Exelon Generation®

Oyster Creek
Route 9 South
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Forked River, NJ 08731

10 CFR 50.36a(a)(2)
10 CFR 72.44 (d)(3)
Technical Specification 6.9.1.a

RA-19-023

April 30, 2019

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
NRC Docket No. 50-219

Independent Spent Fuel Storage Facility
NRC Docket No. 72-15

Subject: Annual Radioactive Effluent Release Report for 2018

Enclosed with this cover letter is the Annual Radioactive Effluent Release Report for the period January 1 to December 31, 2018. This report includes the Oyster Creek Nuclear Generating Station Independent Spent Fuel Storage Facility.

If any further information or assistance is needed, please contact Kevin Wolf, Chemistry Manager, at 609-971-4051.

Sincerely,

Jeff Dostal
Site Vice President
Oyster Creek Nuclear Generating Station

Enclosure: 2018 Annual Radioactive Effluent Release Report

cc: Administrator, USNRC Region I
USNRC Senior Project Manager, Oyster Creek
USNRC Senior Resident Inspector, Oyster Creek
Craig Stewart, American Nuclear Insurers

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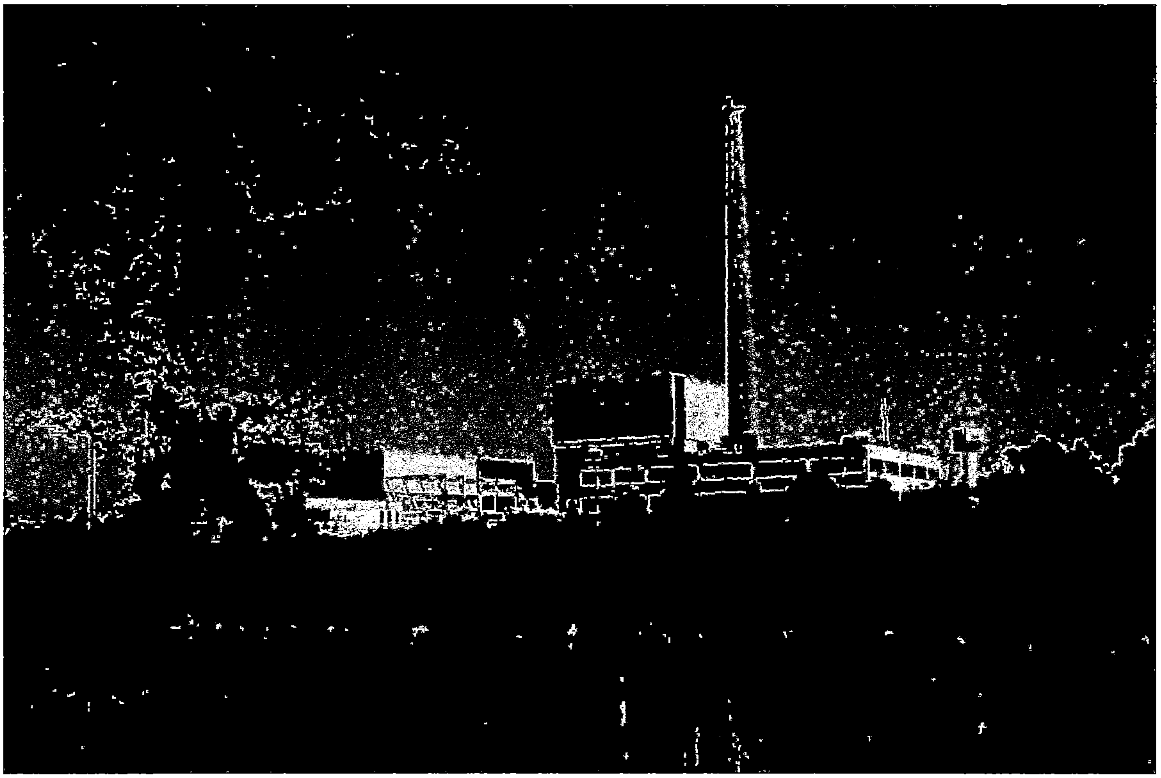

Annual Radioactive Effluent Release Report

2018

Oyster Creek Generating Station

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

January 1, 2018 through December 31, 2018

EXELON GENERATION COMPANY, LLC

OYSTER CREEK GENERATING STATION

DOCKET NO. 50-219 (Oyster Creek Generating Station)

DOCKET NO. 72-15 (Independent Spent Fuel Storage Facility)

Submitted to
The United States Nuclear Regulatory Commission
Pursuant to
Renewed Facility Operating License DPR-16

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EXECUTIVE SUMMARY

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 the 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 Oyster Creek Generating Station (OCGS) does not result in significant radiation exposure to 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).

There were liquid radioactive effluent releases during 2018 of concentrations of tritium too low to detect at an Lower Limit of Detection (LLD) of 200 picocuries per liter (pCi/L) at the New Jersey Pollution Discharge Elimination System (NJPDES) permitted main condenser outfall. The releases were part of nearly continuous pumping of groundwater at approximately 60 gpm containing low levels of tritium and no detectable gamma. Exelon and the State of New Jersey Department of Environmental Protection (NJDEP) agreed to this remediation action instead of natural attenuation to address concentrations of tritium in groundwater. Well 73 and supporting equipment and piping were installed to pump groundwater to the intake structure at the inlet of the main circulating water pumps. Provisions were established for both batch and continuous releases of groundwater. Continuous releases occurred approximately 324 days in 2018. The nearly continuous releases occurred from January 1, 2018 through October 18, 2018 and October 29, 2018 through December 18, 2018 with a total of 3.12E+07 gallons of groundwater pumped resulting in 2.13E-01 Curies (Ci) of tritium released to the intake canal. The dose to the most limiting member of the public due to the release of groundwater was 1.23E-06 mrem.

There were no liquid abnormal releases during 2018.

There were no gaseous abnormal releases during 2018.

The maximum calculated organ dose (Bone) from iodines, tritium, C-14, and particulates to any individual due to gaseous effluents was 2.58E-01 mrem, which was approximately 1.72E+00 percent of the annual limit of 1.50E+01 mrem. The majority of organ dose from gaseous effluents was due to C-14. The maximum calculated gamma air dose in the UNRESTRICTED AREA due to noble gas effluents was 9.12E-04 mrad, which was 9.12E-03 percent of the annual 10 CFR 50 Appendix I, As Low As Reasonably Achievable (ALARA) limit of 1.00E+01 mrad.

For comparison, the background radiation dose averages approximately 620 mrem per year to the average person in the United States.

The Independent Spent Fuel Storage Installation (ISFSI) is a closed system and the only exposure is due to direct radiation. Based on offsite Optically Stimulated Luminescence Dosimeter (OSLD) readings, dose due to direct radiation from the ISFSI was less than 1 mrem for 2018. Because it is a sealed unit, no radioactive material was released.

Comparison of environmental sampling results to iodine and particulate gaseous effluents released, showed no radioactivity attributable to the operation of OCGS. Both elevated and ground-level release paths were considered in this review, with total iodines released of 8.65E-03 Ci and total particulates with half-lives greater than 8 days of 1.16E-02 Ci. This total does not include C-14, which is calculated separately. It was calculated that 6.09E+00 Ci of C-14 were released in 2018.

Joint Frequency Tables of meteorological data, per Stability Classification Category, as well as for all stability classes, are included. All data was collected from the on-site Meteorological Facility. Data recoveries for the 380-foot data and the 33-foot data were 99.8 percent and 99.8 percent, respectively. The Defueled Safety Analysis Report (DSAR) commits to Regulatory Guide (RG) 1.23 for Meteorological Facility data recovery. RG 1.23 requires data recovery of at least 90% on an annual basis.

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.

1. 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?

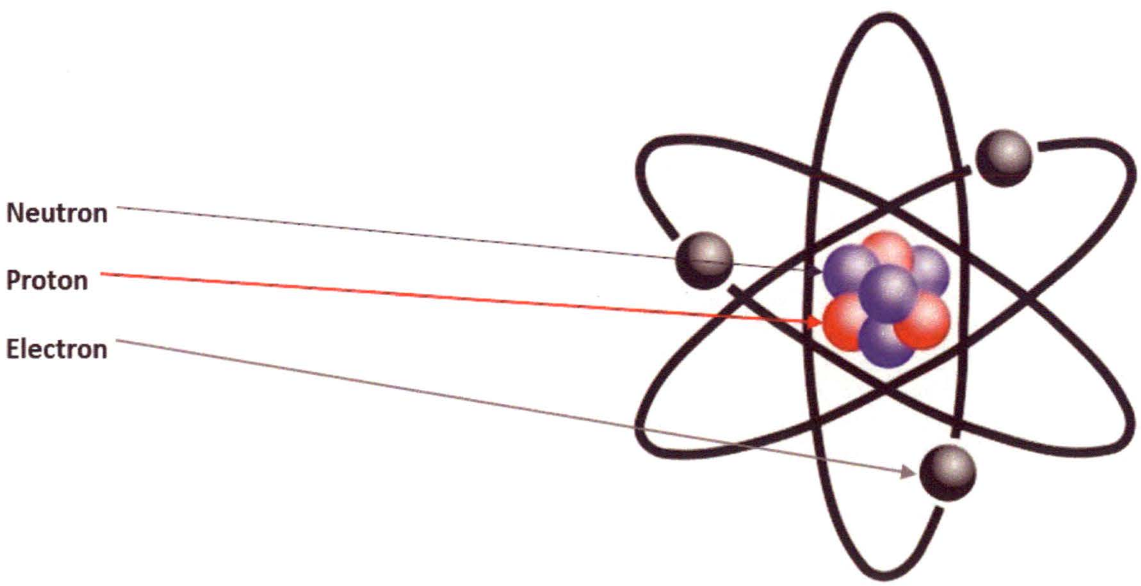
You may have seen a Periodic Table of the Elements:

The Periodic Table of the Elements

Group→ ↓Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

Lanthanides	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
Actinides	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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.



