	1.8 (5/23) *1.5 - 2.2*	2.8 (6/12) *1.6 - 6.9*	2.8 (6/12) *1.6 - 6.9*	37 CONTROL BOOX RD AT LACEY MUA PUMPING STA 2.2 MILES NNE OF SITE	0
	GAMMA	35						
	MN-54		**15**	<LLD	<LLD	-		0
	CO-60		**15**	<LLD	<LLD	-		0
	ZN-65		**30**	<LLD	<LLD	-		0
	ZR-95		**30**	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
GROUNDWATER *(PCI/LITER)*	**H-3**	8	**2000**	<LLD	*NA*	-		0
	GAMMA	8						
	MN-54		**15**	<LLD	*NA*	-		0
	CO-60		**15**	<LLD	*NA*	-		0
	ZN-65		**30**	<LLD	*NA*	-		0
	ZR-95		**30**	<LLD	*NA*	-		0
	CS-134		**15**	<LLD	*NA*	-		0
	CS-137		**18**	<LLD	*NA*	-		0
FISH (PREDATOR) *(PCI/KG WET)*	**GAMMA**	10						
	K-40		*NA*	3415 (9/9) *2831 - 4475*	*3887* (1/1)	3887 (1/1) *3258 - 5466*	94 CONTROL GREAT BAY/LITTLE EGG HARBOR 20.0 MILES SSW OF SITE	0
	MN-54		**130**	<LLD	*NA*	-		0
	CO-60		**130**	<LLD	*NA*	-		0
	ZN-65		**260**	<LLD	*NA*	-		0
	CS-134		**130**	<LLD	*NA*	-		0
	CS-137		**150**	<LLD	*NA*	-		0

(M) *The Mean Values are calculated using the positive values.* ***(F)*** *Fraction of detectable measurement are indicated in parentheses.*

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE OYSTER CREEK GENERATING STATION, 2021

NAME OF FACILITY: OYSTER CREEK GENERATING STATION **DOCKET NUMBER: 50-219**
LOCATION OF FACILITY: OCEAN COUNTY, NJ **REPORTING PERIOD: 2021**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
CLAMS	**GAMMA**	7						
(PCI/KG WET)	*K-40*		*NA*	1489	*1239*	1503	QCA INDICATOR	0
				(5/5)	*(2/2)*	(1/1)	QC DUPLICATE SAMPLE	
				1342 - 1644	*1222 - 1255*			
	MN-54		**130**	<LLD	<LLD	-		0
	CO-60		**130**	<LLD	<LLD	-		0
	ZN-65		**260**	<LLD	<LLD	-		0
	CS-134		**130**	<LLD	<LLD	-		0
	CS-137		**150**	<LLD	<LLD	-		0
CRABS	**GAMMA**	2						
(PCI/KG WET)	*K-40*		*NA*	2300	*NA*	2717	33 INDICATOR	0
				(2/2)		(1/1)	EAST OF RT 9 BRIDGE IN OCGS DISCHARGE	
				1883 - 2717			0.4 MILES ESE OF SITE	
	MN-54		**130**	<LLD	*NA*	-		0
	CO-60		**130**	<LLD	*NA*	-		0
	ZN-65		**260**	<LLD	*NA*	-		0
	CS-134		**130**	<LLD	*NA*	-		0
	CS-137		**150**	<LLD	*NA*	-		0
SEDIMENT	**GAMMA**	10						
(PCI/KG DRY)	*BE-7*		*NA*	<LLD	<LLD	-		0
	K-40		*NA*	2654	16080	16080	94 CONTROL	0
				(8/8)	(2/2)	(2/2)	GREAT BAY/LITTLE EGG HARBOR	
				944 - 5534	*15040 - 17120*	*15040 - 17120*	20.0 MILES SSW OF SITE	
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	CS-134		**150**	<LLD	<LLD	-		0
	CS-137		**180**	<LLD	<LLD	-		0
	Ra-226		*NA*	<LLD	*1749*	1749	94 CONTROL	0
					(2/2)	(2/2)	GREAT BAY/LITTLE EGG HARBOR	
					1325 - 2173	1325 - 2173	20.0 MILES SSW OF SITE	
	Th-226		*NA*	215	601	601	94 CONTROL	
				(7/8)	*(2/2)*	*(2/2)*	GREAT BAY/LITTLE EGG HARBOR	0
				103 - 304	564 - 639	*564 - 639*	20.0 MILES SSW OF SITE	

(M) *The Mean Values are calculated using the positive values.* ***(F)*** *Fraction of detectable measurement are indicated in parentheses.*

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE OYSTER CREEK GENERATING STATION, 2021

NAME OF FACILITY: OYSTER CREEK GENERATING STATION **DOCKET NUMBER: 50-219**

LOCATION OF FACILITY: OCEAN COUNTY, NJ **REPORTING PERIOD: 2021**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE *(E-3 PCI/CU.METER)*	**GR-B**	176	**10**	15 (149/150) *5 - 28*	17 (26/26) *8 - 24*	17 (26/26) *8 - 24*	C CONTROL JCP&L OFFICE - COOKSTOWN NJ 24.7 MILES NW OF SITE	0
	SR-90	28	**10**	<LLD	<LLD	-		0
AIR PARTICULATE *(E-3 PCI/CU.METER)*	**GAMMA**	28						
	BE-7		*NA*	65 (24/24) *46 - 94*	71 (4/4) *50 - 85*	71 (4/4) *50 - 85*	C CONTROL JCP&L OFFICE - COOKSTOWN NJ 24.7 MILES NW OF SITE	0
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	CS-134		**50**	<LLD	<LLD	-		0
	CS-137		**60**	<LLD	<LLD	-		0
VEGETATION *(PCI/KGWET)*	**SR-89**	32	**25**	<LLD	<LLD	-		0
	SR-90	32	**5**	9.7 (8/20) *6.5 - 13.9*	10.6 (7/12) *5.9 - 15*	10.6 (7/12) *5.9 - 15*	36 CONTROL U-PICK FARM - NEW EGYPT NJ 23.1 MILES NW OF SITE	0
	GAMMA	32						
	BE-7		*NA*	326 (3/20) *258 - 369*	426 (2/12) *388 - 465*	426 (2/12) *388 - 465*	36 CONTROL U-PICK FARM - NEW EGYPT NJ 23.1 MILES NW OF SITE	0
	K-40		*NA*	2274 (20/20) *1152 - 4903*	3918 (12/12) *2316 - 6042*	4053 (3/3) *3467 - 4903*	QCA INDICATOR QC DUPLICATE SAMPLE	0
	CS-134		**60**	<LLD	<LLD	-		0
	CS-137		**80**	<LLD	<LLD	-		0
DIRECT RADIATION *(MILLIREM/STD.MO.)*	**OSLD-QUARTERLY**	380	*NA*	23.1 (376/376) *19.0 - 31.1*	23.1 (4/4) *21.2 - 25.7*	29.1 (4/4) *27.5 - 31.1*	55 INDICATOR SOUTHERN AREA STORES SECURITY FENCE 0.3 MILES W	0

(M) *The Mean Values are calculated using the positive values.* ***(F)*** *Fraction of detectable measurement are indicated in parentheses.*

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APPENDIX B

LOCATION DESIGNATION, DISTANCE & DIRECTION, AND SAMPLE COLLECTION & ANALYTICAL METHODS

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TABLE B-1: Location Designation and Identification System for the Oyster Creek Generating Station

Sample Medium	-	APT = Air Particulate	Clam = Clam
		AQS = Aquatic Sediment	Crab = Crab
		DW = Drinking Water	Fish = Fish
		GW = Ground Water	SWA = Surface Water
		OSLD = Optically Stimulated Luminescence Dosimetry	VEG = Vegetation
Station Code	-	Station's Designation	
Distance	-	Distance from the OCGS in miles	
Azimuth	-	Azimuth with respect to the OCGS in degrees	
Description	-	Meteorological sector in which the station is located and a narrative description	

TABLE B-2: Radiological Environmental Monitoring Program – Sampling Locations, Distance and Direction, Oyster Creek Generating Station, 2021

Sample Medium	Station Code	Distance (miles)	Azimuth (degrees)	Description
OSLD	1	0.4	219	SW of site at OCGS Fire Pond, Forked River, NJ
DW	1N	0.2	349	On-site northern domestic well at OCGS, Forked River, NJ
DW	1S	0.1	209	On-site southern domestic well at OCGS, Forked River, NJ
OSLD	6	2.1	13	NNE of site, Lane Place, behind St. Pius Church, Forked River, NJ
OSLD	8	2.3	177	South of site, Route 9 at the Waretown Substation, Waretown, NJ
OSLD	9	2.0	230	WSW of site, west of where Route 532 and the Garden State Parkway meet, Waretown, NJ
APT, OSLD	C	24.7	313	NW of site, JCP&L office in rear parking lot, Cookstown, NJ
APT	20	0.7	95	East of site, on Finninger Farm on south side of access road, Forked River, NJ
OSLD	22	1.6	145	SE of site, on Long John Silver Way, Skippers Cove, Waretown, NJ
SWA, CLAM, AQS	23	3.6	64	ENE of site, Barnegat Bay off Stouts Creek, approximately 400 yards SE of "Flashing Light 1"
SWA, CLAM, AQS	24	2.1	101	East of site, Barnegat Bay, approximately 250 yards SE of "Flashing Light 3"
SWA, AQS, FISH, CRAB	33	0.4	123	ESE of site, east of Route 9 Bridge in OCGS Discharge Canal
VEG	35	0.4	111	ESE of site, east of Route 9 and north of the OCGS Discharge Canal, Forked River, NJ
VEG	36	23.1	319	NW of site, at "U-Pick" Farm, New Egypt, NJ
DW	37	2.2	18	NNE of Site, off Boox Road at Lacey MUA Pumping Station, Forked River, NJ
DW	38	1.6	197	SSW of Site, on Route 532, at Ocean Township MUA Pumping Station, Waretown, NJ
OSLD	51	0.4	358	North of site, on the access road to Forked River site, Forked River, NJ
OSLD	52	0.3	333	NNW of site, on the access road to Forked River site, Forked River, NJ
OSLD	53	0.3	309	NW of site, at sewage lift station on the access road to the Forked River site, Forked River, NJ
OSLD	54	0.3	288	WNW of site, on the access road to Forked River site, Forked River, NJ

TABLE B-2: Radiological Environmental Monitoring Program – Sampling Locations, Distance and Direction, Oyster Creek Generating Station, 2021

Sample Medium	Station Code	Distance (miles)	Azimuth (degrees)	Description
OSLD	55	0.3	263	West of site, on Southern Area Stores security fence, west of OCGS Switchyard, Forked River, NJ
OSLD	56	0.3	249	WSW of site, on utility pole east of Southern Area Stores, west of the OCGS Switchyard, Forked River, NJ
OSLD	57	0.3	206	SSW of site, on Southern Area Stores access road, Forked River, NJ
OSLD	58	0.3	188	South of site, on Southern Area Stores access road, Forked River, NJ
OSLD	59	0.3	166	SSE of site, on Southern Area Stores access road, Waretown, NJ
OSLD	61	0.3	104	ESE of site, on Route 9 south of OCGS Main Entrance, Forked River, NJ
OSLD	62	0.2	83	East of site, on Route 9 at access road to OCGS Main Gate, Forked River, NJ
OSLD	63	0.2	70	ENE of site, on Route 9, between main gate and OCGS North Gate access road, Forked River, NJ
OSLD	64	0.3	42	NE of site, on Route 9 North at entrance to Finninger Farm, Forked River, NJ
OSLD	65	0.4	19	NNE of site, on Route 9 at Intake Canal Bridge, Forked River, NJ
APT, OSLD, VEG	66	0.4	133	SE of site, east of Route 9 and south of the OCGS Discharge Canal, inside fence, Waretown, NJ
OSLD	68	1.3	266	West of site, on Garden State Parkway North at mile marker 71.7, Lacey Township, NJ
APT, OSLD	71	1.6	164	SSE of site, on Route 532 at the Waretown Municipal Building, Waretown, NJ
APT, OSLD	72	1.9	25	NNE of site, on Lacey Road at Knights of Columbus Hall, Forked River, NJ
APT, OSLD	73	1.8	108	ESE of site, on Bay Parkway, Sands Point Harbor, Waretown, NJ
OSLD	74	1.8	88	East of site, Orlando Drive and Penguin Court, Forked River, NJ
OSLD	75	2.0	71	ENE of site, Beach Blvd. and Maui Drive, Forked River, NJ
OSLD	78	1.8	2	North of site, 1514 Arient Road, Forked River, NJ
OSLD	79	2.9	160	SSE of site, Hightide Drive and Bonita Drive, Waretown, NJ
OSLD	81	3.5	201	SSW of site, on Rose Hill Road at intersection with Barnegat Boulevard, Barnegat, NJ
FISH, CRAB	93	0.1	242	WSE of site, OCGS Discharge Canal between Pump Discharges and Route 9, Forked River, NJ

TABLE B-2: Radiological Environmental Monitoring Program – Sampling Locations, Distance and Direction, Oyster Creek Generating Station, 2021

Sample Medium	Station Code	Distance (miles)	Azimuth (degrees)	Description
SWA, AQS, CLAM, FISH	94	20.0	198	SSW of site, in Great Bay/Little Egg Harbor
OSLD	98	1.6	318	NW of site, on Garden State Parkway North at mile marker 73, Lacey Township, NJ
OSLD	99	1.5	310	NW of site, on Garden State Parkway at mile marker 72.8, Lacey Township, NJ
OSLD	100	1.4	43	NE of site, Yacht Basin Plaza South off Lakeside Dr., Lacey Township, NJ
OSLD	101	1.6	49	NE of site, end of Lacey Rd. East, Lacey Township, NJ
OSLD	102	2.4	344	NNW of site, end of Sheffield Dr., Barnegat Pines, Lacey Township, NJ
OSLD	103	1.8	337	NNW of site, Llewellyn Pkwy., Barnegat Pines, Lacey Township, NJ
OSLD	104	1.2	221	W of site, Rt. 532 West, before Garden State Parkway, Ocean Township, NJ
OSLD	106	1.2	288	WNW of site, Garden State Parkway North beside mile marker 72.2, Lacey Township, NJ
OSLD	107	1.3	301	WNW of site, Garden State Parkway North beside mile marker 72.5, Lacey Township, NJ
OSLD	109	1.2	141	SE of site, Lighthouse Dr., Waretown, Ocean Township, NJ
OSLD	110	1.5	127	SE of site, Tiller Dr. and Admiral Way, Waretown, Ocean Township, NJ
OSLD	112	0.2	176	S of site, along southern access road
OSLD	113	0.3	90	E of site, along Rt.9, North
OSLD	T1	0.4	219	SW of site, at OCGS Fire Pond, Forked River, NJ
GW	MW-24-3A	0.8	97	ESE of site, Finninger Farm on South side of access road, Lacey Township, NJ
GW	W-3C	0.4	112	ESE of site, Finninger Farm adjacent to Station 35, Lacey Township, NJ

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Oyster Creek Generating Station, 2021

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Sample Size	Analytical Procedure Number
Drinking Water	Gamma Spectroscopy	Monthly samples	ER-OCGS-06, Collection of water samples for radiological analysis CY-OC-120-1200, REMP sample collection procedure – well water	1 gallon	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Drinking Water	Tritium	Monthly samples	ER-OCGS-06, Collection of water samples for radiological analysis CY-OC-120-1200, REMP sample collection procedure – well water	1 gallon	TBE, TBE-2011 Tritium in Drinking Water by Liquid Scintillation Env. Inc., T-02 Determination of tritium in water (direct method)
Drinking Water	Gross Beta	Monthly Samples	ER-OCGS-06, Collection of water samples for radiological analysis CY-OC-120-1200, REMP sample collection procedure – well water	1 gallon	TBE, TBE-2008 Gross Alpha and/or Gross Beta Activity in Various Matrices
Surface Water	Gamma Spectroscopy	Grab Sample	ER-OCGS-06, Collection of water samples for radiological analysis	1 gallon	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Surface Water	Tritium	Grab Sample	ER-OCGS-06, Collection of water samples for radiological analysis	1 gallon	TBE, TBE-2011 Tritium in Drinking Water by Liquid Scintillation Env. Inc., T-02 Determination of tritium in water (direct method)
Groundwater	Tritium	Grab Sample	ER-OCGS-06, Collection of water samples for radiological analysis	1 gallon	TBE, TBE-2011 Tritium in Drinking Water by Liquid Scintillation
Groundwater	Gamma	Grab Sample	ER-OCGS-06, Collection of water samples for radiological analysis	1 gallon	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Fish	Gamma Spectroscopy	Semi-annual samples collected via hook and line technique and traps	ER-OCGS-14, Collection of fish samples for radiological analysis	250 grams (wet)	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis
Clams and Crabs	Gamma Spectroscopy	Semi-annual and annual samples collected using clam tongs and traps.	ER-OCGS-16, Collection of clam and crab samples for radiological analysis	300 grams (wet)	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Oyster Creek Generating Station, 2021

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Sample Size	Analytical Procedure Number
Sediment	Gamma Spectroscopy	Semi-annual grab samples	ER-OCGS-03, Collection of aquatic sediment samples for radiological analysis	1000 grams (dry)	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Air Particulates	Gross Beta	Two-week composite of continuous air sampling through glass fiber filter paper	ER-OCGS-05, Collection of air iodine and air particulate samples for radiological analysis	1 filter (approximately 300 cubic meters weekly)	TBE, TBE-2008 Gross alpha and/or beta activity in various matrices
Air Particulates	Gamma Spectroscopy	Quarterly composite of each station	TBE, TBE-2023 Compositing of samples Env. Inc., AP-03 Procedure for compositing air particulate filters for gamma spectroscopic analysis	13 filters (approximately 4000 cubic meters)	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis
Air Particulates	Strontium-90	Quarterly composite of each station	ER-OCGS-05, Collection of air iodine and air particulate samples for radiological analysis	13 filters (approximately 4000 cubic meters)	TBE, TBE-2018 Radiostrontium Analysis by Chemical Separation
Vegetation	Gamma Spectroscopy	Grab sample during growing season	ER-OCGS-04, Collection of food products and broadleaf vegetation samples for radiological analysis	1000 grams	TBE, TBE-2007 Gamma-Emitting Radioisotopes Analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Vegetation	Strontium-89/90	Grab sample during growing season	ER-OCGS-04, Collection of food products and broadleaf vegetation samples for radiological analysis	1000 grams	TBE, TBE-2018 Radiostrontium Analysis by Chemical Separation Env. Inc., SR-05 Determination of Sr-89 and Sr-90 in Ashed Samples
OSLD	Optically Stimulated Luminescence Dosimetry	Quarterly OSLDs comprised of two Al_2O_3:C Landauer Incorporated elements.	ER OCGS-02, Collection/Exchange of Field Dosimeters for Radiological Analysis	2 dosimeters	Landauer Incorporated

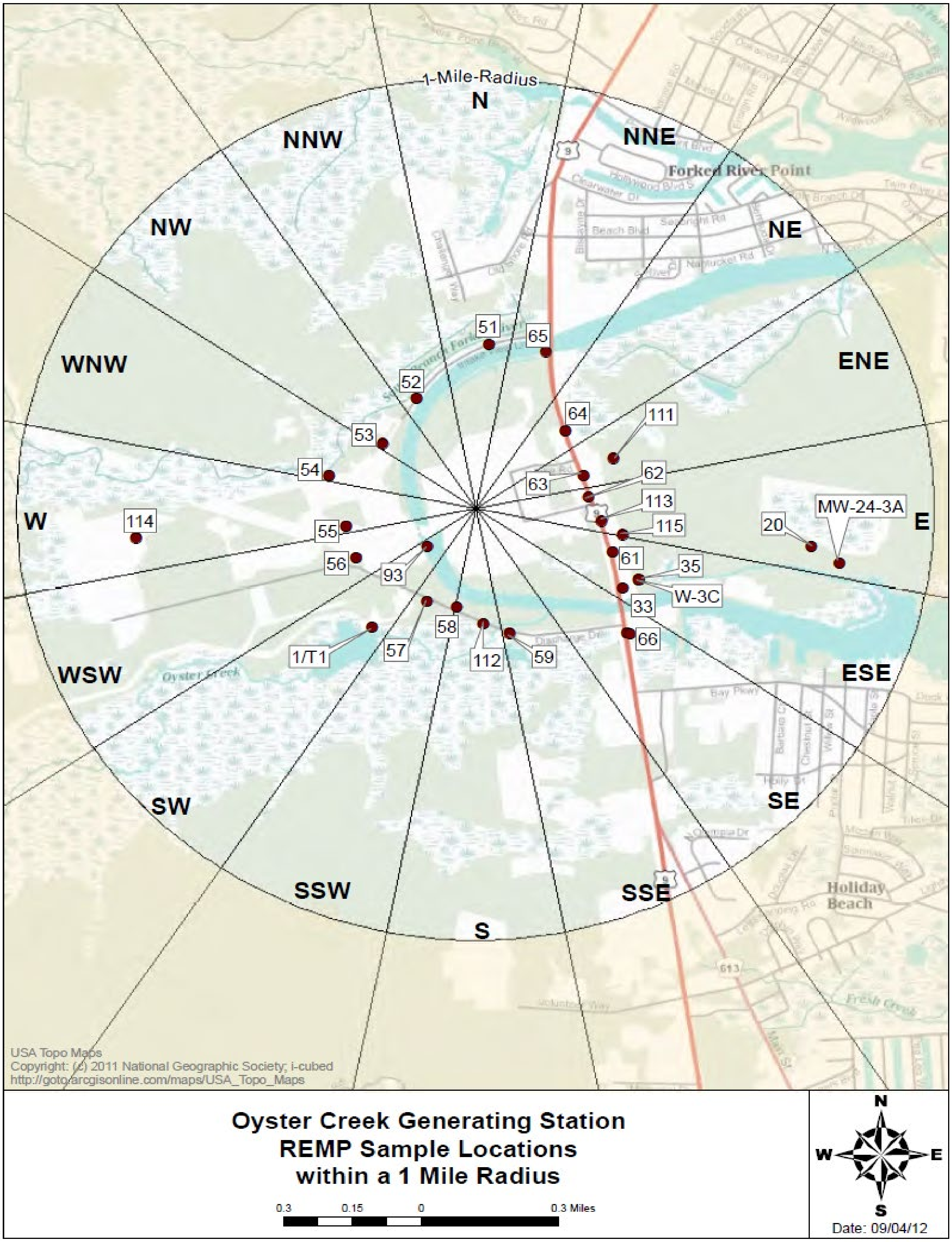

Figure B-1
Locations of REMP Stations within a 1-mile radius
of the Oyster Creek Generating Station, 2021