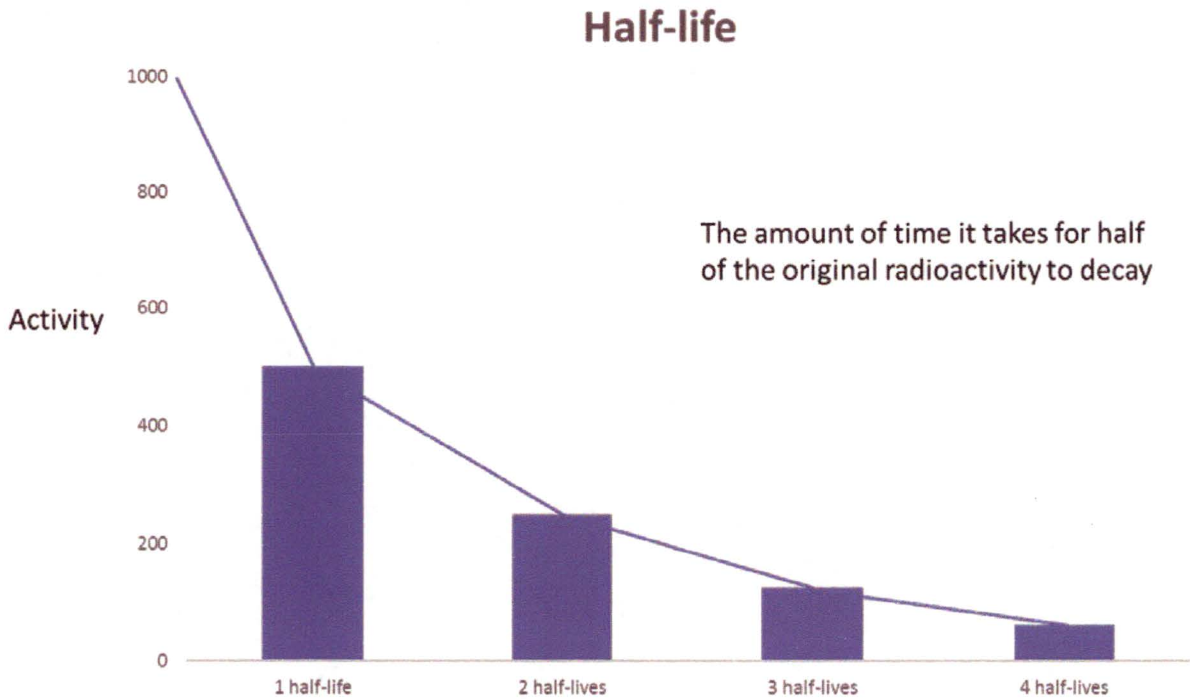
The number of protons in an atom determines the element. A hydrogen atom will always have one proton while an oxygen atom will always have eight protons. The protons are clustered with the neutrons at the center of the atom and this is called the nucleus. Orbiting around the nucleus are the relatively 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.

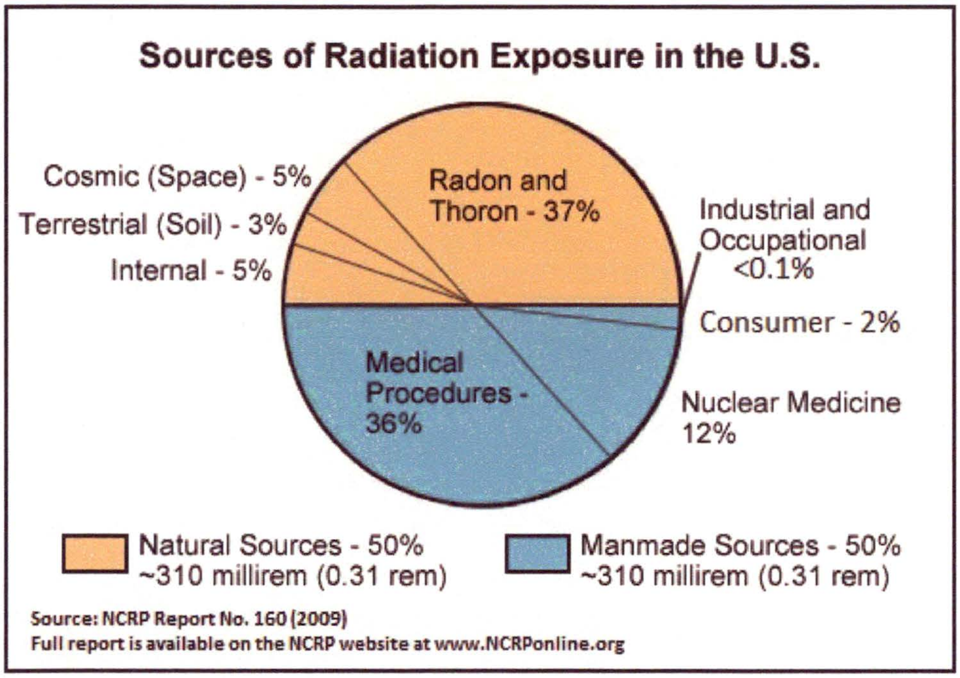
Over time, radioactive atoms will reach a stable state and no longer be radioactive. To do this they must release the excess energy. The release of excess energy can be in different forms and is called radioactive decay and the energy released is called radiation. The time it takes for a radionuclide 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 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.

2. Sources of Radiation

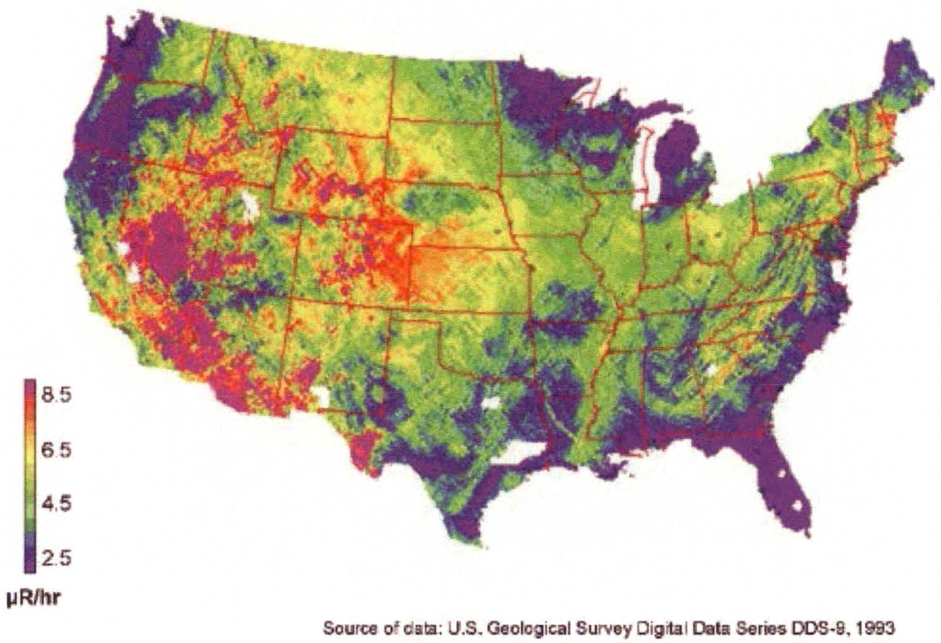
People are exposed to radiation every day of their lives and have been since the dawn of mankind. Some of this radiation is naturally occurring while some is man-made. There are many factors that will determine the amount of radiation an individual will be exposed to such as where you live, medical treatments,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

Terrestrial Gamma-Ray Exposure at 1m above ground

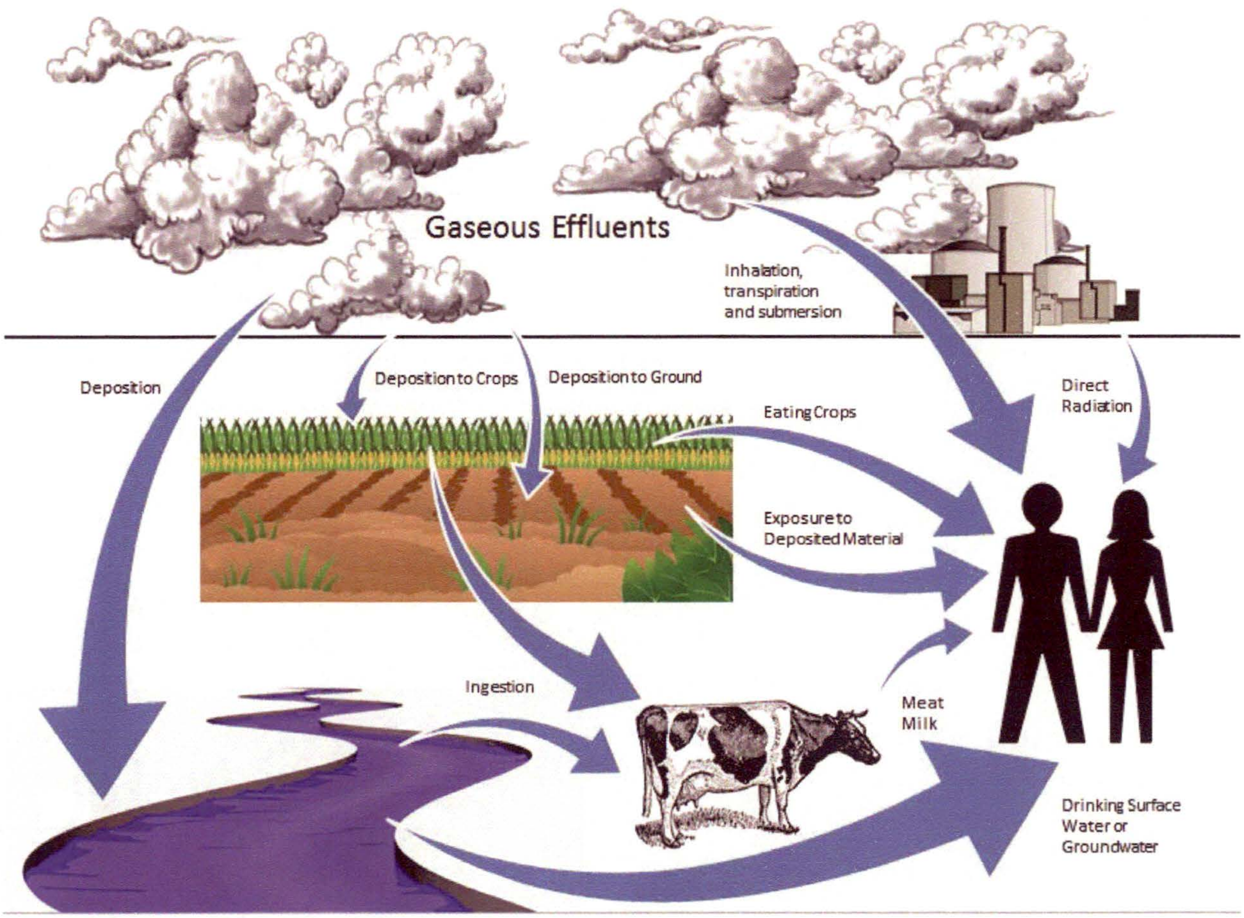


3. Exposure Pathways

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 the picture below. 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.

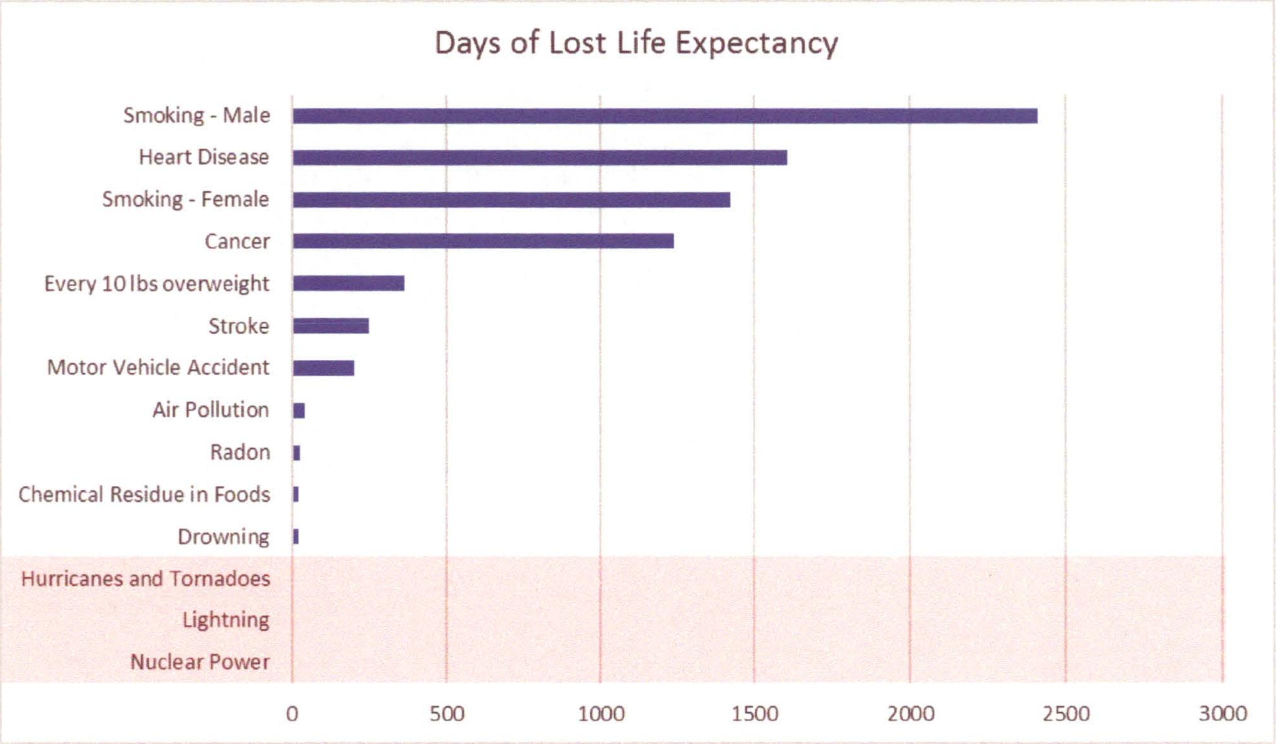
Although radionuclides can reach humans by many different pathways, some result in more dose than others. The critical pathway is the exposure route that will provide, for a specific radionuclide, the greatest dose to a population, or to a specific group of the population called the critical group. The 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.

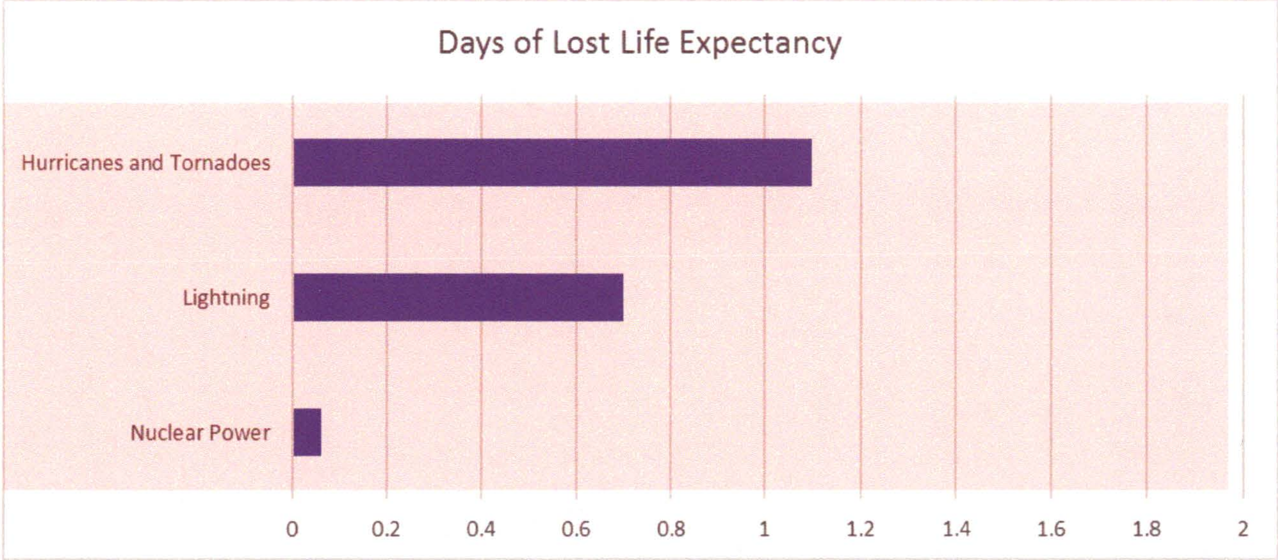


This simple diagram demonstrates some potential exposure pathways from Oyster Creek Generating Station.

4. 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

5. 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 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.

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 µCi that means 1/1,000,000. That means there are 1,000,000 µCi in one 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 milliard (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. For example, at our gaseous effluent release points we use different media to collect samples for particulates, iodines, noble gases and tritium. 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.

6. Introduction

In accordance with the reporting requirements of Technical Specification 6.9.1.a applicable during the reporting period, this report summarizes the effluent release data for OCGS for the period January 1, 2018 through December 31, 2018. This submittal complies with the format described in Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants." Revision 1, June 1974.

Meteorological data was reported in the format specified in Regulatory Guide 1.23, Revision 1, "Meteorological Monitoring Programs for Nuclear Power Plants".

All vendor results were received and included in the report calculations. Therefore, the 2018 report is complete.

7. Supplemental Information

Oyster Creek Generating Station   Exelon Generation Company, LLC

A. Regulatory Limits:

	Limit	Units	Receptor	ODCM and 10 CFR 50, Appendix I Design Objective Limits
1. Noble Gases:				
a.	≤ 500	mrem/yr	Total Body	ODCM Control 3.11.2.1
	≤ 3000	mrem/yr	Skin	
b.	≤ 5	mrad/qtr	Air Gamma	Quarterly air dose limits
	≤ 10	mrad/qtr	Air Beta	ODCM Control 3.11.2.2
c.	≤ 10	mrad/yr	Air Gamma	Yearly air dose limits
	≤ 20	mrad/yr	Air Beta	ODCM Control 3.11.2.2
d.	< 5	mrem/yr	Total Body (Gamma)	10 CFR 50, Appendix I, Section II.B.2(b)
	< 15	mrem/yr	Skin (Beta)	
2. Iodines, Tritium, Particulates with Half Life > 8 days:				
a.	≤ 1500	mrem/yr	Any Organ	ODCM Control 3.11.2.1
b.	≤ 7.5	mrem/qtr	Any Organ	Quarterly dose limits ODCM Control 3.11.2.3
c.	≤ 15	mrem/yr	Any Organ	Yearly dose limits ODCM Control 3.11.2.3
3. Liquid Effluents:				
a.	Concentration 10 CFR 20, Appendix B, Table 2 Column 2			ODCM Control 3.11.1.1
b.	≤ 1.5	mrem/qtr	Total Body	Quarterly dose limits
	≤ 5	mrem/qtr	Any Organ	ODCM Control 3.11.1.2
c.	≤ 3	mrem/yr	Total Body	Yearly dose limits
	≤ 10	mrem/yr	Any Organ	ODCM Control 3.11.1.2

B. Effluent Concentration Limits:

Gaseous dose rates rather than effluent concentrations are used to calculate permissible release rates for gaseous releases. The maximum permissible dose rates for gaseous releases are defined in ODCM Controls 3.11.2.1.

The Effluent Concentration Limit (ECL) specified in 10 CFR 20, Appendix B, Table 2, Column 2 for identified nuclides, were used to calculate permissible release rates and concentrations for liquid release per ODCM Controls 3.11.1.1. The total activity concentration at the Route 9 bridge for all dissolved or entrained gases was limited to < 2E-04 μCi/ml.