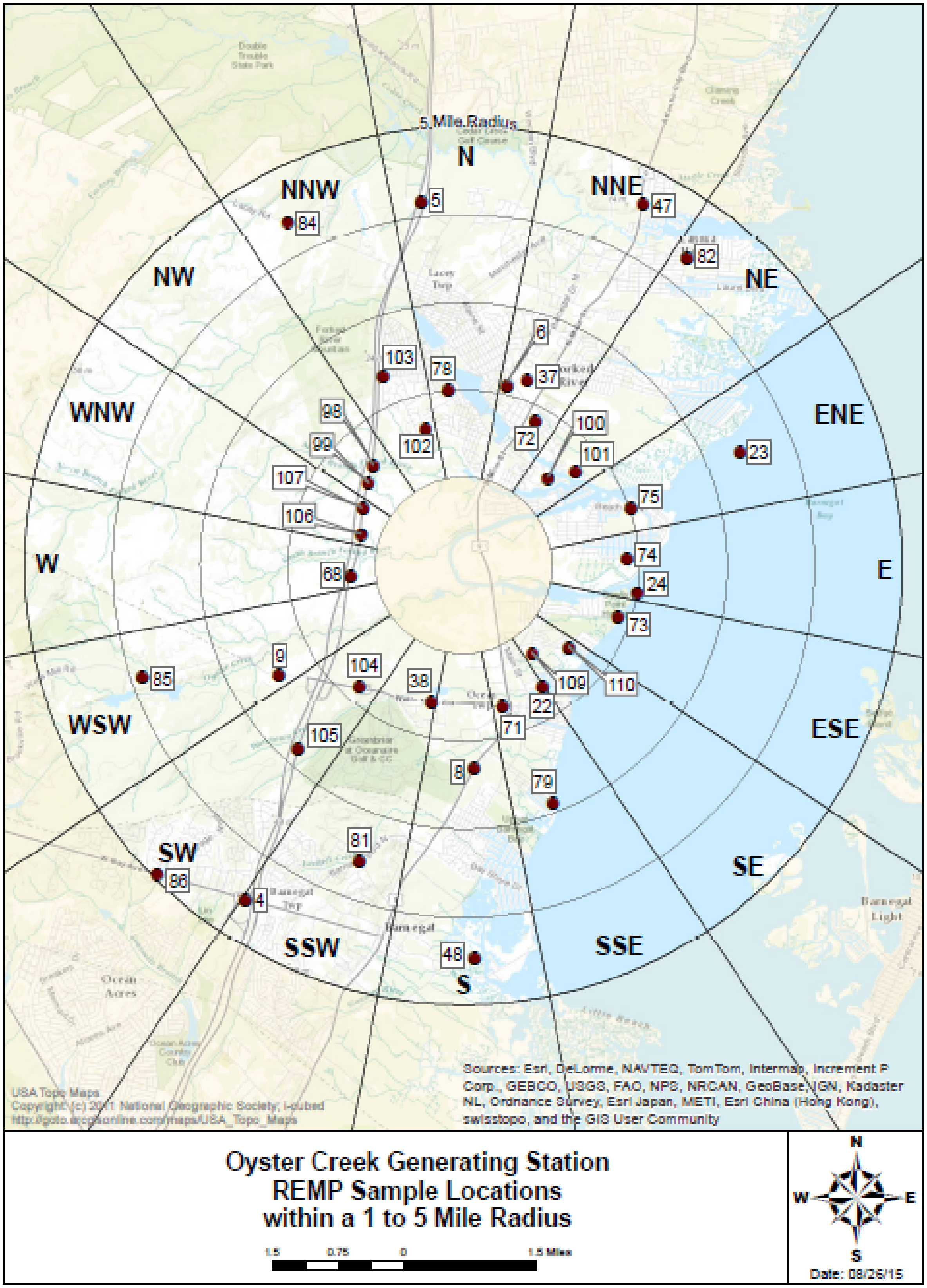

Figure B-2
Locations of REMP Stations within a 1 to 5-mile radius
of the Oyster Creek Generating Station, 2021

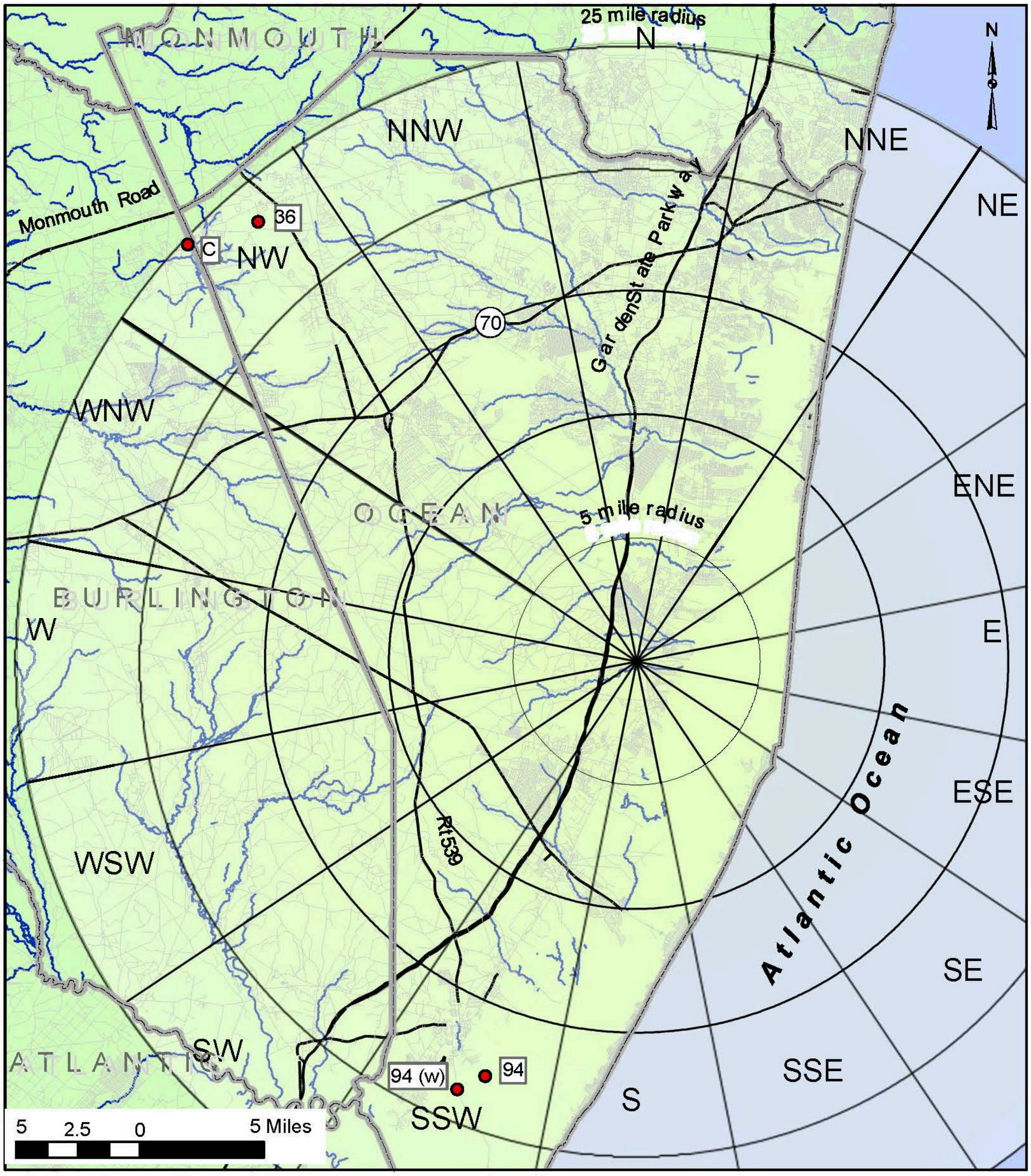

Figure B-3
Locations of REMP Stations greater than 5 miles
from the Oyster Creek Generating Station, 2021

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APPENDIX C

DATA TABLES AND FIGURES
PRIMARY LABORATORY

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Table C-I.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	23	24	33	94
01/27/21 - 01/27/21			< 185	< 184
02/24/21 - 02/24/21			< 284	< 300
03/23/21 - 03/23/21			< 180	< 180
04/22/21 - 04/22/21			< 313	< 313
05/17/21 - 05/19/21	< 179	< 178	< 300	< 532
06/22/21 - 06/22/21			< 492	< 492
07/28/21 - 07/28/21			< 258	< 266
08/25/21 - 08/25/21			< 296	< 292
09/21/21 - 09/27/21	< 269	< 273	< 174	< 171
10/27/21 - 10/27/21			< 248	< 268
11/30/21 - 11/30/21			< 298	< 308
12/30/21 - 12/30/21			< 278	< 247
MEAN	-	-	-	-

Table C-I.2 CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
23	05/17/21 - 05/17/21	< 5	< 7	< 13	< 12	< 6	< 5
	09/27/21 - 09/27/21	< 7	< 9	< 13	< 9	< 8	< 7
	MEAN	-	-	-	-	-	-
24	05/17/21 - 05/17/21	< 6	< 7	< 13	< 14	< 8	< 6
	09/27/21 - 09/27/21	< 5	< 6	< 13	< 11	< 6	< 6
	MEAN	-	-	-	-	-	-
33	01/27/21 - 01/27/21	< 6	< 4	< 13	< 7	< 4	< 6
	02/24/21 - 02/24/21	< 6	< 7	< 13	< 10	< 9	< 6
	03/23/21 - 03/23/21	< 5	< 8	< 15	< 12	< 6	< 7
	04/22/21 - 04/22/21	< 6	< 8	< 15	< 11	< 9	< 7
	05/18/21 - 05/18/21	< 4	< 5	< 10	< 9	< 6	< 5
	06/22/21 - 06/22/21	< 5	< 6	< 12	< 11	< 7	< 7
	07/28/21 - 07/28/21	< 7	< 7	< 16	< 14	< 8	< 8
	08/25/21 - 08/25/21	< 6	< 8	< 11	< 12	< 6	< 7
	09/22/21 - 09/22/21	< 7	< 7	< 17	< 16	< 8	< 8
	10/27/21 - 10/27/21	< 7	< 8	< 18	< 12	< 9	< 8
	11/30/21 - 11/30/21	< 7	< 8	< 17	< 12	< 6	< 6
	12/30/21 - 12/30/21	< 8	< 10	< 17	< 19	< 11	< 10
	MEAN	-	-	-	-	-	-
94	01/27/21 - 01/27/21	< 6	< 10	< 17	< 13	< 8	< 8
	02/24/21 - 02/24/21	< 8	< 7	< 13	< 12	< 10	< 7
	03/23/21 - 03/23/21	< 6	< 7	< 15	< 13	< 8	< 7
	04/22/21 - 04/22/21	< 6	< 6	< 13	< 10	< 7	< 6
	05/19/21 - 05/19/21	< 5	< 6	< 13	< 8	< 6	< 6
	06/22/21 - 06/22/21	< 6	< 8	< 16	< 14	< 7	< 9
	07/28/21 - 07/28/21	< 6	< 8	< 15	< 11	< 7	< 8
	08/25/21 - 08/25/21	< 9	< 9	< 14	< 12	< 7	< 7
	09/21/21 - 09/21/21	< 8	< 8	< 15	< 13	< 8	< 8
	10/27/21 - 10/27/21	< 7	< 9	< 14	< 11	< 7	< 6
	11/30/21 - 11/30/21	< 8	< 7	< 14	< 8	< 9	< 7
	12/30/21 - 12/30/21	< 5	< 5	< 9	< 15	< 7	< 7
	MEAN	-	-	-	-	-	-

Table C-II.1 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	1N	1S	37	38
01/06/21 - 01/29/21	< 297	*(1)*	< 183	< 188
02/03/21 - 02/24/21	< 286	*(1)*	< 288	< 285
03/03/21 - 03/23/21	< 182	*(1)*	< 185	< 186
04/06/21 - 04/22/21	< 190	*(1)*	< 309	< 312
05/04/21 - 05/20/21	< 503	*(1)*	< 499	< 294
06/02/21 - 06/28/21	< 178	*(1)*	< 490	< 496
07/13/21 - 07/28/21	< 169	*(1)*	< 267	< 264
08/24/21 - 08/30/21	< 295	*(1)*	< 300	< 182
09/14/21 - 09/30/21	< 173	*(1)*	< 194	< 179
10/05/21 - 10/27/21	< 278	*(1)*	< 294	< 295
11/02/21 - 11/30/21	< 293	*(1)*	< 293	< 295
12/07/21 - 12/30/21	< 259	*(1)*	< 267	*(1)*
MEAN	-		-	-

Table C-II.2 CONCENTRATIONS OF GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	1N	1S	37	38
01/06/21 - 01/29/21	< 1.7	*(1)*	1.7 ± 1.1	1.5 ± 1.0
02/03/21 - 02/24/21	< 1.4	*(1)*	6.9 ± 1.7	< 1.8
03/03/21 - 03/23/21	< 1.5	*(1)*	1.6 ± 1.0	1.5 ± 1.0
04/06/21 - 04/22/21	< 1.3	*(1)*	2.4 ± 1.1	1.8 ± 1.0
05/04/21 - 05/20/21	< 1.9	*(1)*	< 1.9	< 1.8
06/02/21 - 06/28/21	< 2.1	*(1)*	< 1.9	< 1.9
07/13/21 - 07/28/21	< 1.9	*(1)*	< 1.8	< 1.8
08/24/21 - 08/30/21	< 1.7	*(1)*	< 1.8	2.1 ± 1.2
09/14/21 - 09/30/21	< 1.9	*(1)*	< 1.7	< 1.8
10/05/21 - 10/27/21	< 2.1	*(1)*	< 2.0	< 1.8
11/02/21 - 11/30/21	< 1.7	*(1)*	1.7 ± 1.2	2.2 ± 1.2
12/07/21 - 12/30/21	< 1.6	*(1)*	2.2 ± 1.1	*(1)*
MEAN ± 2 STD DEV	-		2.8 ± 4.1	1.8 ± 0.6

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.3 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
1N	01/06/21 - 01/06/21	< 5	< 8	< 14	< 15	< 9	< 9
	02/03/21 - 02/03/21	< 6	< 6	< 13	< 13	< 6	< 6
	03/03/21 - 03/03/21	< 5	< 6	< 14	< 9	< 6	< 5
	04/06/21 - 04/06/21	< 6	< 6	< 9	< 13	< 6	< 6
	05/04/21 - 05/04/21	< 5	< 4	< 9	< 10	< 6	< 4
	06/02/21 - 06/02/21	< 4	< 5	< 10	< 10	< 6	< 4
	07/13/21 - 07/13/21	< 6	< 7	< 13	< 14	< 6	< 5
	08/24/21 - 08/24/21	< 5	< 6	< 9	< 11	< 5	< 6
	09/14/21 - 09/14/21	< 7	< 8	< 15	< 10	< 7	< 8
	10/05/21 - 10/05/21	< 4	< 9	< 12	< 13	< 5	< 6
	11/02/21 - 11/02/21	< 6	< 5	< 14	< 14	< 5	< 7
	12/07/21 - 12/07/21	< 7	< 8	< 16	< 19	< 7	< 7
	MEAN	-	-	-	-	-	-
1S (1)							
37	01/27/21 - 01/27/21	< 10	< 12	< 12	< 9	< 9	< 10
	02/24/21 - 02/24/21	< 7	< 9	< 14	< 8	< 7	< 8
	03/23/21 - 03/23/21	< 9	< 8	< 10	< 14	< 9	< 7
	04/22/21 - 04/22/21	< 7	< 6	< 9	< 11	< 5	< 5
	05/20/21 - 05/20/21	< 5	< 6	< 11	< 9	< 5	< 5
	06/22/21 - 06/22/21	< 6	< 7	< 14	< 12	< 6	< 6
	07/28/21 - 07/28/21	< 6	< 7	< 13	< 9	< 7	< 6
	08/25/21 - 08/25/21	< 6	< 8	< 14	< 15	< 6	< 7
	09/30/21 - 09/30/21	< 6	< 7	< 16	< 13	< 8	< 6
	10/27/21 - 10/27/21	< 6	< 7	< 14	< 13	< 7	< 7
	11/30/21 - 11/30/21	< 7	< 8	< 10	< 11	< 8	< 8
	12/30/21 - 12/30/21	< 8	< 8	< 12	< 19	< 9	< 10
	MEAN	-	-	-	-	-	-
38	01/29/21 - 01/29/21	< 8	< 9	< 14	< 12	< 8	< 6
	02/24/21 - 02/24/21	< 6	< 6	< 16	< 10	< 8	< 7
	03/23/21 - 03/23/21	< 8	< 6	< 14	< 10	< 7	< 6
	04/22/21 - 04/22/21	< 7	< 5	< 15	< 12	< 8	< 6
	05/20/21 - 05/20/21	< 5	< 5	< 11	< 8	< 5	< 5
	06/28/21 - 06/28/21	< 9	< 7	< 14	< 11	< 7	< 7
	07/28/21 - 07/28/21	< 9	< 8	< 9	< 13	< 8	< 8
	08/30/21 - 08/30/21	< 5	< 6	< 17	< 12	< 7	< 7
	09/22/21 - 09/22/21	< 7	< 7	< 16	< 12	< 7	< 7
	10/27/21 - 10/27/21	< 5	< 7	< 11	< 12	< 7	< 6
	11/30/21 - 11/30/21	< 6	< 7	< 13	< 11	< 7	< 5
	12/07/21 - 12/30/21 *(1)*						
	MEAN	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-III.1 CONCENTRATIONS OF TRITIUM IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	MW-24-3A	W-3C
02/10/21 - 02/10/21	< 179	< 177
05/06/21 - 05/06/21	< 298	< 296
07/28/21 - 07/28/21	< 187	< 183
10/20/21 - 10/20/21	< 283	< 356
MEAN	-	-

Table C-III.2 **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
MW-24-3A	02/10/21 - 02/10/21	< 5	< 6	< 8	< 12	< 6	< 6
	05/06/21 - 05/06/21	< 7	< 7	< 13	< 13	< 7	< 6
	07/28/21 - 07/28/21	< 7	< 8	< 12	< 11	< 6	< 6
	10/20/21 - 10/20/21	< 5	< 5	< 8	< 8	< 5	< 5
	MEAN	-	-	-	-	-	-
W-3C	02/10/21 - 02/10/21	< 5	< 4	< 9	< 10	< 4	< 4
	05/06/21 - 05/06/21	< 5	< 7	< 13	< 13	< 8	< 8
	07/28/21 - 07/28/21	< 6	< 6	< 10	< 11	< 7	< 6
	10/20/21 - 10/20/21	< 5	< 7	< 12	< 9	< 6	< 5
	MEAN	-	-	-	-	-	-

Table C-IV.1 CONCENTRATIONS OF GAMMA EMITTERS IN PREDATOR (FISH) SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-60	Zn-65	Cs-134	Cs-137
33	05/17/21	3235 ± 930	< 53	< 72	< 149	< 68	< 78
	05/17/21	3007 ± 916	< 52	< 24	< 98	< 59	< 43
	05/17/21	3515 ± 1078	< 78	< 117	< 224	< 102	< 101
	09/24/21	3506 ± 1086	< 86	< 57	< 103	< 81	< 73
	09/27/21	4202 ± 1292	< 86	< 83	< 178	< 81	< 88
	09/27/21	3101 ± 959	< 62	< 81	< 149	< 70	< 69
	09/27/21	2867 ± 1294	< 61	< 87	< 158	< 77	< 78
	MEAN ± 2 STD DEV	3348 ± 896	-	-	-	-	-
93	05/19/21	2831 ± 1121	< 41	< 33	< 125	< 67	< 51
	09/27/21	4475 ± 1440	< 75	< 86	< 136	< 78	< 75
	MEAN ± 2 STD DEV	3653 ± 2325	-	-	-	-	-
94	06/08/21	3887 ± 1107	< 71	< 59	< 131	< 57	< 66
	MEAN ± 2 STD DEV	3887 ± 0	-	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-IV.2 CONCENTRATIONS OF GAMMA EMITTERS IN CLAM AND CRAB SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-60	Zn-65	Cs-134	Cs-137
23							
Clams	05/17/21	1344 ± 495	< 54	< 52	< 81	< 53	< 55
	09/27/21	1610 ± 737	< 62	< 76	< 121	< 77	< 68
	MEAN ± 2 STD DEV	1477 ± 376	-	-	-	-	-
24							
Clams	05/17/21	1644 ± 807	< 48	< 77	< 72	< 51	< 52
	09/27/21	1342 ± 565	< 54	< 60	< 81	< 61	< 59
	MEAN ± 2 STD DEV	1493 ± 427	-	-	-	-	-
94							
Clams	05/19/21	1255 ± 478	< 39	< 41	< 94	< 42	< 40
	09/29/21	1222 ± 682	< 57	< 56	< 77	< 47	< 50
	MEAN ± 2 STD DEV	1239 ± 47	-	-	-	-	-
33							
Crabs	09/24/21	2717 ± 1267	< 88	< 85	< 133	< 102	< 85
	MEAN ± 2 STD DEV	2717 ± 0	-	-	-	-	-
93							
Crabs	09/24/21	1883 ± 862	< 48	< 63	< 110	< 58	< 43
	MEAN ± 2 STD DEV	1883 ± 0	-	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-V.1

CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/KG DRY ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	K-40	Mn-54	Co-60	Cs-134	Cs-137	Ra-226	Th-228
23	05/17/21	< 368	1239 ± 557	< 51	< 45	< 50	< 47	< 1085	125 ± 94
	09/27/21	< 668	5534 ± 1113	< 58	< 67	< 94	< 65	< 1487	261 ± 111
MEAN ± 2 STD DEV		-	3387 ± 6074	-	-	-	-	-	193 ± 192
24	05/17/21	< 460	4158 ± 884	< 60	< 49	< 54	< 69	< 1306	201 ± 96
	09/27/21	< 535	2447 ± 799	< 57	< 55	< 62	< 50	< 1270	269 ± 75
MEAN ± 2 STD DEV		-	3303 ± 2420	-	-	-	-	-	235 ± 96
33	05/18/21	< 346	944 ± 454	< 45	< 43	< 52	< 45	< 1018	< 79
	09/27/21	< 539	2603 ± 725	< 55	< 56	< 66	< 67	< 1238	241 ± 89
MEAN ± 2 STD DEV		-	1774 ± 2346	-	-	-	-	-	241 ± 0
94	05/19/21	< 389	15040 ± 1342	< 58	< 51	< 65	< 56	1325 ± 1016	564 ± 100
	09/29/21	< 851	17120 ± 2045	< 80	< 101	< 128	< 113	2173 ± 1495	639 ± 184
MEAN ± 2 STD DEV		-	16080 ± 2942	-	-	-	-	1749 ± 1199	601 ± 106

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-VI.1 CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION	GROUP I			GROUP II			GROUP III
PERIOD	20	66	111	71	72	73	C
12/29/20 - 01/12/21	10 ± 2	9 ± 3	8 ± 2	12 ± 3	11 ± 3	11 ± 3	12 ± 3
01/12/21 - 01/27/21	15 ± 3	16 ± 3	16 ± 3	18 ± 3	16 ± 3	18 ± 3	21 ± 3
01/27/21 - 02/10/21	9 ± 2	8 ± 2	11 ± 3	10 ± 2	10 ± 2	10 ± 2	12 ± 3
02/10/21 - 02/24/21	15 ± 3	12 ± 2	14 ± 3	14 ± 3	14 ± 3	14 ± 3	14 ± 3
02/24/21 - 03/10/21	15 ± 3	14 ± 3	12 ± 2	12 ± 2	16 ± 3	14 ± 3	14 ± 3
03/10/21 - 03/23/21	15 ± 3	20 ± 3	19 ± 3	20 ± 3	16 ± 3	16 ± 3	19 ± 3
03/23/21 - 04/06/21	16 ± 3	12 ± 3	14 ± 3	16 ± 3	14 ± 3	15 ± 3	17 ± 3
04/06/21 - 04/22/21	9 ± 2	< 3	7 ± 2	7 ± 2	9 ± 2	5 ± 2	8 ± 2
04/22/21 - 05/04/21	17 ± 3	8 ± 5	18 ± 3	20 ± 3	*(1)*	17 ± 3	18 ± 3
05/04/21 - 05/20/21	13 ± 3	10 ± 2	12 ± 2	12 ± 2	12 ± 2	*(1)*	16 ± 3
05/20/21 - 06/01/21	10 ± 3	10 ± 3	12 ± 3	12 ± 3	12 ± 3	9 ± 3	16 ± 3
06/01/21 - 06/16/21	7 ± 2	10 ± 2	28 ± 8	9 ± 2	8 ± 2	7 ± 2	11 ± 3
06/16/21 - 07/01/21	12 ± 3	12 ± 3	13 ± 3	12 ± 3	13 ± 3	13 ± 3	14 ± 3
07/01/21 - 07/14/21	10 ± 3	10 ± 3	13 ± 3	9 ± 3	11 ± 3	9 ± 3	12 ± 3
07/14/21 - 07/28/21	19 ± 3	22 ± 3	19 ± 3	20 ± 3	20 ± 3	17 ± 3	19 ± 3
07/28/21 - 08/11/21	14 ± 3	16 ± 3	*(1)*	12 ± 3	14 ± 3	15 ± 3	15 ± 3
08/11/21 - 08/25/21	16 ± 3	19 ± 3	16 ± 3	18 ± 3	17 ± 3	14 ± 3	19 ± 3
08/25/21 - 09/10/21	14 ± 2	*(1)*	*(1)*	16 ± 2	16 ± 3	11 ± 2	17 ± 3
09/10/21 - 09/22/21	23 ± 4	20 ± 3	24 ± 3	*(1)*	20 ± 3	14 ± 4	24 ± 4
09/22/21 - 10/05/21	17 ± 3	17 ± 3	17 ± 3	20 ± 3	18 ± 3	17 ± 3	21 ± 3
10/05/21 - 10/20/21	14 ± 3	12 ± 3	12 ± 3	13 ± 3	13 ± 3	11 ± 3	18 ± 3
10/20/21 - 11/04/21	18 ± 3	19 ± 3	18 ± 3	17 ± 3	15 ± 3	13 ± 3	17 ± 3
11/04/21 - 11/17/21	21 ± 3	19 ± 3	19 ± 3	19 ± 3	18 ± 3	17 ± 3	22 ± 3
11/17/21 - 12/02/21	18 ± 3	16 ± 3	20 ± 3	18 ± 3	18 ± 3	17 ± 3	18 ± 3
12/02/21 - 12/16/21	19 ± 3	19 ± 3	16 ± 3	19 ± 3	18 ± 3	12 ± 3	18 ± 3
12/16/21 - 01/04/22	23 ± 3	21 ± 3	22 ± 3	24 ± 3	25 ± 3	23 ± 3	20 ± 3
MEAN ± 2 STD DEV	15 ± 8	15 ± 9	16 ± 10	15 ± 9	15 ± 8	13 ± 8	17 ± 7

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VI.2 **MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

GROUP I - ON-SITE LOCATIONS				GROUP II - INTERMEDIATE DISTANCE LOCATIONS				GROUP III - CONTROL LOCATIONS			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
12/29/20 - 01/27/21	8	16	12 ± 7	12/29/20 - 01/27/21	11	18	14 ± 7	12/29/20 - 01/27/21	12	21	17 ± 12
01/27/21 - 02/24/21	8	15	12 ± 6	01/27/21 - 02/24/21	10	14	12 ± 5	01/27/21 - 02/24/21	12	14	13 ± 2
02/24/21 - 04/06/21	12	20	15 ± 6	02/24/21 - 04/06/21	12	20	15 ± 4	02/24/21 - 04/06/21	14	19	17 ± 5
04/06/21 - 05/04/21	7	18	12 ± 10	04/06/21 - 05/04/21	5	20	12 ± 13	04/06/21 - 05/04/21	8	18	13 ± 14
05/04/21 - 06/01/21	10	13	11 ± 3	05/04/21 - 06/01/21	9	12	11 ± 3	05/04/21 - 06/01/21	16	16	16 ± 0
06/01/21 - 07/01/21	7	28	14 ± 15	06/01/21 - 07/01/21	7	13	10 ± 5	06/01/21 - 07/01/21	11	14	12 ± 4
07/01/21 - 07/28/21	10	22	15 ± 10	07/01/21 - 07/28/21	9	20	14 ± 11	07/01/21 - 07/28/21	12	19	16 ± 11
07/28/21 - 08/25/21	14	19	16 ± 3	07/28/21 - 08/25/21	12	18	15 ± 4	07/28/21 - 08/25/21	15	19	17 ± 6
08/25/21 - 10/05/21	14	24	19 ± 8	08/25/21 - 10/05/21	11	20	17 ± 6	08/25/21 - 10/05/21	17	24	21 ± 7
10/05/21 - 11/04/21	12	19	15 ± 6	10/05/21 - 11/04/21	11	17	14 ± 5	10/05/21 - 11/04/21	17	18	17 ± 1
11/04/21 - 12/02/21	16	21	19 ± 4	11/04/21 - 12/02/21	17	19	18 ± 2	11/04/21 - 12/02/21	18	22	20 ± 5
12/02/21 - 01/04/22	16	23	20 ± 5	12/02/21 - 12/30/21	12	25	20 ± 9	12/02/21 - 01/04/22	18	20	19 ± 3
12/29/20 - 12/30/21	7	28	15 ± 9	12/29/20 - 12/30/21	5	25	14 ± 8	12/29/20 - 01/04/22	8	24	17 ± 7

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-VI.3 CONCENTRATIONS OF STRONTIUM IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	SR-90
20	12/29/20 - 04/06/21	< 6
	04/06/21 - 07/01/21	< 6
	07/01/21 - 10/05/21	< 6
	10/05/21 - 12/30/21	< 8
	MEAN	-
66	12/29/20 - 04/06/21	< 6
	04/06/21 - 07/01/21	< 8
	07/01/21 - 10/05/21	< 6
	10/05/21 - 12/30/21	< 6
	MEAN	-
71	12/29/20 - 04/06/21	< 6
	04/06/21 - 07/01/21	< 5
	07/01/21 - 10/05/21	< 6
	10/05/21 - 12/30/21	< 7
	MEAN	-
72	12/29/20 - 04/06/21	< 7
	04/06/21 - 07/01/21	< 9
	07/01/21 - 10/05/21	< 6
	10/05/21 - 12/30/21	< 9
	MEAN	-
73	12/29/20 - 04/06/21	< 5
	04/06/21 - 07/01/21	< 7
	07/01/21 - 10/05/21	< 5
	10/05/21 - 12/30/21	< 7
	MEAN	-
111	12/29/20 - 04/06/21	< 6
	04/06/21 - 07/01/21	< 8
	07/01/21 - 10/05/21	< 9
	10/05/21 - 12/30/21	< 7
	MEAN	-
C	12/29/20 - 04/06/21	< 5
	04/06/21 - 07/01/21	< 6
	07/01/21 - 10/05/21	< 7
	10/05/21 - 01/04/22	< 7
	MEAN	-

Table C-VI.4 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	Mn-54	Co-60	Cs-134	Cs-137
20	12/29/20 - 04/06/21	70 ± 22	< 2	< 3	< 2	< 3
	04/06/21 - 07/01/21	70 ± 20	< 3	< 2	< 3	< 3
	07/01/21 - 10/05/21	68 ± 17	< 2	< 2	< 2	< 2
	10/05/21 - 12/30/21	56 ± 16	< 3	< 2	< 3	< 3
	MEAN ± 2 STD DEV	66 ± 14	-	-	-	-
66	12/29/20 - 04/06/21	63 ± 19	< 2	< 2	< 2	< 2
	04/06/21 - 07/01/21	50 ± 13	< 2	< 2	< 2	< 2
	07/01/21 - 10/05/21	76 ± 25	< 4	< 3	< 3	< 4
	10/05/21 - 12/30/21	65 ± 21	< 3	< 2	< 3	< 2
	MEAN ± 2 STD DEV	64 ± 21	-	-	-	-
71	12/29/20 - 04/06/21	62 ± 18	< 2	< 2	< 2	< 2
	04/06/21 - 07/01/21	71 ± 18	< 3	< 2	< 3	< 2
	07/01/21 - 10/05/21	58 ± 17	< 2	< 3	< 2	< 2
	10/05/21 - 12/30/21	64 ± 21	< 3	< 3	< 3	< 2
	MEAN ± 2 STD DEV	64 ± 11	-	-	-	-
72	12/29/20 - 04/06/21	56 ± 15	< 2	< 2	< 2	< 1
	04/06/21 - 07/01/21	46 ± 19	< 2	< 2	< 2	< 2
	07/01/21 - 10/05/21	76 ± 17	< 2	< 2	< 3	< 2
	10/05/21 - 12/30/21	70 ± 20	< 4	< 4	< 3	< 4
	MEAN ± 2 STD DEV	62 ± 27	-	-	-	-
73	12/29/20 - 04/06/21	94 ± 17	< 2	< 2	< 2	< 2
	04/06/21 - 07/01/21	67 ± 17	< 2	< 2	< 3	< 2
	07/01/21 - 10/05/21	50 ± 19	< 3	< 2	< 3	< 2
	10/05/21 - 12/30/21	57 ± 18	< 2	< 2	< 3	< 3
	MEAN ± 2 STD DEV	67 ± 38	-	-	-	-
111	12/29/20 - 04/06/21	67 ± 14	< 2	< 2	< 2	< 2
	04/06/21 - 07/01/21	66 ± 17	< 3	< 3	< 2	< 2
	07/01/21 - 10/05/21	68 ± 16	< 2	< 2	< 3	< 2
	10/05/21 - 12/30/21	74 ± 19	< 3	< 2	< 2	< 2
	MEAN ± 2 STD DEV	69 ± 7	-	-	-	-
C	12/29/20 - 04/06/21	72 ± 19	< 2	< 3	< 2	< 2
	04/06/21 - 07/01/21	85 ± 17	< 2	< 2	< 2	< 2
	07/01/21 - 10/05/21	78 ± 18	< 2	< 2	< 2	< 2
	10/05/21 - 01/04/22	50 ± 14	< 2	< 2	< 2	< 2
	MEAN ± 2 STD DEV	71 ± 30	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-VII.1 CONCENTRATIONS OF STRONTIUM AND GAMMA EMITTERS IN VEGETATION SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	Sr-89	Sr-90	Be-7	K-40	Cs-134	Cs-137
35							
Cabbage	06/28/21	< 17	< 4.0	< 364	2463 ± 488	< 33	< 36
Collards	06/28/21	< 16	6.5 ± 3.1	< 245	2216 ± 535	< 30	< 27
Kale	06/28/21	< 17	< 4.1	< 390	3196 ± 695	< 43	< 38
Cabbage	07/20/21	< 22	< 4.3	< 280	2372 ± 501	< 35	< 33
Collards	07/20/21	< 24	< 4.1	< 216	1614 ± 412	< 30	< 25
Kale	07/20/21	< 22	< 4.4	258 ± 98	2408 ± 229	< 12	< 12
Cabbage	08/18/21	< 24	< 3.9	< 188	1906 ± 340	< 22	< 21
Collards	08/18/21	< 21	< 4.0	< 202	1614 ± 296	< 20	< 20
Kale	08/18/21	< 20	< 4.1	352 ± 176	2104 ± 352	< 22	< 22
Cabbage	09/30/21	< 19	< 4.5	< 377	1915 ± 528	< 43	< 44
MEAN ± 2 STD DEV		-	6.5 ± 0	305 ± 134	2181 ± 941	-	-
36 (Control)							
Cabbage	06/28/21	< 19	< 3.0	< 188	2316 ± 465	< 18	< 24
Collards	06/28/21	< 16	5.9 ± 3.1	< 254	6042 ± 727	< 37	< 32
Kale	06/28/21	< 18	8.3 ± 3.0	< 284	4623 ± 664	< 30	< 26
Cabbage	07/20/21	< 21	8.0 ± 3.5	< 184	2384 ± 447	< 33	< 25
Collards	07/20/21	< 21	< 4.1	< 212	3058 ± 504	< 25	< 29
Kale	07/20/21	< 20	< 4.0	< 353	4855 ± 767	< 32	< 33
Cabbage Leaves	08/18/21	< 21	13.3 ± 2.6	465 ± 229	3296 ± 592	< 20	< 29
Collards	08/18/21	< 22	15.0 ± 3.1	< 161	3803 ± 378	< 19	< 17
Rape	08/18/21	< 15	11.7 ± 3.2	< 191	4103 ± 468	< 25	< 18
Cabbage	09/30/21	< 20	< 3.6	388 ± 223	2980 ± 696	< 33	< 42
Collards	09/30/21	< 18	< 4.6	< 262	4910 ± 638	< 32	< 28
Kale	09/30/21	< 20	11.7 ± 2.6	< 265	4651 ± 642	< 40	< 29
MEAN ± 2 STD DEV		-	10.6 ± 6.5	426 ± 110	3918 ± 2287	-	-
66 (1)							
115							
Cabbage	06/28/21	< 20	11.2 ± 2.6	< 308	1543 ± 458	< 37	< 41
Collards	06/28/21	< 18	9.8 ± 2.2	< 278	1877 ± 568	< 40	< 34
Cabbage	07/20/21	< 22	< 4.4	< 136	1565 ± 237	< 15	< 17
Collards	07/20/21	< 21	8.0 ± 3.1	< 258	1806 ± 493	< 29	< 32
Cabbage	08/18/21	< 22	< 4.0	< 192	1152 ± 363	< 26	< 25
Collards	08/18/21	< 21	13.9 ± 3.2	< 234	1779 ± 401	< 32	< 32
Collards	09/30/21	< 25	9.3 ± 2.6	< 400	1797 ± 683	< 39	< 45
MEAN ± 2 STD DEV		-	10.4 ± 4.5	-	1646 ± 504	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VIII.1 QUARTERLY OSLD RESULTS FOR OYSTER CREEK GENERATING STATION, 2021[(1)]

RESULTS IN UNITS OF MILLIREM/STD. QUARTER ± 2 STANDARD DEVIATION

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
1	1.1 ± 1.7	1.9	1.7	0.1	0.7
6	0.5 ± 0.8	0.5	0.9	0.7	-0.1
8	-1.0 ± 2.1	-0.6	-0.3	-2.5	-0.4
9	-1.9 ± 2.0	-0.8	-2.3	-1.5	-3.1
22	2.5 ± 2.5	1.7	3.9	1.2	3.0
51	2.1 ± 1.7	2.9	1.3	1.6	2.9
52	3.1 ± 2.2	4.5	3.2	1.8	2.8
53	1.2 ± 0.8	1.7	0.8	1.0	1.2
54	-0.7 ± 1.6	-0.6	-1.4	-1.3	0.3
55	6.1 ± 1.7	5.6	7.0	5.1	6.6
56	3.1 ± 2.2	3.0	3.7	1.7	4.2
57	-0.2 ± 1.8	-1.1	-0.4	-0.1	1.0
58	-2.1 ± 2.1	-0.6	-2.3	-3.1	-2.6
59	-0.1 ± 1.4	-0.7	0.6	0.2	-0.8
61	-0.9 ± 1.5	*(2)*	-1.7	-1.0	-0.2
62	0.2 ± 0.9	-0.3	0.6	-0.1	0.6
63	0.7 ± 0.8	1.0	*(2)*	0.2	0.9
64	0.1 ± 2.6	0.3	1.8	-0.5	-1.3
65	0.1 ± 1.4	1.2	-0.2	-0.1	-0.3
66	-0.6 ± 1.8	-0.3	0.3	-0.3	-1.9
68	-1.7 ± 0.7	-1.2	-1.6	-1.9	-2.0
71	-0.4 ± 1.0	-0.1	-0.4	-1.1	-0.2
72	-0.6 ± 0.8	-0.4	-1.0	-0.1	-0.7
73	-1.0 ± 1.2	-1.0	-0.1	-1.4	-1.4
74	-0.2 ± 1.1	-0.8	-0.5	0.0	0.5
75	0.6 ± 2.4	1.9	1.2	-0.9	0.2
78	0.6 ± 0.6	0.9	0.1	0.7	0.8
79	0.5 ± 2.5	1.5	-2.1	-0.1	-0.2
81	-0.4 ± 3.7	1.6	0.1	-0.2	-2.9
98	-1.2 ± 2.8	0.2	-2.0	-0.4	-2.8
99	-2.6 ± 4.2	-1.2	-2.7	-1.0	-5.6
T1	0.0 ± 1.2	0.9	-0.3	-0.3	-0.4
100	-1.1 ± 2.0	0.2	-1.8	-0.9	-2.0
101	-0.8 ± 1.2	0.1	-1.1	-1.1	-1.3
102	0.7 ± 0.7	1.1	0.9	0.6	0.3
103	-0.5 ± 1.7	-0.5	0.4	-1.7	-0.4
104	-0.7 ± 2.2	0.2	0.3	-1.5	-1.8
106	-1.0 ± 3.0	0.5	-1.2	-0.4	-3.1
107	-1.2 ± 3.7	1.1	-1.4	-1.1	-3.5
109	-0.3 ± 2.5	-0.6	-1.5	-0.4	1.5
110	-0.2 ± 3.3	2.2	-0.9	-0.8	-1.5
112	2.1 ± 1.6	2.3	1.6	1.5	3.2
113	0.3 ± 3.7	2.9	-1.3	-0.9	0.3
C	23.1 ± 2.3	21.8	23.0	22.8	24.6

[(1)] Note: There are two (2) OSLD's posted at each indicator station for redundancy and data recovery. In reporting results, the average of the gross mean for the two readings is reported. There are four (4) single OSLD's posted at Control Station C and the average of the gross mean for the four readings is reported.

(2) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

TABLE C-VIII.2 MEAN QUARTERLY OSLD RESULTS FOR THE SITE BOUNDARY, INTERMEDIATE, SPECIAL INTEREST, AND CONTROL LOCATIONS FOR OYSTER CREEK GENERATING STATION, 2021[(1)]

RESULTS IN UNITS OF MILLIREM PER STANDARD QUARTER ± 2 STANDARD DEVIATION

STANDARD DEVIATIONS OF THE STATION DATA

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	INTERMEDIATE ± 2 S.D.	SPECIAL INTEREST ± 2 S.D.	CONTROL ± 2 S.D.
JAN-MAR	1.3 ± 3.8	0.3 ± 2.2	0.4 ± 2.1	21.8 ± 0
APR-JUN	0.8 ± 4.3	-0.5 ± 3.0	-0.4 ± 1.1	23.0 ± 0
JUL-SEP	0.2 ± 3.3	-0.6 ± 1.9	-0.5 ± 1.2	22.8 ± 0
OCT-DEC	0.8 ± 4.4	-1.1 ± 3.9	-1.3 ± 2.9	24.6 ± 0

TABLE C-VIII.3 SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF MILLIREM PER STANDARD QUARTER ± 2 STANDARD DEVIATION

LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
SITE BOUNDARY	156	-3.1	7.0	0.8 ± 4.0
INTERMEDIATE	184	-5.6	3.9	-0.5 ± 2.9
SPECIAL INTEREST	24	-2.9	1.6	-0.4 ± 2.1
CONTROL	16	21.2	25.7	23.1 ± 2.8

SITE BOUNDARY STATIONS - 1, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 112, 113, T1

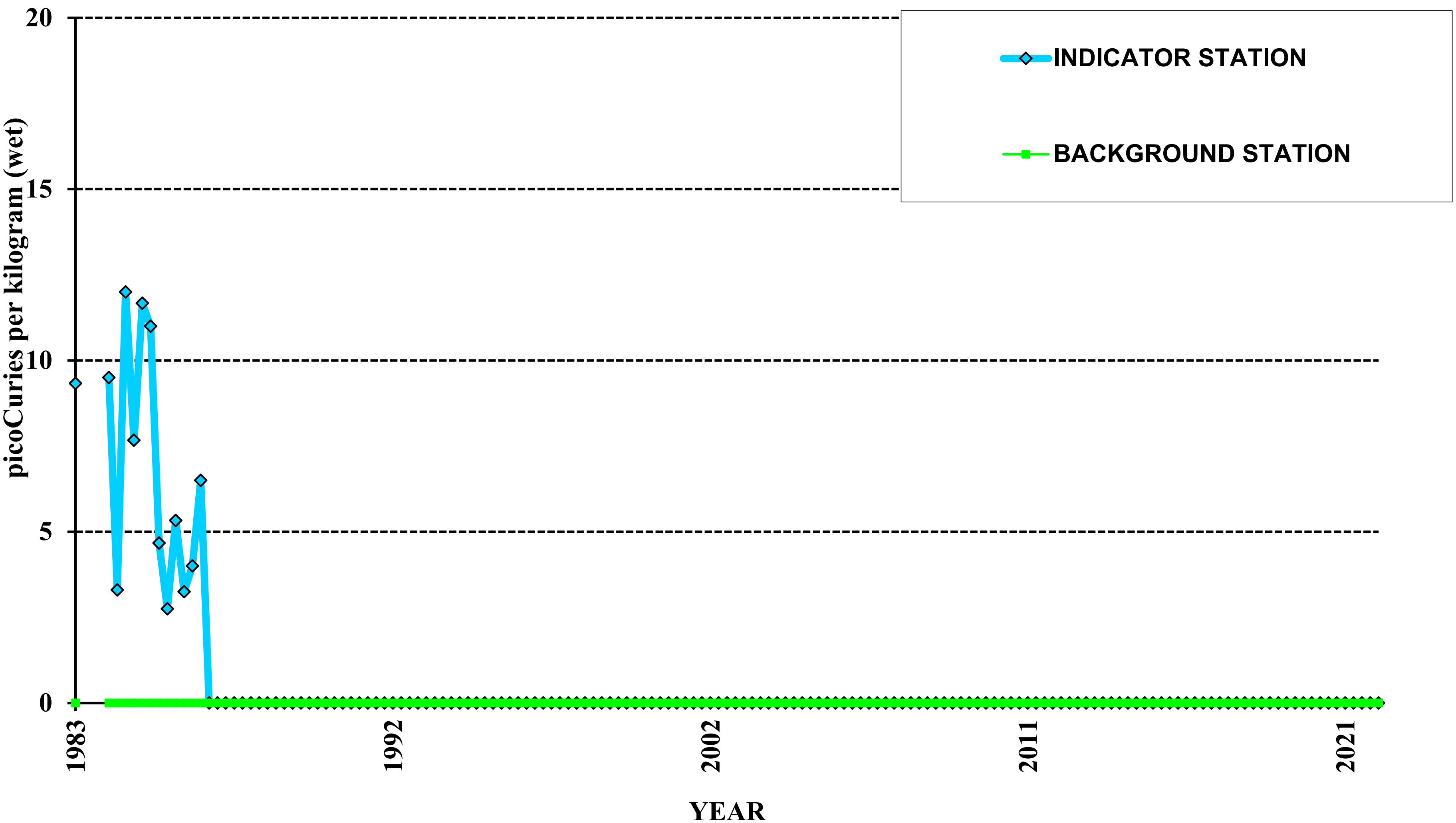
INTERMEDIATE STATIONS - 6, 8, 9, 22, 68, 73, 74, 75, 78, 79, 98, 99, 100, 101, 102, 103, 104, 106, 107, 109, 110

SPECIAL INTEREST STATIONS - 71, 72, 81

CONTROL STATIONS - C

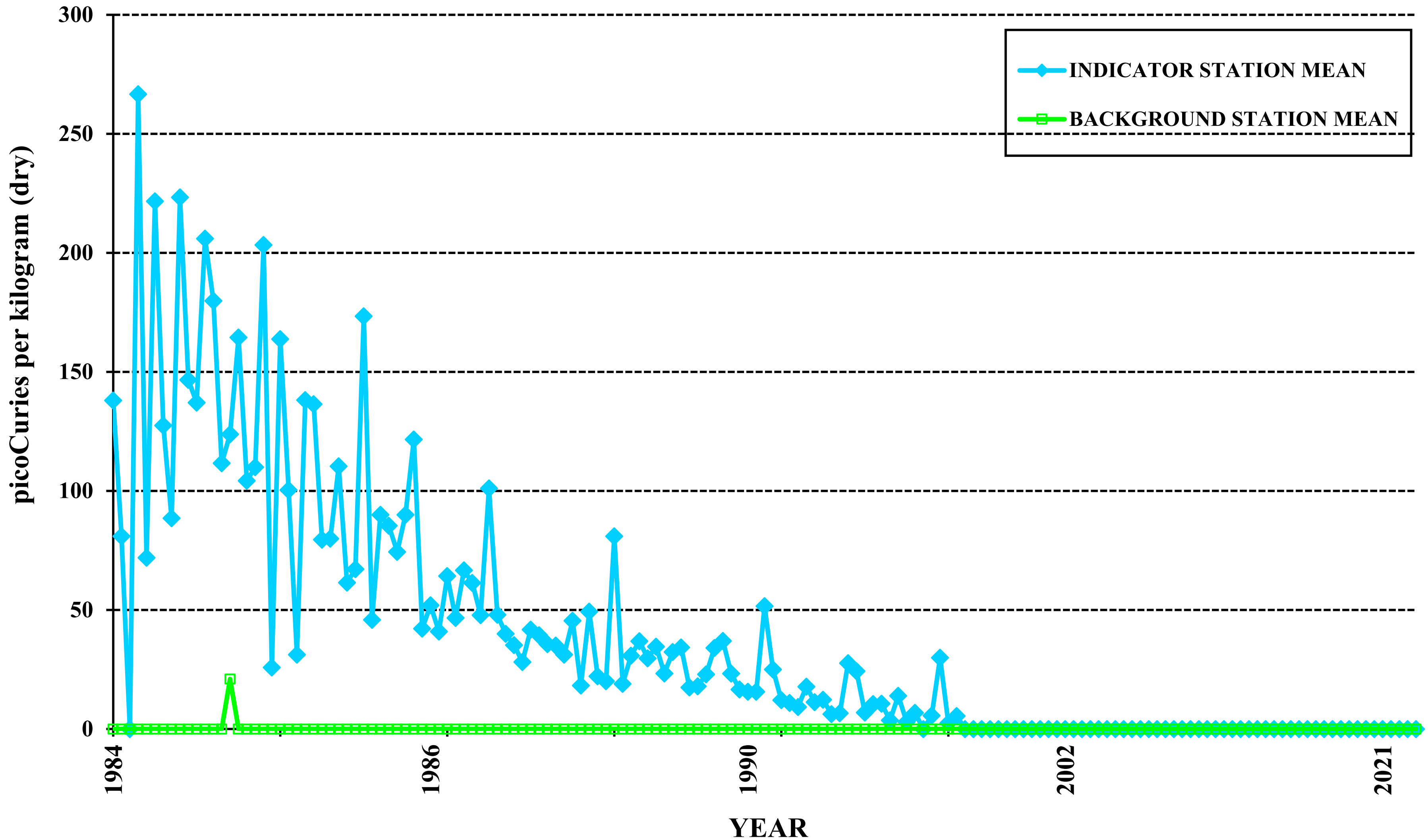
(1) Note: There are two (2) OSLD's posted at each indicator station for redundancy and data recovery. In reporting results, the average of the gross mean for the two readings is reported. There are four (4) single OSLD's posted at Control Station C and the average of the gross mean for the four readings is reported.

FIGURE C-1
MEAN COBALT-60 CONCENTRATION IN CLAMS
OYSTER CREEK GENERATING STATION, 1983 - 2021



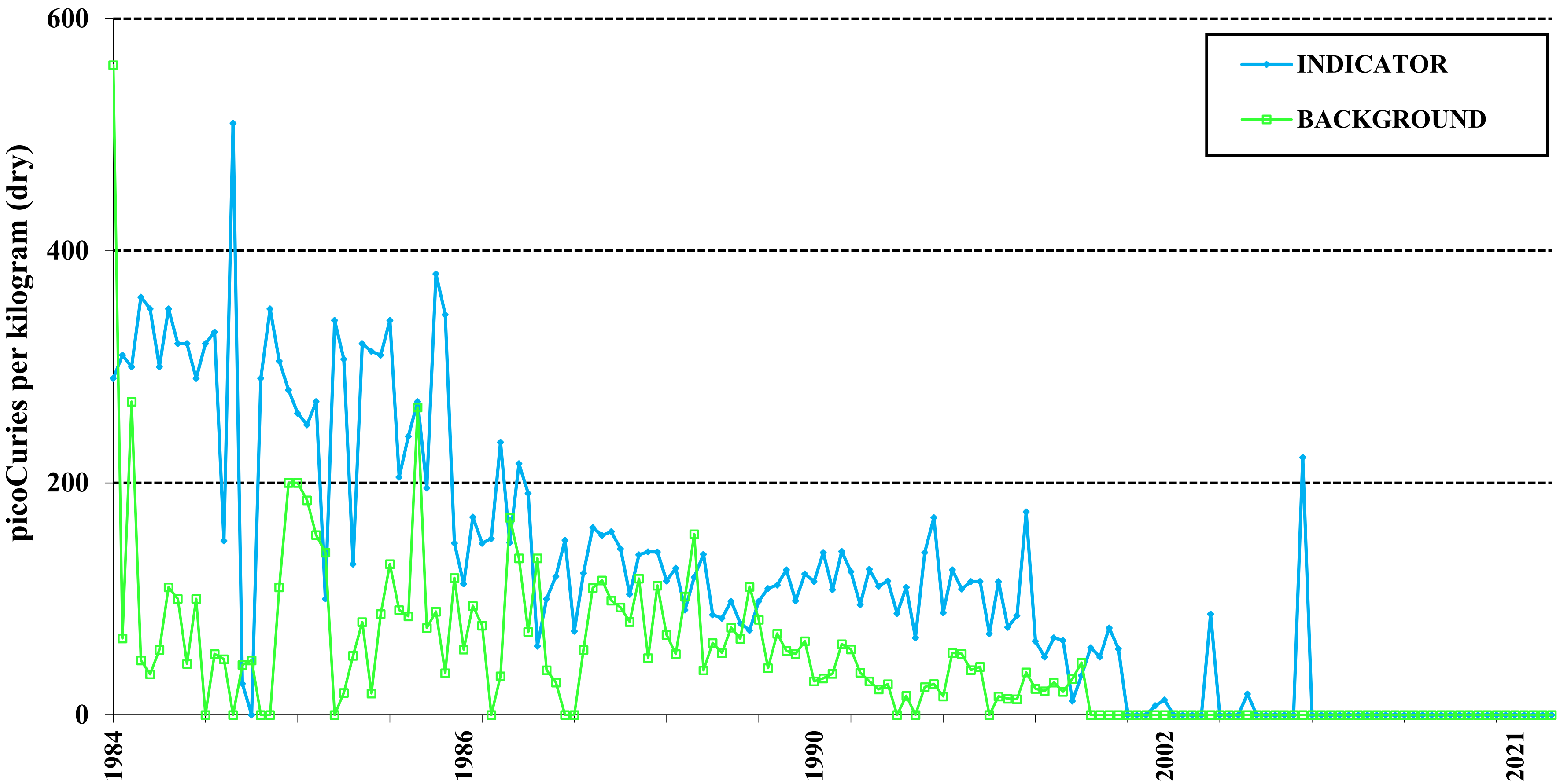
* The year designations on the x-axis reflect multiple sampling periods in a given year, as well as historical changes in the number of sampling periods per year.

FIGURE C-2
MEAN COBALT-60 CONCENTRATION IN AQUATIC SEDIMENT
OYSTER CREEK GENERATING STATION, 1984 - 2021



* The year designations on the x-axis reflect multiple sampling periods in a given year, as well as historical changes in the number of sampling periods per year.

FIGURE C-3
MEAN CESIUM-137 CONCENTRATION IN AQUATIC SEDIMENT OYSTER CREEK GENERATING STATION, 1984 - 2021



* The year designations on the x-axis reflect multiple sampling periods in a given year, as well as historical changes in the number of sampling periods per year.

FIGURE C-4
MEAN WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATES OYSTER CREEK GENERATING STATION, 2008 - 2021

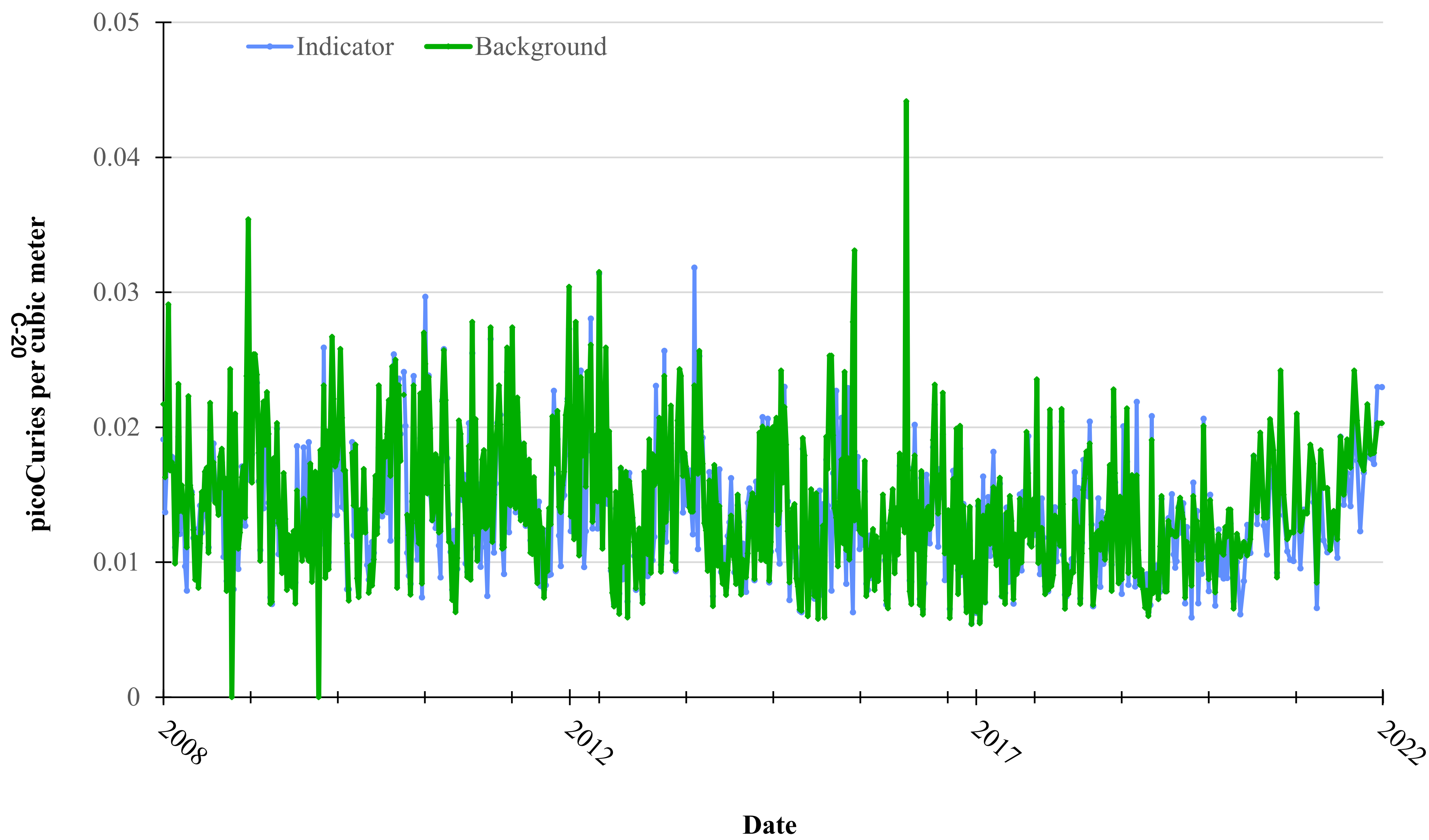
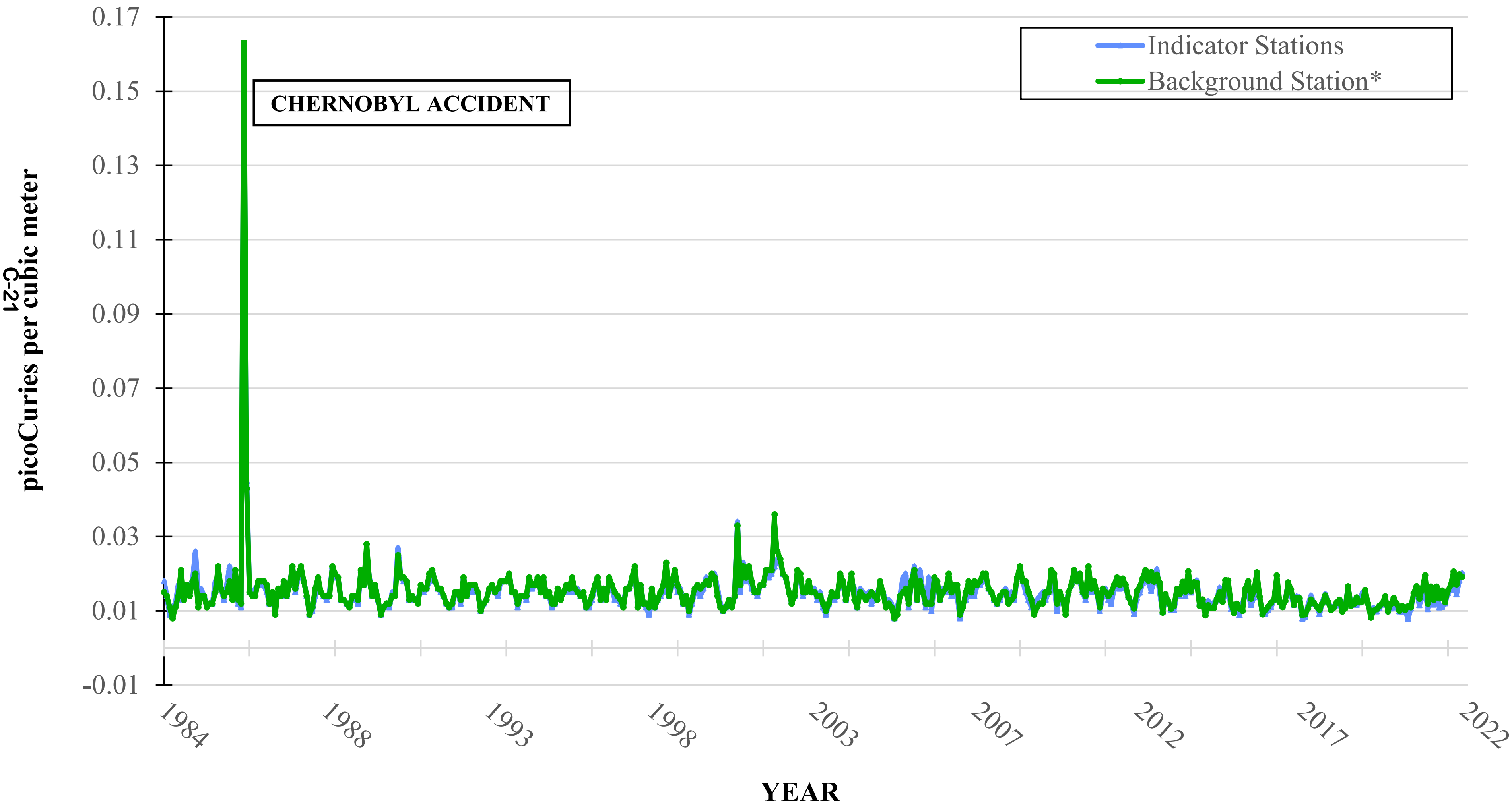
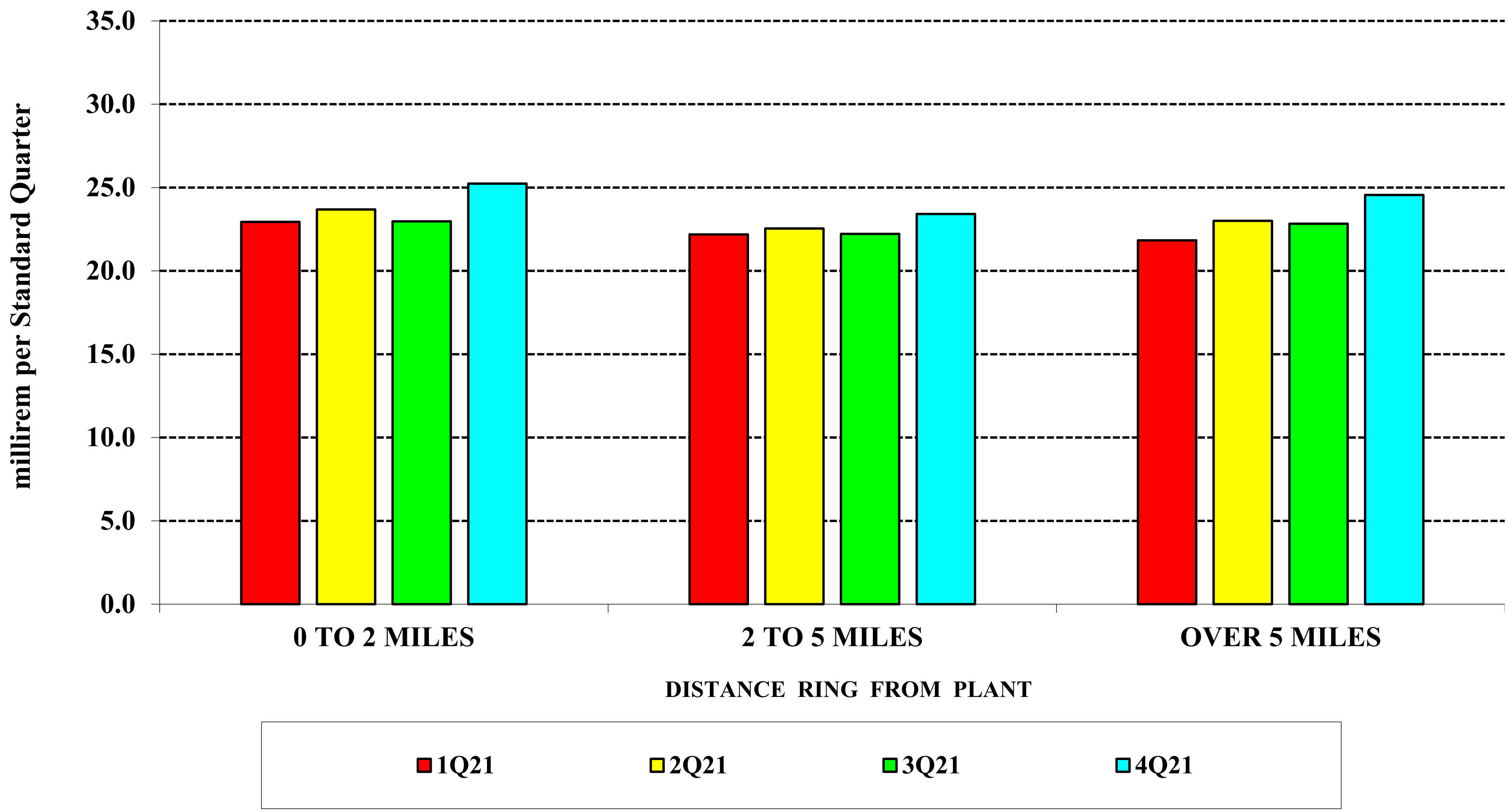