C. Average Energy ($\bar{E}$):

The Oyster Creek ODCM limits the instantaneous dose equivalent rates due to the release of noble gases to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin. The average beta and gamma energies ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases as described in Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plant" may be used to calculate doses in lieu of more sophisticated software. The Oyster Creek radioactive effluent program employs the methodologies presented in U.S. NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977. Therefore, average energy ($\bar{E}$) as described in Regulatory Guide 1.21 is not applicable to Oyster Creek.

D. Measurements and Approximations of Total Radioactivity:

1. Fission and Activation Gases

The method used for Gamma Isotopic Analysis is the Canberra Gamma Spectroscopy System with a gas Marinelli beaker. Airborne effluent gaseous activity was continuously monitored and recorded in accordance with ODCM Table 4.11.2.1.2-1. Additional grab samples were taken from the stack Radioactive and Gaseous Effluent Monitoring System (RAGEMS) sample point and ground-level release sample points and analyzed at least monthly to determine the isotopic mixture of noble gas activity released for the month. If activity was found in the grab isotopic analysis, the results are entered into Simplified Environmental Effluent Dosimetry System (SEEDS) to calculate dose and dose rates. If no activity is detected in the stack grab samples, post treatment or Off Gas Isotopic Analysis data may be used.

2. Iodines

The method used for Gamma Isotopic Analysis is the Canberra Gamma Spectroscopy System with a charcoal cartridge. Iodine activity was continuously sampled and analyzed in accordance with ODCM Table 4.11.2.1.2-1. Charcoal samples are taken from the stack RAGEMS sample point and ground-level release sample points and analyzed at least weekly to determine the total activity released from the plant based on the average vent flow rates recorded for the sampling period.

3. Particulates (half-lives > 8 days)

The method used for Gamma Isotopic Analysis is the Canberra Gamma Spectroscopy System with a particulate filter (47 mm). Particulate activity was continuously sampled and analyzed in accordance with ODCM Table 4.11.2.1.2-1. Particulate samples are taken from the stack RAGEMS sample point and ground-level release sample points and analyzed at least weekly to determine the total activity released from the plant based on the average vent flow rates recorded for the sampling period.

4. Tritium

A. Gaseous Effluents

Air from stack and vent effluents was passed through a desiccant column and distilled to remove the moisture collected. An aliquot of the water from the distillate was analyzed for tritium using a liquid scintillation counter.

B. Liquid Effluents

Water from liquid effluents was analyzed for tritium using a liquid scintillation counter.

5. Gross Alpha

Gross alpha was measured by an off-site vendor for both the gas and liquid effluent composite samples.

6. Hard-To-Detects

Hard-To-Detects were measured by an off-site vendor for one set of gas monthly composites. The analysis included Fe-55, I-129, Ni-59, Ni-63, Tc-99, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240 and Pu-241. Fe-55 and Ni-63 have been added to the routine monthly composite analysis schedule based on previous sample results for Hard-To-Detects. Only nuclides that have been detected are included in Table A-2 and/or Table A-3.

7. Carbon-14 (C-14)

The amount of C-14 (Ci) released was estimated using the guidance from Electric Power Research Institute (EPRI) Technical Report 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents. The C-14 was released primarily through the stack (97%) with a small amount (3%) released through plant vents. The activity in liquid effluents was determined to not be significant.

The offsite dose from C-14 was calculated using SEEDS, which uses approved ODCM methodologies. The resulting annual dose to a child from gaseous releases of C-14 is about 2.55E-01 mrem to the bone.

8. Liquid Effluents

Groundwater containing tritium was released during 2018. For continuous releases, tritium and principal gamma emitters were determined for a composite sample daily. The concentration of tritium is limited to ensure concentrations were less than 200 pCi/L in the discharge canal. The gamma emitters were limited to less than detectable concentrations. Gross alpha and Hard-to-Detect analyses (Fe-55, Ni-63, Sr-89 and Sr-90) were determined for monthly composite samples for each type of release (batch or continuous).

The leaks into the groundwater were reported in the 2009 Annual Radioactive Effluent Release Report as abnormal releases. Estimates of the curies of the tritium releases were reported. Doses due to the release of the groundwater to the discharge canal were included in the report. To ensure that the amount of activity discharge is accurate and limiting, the activity and doses as a result of discharges during 2018 from the groundwater remediation project are included in this report.

9. Estimated Total Error Present

Procedure CY-AA-170-2100, "Estimated Errors of Effluent Measurements" provides the methodology to obtain an overall estimate of the error associated with radioactive effluents.

10. Composite Samples and Lower Limit of Detection (LLD)

Particulate air samples were composited monthly and analyzed for gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63. Groundwater batch and continuous releases were composited at least monthly and analyzed for gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63. These composites are submitted to an offsite vendor laboratory for analysis. The ODCM required LLD for liquid and airborne releases are as follows:

Liquid:	**LLD**
Principal Gamma Emitters (Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Ce-141, Cs-134, Cs-137)	5E-07 µCi/ml
Principal Gamma Emitters (Ce-144)	5E-06 µCi/ml
Dissolved and Entrained Gases	1E-05 µCi/ml
H-3	1E-05 µCi/ml
Gross Alpha	1E-07 µCi/ml
Sr-89 and Sr-90	5E-08 µCi/ml
Fe-55 and Ni-63	1E-06 µCi/ml
Airborne	**LLD**
Principal Gamma Emitters (Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, Xe-138)	1E-04 µCi/ml
H-3	1E-06 µCi/ml
I-131	1E-12 µCi/ml
I-133	1E-10 µCi/ml
Principal Gamma Emitters (Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, Cs-137, Ce-141)	1E-11 µCi/ml
Principal Gamma Emitters (Mo-99, Ce-144)	1E-10 µCi/ml
Gross Alpha	1E-11 µCi/ml
Sr-89, Sr-90	1E-11 µCi/ml

E. Batch Releases:

1. Liquid

There were no batch releases of liquid effluents during 2018.

2. Gaseous

There were no batch releases of gaseous effluents during 2018.

F. Abnormal Releases:

There were no abnormal liquid releases during 2018.

There were no abnormal gaseous releases during 2018.

G. Revisions to the ODCM:

Revision 8 of the ODCM, CY-OC-170-301, was implemented 11/14/2018. The revision supported PDTS (Permanently Defueled Technical Specifications) implementation following final shut down 17 September 2018 and the facility in a permanently defueled condition.

See the complete copy of CY-OC-170-301 Revision 8attached in Appendix E, as part of this report.

H. Radiation Effluent Monitors Out of Service More Than 30 Days

Per ODCM Control 3.3.3.10, "Radioactive Liquid Effluent Monitoring Instrumentation" and 3.3.3.11, Radioactive Gaseous Effluent Monitoring Instrumentation requires:

With less than the minimum number of radioactive liquid/gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3.3.10-1/3.3.3.11-1. Make every reasonable effort to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

No instrumentation was out of service for greater than 30 days in 2018.

I. Releases from the Independent Spent Fuel Storage Facility (ISFSI):

The ISFSI is a closed system and the only exposure would be due to direct radiation. This includes iodines, particulates, and noble gases. Based on offsite OSLD readings, dose due to direct radiation from the ISFSI was less than 1 mrem for 2018. Because it is a sealed unit, no radioactive material was released.

J. Program Deviations:

Issue Report 4122771: During calibration of the Turbine Building RAGEMS flowmeters on 4/4/18, technicians noticed the flow was much higher than expected and could not be calibrated. While inspecting the system the technicians found the Feed Pump Room (FPR) sample tubing was cracked. The FPR sample system was in-service with this leak, thus the sample would have been partially mixed with ambient air and not all from the turbine FPR discharge to the stack. High range and low range monitors would read lower than the actual radiation levels discharging out the stack. The ambient air being drawn into the cracked hose would dilute the sample. The cracked tubing was replaced within 7 days. No releases have been typically recorded from the Feed Pump Room and the Continuous Air Monitors within the room monitored the atmosphere.

Appendix A
Effluent and Waste Disposal Summary

LIST OF TABLES

Table A-1: Gaseous Effluents - Summary Of All Releases

Period: January 1, 2018 through December 31, 2018 **Unit: Oyster Creek**

A. Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1. Total Release	Ci	3.89E+01	2.84E+01	2.41E+01	<LLD	24.64%
2. Average Release Rate for Period	µCi/sec	5.00E+00	3.61E+00	3.03E+00	<LLD	
3. Gamma Air Dose	mrad	4.88E-04	3.01E-04	3.95E-04	N/A	
4. Beta Air Dose	mrad	1.88E-04	1.77E-04	1.99E-04	N/A	
5. Percent of ODCM Limit						
- Gamma Air Dose	%	9.76E-03	6.02E-03	7.90E-03	N/A	
- Beta Air Dose	%	1.88E-03	1.77E-03	1.99E-03	N/A	
B. Iodines						
1. Total – I-131	Ci	5.38E-04	8.16E-04	7.38E-04	<LLD	17.61%
2. Average Release Rate for Period	µCi/sec	6.91E-05	1.04E-04	9.28E-05	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	
C. Particulate						
1. Particulates with T 1/2 > 8 days	Ci	5.90E-03	3.39E-03	2.31E-03	<LLD	18.20%
2. Average Release Rate for Period	µCi/sec	7.59E-04	4.32E-04	2.90E-04	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	
D. Tritium						
1. Total Release	Ci	5.90E+00	7.22E+00	5.68E+00	8.63E-01	22.74%
2. Average Release Rate for Period	µCi/sec	7.59E-01	9.18E-01	7.15E-01	1.09E-01	
3. Percent of ODCM limit	%	*	*	*	*	
E. Gross Alpha						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	23.96%
2. Average Release Rate for Period	µCi/sec	<LLD	<LLD	<LLD	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	
F. Carbon-14						
1. Total Release	Ci	2.38E+00	2.41E+00	1.30E+00	<LLD	
2. Average Release Rate for Period	µCi/sec	3.06E-01	3.07E-01	1.63E-01	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	
G. Iodine 131 & 133, Tritium & Particulate						
1. Organ Dose	mrem	5.10E-02	1.17E-01	9.00E-02	6.26E-06	
2. Percent of ODCM Limit	%	6.80E-01	1.56E+00	1.20E+00	8.35E-05	

* ODCM Limit is for combined Iodine, Tritium, Carbon-14 and particulate only, which is shown in Item G.

Table A-2: Gaseous Effluents Release Point: Elevated Release

Period: January 1, 2018 through December 31, 2018 **Unit: Oyster Creek**

Nuclides Released		Continuous Mode				Batch Mode			
1. Fission gases	**Unit**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Kr- 85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr- 85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	3.89E+01	2.84E+01	2.41E+01	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	3.89E+01	2.84E+01	2.41E+01	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	5.37E-04	8.12E-04	7.36E-04	<LLD	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	1.44E-03	2.63E-03	2.45E-03	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.98E-03	3.44E-03	3.19E-03	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	2.33E-03	3.15E-04	1.12E-03	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	2.68E-05	1.75E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	3.13E-03	2.60E-03	9.95E-04	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	1.12E-05	1.37E-05	1.81E-05	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	1.29E-04	1.27E-04	4.59E-05	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	2.49E-04	2.73E-04	1.03E-04	<LLD	<LLD	<LLD	<LLD	<LLD
Ni-63	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	1.51E-05	3.87E-05	1.06E-05	<LLD	<LLD	<LLD	<LLD	<LLD
Am-241	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	5.89E-03	3.37E-03	2.29E-03	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3	Ci	5.46E+00	5.38E+00	4.99E+00	8.63E-01	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon-14									
C-14	Ci	2.31E+00	2.34E+00	1.26E+00	<LLD	<LLD	<LLD	<LLD	<LLD

Table A-3: Gaseous Effluent Release Point: Ground Level Releases

Period: January 1, 2018 through December 31, 2018 **Unit: Oyster Creek**

Nuclides Released		Continuous Mode				Batch Mode			
1. Fission gases	**Unit**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Kr- 85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr- 85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	5.04E-07	3.88E-06	1.91E-06	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	1.49E-06	1.79E-05	1.59E-05	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.99E-06	2.18E-05	1.78E-05	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	1.90E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	3.35E-07	8.77E-07	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	2.40E-06	7.94E-06	4.14E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	5.70E-06	1.39E-05	7.81E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Ni-63	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Am-241	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	8.10E-06	2.41E-05	1.28E-05	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3	Ci	4.43E-01	1.84E+00	6.94E-01	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon-14									
C-14	Ci	7.13E-02	7.24E-02	3.88E-02	<LLD	<LLD	<LLD	<LLD	<LLD

Table A-4: Liquid Effluents - Summary Of All Releases

Period: January 1, 2018 through December 31, 2018 **Unit: Oyster Creek**

A. Fission & Activation Products	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	Est. Total Error %
1. Total Release not including tritium, gases, alpha	Ci	<LLD	<LLD	<LLD	<LLD	15.24%
2. Average Diluted concentration during period	µCi/ml	<LLD	<LLD	<LLD	<LLD	
3. Total Body Dose	mrem	3.16E-07	2.02E-07	3.48E-07	3.62E-07	
4. Organ Dose	mrem	3.16E-07	2.02E-07	3.48E-07	3.62E-07	
3. Percent of ODCM Limit						
-Total Body Dose	%	2.11E-05	1.35E-05	2.32E-05	2.41E-05	
-Organ Dose	%	6.32E-06	4.04E-06	6.96E-06	7.24E-06	
B. Tritium						
	Units	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	Est. Total Error %
1. Total Release	Ci	6.65E-02	6.52E-02	6.63E-02	1.52E-02	15.24%
2. Average diluted concentration during period	µCi/ml	1.40E-10	1.34E-10	1.51E-10	3.11E-10	
3. Percent of 10CFR20 limit	%	1.40E-05	1.34E-05	1.51E-05	3.11E-05	
C. Dissolved and Entrained Gases						
	Units	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	Est. Total Error %
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	15.24%
2. Average diluted concentration	µCi/ml	<LLD	<LLD	<LLD	<LLD	
3. Percent of ODCM limit	%	<LLD	<LLD	<LLD	<LLD	
D. Gross Alpha Activity						
	Units	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	Est. Total Error %
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	21.79%
E. Volume of Waste Released prior to dilution	Liters	3.27E+07	3.29E+07	3.37E+07	2.02E+07	
F. Volume of Dilution Water Used During Period	Liters	4.76E+11	4.86E+11	4.38E+11	4.89E+10	

Table A-5: Liquid Release Point: Groundwater Remediation

Period: January 1, 2018 through December 31, 2018 **Unit: Oyster Creek**

Nuclides Released		Continuous Mode				Batch Mode			
Fission & Activation Products	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ni-63	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Dissolved Entrained Gases									
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tritium									
H-3	Ci	6.65E-02	6.52E-02	6.63E-02	1.52E-02	<LLD	<LLD	<LLD	<LLD
Gross Alpha									
Gross Alpha	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Appendix B
Solid Waste and Irradiated Fuel Shipments

A. Solid waste shipped offsite for burial or disposal (not irradiated fuel)

1. Type of waste

Types of Waste	Total Quantity (m^3)	Total Activity (Ci)	Period	Est. Total Error%
a. Spent resins,filter sludges, evaporator bottom, etc	1.25E+02	4.21E+02	2018	18.05%
b. Dry compressible waste, contaminated equip, etc	1.20E+02	1.95E+00	2018	18.05%
c. Irradiated components, control rods,etc	0.00E+00	0.00E+00	2018	18.05%
d. Other	7.14E+00	1.23E-02	2018	18.05%

1. Estimate of Major Nuclide Composition (By Waste Type)

Category A – Spent Resin, Filters, Sludges, Evaporator Bottoms, etc.

Isotope	Waste Class A		Waste Class B		Waste Class C	
	Curies	Percent	Curies	Percent	Curies	Percent
H-3						
C-14						
Cr-51						
P-32						
Mn-54	4.73E+00	2.03E+00	3.18E+00	1.72E+00		
Fe-55	1.16E+02	4.98E+01	9.47E+01	5.12E+01		
Fe-59						
Co-57						
Co-58						
Co-60	1.01E+02	4.34E+01	7.01E+01	3.79E+01		
Ni-59						
Ni-63	3.49E+00	1.50E+00	3.74E+00	2.02E+00		
Zn-65						
Sr-89						
Sr-90						
Nb-95						
Tc-99						
Ag-110m						
Sb-125						
I-129						
Cs-134						
Cs-137	7.67E+00	3.29E+00	1.33E+01	7.19E+00		
Ce-144						
Pu-238						
Pu-239						
Pu-240						
Pu-241						
Am-241						
Cm-242						
Cm-243						
Cm-244						
Totals	2.33E+02	1.00E+02	1.85E+02	1.00E+02	0.00E+00	0.00E+00

Note: Grey fields are where results were not reported in the NRC Regulatory Guide 1.21 Report

Category B – Dry Compressible Waste, Contaminated Equipment, etc.

Isotope	Waste Class A	
	Curies	Percent
H-3		
C-14		
P-32		
Mn-54	5.78E-02	2.99E+00
Fe-55	1.10E+00	5.69E+01
Co-57		
Co-58		
Co-60	6.82E-01	3.53E+01
Ni-59		
Ni-63	4.27E-02	2.21E+00
Zn-65		
Sb-125		
Sr-89		
Sr-90		
Tc-99		
I-129		
Cs-137	4.96E-02	2.57E+00
Ce-144		
Pu-238		
Pu-239		
Pu-240		
Pu-241		
Am-241		
Cm-242		
Cm-243		
Cm-244		
Totals	1.93E+00	1.00E+02

Note: Grey fields are where results were not reported in the NRC Regulatory Guide 1.21 Report

Category C – Irradiated components, control rods, etc.

Isotope	Waste Class B	
	Curies	Percent Abundance %
H-3		
C-14		
Cr-51		
Mn-54		
Fe-55		
Fe-59		
Co-58		
Co-60		
Ni-59		
Ni-63		
Zn-65		
Sr-90		
Zr-95		
Nb-94		
Mo-93		
Tc-99		
Sb-125		
I-129		
Cs-137		
Ce-144		
U-235		
Np-237		
Pu-238		
Pu-239		
Pu-240		
Pu-241		
Am-241		
Am-243		
Cm-242		
Cm-243		
Cm-244		
Totals	0.00E+00	0.00E+00

Note: Grey fields are where results were not reported in the NRC Regulatory Guide 1.21 Report

Category D - Other - Scrap Metal

Isotope	Waste Class A		Waste Class B	
	Curies	Percent	Curies	Percent
H-3				
C-14				
P-32				
Mn-54	3.85E-04	3.13E+00		
Fe-55	7.21E-03	5.87E+01		
Co-57				
Co-58				
Co-60	4.00E-03	3.25E+01		
Ni-59				
Ni-63	1.28E-04	1.04E+00		
Zn-65	1.25E-04	1.02E+00		
Sr-85				
Sr-89				
Sr-90				
Y-88				
Tc-99				
Cd-109				
Sn-113				
I-129				
Cs-137	4.41E-04	3.59E+00		
Ba-133				
Ce-139				
Ce-144				
Hg-203				
Pu-238				
Pu-239				
Pu-240				
Pu-241				
Am-241				
Cm-242				
Cm-243				
Cm-244				
Totals	1.23E-02	1.00E+02	0.00E+00	0.00E+00

Note: Grey fields are where results were not reported in the NRC Regulatory Guide 1.21 Report

2. Solid Waste (Disposition)

Number of Shipments	Mode of Transportation	Destination
16	HITTMAN TRANSPORT CO.	Barnwell Disposal Facility Operated by Energy Solutions, LLC
5	HITTMAN TRANSPORT CO.	Energy Solutions Services 1560 Bear Creek Road
1	HITTMAN TRANSPORT CO.	Energy Solutions Services, Inc. Gallaher Road Facility
1	HITTMAN TRANSPORT CO.	Barnwell Processing Facility 16043 Dunbarton Boulevard
4	HITTMAN TRANSPORT CO.	Energy Solutions Services 1560 Bear Creek Road
1	HITTMAN TRANSPORT CO.	Energy Solutions Services 1560 Bear Creek Road

B. Irradiated Fuel Shipments (disposition).

There were no irradiated fuel shipments.