FIGURE C-5
MEAN MONTHLY GROSS BETA CONCENTRATIONS
IN AIR PARTICULATES
OYSTER CREEK GENERATING STATION, 1984 - 2021



** Data from Cookstown station ONLY after December 1996*

FIGURE C-6
MEAN QUARTERLY OSLD GAMMA DOSE
OYSTER CREEK GENERATING STATION, 2021



Oyster Creek's dosimetry changed from TLD to OSLD in 2012.

APPENDIX D

DATA TABLES

QC COMPARISON SAMPLES

The following section presents the results of data analysis performed by the QC laboratory, Environmental Inc. Duplicate samples were obtained from several locations and media and were split with the primary laboratory, Teledyne Brown Engineering (TBE) and the QC Laboratory. Comparison of the results for all media were within expected ranges.

Table D-I.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	24 (TBE)	QCA (TBE)	OC-24 (EIML)
05/17/21	< 178	< 179	< 158
09/27/22	< 273	< 266	< 159

Table D-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
24	05/17/21	< 6	< 7	< 13	< 14	< 8	< 6
(TBE)	09/27/21	< 5	< 6	< 13	< 11	< 6	< 6
QCA	05/17/21	< 7	< 6	< 12	< 11	< 7	< 6
(TBE)	09/27/21	< 7	< 7	< 16	< 13	< 8	< 9
OC-24	05/17/21	< 3	< 2	< 7	*(1)*	*(1)*	< 4
(EIML)	09/27/21	< 3	< 2	< 6	*(1)*	*(1)*	< 4

(1) Not reported

Table D-II.1 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	1N (TBE)	OC-QC1N (EIML)
01/06/21 - 01/29/21	< 297	< 166
02/03/21 - 02/24/21	< 286	< 161
03/03/21 - 03/23/21	< 182	< 158
04/06/21 - 04/22/21	< 190	< 160
05/04/21 - 05/20/21	< 503	< 158
06/02/21 - 06/28/21	< 178	< 159
07/13/21 - 07/28/21	< 169	< 158
08/24/21 - 08/30/21	< 295	< 164
09/14/21 - 09/30/21	< 173	< 131
10/05/21 - 10/27/21	< 278	< 163
11/02/21 - 11/30/21	< 293	< 163
12/07/21 - 12/30/21	< 259	< 157

Table D-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
1N	01/06/21 - 01/06/21	< 5	< 8	< 14	< 15	< 9	< 9
(TBE)	02/03/21 - 02/03/21	< 6	< 6	< 13	< 13	< 6	< 6
	03/03/21 - 03/03/21	< 5	< 6	< 14	< 9	< 6	< 5
	04/06/21 - 04/06/21	< 6	< 6	< 9	< 13	< 6	< 6
	05/04/21 - 05/04/21	< 5	< 4	< 9	< 10	< 6	< 4
	06/02/21 - 06/02/21	< 4	< 5	< 10	< 10	< 6	< 4
	07/13/21 - 07/13/21	< 6	< 7	< 13	< 14	< 6	< 5
	08/24/21 - 08/24/21	< 5	< 6	< 9	< 11	< 5	< 6
	09/14/21 - 09/14/21	< 7	< 8	< 15	< 10	< 7	< 8
	10/05/21 - 10/05/21	< 4	< 9	< 12	< 13	< 5	< 6
	11/02/21 - 11/02/21	< 6	< 5	< 14	< 14	< 5	< 7
	12/07/21 - 12/07/21	< 7	< 8	< 16	< 19	< 7	< 7
OC-QC1N	01/06/21 - 01/06/21	< 3	< 3	< 6	< 5	< 2	< 3
(EIML)	02/03/21 - 02/03/21	< 4	< 4	< 4	< 8	< 5	< 4
	03/03/21 - 03/03/21	< 2	< 3	< 4	< 6	< 3	< 3
	04/06/21 - 04/06/21	< 4	< 2	< 6	< 5	< 2	< 3
	05/04/21 - 05/04/21	< 2	< 2	< 5	*(1)*	*(1)*	< 3
	06/02/21 - 06/02/21	< 1	< 1	< 2	*(1)*	*(1)*	< 1
	07/13/21 - 07/13/21	< 3	< 1	< 3	*(1)*	*(1)*	< 3
	08/24/21 - 08/24/21	< 2	< 3	< 5	*(1)*	*(1)*	< 4
	09/14/21 - 09/14/21	< 1	< 2	< 5	*(1)*	*(1)*	< 2
	10/05/21 - 10/05/21	< 1	< 1	< 2	*(1)*	*(1)*	< 1
	11/02/21 - 11/02/21	< 3	< 2	< 4	*(1)*	*(1)*	< 2
	12/07/21 - 12/07/21	< 5	< 3	< 6	*(1)*	*(1)*	< 4

(1) Not reported

Table D-III.1 CONCENTRATIONS OF GAMMA EMITTERS IN CLAM SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-60	Zn-65	Cs-134	Cs-137
24 (TBE)	05/17/21	1644 ± 807	< 48	< 77	< 72	< 51	< 52
QCA (TBE)	05/17/21	1503 ± 703	< 72	< 80	< 162	< 91	< 84
OC-24 (EIML)	05/17/21	1530 ± 80	< 4	< 3	< 6	*(1)*	< 4

(1) Not reported

Table D-IV.1 **CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF PCI/KG DRY ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	K-40	Mn-54	Co-60	Cs-134	Cs-137	Ra-226	Th-228
24	05/17/21	< 460	4158 ± 884	< 60	< 49	< 54	< 69	< 1306	201 ± 96
(TBE)	09/27/21	< 535	2447 ± 799	< 57	< 55	< 62	< 50	< 1270	269 ± 75
QCA	05/17/21	< 284	1064 ± 553	< 38	< 40	< 43	< 40	< 756	103 ± 74
(TBE)	09/27/21	< 549	3239 ± 924	< 61	< 51	< 64	< 75	< 1478	304 ± 130
OC-24	05/17/21	< 250	761 ± 232	< 16	< 9	*(1)*	< 14	< 371	< 1154
(EIML)	09/27/21	< 368	2786 ± 420	< 24	< 18	*(1)*	< 18	< 608	< 1827

(1) Not reported

TABLE D-V.1 CONCENTRATIONS OF STRONTIUM AND GAMMA EMITTERS IN VEGETATION SAMPLES COLLECTED IN THE VICINITY OF OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	Sr-89	Sr-90	Be-7	K-40	Cs-134	Cs-137
36 (TBE)							
Cabbage Leaves	08/18/21	< 21	13.3 ± 2.6	465 ± 229	3296 ± 592	< 20	< 29
Collards	08/18/21	< 22	15.0 ± 3.1	< 161	3803 ± 378	< 19	< 17
Rape	08/18/21	< 15	11.7 ± 3.2	< 191	4103 ± 468	< 25	< 18
QCA (TBE)							
Cabbage Leaves	08/18/21	< 19	< 4.4	369 ± 137	3467 ± 385	< 20	< 20
Collards	08/18/21	< 23	10.8 ± 2.5	< 221	4903 ± 553	< 24	< 24
Rape	08/18/21	< 20	8.4 ± 2.7	< 196	3788 ± 422	< 22	< 23
OC-36 (EIML)							
Cabbage Leaves	08/18/21	< 5	< 5.0	357 ± 124	3727 ± 324	*(1)*	< 8
Collards	08/18/21	< 4	< 3.0	< 130	4391 ± 357	*(1)*	< 12
Rape	08/18/21	< 3	< 3.0	< 100	4494 ± 364	*(1)*	< 9

(1) Not reported

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APPENDIX E

INTER-LABORATORY COMPARISON PROGRAM

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Table E.1

Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
March 2021	E13466	Milk	Sr-89	pCi/L	84.6	87.1	0.97	A
			Sr-90	pCi/L	11.5	12.6	0.91	A
	E13467	Milk	Ce-141	pCi/L	111	125	0.89	A
			Co-58	pCi/L	123	128	0.96	A
			Co-60	pCi/L	140	154	0.91	A
			Cr-51	pCi/L	252	242	1.04	A
			Cs-134	pCi/L	130	151	0.86	A
			Cs-137	pCi/L	110	110	1.00	A
			Fe-59	pCi/L	105	109	0.96	A
			I-131	pCi/L	77.6	86.9	0.89	A
			Mn-54	pCi/L	111	112	0.99	A
			Zn-65	pCi/L	200	211	0.95	A
	E13468	Charcoal	I-131	pCi	83.5	88.5	0.94	A
	E13469	AP	Ce-141	pCi	103.0	103	1.00	A
			Co-58	pCi	93.3	105	0.89	A
			Co-60	pCi	136	126	1.08	A
			Cr-51	pCi	213	198	1.07	A
			Cs-134	pCi	123.0	124	0.99	A
			Cs-137	pCi	86.3	90.1	0.96	A
			Fe-59	pCi	81.3	89.6	0.91	A
			Mn-54	pCi	93.5	92.0	1.02	A
			Zn-65	pCi	166	173	0.96	A
	E13470	Soil	Ce-141	pCi/g	0.232	0.262	0.89	A
			Co-58	pCi/g	0.251	0.268	0.94	A
			Co-60	pCi/g	0.306	0.322	0.95	A
			Cr-51	pCi/g	0.517	0.506	1.02	A
			Cs-134	pCi/g	0.263	0.317	0.83	A
			Cs-137	pCi/g	0.278	0.301	0.92	A
			Fe-59	pCi/g	0.228	0.229	1.00	A
			Mn-54	pCi/g	0.221	0.235	0.94	A
			Zn-65	pCi/g	0.448	0.441	1.02	A
	E13471	AP	Sr-89	pCi	92.2	95.5	0.97	A
			Sr-90	pCi	11.7	13.9	0.84	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table E.1

Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
September 2021	E13472	Milk	Sr-89	pCi/L	66.4	85.4	0.78	W
			Sr-90	pCi/L	11.9	14.0	0.85	A
	E13473	Milk	Ce-141	pCi/L	118	114	1.03	A
			Co-58	pCi/L	116	118	0.98	A
			Co-60	pCi/L	142	145	0.98	A
			Cr-51	pCi/L	244	236	1.03	A
			Cs-134	pCi/L	81	93.1	0.87	A
			Cs-137	pCi/L	105	112	0.94	A
			Fe-59	pCi/L	105	102	1.03	A
			I-131	pCi/L	65.1	85.6	0.76	W
			Mn-54	pCi/L	128	128	1.00	A
			Zn-65	pCi/L	158	153	1.03	A
	E13474	Charcoal	I-131	pCi	85.2	90.9	0.94	A
	E13475	AP	Ce-141	pCi	126	135	0.94	A
			Co-58	pCi	148	139	1.07	A
			Co-60	pCi	183	171	1.07	A
			Cr-51	pCi	322	278	1.16	A
			Cs-134	pCi	118	110	1.08	A
			Cs-137	pCi	147	132	1.12	A
			Fe-59	pCi	131	120	1.09	A
			Mn-54	pCi	161	151	1.06	A
			Zn-65	pCi	202	180	1.12	A
	E13476	Soil	Ce-141	pCi/g	0.215	0.219	0.98	A
			Co-58	pCi/g	0.208	0.226	0.92	A
			Co-60	pCi/g	0.277	0.277	1.00	A
			Cr-51	pCi/g	0.388	0.452	0.86	A
			Cs-134	pCi/g	0.157	0.178	0.88	A
			Cs-137	pCi/g	0.270	0.284	0.95	A
			Fe-59	pCi/g	0.218	0.195	1.12	A
			Mn-54	pCi/g	0.239	0.246	0.97	A
			Zn-65	pCi/g	0.312	0.293	1.06	A
	E13477	AP	Sr-89	pCi	85.6	68.3	1.25	W
			Sr-90	pCi	12.6	11.2	1.13	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table E.2

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Acceptance Range	Evaluation [(b)]
February 2021	21-GrF44	AP	Gross Alpha	Bq/sample	0.371	1.77	0.53 - 3.01	N[(3)]
			Gross Beta	Bq/sample	0.731	0.65	0.325 - 0.974	A
	21-MaS44	Soil	Ni-63	Bq/kg	310	689.0	482 - 896	N[(4)]
			Tc-99	Bq/kg	457	638	447 - 829	W
	21-MaSU44	Urine	Cs-134	Bq/L	2.34	2.73	1.91 - 3.55	A
			Cs-137	Bq/L	2.54	2.71	1.90 - 3.52	A
			Co-57	Bq/L	0.4100		*(1)*	A
			Co-60	Bq/L	2.24	2.44	1.71 - 3.17	A
			Mn-54	Bq/L	2.03	2.03	1.42 - 2.64	A
			K-40	Bq/L	52.8	54.0	38 - 70	A
			U-234	Bq/L	0.108	0.0877	0.0614 - 0.114	W
			U-238	Bq/L	0.101	0.091	0.064 - 0.118	A
			Zn-65	Bq/L	1.06	1.34	*(2)*	A
	21-MaW44	Water	Ni-63	Bq/L	6.7	8.2	5.7 - 10.7	A
			Tc-99	Bq/L	3.850	4.01	2.81 - 5.21	A
	21-RdV44	Vegetation	Cs-134	Bq/sample	3.13	3.60	2.5 - 4.7	A
			Cs-137	Bq/sample	4.64	4.69	3.28 - 6.10	A
			Co-57	Bq/sample	5.25	5.05	3.54 - 6.57	A
			Co-60	Bq/sample	2.86	2.99	2.09 - 3.89	A
			Mn-54	Bq/sample	5.02	5.25	3.68 - 6.83	A
			Sr-90	Bq/sample	0.631	0.673	0.471 - 0.875	A
			Zn-65	Bq/sample	-0.233		*(1)*	A
August 2021	21-GrF45	AP	Gross Alpha	Bq/sample	0.368	0.960	0.288 - 1.632	A
			Gross Beta	Bq/sample	0.595	0.553	0.277 - 0.830	A
	21-MaS45	Soil	Ni-63	Bq/kg	546	1280	896 - 1664	N[(5)]
			Tc-99	Bq/kg	453	777	544 - 1010	N[(6)]
	21-MaSU45	Urine	Cs-134	Bq/L	3.10	3.62	2.53 - 4.71	A
			Cs-137	Bq/L	0.083		*(1)*	A
			Co-57	Bq/L	0.844	0.87	0.606 - 1.125	A
			Co-60	Bq/L	0.0535		*(1)*	A
			Mn-54	Bq/L	0.459	0.417	*(2)*	A
			K-40	Bq/L	48.8	54.0	38 - 70	A
			U-234	Bq/L	0.133	0.116	0.081 - 0.151	A
			U-238	Bq/L	0.137	0.121	0.085 - 0.157	A
			Zn-65	Bq/L	0.339	0.420	*(2)*	A
	21-MaW45	Water	Ni-63	Bq/L	33.5	39.5	27.7 - 51.4	A
			Tc-99	Bq/L	3.5	3.7	2.60 - 4.82	A
	21-RdV45	Vegetation	Cs-134	Bq/sample	3.42	4.34	3.04 - 5.64	W
			Cs-137	Bq/sample	2.14	2.21	1.55 - 2.87	A
			Co-57	Bq/sample	4.08	4.66	3.26 - 6.06	A
			Co-60	Bq/sample	2.81	3.51	2.46 - 4.56	A
			Mn-54	Bq/sample	0.035		*(1)*	A
			Sr-90	Bq/sample	1.15	1.320	0.92 - 1.72	A
			Zn-65	Bq/sample	2.05	2.43	1.70 - 3.16	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test
(2) Sensitivity evaluation
*(3) See **NCR 21-02***
*(4) See **NCR 21-03***
*(5) See **NCR 21-13***
(6) Tc-99 cross-checks done for TBE information only - not required

Table E.3

ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Acceptance Limits	Evaluation [(b)]
March 2021	MRAD-34	Water	Am-241	pCi/L	175	157	108 - 201	A
			Fe-55	pCi/L	579	275	162 - 400	N[(1)]
			Pu-238	pCi/L	181	171	103 - 222	A
			Pu-239	pCi/L	153	142	87.9 - 175	A
		Soil	Sr-90	pCi/kg	6570	9190	2860 - 14,300	A
		AP	Fe-55	pCi/filter	107	121	44.2 - 193	A
			U-234	pCi/filter	25.99	25.5	18.9 - 29.9	A
			U-238	pCi/filter	24.7	25.3	19.1 - 30.2	A
April 2021	RAD-125	Water	Ba-133	pCi/L	92.3	90.5	76.2 - 99.6	A
			Cs-134	pCi/L	62.9	70.5	57.5 - 77.6	A
			Cs-137	pCi/L	161	168	151 - 187	A
			Co-60	pCi/L	22.5	20.9	17.7 - 25.8	A
			Zn-65	pCi/L	183	177.0	159 - 208	A
			GR-A	pCi/L	30.8	30.2	15.4 - 39.4	A
			GR-B	pCi/L	60.1	67.5	46.8 - 74.2	A
			U-Nat	pCi/L	36.45	36.9	30.0 - 40.8	A
			H-3	pCi/L	13,400	14,600	12,800 - 16,100	A
			Sr-89	pCi/L	64.5	63.5	51.4 - 71.5	A
			Sr-90	pCi/L	22.8	23.0	16.5 - 27.0	A
			I-131	pCi/L	28.2	26.7	22.2 - 31.4	A
September 2021	MRAD-35	Water	Am-241	pCi/L	68	63.7	43.7 - 81.5	A
			Fe-55	pCi/L	179	246	145 - 358	A
			Pu-238	pCi/L	102	114	68.5 - 148	A
			Pu-239	pCi/L	32	34.3	21.2 - 42.3	A
		Soil	Sr-90	pCi/kg	6160	6090	1,900 - 9,490	A
		AP	Fe-55	pCi/filter	493	548	200 - 874	A
			Pu-238	pCi/filter	28	28.5	21.5 - 35.0	A
			Pu-239	pCi/filter	21	21.6	16.1 - 26.1	A
			U-234	pCi/filter	7.95	7.76	5.75 - 9.09	A
			U-238	pCi/filter	8.0	7.69	5.81 - 9.17	A
October 2021	RAD-127	Water	Ba-133	pCi/L	82.8	87.5	73.6 - 96.2	A
			Cs-134	pCi/L	64.0	70.1	57.1 - 77.1	A
			Cs-137	pCi/L	145	156	140 - 174	A
			Co-60	pCi/L	83.2	85.9	77.3 - 96.8	A
			Zn-65	pCi/L	133	145	130 - 171	A
			GR-A	pCi/L	76.0	66.7	35.0 - 82.5	A
			GR-B	pCi/L	63.0	55.7	38.1 - 62.6	N[(2)]
			U-Nat	pCi/L	52.88	55.5	45.3 - 61.1	A
			H-3	pCi/L	13,800	17,200	15,000 - 18,900	N[(3)]
			Sr-89	pCi/L	54.9	61.0	49.1 - 68.9	A
			Sr-90	pCi/L	24.8	29.3	21.3 - 34.0	A
			I-131	pCi/L	27.4	26.4	21.9 - 31.1	A
December 2021	QR 120121Y	Water	GR-B	pCi/L	47.6	39.8	26.4 - 47.3	N[(4)]
			H-3	pCi/L	17,500	17,800	15,600 - 19,600	A