C. Changes to the Process Control Program

There were no changes to the Process Control Program in 2018.

Appendix C
Radiological Impact to Man

Per ODCM Administrative Control 6.2, an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year must be made to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation. For purposes of this calculation the following assumptions were made:

Gaseous

- Nearest member of the public was W sector at 483 meters.
- Actual 2018 meteorology and measured gaseous effluent releases were used.
- All significant pathways were assumed to be present.
- Occupancy factor was considered 22.8% (40 hours/week for 50 weeks).

Liquid

- Doses calculated in the discharge canal at the Route 9 Bridge.
- Fish, shellfish and shoreline pathways doses calculated.

40 CFR Part 190 Compliance

- Dosimetry measurements (minus average of control stations) measured direct radiation for the nearest member of the public. The nearest member of the public for direct radiation is considered an individual that works in the warehouse west of the site. As a worker, the individual is assumed to work 2,000 hours per year at this location. A shielding factor of 7.00E-01 is applied for direct radiation.
- Nearest resident was at SE sector at 937 meters.
- The highest calculated dose for gamma air dose and liquid total body were summed for total body dose.
- The highest calculated dose for gamma air dose, child bone and liquid organ were summed for organ dose.
- The limits for Kr-85, I-129, Pu-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year were not exceeded.

The ODCM does not require total body doses to the population and average doses to individuals in the population from gaseous effluents to a distance of 50 miles from the site to be calculated.

A summary of gaseous and liquid radiation doses to most likely exposed MEMBER OF THE PUBLIC was as follows:

Effluent	Applicable Organ	Estimated Dose	Age Group	Location Distance (meters)	Location Direction (toward)	% of Applicable Limit	Limit	Unit
Noble Gas	Gamma - Air Dose	9.12E-04	All	500	NNE	9.12E-03	10	mrad
Noble Gas	Beta – Air Dose	3.36E-04	All	522	SE	1.68E-03	20	mrad
Noble Gas	Total Body (Gamma)	4.12E-04	All	988	NNE	8.24E-03	5	mrem
Noble Gas	Skin (Beta)	5.45E-04	All	988	NNE	3.63E-03	15	mrem
Iodine, Particulate, Carbon-14 & Tritium	Bone	2.58E-01	Child	937	SE	1.72E+00	15	mrem
Liquid	Total body	1.23E-06	All	South Route 9 Bridge		4.10E-05	3	mrem
Liquid	Organ	1.23E-06	All			1.23E-05	10	mrem
Direct Radiation	Total Body	5.87E+00	All	483	W	2.35E+01	25	mrem
Direct Radiation	Total Body	<LLD	All	937	SE	<LLD	25	mrem
40 CFR Part 190 Compliance								
Warehouse Worker								
Total Dose	Total Body	5.87E+00	All	483	W	2.35E+01	25	mrem
Total Dose	Bone	5.93E+00	All	483	W	2.37E+01	25	mrem
Total Dose	Thyroid	5.87E+00	All	483	W	7.83E+00	75	mrem
Nearest Resident								
Total Dose	Total Body	9.13E-04	All	937	SE	3.65E-03	25	mrem
Total Dose	Bone	2.59E-01	All	937	SE	1.04E+00	25	mrem
Total Dose	Thyroid	9.13E-04	All	937	SE	1.22E-03	75	mrem

Appendix D
Meteorological Data

LIST OF METEOROLOGICAL DATA TABLES

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F).
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	8	1	0	0	9
NNE	0	0	0	0	0	0	0
NE	0	0	8	0	0	0	8
ENE	0	1	11	0	0	0	12
E	0	3	4	0	0	0	7
ESE	0	4	2	0	0	0	6
SE	0	1	4	0	0	0	5
SSE	0	0	4	0	0	0	4
S	0	0	1	0	0	0	1
SSW	0	0	1	0	0	0	1
SW	0	0	5	3	0	0	8
WSW	0	2	8	1	0	0	11
W	0	2	12	8	0	0	22
WNW	0	3	21	5	0	0	29
NW	0	3	25	9	0	0	37
NNW	0	0	10	4	0	0	14
Variable	0	0	0	0	0	0	0
Total	0	19	124	31	0	0	174

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	0	0	0	0	2
NNE	0	2	0	0	0	0	2
NE	0	0	3	0	0	0	3
ENE	0	7	1	0	0	0	8
E	0	5	1	0	0	0	6
ESE	0	10	0	0	0	0	10
SE	0	4	0	0	0	0	4
SSE	0	2	1	0	0	0	3
S	0	0	5	0	0	0	5
SSW	0	1	3	1	0	0	5
SW	0	1	5	2	0	0	8
WSW	0	0	3	0	0	0	3
W	0	1	7	7	0	0	15
WNW	0	2	8	1	0	0	11
NW	0	8	14	9	0	0	31
NNW	0	3	7	2	0	0	12
Variable	0	0	0	0	0	0	0
Total	0	48	58	22	0	0	128

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	1	0	0	0	2
NNE	0	0	0	0	0	0	0
NE	0	0	3	0	0	0	3
ENE	0	1	1	0	0	0	2
E	0	2	0	0	0	0	2
ESE	0	6	1	0	0	0	7
SE	0	2	0	0	0	0	2
SSE	0	3	0	0	0	0	3
S	0	1	1	0	0	0	2
SSW	0	0	1	0	0	0	1
SW	0	1	2	0	0	0	3
WSW	0	0	2	0	0	0	2
W	0	0	2	0	0	0	2
WNW	0	0	4	3	0	0	7
NW	0	2	7	4	0	0	13
NNW	0	4	1	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	0	23	26	7	0	0	56

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	7	18	5	2	0	0	32
NNE	6	6	15	1	0	0	28
NE	4	17	67	0	0	0	88
ENE	6	18	21	2	0	0	47
E	2	6	3	0	0	0	11
ESE	4	9	2	0	0	0	15
SE	5	8	4	0	0	0	17
SSE	2	5	8	0	0	0	15
S	4	12	14	6	0	0	36
SSW	5	14	22	7	0	0	48
SW	7	19	14	0	0	0	40
WSW	2	16	9	0	0	0	27
W	6	10	20	7	0	0	43
WNW	11	27	29	18	0	0	85
NW	6	28	55	21	0	0	110
NNW	9	30	37	13	0	0	89
Variable	0	0	0	0	0	0	0
Total	86	243	325	77	0	0	731

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	8	0	0	0	0	14
NNE	11	2	2	0	0	0	15
NE	5	16	11	0	0	0	32
ENE	2	6	2	0	0	0	10
E	4	3	1	0	0	0	8
ESE	5	3	0	0	0	0	8
SE	3	1	0	0	0	0	4
SSE	7	11	5	1	0	0	24
S	5	17	18	7	0	0	47
SSW	13	48	26	12	0	0	99
SW	14	49	4	0	0	0	67
WSW	6	29	1	1	0	0	37
W	3	46	18	3	0	0	70
WNW	6	58	9	10	0	0	83
NW	8	43	21	3	0	0	75
NNW	7	11	21	9	0	0	48
Variable	0	0	0	0	0	0	0
Total	105	351	139	46	0	0	641

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	3	1	0	0	0	0	4
NNE	3	0	0	0	0	0	3
NE	3	0	0	0	0	0	3
ENE	0	2	0	0	0	0	2
E	1	0	0	0	0	0	1
ESE	3	0	0	0	0	0	3
SE	1	2	0	0	0	0	3
SSE	4	4	1	0	0	0	9
S	6	3	0	0	0	0	9
SSW	3	4	0	0	0	0	7
SW	4	13	0	0	0	0	17
WSW	5	15	0	0	0	0	20
W	8	23	0	0	0	0	31
WNW	9	14	0	0	0	0	23
NW	13	7	0	0	0	0	20
NNW	5	7	0	0	0	0	12
Variable	0	0	0	0	0	0	0
Total	71	95	1	0	0	0	167

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 1 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	0	0	0	0	0	9
NNE	2	0	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	1	1	0	0	0	0	2
E	1	0	0	0	0	0	1
ESE	1	0	0	0	0	0	1
SE	1	0	0	0	0	0	1
SSE	4	0	0	0	0	0	4
S	6	1	0	0	0	0	7
SSW	6	0	0	0	0	0	6
SW	12	4	0	0	0	0	16
WSW	35	10	0	0	0	0	45
W	56	9	0	0	0	0	65
WNW	31	3	0	0	0	0	34
NW	31	4	0	0	0	0	35
NNW	14	6	0	0	0	0	20
Variable	0	0	0	0	0	0	0
Total	211	38	0	0	0	0	249

Hours of calm in this stability class: 6
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Extremely Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	2	2	0	4
ENE	0	0	1	1	0	0	2
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	1	0	1
W	0	0	0	0	5	0	5
WNW	0	0	0	0	1	2	3
NW	0	0	0	1	1	0	2
NNW	0	0	0	0	1	0	1
Variable	0	0	0	0	0	0	0
Total	0	0	1	4	11	2	18

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Moderately Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	1	0	1
NNE	0	0	0	0	0	0	0
NE	0	0	0	3	2	0	5
ENE	0	0	0	2	0	0	2
E	0	0	4	1	0	0	5
ESE	0	0	0	0	0	0	0
SE	0	0	0	1	0	0	1
SSE	0	0	0	1	0	0	1
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	4	1	5
WSW	0	0	0	1	1	0	2
W	0	0	2	1	6	2	11
WNW	0	0	1	1	2	2	6
NW	0	0	0	6	0	3	9
NNW	0	0	0	1	1	2	4
Variable	0	0	0	0	0	0	0
Total	0	0	7	18	17	10	52