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation:
A = Acceptable - Reported value falls within the Acceptance Limits
N = Not Acceptable - Reported value falls outside of the Acceptance Limits

(1) See ***NCR 21-01***
(2) See ***NCR 21-10***
(3) See ***NCR 21-11***
(4) See ***NCR 21-14***

TABLE E.4

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Environmental, Inc., Midwest Laboratory
(Relevant Nuclides Only)

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory Result	Known Activity	Control Limits [c]	Acceptance
MADW-571	02/01/21	GR-A	0.73 ± 0.06	0.87	0.26 - 1.48	Pass
MASO-591	02/01/21	Cs-137	1700 ± 20	1,550	1,085 - 2,015	Pass
MASO-591	02/01/21	Co-60	1,360 ± 10	1,370	959 - 1781	Pass
MASO-591	02/01/21	Mn-54	0.91 ± 2.85	0	NA [c]	Pass
MASO-591	02/01/21	K-40	682 ± 53	618	433 - 803	Pass
MAW-569	02/01/21	Cs-137	10.5 ± 0.3	11.5	8.1 - 15.0	Pass
MAW-569	02/01/21	Co-60	0.3 ± 0.05	0	NA [c]	Pass
MAW-569	02/01/21	Mn-54	16.5 ± 0.4	15.5	10.9 - 20.2	Pass
MAW-569	02/01/21	Zn-65	11.5 ± 0.5	10.5	7.40 - 13.7	Pass
MAVE-568	02/01/21	Cs-137	5.69 ± 0.10	3.82	2.67 - 4.97	Pass
MAVE-568	02/01/21	Co-60	3.29 ± 0.06	2.99	2.09 - 3.89	Pass
MAVE-568	02/01/21	Mn-54	6.17 ± 0.16	5.25	3.68 - 6.83	Pass
MAVE-568	02/01/21	Zn-65	-0.04 ± 0.08	0.00	NA [c]	Pass
MADW-2688	08/01/21	GR-A	0.19 ± 0.03	0.232	0.070 - 0.394	Pass
MASO-3004	08/01/21	Cs-137	628 ± 11	572	400 - 744	Pass
MASO-3004	08/01/21	Co-60	720 ± 7	722	714 - 1,326	Pass
MASO-3004	08/01/21	Mn-54	456 ± 11	410	287 - 533	Pass
MASO-3004	08/01/21	K-40	663 ± 50	607	425 - 789	Pass
MADW-3003	08/01/21	Sr-90	3.63 ± 0.16	3.9	2.70 - 5.02	Pass

[a] *Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (vegetation)*

[b] *Laboratory codes as follows: MAW (water), MASO (soil), MAVE (vegetation)*

[c] *MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". MAPEP does not provide control limits.*

TABLE E.5

Interlaboratory Comparison Crosscheck Program
Environmental Resource Associates (ERA)[a] RAD Study
Environmental, Inc., Midwest Laboratory
(Relevant Nuclides Only)

Lab Code	Date	Analysis	Laboratory Result	ERA Result	Control Limits	Acceptance
RAD-124						
ERW-94	01/11/21	Cs-137	154 ± 6.0	148	133 - 165	Pass
ERW-94	01/11/21	Co-60	39.4 ± 3.2	34.6	30.8 - 40.8	Pass
ERW-94	01/11/21	Zn-65	66.2 ± 6.3	61.6	54.6 - 75.0	Pass
ERW-94	01/11/21	GR-A	58.4 ± 2.6	39.8	26.4 - 47.3	Pass
ERW-94	01/11/21	H-3	2,100 ± 160	2,120	1,750 - 2,350	Pass
RAD-126						
ERDW-2194	07/12/21	Cs-137	218 ± 8	208	187 - 230	Pass
ERDW-2194	07/12/21	Co-60	91.7 ± 4.0	87.1	78.4 - 98.1	Pass
ERDW-2194	07/12/21	Zn-65	114 ± 9	102	91.8 - 122	Pass
ERDW-2194	07/12/21	GR-A	61.5 ± 2.9	49.1	25.6 - 61.7	Pass
ERDW-2194	07/12/21	H-3	11,300 ± 300	10,400	9,050 - 11,400	Pass

[a] *Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resources Associates (ERA).*

APPENDIX F

ERRATA DATA

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There was no errata data for 2021.

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APPENDIX G

OSLD ANOMALOUS DATA

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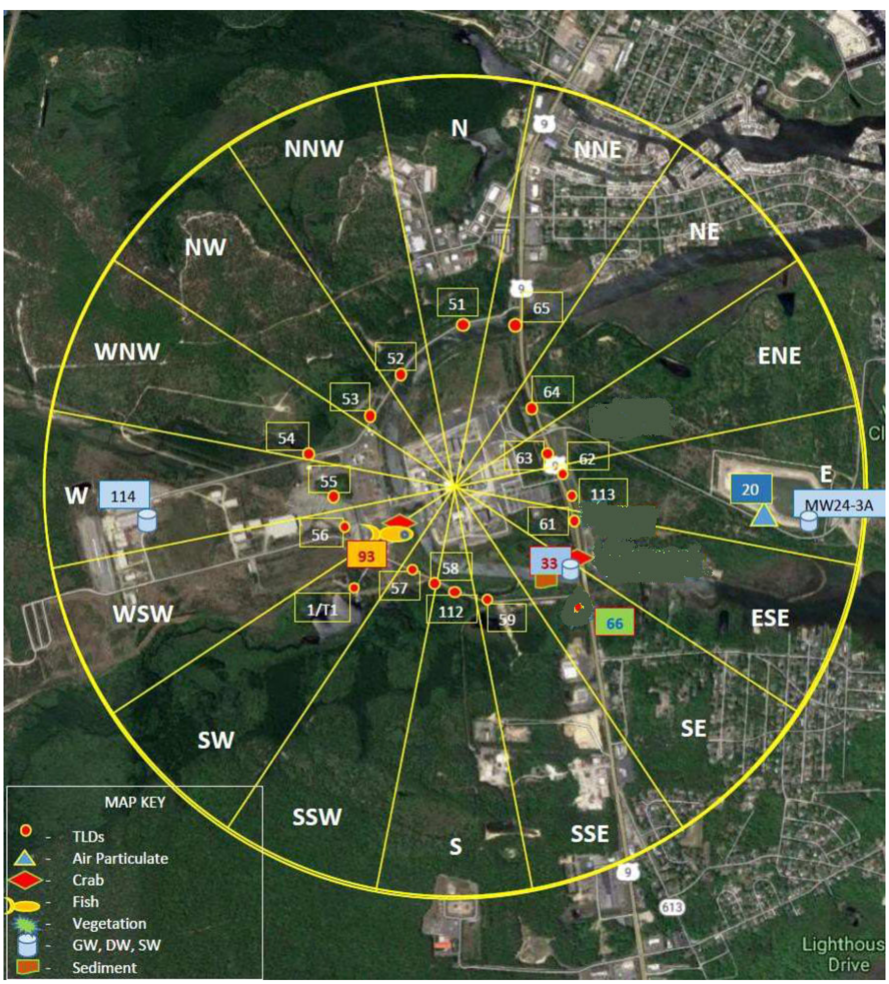
Observed Dose Anomalies on REMP OSLDs Posted on Route 9

Introduction

While reviewing the first quarter 2021 OSLD data, there was a spike in dose observed on OC-OSLD-61, which is located on the east side of Route 9 south of the Main Plant Entrance and just north of the Discharge Canal (See Figure 1). Through inquiries made within the department it was discovered that radiography was being performed on the new gas pipeline being constructed on the east side of route 9. Kevan Whippie spoke with Jim Cusson from Gray Supply Corp. and he verified that radiography had occurred in the first quarter, and further that more shots would occur in the second quarter. As shown in Figure 1, there is a line of environmental dosimeters (OSLDs) that are part of Oyster Creek's Radiological Environmental Monitoring Program (REMP) posted along the east side of Route 9. Two locations, OC-OSLD-61 and OC-OSLD-63 are located close to areas that were used to stage pipe sections for radiography and these OSLDs recorded dose from this construction activity.

Figure 1:

Oyster Creek Nuclear Station
REMP Sample Locations
Within a 1 Mile Radius



Data

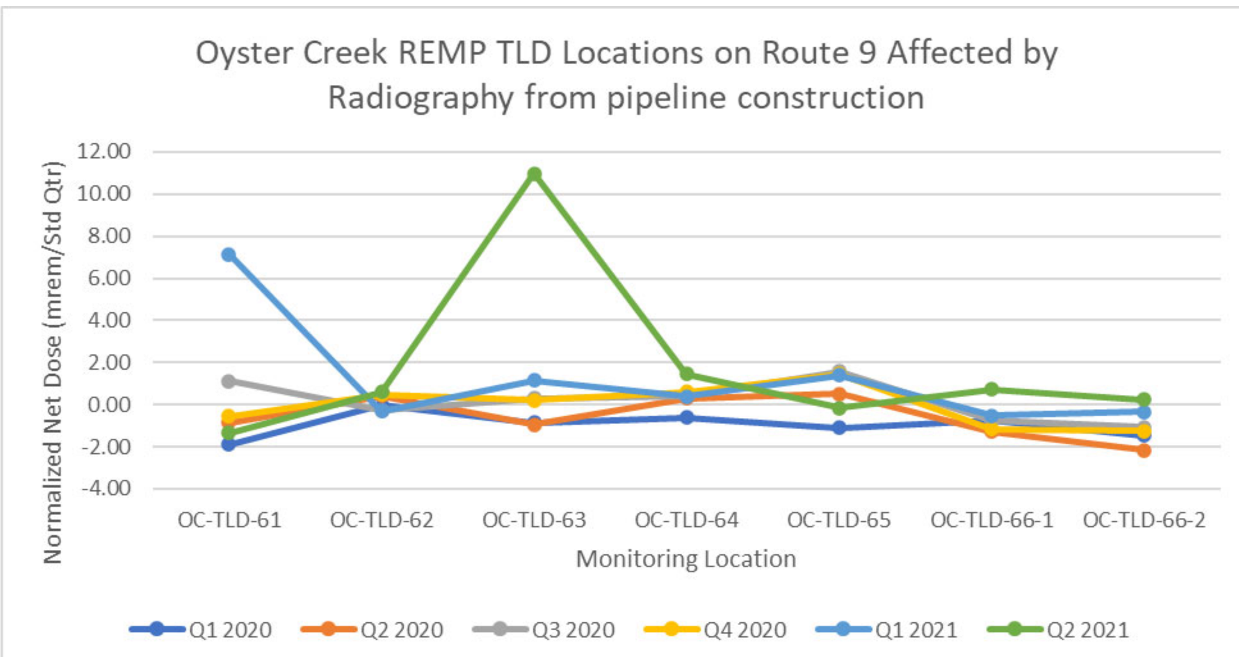
Dosimeters OC-OSLD-61 through 65 are posted along the east side of Route 9 from the north side of the discharge canal (61) to the south side of the intake canal (65).

In the first quarter of 2021, OC-OSLD-61 recorded 7.14 mRem/std qtr. The average of the dose for dosimeters OC-OSLD-62-65 was 0.65 mRem/std qtr.

In the second quarter of 2021, OC-OSLD-63 recorded 10.97 mRem/std qtr. The average of the dose for dosimeters OC-OSLD-62-65 was 0.13 mRem/std qtr.

The average for the last 6 quarters (Q1-2020 to Q2 2021) of dosimeters 61-65, exclusive of the elevated readings previously discussed, was 0.12 mrem/std qtr.

Figure 2: REMP OSLD Readings – OC-OSLD-61 to OC-OSLD-65



Discussion

Optically Stimulated Luminescent Dosimeters (OSLDs) are deployed by all nuclear power stations to monitor direct radiation to members of the public and ensure that each station remains within the regulatory limits set for this. As Route 9 is a busy road immediately adjacent to the plant property, a series of dosimeters is posted along the road to cover the compass sectors of North Northeast, Northeast, East Northeast, East, and East Southeast. These dosimeters are posted and retrieved on a quarterly schedule. When they have been retrieved from the field, they are sent to a vendor laboratory facility where the radiation exposure is read and reported back to the REMP owner.

Construction work on a new natural gas pipeline was commenced in the first quarter of 2021. The construction company made required notifications to Oyster Creek staff (Security) but there was not a notification to Chemistry/Environmental. During review of the OSLD data for the first quarter of 2021, a significant increase was noted for OC-OSLD-61. During inquiry regarding this result, it was discovered that radiography was conducted on the property east of Route 9 to inspect weld quality on the pipeline welds. Radiography, in the context of pipeline construction, involves exposing pipe welds to a source of radiation to capture an image of the weld for quality analysis. Because the source of radiation has a high specific activity, this source, if not specifically shielded, can create a dose field in the vicinity of the radiography. Since the environmental dosimeters were not known to be located nearby, they were not shielded, and the dose recorded is a result.

Oyster Creek operates the REMP as required in the Decommissioning Safety Analysis Report (DSAR) Appendix B.1.4.(b). A requirement is contained in DSAR Appendix B.2.1.b to produce an Annual Radiological Environmental Operating Report summarizing the functional aspects of the REMP for the previous year and summarizing the effects of the plant, if any are found, on the surrounding area. In this report, there is a section to describe any missed samples due to environmental factors (storm effects, unavailability due to conditions, *etc.*) or any anomalous data. In the AREOR due for submission on May 1, 2022, these anomalous OSLD readings will be addressed. Because there is a known source of radiation that did not come from the plant that created these elevated readings, the data points affected will not be used to calculate the annual dose for each dosimeter location. Review of historical data shows no similar elevated dose reading from either of the affected locations. The dosimeters affected were in proximity to accessible work areas to perform the radiography required for the safe use of the new pipeline, and therefore the dose is assigned to this activity. No dose increase was seen in the second quarter for OC-OSLD-61, which had an elevated dose reading from the first quarter and the dosimeter reading for the third quarter of 2021 showed the result for OC-OSLD-63 has returned to normal.

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APPENDIX H

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Docket No: 50-219

OYSTER CREEK GENERATING STATION
UNIT 1

Annual Radiological
Groundwater Protection Program Report

1 January through 31 December 2021

Prepared By
Teledyne Brown Engineering
Environmental Services

HOLTEC DECOMMISSIONING INTERNATIONAL

Oyster Creek Generating Station
Forked River, NJ 08731

April 2022

Table of Contents

Appendices

Appendix A Location Designation

<u>Tables</u>

<u>Figures</u>

Security-Related Information: Detailed maps of the Oyster Creek Generating Station have been withheld from public disclosure under 10 CFR 2.390 and N.J.S.A. 47:1A-1.1

Appendix B Data Tables

<u>Tables</u>

I. Summary and Conclusions

This report on the Radiological Groundwater Protection Program (RGPP) conducted for the Oyster Creek Generating Station (OCGS) by Holtec Decommissioning International (HDI) covers the period 01 January 2021 through 31 December 2021.

This report covers groundwater and surface water samples collected from the environment, both on and off station property in 2021. In 2021, 497 analyses were performed on 148 samples from 39 locations.

There were three inadvertent releases of contaminated water into the groundwater during 2009 resulting in a plume located west of the turbine building, which is monitored via a series of monitoring wells.

Gamma-emitting nuclide K-40 was detected at a concentration of 35 pCi/L in a QC sample analyzed by the secondary laboratory. No other gamma emitting radionuclides were detected at any of the 33 groundwater well sample locations or 6 surface water location analyzed during 2021.

In the case of tritium, HDI specified that the laboratory achieve a lower limit of detection 10 times lower than the drinking water limit specified by the United States Environmental Protection Agency (USEPA) (2,000 pCi/l versus 20,000 pCi/l). As expected, tritium was detected in groundwater samples, although tritium concentrations have decreased substantially since 2009. The 2021 tritium concentrations varied from <158 to 364 pCi/l. The well with the highest concentration was MW-56I.

Surface water samples were collected from onsite and offsite monitoring locations during 2021. Tritium was not detected in any of the 23 samples.

Strontium-89 (Sr-89) and Strontium-90 (Sr-90) were not detected in any groundwater samples during 2021.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples in 2021. There were 46 samples taken from 20 groundwater well locations. Gross Alpha (dissolved) was detected in 3 samples. The concentrations ranged from 0.7 to 7.4 pCi/L. Gross Alpha (suspended) was detected in 14 samples and ranged from 1.2 to 9.0 pCi/L. Gross Beta (dissolved) was detected in 33 samples and ranged from 0.9 to 38.9 pCi/L. Gross Beta (suspended) was detected in 11 samples and ranged from 2.2 to 22.1 pCi/L.

“Hard-To-Detect” (HTD) analyses were performed on one groundwater sample in 2021. These analyses included americium-241 (Am-241), cerium-242 (Ce-242), cerium-243/244 (Ce-243/244), plutonium-238 (Pu-238), plutonium-239/240 (Pu-239/240), uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238). U-234 was detected at a concentration of 0.4 pCi/L and U-238 was detected at a concentration of 0.8 pCi/L All other HTD analyses were less than the MDC.

II. Introduction

On July 1st, 2019, ownership of the Oyster Creek Nuclear Generating Station and transfer of the license from Exelon Generation Company, LLC to Oyster Creek Environmental Protection, LLC (OCEP) as the licensed owner and Holtec Decommissioning International, LLC (HDI) as the licensed operator, was completed. OCEP and HDI are wholly-owned subsidiaries of Holtec International.

The Oyster Creek Nuclear Generating Station consisted of a single boiling water reactor (BWR) and turbine generator was capable of producing 650 megawatts of electricity. The Station operated under Nuclear Regulatory Commission (NRC) renewed facility operating license number DPR-16. Brackish water from Barnegat Bay is supplied to the circulating water system. The circulating water system is designed to supply a continuous flow of water from Barnegat Bay through the plant to remove the waste heat released by the power cycle in the Main Condenser. The circulating water system is comprised of the intake canal from Barnegat Bay to the plant, the Main Condenser Circulating Water System, the dilution plant, and the discharge canal to Barnegat Bay. The dilution plant portion of the system minimized the adverse effects of the thermal discharge on aquatic life in the discharge canal and Barnegat Bay.

The Station is located in the Atlantic Coastal Plain physiographic province. Topography in the region of the Station is a slightly undulating coastal plain having low relief. The land surface gradually rises from sea level at Barnegat Bay, which is located east of the Station, to approximately 50 feet above mean sea level (AMSL) 2 miles inland. This region of the coastal plain has numerous tidal marshes and is incised by easterly flowing streams and creeks. Elevations at the Station property west of Route 9 range from approximately 0 to 15 feet AMSL immediately adjacent to the intake and discharge canals to slightly more than 30 feet AMSL in the northwest portion of the Station property. The 150-acre developed portion of the Site located within the "horseshoe" formed by the intake and discharge canals west of Route 9 has an approximate average elevation of 20 feet AMSL. In the immediate vicinity of the intake and discharge canals, the Station property slopes steeply down to the canal. The average elevation of the surface water level in the intake and discharge canals is approximately 1-foot AMSL. The ground surface is relatively level except for the steep slopes at areas adjacent to the intake and discharge canals.

The three shallowest stratigraphic units in the vicinity of the Oyster Creek area in descending order are the Cape May Formation, the Cohansey Formation, and the Kirkwood Formation. Some of the Station structures are constructed to depths of approximately 50 feet below ground surface (bgs). Excavations were completed from grade, through the fill, Cape May Formation, Upper Clay, and into the Cohansey Formation during construction. Consequently, the bottoms of some Station structures are completed within the Cohansey Formation and some structures breach the Upper Clay.

The Cape May Formation regionally has an average thickness of 40 feet and at OCGS, the Cape May is described as a light gray to tan, medium- to fine-grained sand, with trace to some silt and occasional coarse sand. It is generally poorly compacted. The Cape May Formation varies from 0 to 21 feet in thickness based on historical boring logs. The variation principally is due to the varying amount of material excavated and replaced by fill during Station construction. When present, the thickness of the Cape May generally ranges from 15 to 20 feet thick. The base of the Cape May generally is defined by the presence of a dark clay unit referred to as the Upper Clay unit. The Upper Clay is a stiff to hard, gray, plastic organic clay containing inclusions (also described as lenses or partings) of dense fine sand with trace to some organic silt. The deposits of fine sand within the Upper Clay layer have high relative densities and occur as lenses or inclusions.

The Cohansey Formation is primarily composed of a light-colored, fine- to very coarse-grained quartzose sand with lenses of silt and clay. Although most borings at the Station do not penetrate the entire Cohansey Formation, this formation appears to be approximately 60 to 80 feet thick at OCGS. A clay sequence, referred to at the Station as the "Lower Clay", marks the base of the Cohansey, which generally is present to approximately 90 to 100 feet bgs. The lower clay is a dense gray medium- to fine-grained sand containing trace to some organic silt and layers or inclusions of very stiff to hard gray organic clay. The thickness of the lower clay is estimated to be approximately 10 to 20 feet in the vicinity of OCGS.

The Cohansey Formation is underlain by the Kirkwood Formation which consists of several stratigraphic units. The Kirkwood Formation is described as a medium- to fine-grained sand with trace silt. The thickness of this formation beneath the Station is unknown. The south domestic supply well terminates in the Kirkwood at a depth of 310 feet bgs. The Kirkwood thickness in Ocean County ranges from approximately 300 to 400 feet.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Environmental Inc. (Midwest Labs) on samples collected in 2021.

A. Objectives of the RGPP

The long-term objectives of the RGPP are as follows:

- Ensure that the site characterization of geology and hydrology provides an understanding of predominant ground water gradients based upon current site conditions
- Identify site risk based on plant design and work practices
- Evaluate all structures, systems and components (SSC) that contain or could contain licensed material and for which there is a credible mechanism for the licensed material to reach groundwater
- Evaluate work practices that involve licensed material and for which there is a credible mechanism for the licensed material to reach groundwater
- Perform on-site monitoring to ensure timely detection of inadvertent radiological releases to ground water
- Understand background concentrations of radioactive analytes outside of

the REMP, as required

- Evaluate return/re-use of previously discharged radioactive effluents in gaseous or liquid effluents that are returned from the environment to the operating nuclear power facility
- Ensure controls are established for the selection, installation and retirement of monitoring wells
- Perform remediation protocols to prevent migration of licensed material off-site and to minimize decommissioning impacts
- Ensure that records of leaks, spills, remediation efforts are retained and retrievable to meet the requirements of 10 CFR 50.75(g)
- Ensure periodic communications are held on the RGPP with the designated State/Local officials
- Ensure timely verbal and written reporting occurs if there is an inadvertent release of licensed materials to the soil, groundwater or surface water
- Document and report all applicable RGPP data
- Identify and resolve deficiencies via the Decommissioning Corrective Action Program
- Perform program oversight to ensure effective implementation of the voluntary RGPP

B. Implementation of the Objectives

The objectives identified have been implemented at the Oyster Creek Generating Station through compliance with approved procedures EN-AA-408-4000, Radiological Groundwater Protection Program Implementation, and site specific procedure EN-OC-408-4160, RGPP Reference Material, for Oyster Creek Generating Station.

C. Program Description

Samples for the OCGS site were collected for HDI by on-site personnel and Normandeau Associates, Inc. This section describes the general collection methods used to obtain environmental samples for the OCGS RGPP in 2021. Sample locations can be found in Table A–1, Appendix A.

1. Sample Collection

Samples of water are collected, managed, transported and analyzed in accordance with approved procedures. Both groundwater and surface water are collected. Sample locations, sample collection frequencies and analytical frequencies are controlled in accordance with approved station procedures. Contractor and/or station personnel are trained in the collection, preservation management, and shipment of samples, as well as in documentation of sampling events.

2. Sample Analysis

   Samples are analyzed in accordance with approved procedures that are based on industry standards.

3. Quality Control

   Analytical laboratories are subject to internal quality assurance programs, industry cross-check programs, nuclear industry audits, as well as being certified by the State of New Jersey.

4. Data Interpretation

   Station personnel review and evaluate all analytical data deliverables as data is received. Analytical data results are reviewed by both station personnel and independent consultants, including a hydrogeologist, for adverse trends or changes to hydrogeologic conditions.

D. Characteristics of Tritium (H-3)

Tritium (chemical symbol H-3) is a radioactive isotope of hydrogen. The most common form of tritium is tritium oxide, which is also called "tritiated water." The chemical properties of tritium are essentially those of ordinary hydrogen.

Tritiated water behaves the same as ordinary water in both the environment and the body. Tritium can be taken into the body by drinking water, breathing air, eating food, or absorption through the skin. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted primarily through urine with a clearance rate characterized by an effective biological half-life of about 10 days.

Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Tritium is also produced during nuclear weapons explosions, as a by-product in reactors producing electricity, and in special production reactors. Also, tritium was released into the atmosphere from Chernobyl in 1986. Like normal water, tritiated water is colorless and odorless. Tritiated water behaves chemically and physically like non-tritiated water in the subsurface, and therefore tritiated water will travel at the same velocity as the average groundwater velocity.

Tritium has a half-life of approximately 12.3 years. It decays spontaneously to Helium-3 (He-3). This radioactive decay releases a beta particle (18.6 keV low-energy electron). The radioactive decay of tritium is the source of the health risk from exposure to tritium. Tritium is one of the least dangerous radionuclides because it emits very weak radiation and leaves the body relatively quickly. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues is generally uniform and is dependent on the water content of the specific tissue.

III. Program Description

A. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the Oyster Creek Generating Station RGPP in 2021. The sampling frequencies are increased if activity is detected.

In order to achieve the stated objectives, the current program includes the following analyses for groundwater, surface water, and precipitation water:

1. Gamma emitters
2. Strontium-89 and Strontium-90
3. Tritium
4. Gross Alpha (Dissolved and Suspended) and Gross Beta (Dissolved and Suspended)
5. Selected transuranics
6. Fe-55
7. Ni-63

B. Data Interpretation

The radiological data collected prior to Oyster Creek Generating Station becoming operational, as well as background data from publicly available databases, were used as a baseline with which these operational data were compared. For the purpose of this report, Oyster Creek Generating Station was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. <u>Lower Limit of Detection and Minimum Detectable Concentration</u>

   The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as a before the fact (*a priori*) estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact (*a posteriori*) criterion for the presence of activity. All analyses were designed to achieve the required OCGS detection capabilities for environmental sample analysis.

   The minimum detectable concentration (MDC) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal as an after the fact estimate of the presence of activity.

2. Laboratory Measurements Uncertainty

The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value.

Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. Uncertainty comes from factors such as calibration standards, sample volume/weight measurements, or sampling uncertainty. The uncertainty of a measurement created by statistical process (counting error) is reported as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. Each counting result is reported and then followed with a plus or minus (±) result of the estimated sample standard deviation (as TPU) that is obtained by propagating all sources of analytical uncertainty in measurements.

Analytical uncertainties are reported at the 95% confidence level.

C. Background Analysis

1. Background Concentrations of Tritium

The purpose of the following discussion is to summarize background measurements of tritium in various media performed by others. Additional detail may be found by consulting references.

a. Tritium Production

Tritium is created in the environment from naturally occurring processes both cosmic and subterranean, as well as from anthropogenic (i.e., man-made) sources. In the upper atmosphere, “cosmogenic” tritium is produced from the bombardment of stable nuclides and combines with oxygen to form tritiated water, which will then enter the hydrologic cycle. Below ground, “lithogenic” tritium is produced by the bombardment of natural lithium present in crystalline rocks by neutrons produced by the radioactive decay of naturally abundant uranium and thorium. Lithogenic production of tritium is usually negligible compared to other sources due to the limited abundance of lithium in rock. The lithogenic tritium is introduced directly to groundwater.

A major anthropogenic source of tritium and Sr-90 comes from the former atmospheric testing of thermonuclear weapons. Levels of tritium in precipitation increased significantly during the 1950s and peaked in 1963 with the signing of the limited test ban treaty. The Canadian heavy water nuclear power reactors, other commercial power reactors, nuclear research and weapons production continue to influence tritium concentrations in the environment. Also, tritium was released into the atmosphere from Chernobyl in 1986.

b. Precipitation Data

Precipitation samples are routinely collected at stations around the world for the analysis of tritium and other radionuclides. One publicly available database that provides tritium concentrations in precipitation is the USEPA's RadNet database. RadNet provides tritium precipitation concentration data for samples collected at stations throughout the U.S. from 1978 up to and including 1996. Tritium concentrations in precipitation in New Jersey from 1978 through 1996 have ranged from 600 pCi/L in 1979 to 0 pCi/L in 1996, with an average of 185 pCi/L. Tritium concentrations in wells may still be above the 2000 pCi/l detection limit from the external causes described above. Water from previous years and decades is naturally captured in groundwater, so some well water sources today are affected by the surface water from the 1960s that was elevated in tritium.

c. Surface Water Data

Tritium concentrations are routinely measured in surface water bodies, including Oyster Creek and the Delaware River. New Jersey surface water data between 1978 and 1998 averaged 185 pCi/L.

The USEPA RadNet surface water data typically has a reported 'Combined Standard Uncertainty' of 2 standard deviations. This corresponds to a ± 36 to ±100 pCi/L confidence bound on each given reported measurement so that the typical surface water background data provided by RadNet may be subject to measurement uncertainty of up to 100 pCi/L.

The radio-analytical laboratory counts tritium results to an HDI-specified LLD of 200 pCi/L with a typical uncertainty of ±100 pCi/L. Therefore, sample results reported by TBE near this LLD cannot be distinguished from natural background concentrations in surface water.

IV. Results and Discussion

A. Program Exceptions

There were no program exceptions in 2021. All samples required by station procedures were collected as required.

B. Groundwater Results

Samples were collected from on-site locations in accordance with the station radiological groundwater protection program. As reported in the latest Hydrogeologic Investigation Report, groundwater flow is towards the intake and discharge canals.

Tritium

Samples from 33 locations were analyzed for tritium activity. Tritium was detected in 10 of 119 samples. The values ranged from <158 to 364 pCi/L. The well with the highest concentration was MW-56I. (Table B–I.1, Appendix B)

Strontium

Samples collected from onsite wells are analyzed for hard-to-detect (HTD) isotopes, including strontium to characterize the source of any contaminant. Per station procedures, ongoing surveillance for HTD isotopes is required after initial negative findings to ensure a new source of contamination is not present.

Strontium-89 and Strontium-90 were not detected in any location sampled in 2021. (Table B-I.1, Appendix B)

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples in 2021. There were 46 samples taken from 20 groundwater well locations. Gross Alpha (dissolved) was detected in 3 samples. The concentrations ranged from 0.7 to 7.4 pCi/L. Gross Alpha (suspended) was detected in 14 samples and ranged from 1.2 to 9.0 pCi/L. Gross Beta (dissolved) was detected in 33 samples and ranged from 0.9 to 38.9 pCi/L. Gross Beta (suspended) was detected in 11 samples and ranged from 2.2 to 22.1 pCi/L. (Table B-I.1, Appendix B)

Gamma Emitters

Naturally-occurring K-40 was detected at a concentration of 35 pCi/L in a QC sample analyzed by the secondary laboratory. No other gamma-emitting nuclides were detected in any groundwater sample in 2021.
(Table B–I.2, Appendix B).

“Hard-To-Detect”

“Hard-To-Detect” (HTD) analyses were performed on one groundwater sample in 2021. U-234 was detected at a concentration of 0.4 pCi/L and U-238 was detected at a concentration of 0.8 pCi/L All other HTD analyses were less than the MDC. (Table B-I.3, Appendix B)

C. Surface Water Results

Samples were collected from on-site locations in accordance with the station radiological groundwater protection program. Analytical results and anomalies are discussed below:

Tritium

Samples from 6 locations were analyzed for tritium activity. No H-3 was detected in any sample. (Table B–II.1, Appendix B)

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions are not required on a routine basis and were not analyzed in 2021.

Gamma Emitters

No gamma emitting nuclides were detected in surface water samples during 2021. (Table B–II.2, Appendix B)

“Hard-To-Detect”

“Hard-To-Detect” analyses are not required on a routine basis and were not analyzed in 2021.

D. Precipitation Water Results

No precipitation samples were collected in 2021. (Table B–III.1, Appendix B)

E. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE and Environmental Inc. (Midwest Labs) are presented in the 2021 Oyster Creek AREOR. This report is part of the AREOR.

F. Leaks, Spills, and Releases

There were no abnormal liquid releases during 2021.

G. Trends

Active remediation of tritium in groundwater due to the spills that occurred in 2009 was initiated in October 2010. Trending of the data due to active remediation is on-going. Continuous remediation was terminated in October 2019 with State of New Jersey concurrence. Overall, the station has seen a decreasing trend in tritium values to the point where ground water tritium is below the ODCM LLD (2,000 pCi/L) and the TBE lab MDL of 200 pCi/L in 33 monitoring wells.

H. Investigations

GHD Services Inc. performed an independent assessment of the tritium plume. The results of their assessment can be found in References 1, 2 and 3.

I. Actions Taken

1. Compensatory Actions

Active remediation of tritium in groundwater due to the spills that occurred in 2009 was initiated in October 2010. Due to the decrease in groundwater tritium as a result of the remediation project, continuous remediation was ceased in 2019. The Oyster Creek ODCM has provision to re-start remediation from this well, if necessary, via either continuous or batch discharge methods.

2. Installation of Monitoring Wells

The following wells were installed in 2010 to better characterize and monitor the tritium plume and site hydrology:

Well Number	Formation	Well Installation Date
W-58 I	Cohansey	July
W-59 I	Cohansey	March
W-60 I	Cohansey	July
W-61 I	Cohansey	July
W-62	Cape May	March
W-63 I	Cohansey	July
W-64	Cape May	March
W-65	Cape May	March
W-66 I	Cohansey	July
W-67	Cape May	March
W-68 I	Cohansey	July
W-69 I	Cohansey	July
W-70 I	Cohansey	July
W-71	Cape May	August
W-72	Cape May	August
W-73 Pumping well	Cohansey	October

3. Actions to Recover/Reverse Plumes

Oyster Creek Generating Station addressed the tritium in groundwater through continuous pumping of groundwater from of W-73 to the intake structure. Remediation of groundwater progressed to the stage where this program was terminated in the 4th quarter of 2019 with State of New Jersey concurrence. Should groundwater tritium levels regress initiating an adverse trend, the ODCM has provisions to restore ground water remediation using well 73 in batch or continuous mode.

V. References

1. Conestoga Rovers and Associates, Hydrogeologic Investigation Report, Fleetwide Assessment, Oyster Creek Generating Station, Forked River, New Jersey, Ref. No. 055875 (6), April 2011
2. Conestoga Rovers and Associates, Site Investigation Report, Oyster Creek Generating Station, Forked River, New Jersey, Ref. No. 055875 (4), August 2009
3. Conestoga Rovers and Associates, Remedial Investigation Workplan, Oyster Creek Generating Station, Forked River, New Jersey, Ref. No. 055875 (5), October 2009

APPENDIX A

LOCATION DESIGNATION

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TABLE A-1: Radiological Groundwater Protection Program - Sampling Locations, Oyster Creek Generating Station, 2021

Oyster Creek Generating Station RGPP Sample Point List

Sample Identification Number	Location	Well GPS Coordinates (Northing/Easting)	Depth (ft)	RGPP Sample Point Designation	Tritium Alert Value	Aquifer or Water Body Monitored
MW-1A-2A	SW of MFOT Moat	357380.76 575043.44	24.0	D	2,000 pCi/L	Cape May
MW-1I-1A	Roadway – NW of TWST	357598.17 574412.70	19.0	D	2,000 pCi/L	Cape May
MW-1I-2A	Roadway – SE of TWST	357574.80 574493.50	17.5	D	2,000 pCi/L	Cape May
MW-15K-1A	Roadway - Intake	357297.90 574469.50	19.0	D	2,000 pCi/L	Cape May
MW-16D	Yard – W of MAC Building	357573.30 574746.50	25.0	D	2,000 pCi/L	Cape May
SW-1	Intake Canal	N/A	N/A	SW	2,000 pCi/L	Surface Water
SW-2	RT 9 South Bridge	N/A	N/A	SW	2,000 pCi/L	Surface Water
SW-3	Fire Pond	N/A	N/A	SW	2,000 pCi/L	Surface Water
W-1A	North Yard Area	358311.70 574679.00	50.0	B	2,000 pCi/L	Cohansey
W-3	Intake – Access Road	357173.00 574499.10	24.0	D	2,000 pCi/L	Cape May
W-4	Intake – Access Road	357176.40 574497.70	55.0	D	2,000 pCi/L	Cohansey
W-4A	SE of OCAB Building	356913.30 575387.10	50.0	B	2,000 pCi/L	Cohansey
W-5	NW Yard area, near Fire Water Tank	357510.95 574374.05	20.5	D	2,000 pCi/L	Cape May
W-6	NW Yard – near Fire Water Tank	357514.02 574373.77	52.0	D	2,000 pCi/L	Cohansey
W-9	Roadway – NE of SAS Building	357289.29 574892.74	20.0	D	2,000 pCi/L	Cape May
W-9	Roadway – NE of SAS Building	357289.29 574892.74	20.0	D	2,000 pCi/L	Cape May
W-10	NW of SAS Building	357286.29 574890.61	60.0	D	2,000 pCi/L	Cape May
W-12	Yard – NW of DWPC Building	357669.10 574755.60	20.0	D	2,000 pCi/L	Cape May
W-13	Yard – NW of DWPC Building	357666.00 574755.90	50.0	D	2,000 pCi/L	Cape May
W-14	Yard – SW of Warehouse	357702.41 575018.75	53.0	D	2,000 pCi/L	Cape May
W-15	Yard – SW of Warehouse	357705.83 575017.70	20.0	D	2,000 pCi/L	Cape May

TABLE A-1: Radiological Groundwater Protection Program - Sampling Locations, Oyster Creek Generating Station, 2021

Oyster Creek Generating Station RGPP Sample Point List

Sample Identification Number	Location	Well GPS Coordinates (Northing/Easting)	Depth (ft)	RGPP Sample Point Designation	Tritium Alert Value	Aquifer or Water Body Monitored
W-16	Yard – E of LLRW	357967.26 574933.03	20.0	D	2,000 pCi/L	Cape May
W-24	South of TB W of old Machine Shop	357128.94 574650.77	19.0	D	2,000 pCi/L	Cape May
W-34	South of TB W of old Machine Shop	357196.14 574649.43	40.0	D	2,000 pCi/L	Cohansey
MW-52	Near Intake Structure	357400.90 574353.00	20.0	D	2,000 pCi/L	Cape May
MW-53	Near end of CW discharge piping	357272.80 574447.60	20.0	D	2,000 pCi/L	Cape May
MW-54	Near Intake Structure	357276.20 574311.70	20.0	E	2,000 pCi/L	Cape May
MW-55	Between CST and Intake Structure	357354.88 574440.07	30.0	E	2,000 pCi/L	Cape May
MW-56I	By NaOCl tanks	357305.30 574465.50	52.0	E	2,000 pCi/L	Cohansey
MW-57I	Near Intake Structure	357343.71 574373.89	50.0	E	2,000 pCi/L	Cohansey
MW-59I	Intake Roadway – NW of CST	357422.14 574406.38	44.0	D	2,000 pCi/L	Cohansey
MW-61I	Between CST and Intake Structure	357328.64 574444.45	72.0	E	2,000 pCi/L	Cohansey
MW-62	NW Corner of Turbine Bldg	357467.93 574524.10	25.0	D	2,000 pCi/L	Cape May
MW-64	Near Intake Structure	357343.96 574377.88	25.0	E	2,000 pCi/L	Cape May
MW-65	Intake Roadway – NW of CST	357421.00 574402.55	25.0	D	2,000 pCi/L	Cape May
MW-67	West side of Turbine Bldg	357401.99 574540.38	25.0	E	2,000 pCi/L	Cape May
MW-68I	SE of Reactor Bldg	357323.83 574897.64	100.0	D	2,000 pCi/L	Cohansey
MW-71	S of Reactor Bldg	357365.52 574841.89	25.0	D	2,000 pCi/L	Cape May
MW-72	N of Reactor Bldg	357549.87 574788.52	25.0	D	2,000 pCi/L	Cape May

KEY: B = Background D = Detection E = Elevated I = Idle/Standby
P = Plume L = Long-Term Shutdown SW = Surface Water

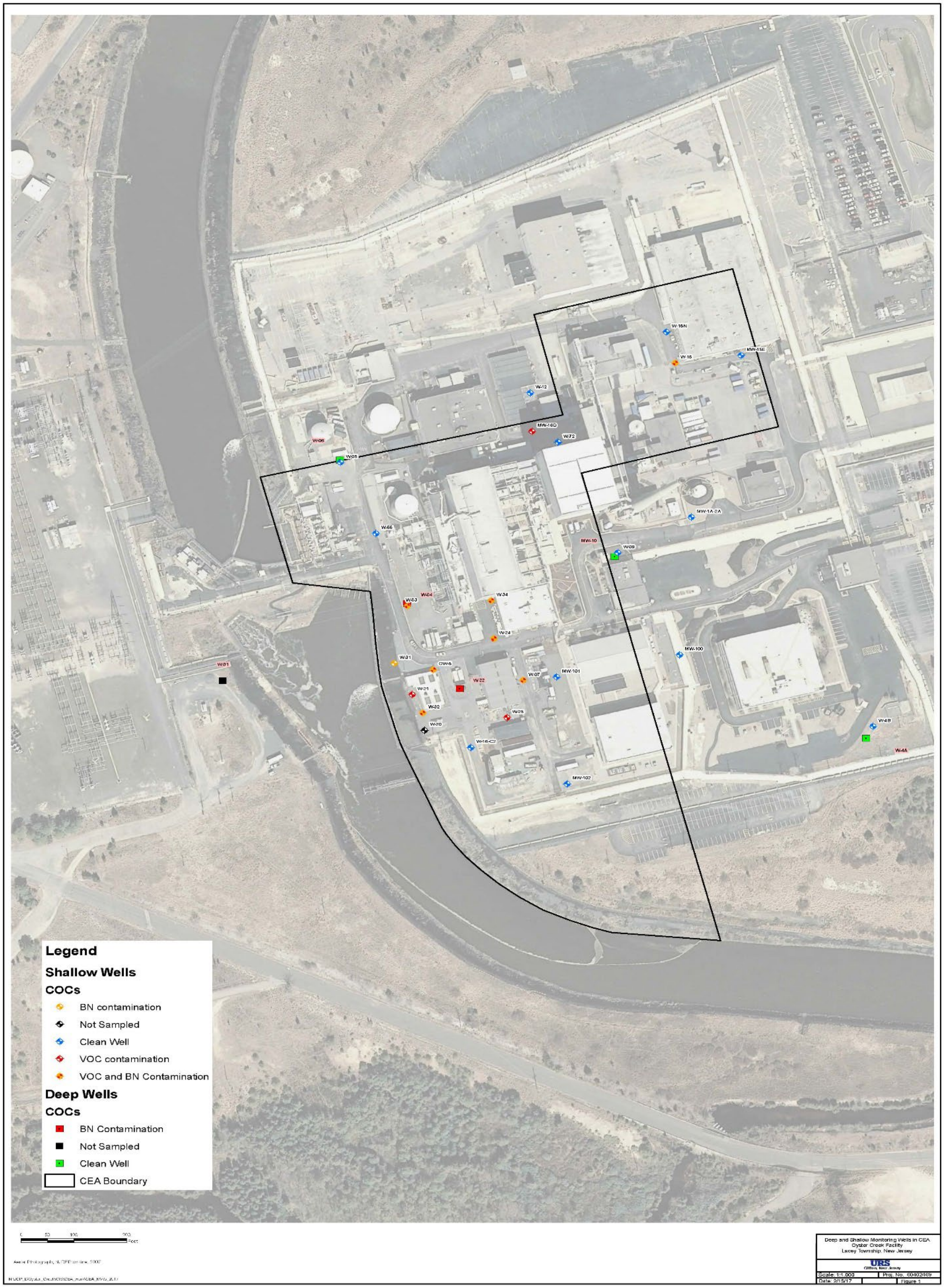

Figure A-1
Sampling Locations – Selected Cohansey
and Cape May Formation Wells,
Oyster Creek Generating Station, 2021