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Slightly Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	0	0	1	1	0	2
NNE	0	0	1	0	0	0	1
NE	0	0	0	3	4	0	7
ENE	0	1	4	2	0	0	7
E	0	0	2	0	0	0	2
ESE	0	0	2	1	0	0	3
SE	0	0	2	1	0	0	3
SSE	0	0	1	1	0	0	2
S	0	0	0	1	0	0	1
SSW	0	0	0	1	0	0	1
SW	0	0	2	4	5	1	12
WSW	0	0	1	1	2	0	4
W	0	0	2	6	8	2	18
WNW	0	1	2	10	1	3	17
NW	0	0	3	16	9	4	32
NNW	0	0	1	5	1	3	10
Variable	0	0	0	0	0	0	0
Total	0	2	23	53	31	13	122

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Neutral - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	7	6	14	8	2	37
NNE	1	4	7	26	9	0	47
NE	3	7	5	26	54	10	105
ENE	0	4	12	6	12	4	38
E	1	9	7	2	3	0	22
ESE	0	15	8	5	0	0	28
SE	0	4	1	7	0	0	12
SSE	0	5	6	5	0	0	16
S	0	4	4	18	4	1	31
SSW	0	2	9	24	15	5	55
SW	2	4	13	27	12	1	59
WSW	1	3	6	13	9	2	34
W	1	5	7	17	18	24	72
WNW	2	5	18	36	34	41	136
NW	1	4	14	38	66	30	153
NNW	1	7	11	22	37	19	97
Variable	0	0	0	0	0	0	0
Total	13	89	134	286	281	139	942

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Slightly Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	8	18	0	0	29
NNE	2	1	7	3	1	1	15
NE	1	1	6	14	5	0	27
ENE	1	4	2	9	1	0	17
E	0	2	2	4	1	0	9
ESE	0	3	0	2	0	0	5
SE	0	3	5	0	0	0	8
SSE	0	4	0	9	2	1	16
S	1	1	2	10	16	23	53
SSW	0	2	11	43	37	18	111
SW	0	5	9	23	22	5	64
WSW	0	3	10	14	25	0	52
W	0	3	4	17	31	7	62
WNW	0	0	4	24	31	0	59
NW	0	2	2	18	45	13	80
NNW	0	1	3	8	9	2	23
Variable	0	0	0	0	0	0	0
Total	5	38	75	216	226	70	630

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Moderately Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	9	5	0	14
NNE	0	0	3	3	0	0	6
NE	0	1	2	3	0	0	6
ENE	0	1	5	0	0	0	6
E	0	0	6	0	1	0	7
ESE	1	1	2	0	0	0	4
SE	0	0	1	1	0	0	2
SSE	0	1	3	2	4	0	10
S	0	0	1	8	7	5	21
SSW	0	0	5	6	2	0	13
SW	1	1	2	2	10	7	23
WSW	1	2	3	7	13	5	31
W	1	0	6	4	14	5	30
WNW	0	0	0	12	14	1	27
NW	0	0	0	10	11	2	23
NNW	0	1	1	3	5	0	10
Variable	0	0	0	0	0	0	0
Total	4	8	40	70	86	25	233

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 2 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – March, 2018

Oyster Creek Alpha

Period of Record: January - March 2018
Stability Class - Extremely Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	3	10	2	1	19
NNE	0	4	4	2	0	0	10
NE	1	0	5	2	0	0	8
ENE	0	2	3	6	0	0	11
E	0	1	1	1	0	0	3
ESE	0	1	0	0	0	0	1
SE	0	1	0	0	0	0	1
SSE	0	0	0	5	0	3	8
S	0	0	0	2	4	1	7
SSW	0	0	0	5	4	1	10
SW	0	0	0	0	0	0	0
WSW	0	0	1	3	2	0	6
W	0	0	1	4	2	1	8
WNW	1	0	3	7	6	6	23
NW	0	2	1	8	9	1	21
NNW	0	6	3	6	4	1	20
Variable	0	0	0	0	0	0	0
Total	2	20	25	61	33	15	156

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 7

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	0	0	0	0	4
NNE	0	2	1	0	0	0	3
NE	0	4	4	0	0	0	8
ENE	0	10	18	1	0	0	29
E	0	12	15	0	0	0	27
ESE	0	9	14	0	0	0	23
SE	0	9	39	1	0	0	49
SSE	0	2	19	0	0	0	21
S	0	3	29	8	1	0	41
SSW	0	2	5	3	0	0	10
SW	0	5	10	1	0	0	16
WSW	0	9	24	3	0	0	36
W	0	6	20	2	0	0	28
WNW	1	1	22	9	0	0	33
NW	0	3	29	0	0	0	32
NNW	0	10	19	0	0	0	29
Variable	0	0	0	0	0	0	0
Total	1	91	268	28	1	0	389

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

	Wind Speed (in mph)						
Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	6	1	0	0	0	7
NNE	1	4	0	0	0	0	5
NE	0	5	0	0	0	0	5
ENE	0	6	2	3	0	0	11
E	0	5	7	0	0	0	12
ESE	0	8	3	0	0	0	11
SE	2	10	6	0	0	0	18
SSE	0	0	10	0	0	0	10
S	0	2	10	2	0	0	14
SSW	0	4	4	0	0	0	8
SW	0	4	1	0	0	0	5
WSW	0	5	4	0	0	0	9
W	0	2	6	1	0	0	9
WNW	0	4	5	0	0	0	9
NW	1	7	6	0	0	0	14
NNW	0	2	5	0	0	0	7
Variable	0	0	0	0	0	0	0
Total	4	74	70	6	0	0	154

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	1	0	0	0	3
NNE	1	1	0	0	0	0	2
NE	1	5	6	0	0	0	12
ENE	0	6	6	3	0	0	15
E	0	6	2	0	0	0	8
ESE	0	9	1	0	0	0	10
SE	0	5	0	0	0	0	5
SSE	0	5	3	0	0	0	8
S	0	0	4	2	0	0	6
SSW	0	2	2	3	0	0	7
SW	0	2	0	0	0	0	2
WSW	0	3	0	0	0	0	3
W	0	2	0	0	0	0	2
WNW	0	3	1	0	0	0	4
NW	0	3	1	0	0	0	4
NNW	0	2	1	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	2	56	28	8	0	0	94

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	10	4	0	0	0	17
NNE	8	25	4	0	0	0	37
NE	18	57	32	5	0	0	112
ENE	12	41	49	16	0	0	118
E	7	21	19	0	0	0	47
ESE	5	14	12	0	0	0	31
SE	5	19	3	0	0	0	27
SSE	6	30	5	5	0	0	46
S	3	28	24	1	0	0	56
SSW	5	18	19	7	0	0	49
SW	1	15	4	0	0	0	20
WSW	7	10	8	1	0	0	26
W	3	10	9	0	0	0	22
WNW	6	6	16	4	0	0	32
NW	4	5	10	0	0	0	19
NNW	2	7	6	0	0	0	15
Variable	0	0	0	0	0	0	0
Total	95	316	224	39	0	0	674

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	4	0	0	0	0	5
NNE	7	4	0	0	0	0	11
NE	17	13	0	0	0	0	30
ENE	13	10	2	1	0	0	26
E	9	13	0	0	0	0	22
ESE	3	3	0	0	0	0	6
SE	12	6	2	1	0	0	21
SSE	9	10	0	1	0	0	20
S	16	14	1	0	0	0	31
SSW	12	26	29	8	0	0	75
SW	13	43	17	2	0	0	75
WSW	14	39	3	0	0	0	56
W	12	19	2	0	0	0	33
WNW	11	28	9	6	0	0	54
NW	11	10	2	1	0	0	24
NNW	5	10	2	0	0	0	17
Variable	0	0	0	0	0	0	0
Total	165	252	69	20	0	0	506

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	4	0	0	0	0	0	4
NNE	2	1	0	0	0	0	3
NE	2	0	0	0	0	0	2
ENE	1	2	0	0	0	0	3
E	1	0	0	0	0	0	1
ESE	2	0	0	0	0	0	2
SE	1	0	0	0	0	0	1
SSE	3	0	0	0	0	0	3
S	6	1	0	0	0	0	7
SSW	10	1	0	0	0	0	11
SW	7	5	0	0	0	0	12
WSW	6	13	0	0	0	0	19
W	8	11	0	0	0	0	19
WNW	9	3	0	0	0	0	12
NW	11	4	0	0	0	0	15
NNW	9	1	0	0	0	0	10
Variable	0	0	0	0	0	0	0
Total	82	42	0	0	0	0	124

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 3 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	0	0	0	0	0	2
NNE	5	0	0	0	0	0	5
NE	4	0	0	0	0	0	4
ENE	2	0	0	0	0	0	2
E	0	0	0	0	0	0	0
ESE	2	0	0	0	0	0	2
SE	2	1	0	0	0	0	3
SSE	3	1	0	0	0	0	4
S	4	2	0	0	0	0	6
SSW	5	0	0	0	0	0	5
SW	15	0	0	0	0	0	15
WSW	31	7	0	0	0	0	38
W	59	8	0	0	0	0	67
WNW	36	4	0	0	0	0	40
NW	19	4	0	0	0	0	23
NNW	13	1	0	0	0	0	14
Variable	0	0	0	0	0	0	0
Total	202	28	0	0	0	0	230

Hours of calm in this stability class: 7
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Extremely Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	1	1	4	0	0	6
ENE	0	0	0	3	0	0	3
E	0	0	1	0	0	0	1
ESE	0	0	1	0	0	0	1
SE	0	0	0	1	0	0	1
SSE	0	0	0	0	0	0	0
S	0	0	2	0	0	0	2
SSW	0	0	0	0	0	0	0
SW	0	0	0	2	0	0	2
WSW	0	0	0	4	3	0	7
W	0	0	0	4	4	0	8
WNW	0	0	0	3	6	1	10
NW	0	0	0	2	1	0	3
NNW	0	0	0	2	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	1	5	25	14	1	46

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Moderately Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	1	0	0	0	1
NNE	0	0	0	2	0	0	2
NE	0	0	4	3	0	0	7
ENE	0	1	7	3	0	0	11
E	0	0	9	0	0	0	9
ESE	0	0	3	0	0	0	3
SE	0	0	10	7	1	0	18
SSE	0	0	1	6	0	0	7
S	0	0	3	8	2	0	13
SSW	0	0	1	0	1	1	3
SW	0	0	0	6	1	0	7
WSW	0	1	0	8	5	0	14
W	0	0	0	6	5	0	11
WNW	0	1	1	3	7	2	14
NW	0	0	3	8	3	0	14
NNW	0	0	0	1	3	0	4
Variable	0	0	0	0	0	0	0
Total	0	3	43	61	28	3	138