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APPENDIX B

DATA TABLES

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TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA, AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-1A-2A	05/06/21		< 184						
MW-1I-1A	02/09/21		< 179						
MW-1I-1A	05/05/21		< 180	< 9.3	< 0.9	< 0.4	1.4 ± 0.8	1.2 ± 0.5	< 1.6
MW-1I-1A	07/27/21		< 184						
MW-1I-1A	10/19/21		< 183						
MW-1I-2A	02/09/21		< 180						
MW-1I-2A	05/05/21		< 181	< 8.9	< 0.9	< 0.4	< 0.7	1.6 ± 0.6	< 1.7
MW-1I-2A	07/28/21		< 180						
MW-1I-2A	10/19/21		< 176						
MW-15K-1A	02/09/21		< 183	< 7.1	< 0.9	< 0.8	< 0.6	2.1 ± 0.7	< 1.5
MW-15K-1A	05/04/21		< 177	< 8.9	< 0.9	< 0.4	1.8 ± 1.0	0.9 ± 0.5	< 1.7
MW-15K-1A	07/27/21		< 183	< 5.6	< 0.5	< 0.3	< 2.4	< 0.8	< 3.6
MW-15K-1A	10/19/21		< 187	< 4.4	< 0.8	7.4 ± 3.2	4.4 ± 1.2	38.9 ± 3.8	5.1 ± 1.5
MW-16D	02/10/21		< 178						
MW-16D	05/05/21		< 182	< 7.5	< 0.9	< 0.8	< 0.6	2.6 ± 0.8	< 1.6
MW-16D	05/05/21	*Duplicate*	< 176	< 6.0	< 0.8	< 0.7	< 0.6	2.5 ± 0.8	< 1.6
MW-16D	05/05/21	*EIML*	< 158	< 0.7	< 0.5	< 1.8	(1)		
MW-16D	07/28/21		< 180						
MW-16D	07/28/21	*Duplicate*	< 191						
MW-16D	07/28/21	*EIML*	< 162						
MW-16D	10/19/21		< 184						
MW-16D	10/19/21	*Duplicate*	< 197						
MW-16D	10/19/21	*EIML*	< 163						
MW-52	05/04/21		< 186						
MW-53	05/04/21		< 184						
MW-54	05/04/21		< 189						
MW-55	02/09/21		< 182	< 6.5	< 1.0	< 0.6	2.3 ± 1.2	1.6 ± 0.7	4.2 ± 1.3
MW-55	05/04/21		< 183	< 6.1	< 0.9	< 0.6	< 1.4	< 1.2	2.4 ± 1.3
MW-55	07/28/21		< 188	< 5.6	< 1.0	< 0.9	< 1.0	5.4 ± 1.1	< 1.7
MW-55	10/19/21		< 191	< 3.5	< 0.8	< 0.7	< 0.8	3.4 ± 0.7	< 1.6
MW-56I	02/09/21		364 ± 125	< 6.4	< 0.9	< 0.4	1.8 ± 1.1	2.4 ± 0.6	2.2 ± 1.1
MW-56I	05/04/21		323 ± 128	< 7.4	< 0.8	< 0.5	< 1.2	3.9 ± 0.7	< 1.7
MW-56I	07/27/21		299 ± 124	< 5.4	< 0.7	< 0.5	< 1.7	5.3 ± 0.8	4.7 ± 1.6
MW-56I	10/19/21		231 ± 125	< 5.8	< 0.9	< 1.0	< 0.8	7.7 ± 1.1	< 1.6
MW-57I	02/10/21		355 ± 127	< 5.3	< 1.0	< 0.8	4.1 ± 1.0	3.7 ± 1.5	< 2.2
MW-57I	05/04/21		347 ± 126	< 5.7	< 0.7	< 0.7	2.6 ± 1.6	4.9 ± 0.8	4.4 ± 1.5
MW-57I	07/27/21		< 180	< 6.8	< 0.7	< 0.6	3.2 ± 1.7	6.2 ± 0.9	5.5 ± 1.6
MW-57I	10/19/21		191 ± 120	< 7.7	< 0.8	0.7 ± 0.4	3.8 ± 1.9	4.2 ± 0.8	5.9 ± 1.7
MW-59I	02/09/21		< 180						
MW-59I	05/04/21		< 187	< 6.8	< 0.9	< 0.4	< 1.5	1.6 ± 0.6	< 1.8
MW-59I	07/27/21		< 181						
MW-59I	10/19/21		< 193						
MW-61I	02/10/21		< 181						
MW-61I	05/05/21		< 179	< 6.5	< 0.9	< 0.5	< 1.1	< 0.9	< 1.6
MW-61I	07/28/21		< 177						
MW-61I	10/19/21		< 183						
MW-62	02/09/21		< 182						
MW-62	05/05/21		< 188	< 5.4	< 0.9	< 0.9	< 1.4	7.3 ± 1.0	2.9 ± 1.3
MW-62	07/27/21		< 182						

(1) Total Gross Alpha result reported (not dissolved/suspended)

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA, AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-62	10/20/21		< 176						
MW-64	02/09/21		< 181						
MW-64	02/09/21	*Duplicate*	< 182						
MW-64	02/09/21	*EIML*	< 161						
MW-64	05/04/21		< 189	< 9.0	< 0.9	< 1.2	9.0 ± 4.4	< 2.1	22.1 ± 5.0
MW-64	05/04/21	*Duplicate*	< 182						
MW-64	05/04/21	*EIML*	< 182	< 0.7	< 0.5	< 11.8	*(1)*		
MW-64	07/27/21		< 183						
MW-64	07/27/21	*Duplicate*	< 186						
MW-64	07/27/21	*EIML*	< 162						
MW-64	10/19/21		< 191						
MW-64	10/19/21	*Duplicate*	< 182						
MW-64	10/19/21	*EIML*	< 163						
MW-65	02/09/21		< 182	< 4.5	< 1.0	1.1 ± 0.6	5.9 ± 1.3	2.5 ± 1.3	5.7 ± 1.5
MW-65	05/04/21		< 186	< 7.2	< 1.0	< 0.7	1.5 ± 0.8	4.7 ± 1.0	< 1.7
MW-65	07/27/21		< 182	< 8.4	< 0.7	< 0.7	1.6 ± 0.9	4.6 ± 0.9	< 1.7
MW-65	10/19/21		< 180	< 3.2	< 0.6	< 0.8	1.3 ± 0.9	2.3 ± 1.0	< 1.7
MW-67	02/09/21		< 182	< 6.7	< 0.9	< 0.4	< 1.1	4.6 ± 0.7	< 1.5
MW-67	05/05/21		< 181	< 7.0	< 0.7	< 0.5	< 0.5	4.3 ± 0.7	< 1.6
MW-67	07/27/21		< 185	< 6.5	< 0.8	< 0.5	< 0.9	5.2 ± 0.8	< 1.7
MW-67	10/20/21		< 186	< 4.4	< 0.8	< 0.9	< 0.9	13.7 ± 1.4	< 1.7
MW-71	02/10/21		< 181						
MW-71	02/10/21	*Duplicate*	< 173						
MW-71	02/10/22	*EIML*	< 161						
MW-71	05/06/21		< 185	< 7.1	< 1.0	< 0.5	< 0.5	1.4 ± 0.6	< 1.7
MW-71	07/28/21		< 175						
MW-71	10/19/21		< 193						
MW-72	02/10/21		< 167						
MW-72	05/05/21		< 186	< 7.9	< 0.9	< 0.4	< 0.5	2.4 ± 0.7	< 1.6
MW-72	05/05/21	*Duplicate*	< 187	< 7.5	< 0.9	< 0.4	< 0.5	2.5 ± 0.7	< 1.6
MW-72	05/05/21	*EIML*	< 158	< 0.7	< 0.6	< 1.3	*(1)*		
MW-72	07/27/21		< 180						
MW-72	10/19/21		< 184						
W-1A	05/06/21		< 185						
W-3	02/09/21		< 179						
W-3C	02/10/21	*EIML*	< 161						
W-3	05/04/21		< 180	< 9.1	< 0.8	< 0.5	< 0.7	1.3 ± 0.6	< 1.7
W-3C	05/06/21	*EIML*	< 158						
W-3	07/27/21		< 180						
W-3C	07/28/22	*EIML*	< 162						
W-3	10/19/21		< 177						
W-3C	10/20/21	*EIML*	< 163						
W-4	05/04/21		< 184						
W-4A	05/06/21		< 180						
W-5	02/09/21		< 180						
W-5	02/09/21	*Duplicate*	< 181						
W-5	02/09/21	*EIML*	< 161						
W-5	05/04/21		< 184	< 8.5	< 0.8	< 0.5	1.2 ± 0.7	< 1.1	< 1.7
W-5	05/04/21	*Duplicate*	< 184	< 8.7	< 0.8	< 0.5	< 0.7	< 1.1	< 1.7

(1) Total Gross Alpha result reported (not dissolved/suspended)

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA, AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
W-5	05/05/21	*EIML*	< 158	< 0.7	< 0.5	< 1.5	*(1)*		
W-5	05/05/21	*EIML DUP*	< 158	< 0.8	< 0.5	< 1.5	*(1)*		
W-5	07/27/21		< 184						
W-5	07/27/21	*Duplicate*	< 184						
W-5	07/27/21	*EIML*	< 162						
W-5	10/19/21		< 179						
W-5	10/19/21	*Duplicate*	< 188						
W-5	10/19/21	*EIML*	< 163						
W-6	05/04/21		< 181						
W-9	02/10/21		< 182						
W-9	05/06/21		< 184	< 7.8	< 0.8	< 0.9	< 0.7	2.1 ± 1.0	< 1.7
W-9	07/27/21		< 181						
W-9	10/19/21		< 176						
W-10	05/06/21		< 178						
W-12	02/10/21		< 180						
W-12	05/05/21		< 183	< 8.1	< 0.9	< 0.6	< 0.7	< 1.2	< 1.7
W-12	07/28/21		< 182						
W-12	10/19/21		< 175						
W-13	05/05/21		< 176						
W-14	05/05/21		< 184						
W-15	05/05/21		< 188						
W-16	05/05/21		< 185						
W-24	05/05/21		< 186						
W-34	02/09/21		< 182						
W-34	05/04/21		< 182	< 9.3	< 0.9	< 0.5	< 1.1	< 1.1	< 1.6
W-34	07/27/21		< 182						
W-34	10/20/21		< 177						

(1) Total Gross Alpha result reported (not dissolved/suspended)

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
MW-1A-2A	05/06/21		< 62	< 144	< 6	< 5	< 13	< 7	< 13	< 13	< 6	< 7
MW-1I-1A	05/05/21		< 53	< 147	< 7	< 7	< 10	< 7	< 15	< 10	< 8	< 8
MW-1I-2A	05/05/21		< 63	< 111	< 7	< 8	< 14	< 5	< 12	< 11	< 7	< 7
MW-15K-1A	02/09/21		< 14	< 25	< 1	< 2	< 4	< 2	< 3	< 3	< 2	< 1
MW-15K-1A	05/04/21		< 49	< 80	< 5	< 5	< 13	< 5	< 12	< 12	< 7	< 6
MW-15K-1A	07/27/21		< 40	< 109	< 5	< 5	< 9	< 3	< 8	< 9	< 6	< 5
MW-15K-1A	10/19/21		< 44	< 138	< 6	< 5	< 12	< 6	< 13	< 14	< 6	< 7
MW-16D	05/05/21		< 39	< 90	< 4	< 5	< 9	< 6	< 7	< 12	< 6	< 6
MW-16D	05/05/21	*Duplicate*	< 71	< 129	< 8	< 7	< 18	< 8	< 17	< 10	< 7	< 7
MW-16D	05/05/21	*EIML*	< 17	< 36	< 1			< 1	< 2			< 1
MW-52	05/04/21		< 62	< 112	< 6	< 8	< 15	< 8	< 15	< 11	< 7	< 6
MW-53	05/04/21		< 50	< 104	< 5	< 6	< 11	< 7	< 11	< 9	< 6	< 6
MW-54	05/04/21		< 42	< 121	< 6	< 6	< 14	< 6	< 12	< 9	< 7	< 8
MW-55	02/09/21		< 68	< 95	< 5	< 5	< 10	< 7	< 14	< 12	< 6	< 6
MW-55	05/04/21		< 67	< 108	< 7	< 8	< 15	< 6	< 14	< 13	< 6	< 5
MW-55	07/28/21		< 54	< 105	< 6	< 7	< 11	< 5	< 13	< 9	< 6	< 5
MW-55	10/19/21		< 48	< 109	< 7	< 5	< 14	< 6	< 10	< 10	< 5	< 5
MW-56I	02/09/21		< 68	< 131	< 5	< 6	< 14	< 5	< 14	< 11	< 7	< 6
MW-56I	05/04/21		< 56	< 104	< 5	< 6	< 12	< 7	< 14	< 14	< 7	< 7
MW-56I	07/27/21		< 43	< 86	< 5	< 5	< 11	< 8	< 14	< 8	< 7	< 6
MW-56I	10/19/21		< 54	< 53	< 7	< 6	< 12	< 5	< 11	< 9	< 6	< 6
MW-57I	02/10/21		< 58	< 108	< 6	< 6	< 15	< 8	< 11	< 9	< 7	< 6
MW-57I	05/04/21		< 53	< 110	< 6	< 6	< 12	< 5	< 11	< 11	< 6	< 6
MW-57I	07/27/21		< 62	< 112	< 6	< 6	< 14	< 8	< 13	< 11	< 6	< 7
MW-57I	10/19/21		< 57	< 54	< 6	< 6	< 13	< 7	< 13	< 8	< 6	< 6
MW-59I	05/04/21		< 63	< 126	< 6	< 6	< 12	< 6	< 11	< 10	< 6	< 7
MW-61I	05/05/21		< 68	< 128	< 6	< 7	< 16	< 6	< 13	< 9	< 8	< 6
MW-62	05/05/21		< 43	< 164	< 5	< 5	< 16	< 7	< 10	< 13	< 8	< 5
MW-64	05/04/21		< 36	< 31	< 4	< 4	< 8	< 4	< 8	< 6	< 4	< 4
MW-64	05/04/21	*EIML*	< 36	< 89	< 3			< 3	< 3			< 3
MW-65	02/09/21		< 74	< 139	< 7	< 7	< 13	< 5	< 12	< 11	< 6	< 8
MW-65	05/04/21		< 42	< 65	< 4	< 4	< 11	< 4	< 10	< 8	< 5	< 6
MW-65	07/27/21		< 51	< 127	< 6	< 8	< 11	< 4	< 14	< 13	< 7	< 7

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
MW-65	10/19/21		< 48	< 104	< 6	< 5	< 12	< 4	< 12	< 9	< 6	< 6
MW-67	02/09/21		< 60	< 114	< 5	< 6	< 13	< 8	< 12	< 13	< 7	< 6
MW-67	05/05/21		< 62	< 132	< 4	< 8	< 13	< 8	< 10	< 11	< 6	< 5
MW-67	07/27/21		< 54	< 120	< 5	< 7	< 14	< 5	< 13	< 9	< 6	< 6
MW-67	10/20/21		< 47	< 66	< 5	< 5	< 11	< 7	< 15	< 9	< 7	< 7
MW-71	05/06/21		< 59	< 129	< 7	< 7	< 13	< 9	< 8	< 13	< 6	< 7
MW-72	05/05/21		< 50	< 90	< 7	< 7	< 11	< 8	< 14	< 14	< 7	< 8
MW-72	05/05/21	*Duplicate*	< 55	< 112	< 6	< 7	< 11	< 5	< 13	< 11	< 5	< 5
MW-72	05/05/21	*EIML*	< 13	35 ± 18	< 2			< 1	< 2			< 2
W-1A	05/06/21		< 51	< 97	< 6	< 7	< 13	< 8	< 14	< 11	< 7	< 7
W-3C	02/10/21	*EIML*	< 37	< 77	< 4	< 2	< 5	< 3	< 6	< 7	< 3	< 4
W-3	05/04/21		< 40	< 97	< 5	< 5	< 14	< 6	< 11	< 9	< 6	< 5
W-3C	05/06/21	*EIML*	< 13	< 31	< 1			< 1	< 2			< 1
W-3C	07/28/21	*EIML*	< 46	< 72	< 2			< 2	< 6			< 3
W-3C	10/20/21	*EIML*	< 26	< 48	< 2			< 2	< 4			< 2
W-4	05/04/21		< 56	< 109	< 5	< 6	< 13	< 8	< 13	< 11	< 6	< 5
W-4A	05/06/21		< 55	< 102	< 6	< 7	< 15	< 8	< 8	< 8	< 7	< 7
W-5	05/04/21		< 42	< 53	< 4	< 4	< 9	< 5	< 7	< 8	< 4	< 5
W-5	05/04/21	Duplicate	< 58	< 137	< 7	< 5	< 14	< 6	< 11	< 11	< 7	< 6
W-5	05/04/21	*EIML*	< 37	< 65	< 3			< 2	< 5			< 3
W-5	05/04/21	*EIML DUP*	< 15	< 33	< 2			< 2	< 3			< 2
W-6	05/04/21		< 56	< 126	< 5	< 6	< 14	< 5	< 12	< 12	< 8	< 6
W-9	05/06/21		< 43	< 115	< 7	< 6	< 14	< 5	< 13	< 11	< 7	< 6
W-10	05/06/21		< 57	< 58	< 6	< 5	< 11	< 7	< 14	< 11	< 6	< 7
W-12	05/05/21		< 52	< 54	< 6	< 7	< 13	< 8	< 15	< 10	< 7	< 6
W-13	05/05/21		< 62	< 77	< 6	< 7	< 10	< 5	< 12	< 11	< 8	< 7
W-14	05/05/21		< 64	< 105	< 6	< 7	< 18	< 8	< 13	< 10	< 7	< 7
W-15	05/05/21		< 65	< 133	< 5	< 9	< 17	< 10	< 19	< 12	< 8	< 7
W-16	05/05/21		< 57	< 108	< 7	< 7	< 15	< 7	< 15	< 11	< 8	< 6
W-24	05/05/21		< 67	< 116	< 7	< 7	< 17	< 7	< 13	< 9	< 8	< 8
W-34	05/04/21		< 51	< 47	< 5	< 5	< 12	< 5	< 13	< 8	< 6	< 5

TABLE B-I.3 CONCENTRATIONS OF HARD-TO-DETECTS IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Am-241	Cm-242	Cm-243/244	Pu-238	Pu-239/240	U-234	U-235	U-238	Fe-55	Ni-63
MW-57I	02/10/21	< 0.08	< 0.08	< 0.14	< 0.05	< 0.10	0.4 ± 0.3	< 0.13	0.8 ± 0.3	< 54	< 5.0
	02/10/21	*(Reanalysis)*					0.3 ± 0.2	< 0.16	0.2 ± 0.2		

TABLE B-II.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER + 2 SIGMA

SITE	COLLECTION DATE	H-3
SEWER PIT	01/06/21	< 183
SEWER PIT	04/13/21	< 174
SEWER PIT	07/26/21	< 178
STORM DRAIN EAST	02/08/21	< 173
STORM DRAIN EAST	05/03/21	< 185
STORM DRAIN EAST	07/26/21	< 180
STORM DRAIN EAST	10/18/21	< 186
STORM DRAIN OUTFALL #2	02/08/21	< 174
STORM DRAIN OUTFALL #2	04/13/21	< 192
STORM DRAIN OUTFALL #2	10/18/21	< 190
SW-1	02/08/21	< 172
SW-1	05/03/21	< 186
SW-1	07/26/21	< 180
SW-1	10/18/21	< 193
SW-2	02/08/21	< 173
SW-2	05/03/21	< 186
SW-2	07/26/21	< 179
SW-2	10/18/21	< 178
SW-3	02/08/21	< 171
SW-3	05/03/21	< 188
SW-3	07/26/21	< 176
SW-3	10/18/21	< 180

TABLE B-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-95	Cs-134	Cs-137
SW-1	05/03/21	< 40	< 41	< 3	< 4	< 11	< 5	< 9	< 9	< 6	< 4
SW-2	05/03/21	< 43	< 93	< 4	< 5	< 12	< 5	< 9	< 8	< 6	< 5
SW-3	05/03/21	< 33	< 65	< 5	< 5	< 9	< 5	< 9	< 7	< 4	< 4

TABLE B-II.3 CONCENTRATIONS OF HARD TO DETECTS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Am-241	Cm-242	Cm-243/244	Pu-238	Pu-239/240	U-234	U-235	U-238	Fe-55	Ni-63

NO SURFACE WATER HTD'S FOR 2021

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, OYSTER CREEK GENERATING STATION, 2021

RESULTS IN UNITS OF PCI/LITER + 2 SIGMA

SITE	COLLECTION DATE	H-3

NO PRECIPITATION SAMPLES FOR 2021