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Slightly Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	0	0	0	2
NNE	0	0	1	0	0	0	1
NE	0	1	8	2	0	0	11
ENE	0	1	5	3	0	1	10
E	0	1	10	0	0	0	11
ESE	0	3	5	0	0	0	8
SE	0	2	13	4	1	0	20
SSE	0	1	4	7	0	0	12
S	0	1	2	11	2	3	19
SSW	0	0	0	1	2	1	4
SW	0	0	4	3	1	0	8
WSW	0	2	7	4	4	0	17
W	0	1	2	3	4	0	10
WNW	0	0	0	2	8	0	10
NW	0	0	7	7	2	0	16
NNW	0	0	8	5	0	0	13
Variable	0	0	0	0	0	0	0
Total	0	13	78	52	24	5	172

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Neutral - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	7	8	12	0	0	29
NNE	1	24	29	9	1	0	64
NE	1	28	40	31	33	35	168
ENE	2	15	31	31	19	18	116
E	1	20	19	13	3	4	60
ESE	2	22	14	2	5	3	48
SE	0	14	21	4	0	1	40
SSE	1	11	35	9	3	2	61
S	0	6	34	25	13	2	80
SSW	0	4	31	16	20	8	79
SW	1	5	14	11	6	0	37
WSW	1	8	11	12	1	2	35
W	0	4	6	15	16	3	44
WNW	1	7	6	12	20	11	57
NW	0	4	8	16	4	0	32
NNW	0	2	8	12	2	0	24
Variable	0	0	0	0	0	0	0
Total	13	181	315	230	146	89	974

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Slightly Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	1	2	3	0	0	10
NNE	4	5	4	0	0	0	13
NE	2	1	13	5	2	0	23
ENE	2	5	13	6	2	0	28
E	1	6	14	0	1	2	24
ESE	1	3	4	2	3	3	16
SE	2	6	5	0	0	4	17
SSE	1	12	18	1	0	2	34
S	0	10	18	6	1	0	35
SSW	2	2	9	24	36	9	82
SW	3	5	8	22	37	8	83
WSW	2	2	6	13	13	1	37
W	1	3	9	11	14	0	38
WNW	1	7	2	9	22	0	41
NW	0	3	5	9	3	1	21
NNW	0	3	4	8	3	0	18
Variable	0	0	0	0	0	0	0
Total	26	74	134	119	137	30	520

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Moderately Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	5	3	0	10
NNE	1	1	0	0	0	0	2
NE	0	0	3	1	0	0	4
ENE	0	3	3	1	0	0	7
E	1	0	4	0	0	0	5
ESE	1	2	1	0	0	0	4
SE	0	0	2	1	0	0	3
SSE	0	0	2	1	0	0	3
S	0	2	7	8	1	0	18
SSW	0	3	6	8	2	0	19
SW	0	0	2	8	10	6	26
WSW	0	1	0	8	12	4	25
W	0	2	5	7	5	1	20
WNW	0	1	2	4	3	0	10
NW	0	1	2	5	7	0	15
NNW	2	0	1	11	7	0	21
Variable	0	0	0	0	0	0	0
Total	5	16	42	68	50	11	192

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 4 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, April – June, 2018

Oyster Creek Alpha

Period of Record: April - June 2018
Stability Class - Extremely Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	9	1	0	12
NNE	1	0	1	0	0	0	2
NE	0	0	1	3	0	0	4
ENE	0	0	0	1	0	0	1
E	0	4	1	0	0	0	5
ESE	0	0	1	0	0	0	1
SE	0	1	2	4	0	0	7
SSE	0	1	6	1	0	0	8
S	0	1	6	2	0	0	9
SSW	0	2	2	0	0	0	4
SW	0	2	3	3	1	1	10
WSW	0	5	4	5	4	1	19
W	0	1	4	4	4	0	13
WNW	0	0	2	3	2	1	8
NW	0	0	4	8	3	2	17
NNW	0	0	5	6	3	3	17
Variable	0	0	0	0	0	0	0
Total	1	17	44	49	18	8	137

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 5

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	1	0	0	0	4
NNE	0	1	0	0	0	0	1
NE	0	4	5	0	0	0	9
ENE	0	18	31	6	0	0	55
E	0	10	10	5	0	0	25
ESE	0	12	8	0	0	0	20
SE	0	11	35	1	0	0	47
SSE	0	1	20	5	0	0	26
S	0	4	36	6	0	0	46
SSW	0	4	7	1	0	0	12
SW	0	14	6	0	0	0	20
WSW	0	10	7	0	0	0	17
W	0	4	2	0	0	0	6
WNW	0	2	3	0	0	0	5
NW	0	3	1	0	0	0	4
NNW	0	6	8	0	0	0	14
Variable	0	0	0	0	0	0	0
Total	0	107	180	24	0	0	311

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	7	1	0	0	0	8
NNE	0	5	0	0	0	0	5
NE	0	10	3	0	0	0	13
ENE	0	8	8	3	0	0	19
E	0	7	6	0	0	0	13
ESE	0	11	1	0	0	0	12
SE	1	10	6	0	0	0	17
SSE	0	2	12	4	0	0	18
S	0	0	13	0	0	0	13
SSW	0	3	12	1	0	0	16
SW	0	5	3	0	0	0	8
WSW	1	8	6	0	0	0	15
W	0	8	5	0	0	0	13
WNW	0	9	3	0	0	0	12
NW	1	7	1	0	0	0	9
NNW	0	1	2	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	3	101	82	8	0	0	194

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

	Wind Speed (in mph)						
Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	2	1	0	0	0	0	3
NE	0	8	1	0	0	0	9
ENE	1	8	5	1	0	0	15
E	0	2	2	0	0	0	4
ESE	0	3	1	0	0	0	4
SE	0	4	3	0	0	0	7
SSE	0	2	7	1	0	0	10
S	0	1	14	0	0	0	15
SSW	0	0	7	1	0	0	8
SW	0	3	2	0	0	0	5
WSW	0	5	1	0	0	0	6
W	0	2	1	0	0	0	3
WNW	0	3	0	0	0	0	3
NW	0	6	0	0	0	0	6
NNW	1	3	1	1	0	0	6
Variable	0	0	0	0	0	0	0
Total	4	51	45	4	0	0	104

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	10	0	0	0	0	14
NNE	2	11	1	0	0	0	14
NE	7	58	12	0	0	0	77
ENE	17	48	20	12	0	0	97
E	4	43	29	5	0	0	81
ESE	2	12	5	0	1	0	20
SE	1	14	29	1	0	0	45
SSE	0	24	29	3	0	0	56
S	1	18	28	1	0	0	48
SSW	2	28	18	1	0	0	49
SW	3	10	1	0	0	0	14
WSW	5	15	2	0	0	0	22
W	7	20	3	0	0	0	30
WNW	8	14	2	0	0	0	24
NW	5	3	0	0	0	0	8
NNW	4	21	2	0	0	0	27
Variable	0	0	0	0	0	0	0
Total	72	349	181	23	1	0	626

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	10	0	1	0	0	0	11
NNE	11	4	3	0	0	0	18
NE	13	19	4	0	0	0	36
ENE	10	22	5	0	0	0	37
E	11	15	4	0	0	0	30
ESE	2	6	1	0	0	0	9
SE	2	15	2	0	0	0	19
SSE	3	10	3	0	0	0	16
S	18	23	8	1	0	0	50
SSW	17	58	19	0	0	0	94
SW	12	59	5	0	0	0	76
WSW	20	40	0	0	0	0	60
W	13	22	0	0	0	0	35
WNW	9	4	0	0	0	0	13
NW	7	10	0	0	0	0	17
NNW	9	11	1	0	0	0	21
Variable	0	0	0	0	0	0	0
Total	167	318	56	1	0	0	542

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	5	0	0	0	0	0	5
NNE	7	0	0	0	0	0	7
NE	3	0	0	0	0	0	3
ENE	0	0	0	0	0	0	0
E	1	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	3	0	0	0	0	0	3
SSE	3	0	0	0	0	0	3
S	8	0	0	0	0	0	8
SSW	10	1	0	0	0	0	11
SW	17	3	0	0	0	0	20
WSW	30	11	0	0	0	0	41
W	21	3	0	0	0	0	24
WNW	11	3	0	0	0	0	14
NW	13	4	0	0	0	0	17
NNW	14	5	0	0	0	0	19
Variable	0	0	0	0	0	0	0
Total	146	30	0	0	0	0	176

Hours of calm in this stability class: 2
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 5 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	0	0	0	0	0	3
NNE	2	0	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	1	0	0	0	0	0	1
S	3	0	0	0	0	0	3
SSW	5	0	0	0	0	0	5
SW	6	0	0	0	0	0	6
WSW	32	3	0	0	0	0	35
W	83	2	0	0	0	0	85
WNW	40	0	0	0	0	0	40
NW	38	0	0	0	0	0	38
NNW	20	1	0	0	0	0	21
Variable	0	0	0	0	0	0	0
Total	234	6	0	0	0	0	240

Hours of calm in this stability class: 13
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Extremely Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	2	0	0	2
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	1	0	0	1
S	0	0	0	4	1	0	5
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	0	0	7	1	0	8

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Moderately Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	1	3	1	0	5
ENE	0	0	7	4	0	0	11
E	0	0	2	0	0	0	2
ESE	0	0	4	1	0	0	5
SE	0	0	5	0	0	0	5
SSE	0	0	6	5	1	0	12
S	0	0	1	10	2	0	13
SSW	0	0	1	0	3	0	4
SW	0	0	3	2	0	0	5
WSW	0	0	1	0	0	0	1
W	0	0	2	0	0	0	2
WNW	0	0	0	0	0	0	0
NW	0	0	0	1	0	0	1
NNW	0	0	0	2	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	0	33	28	7	0	68

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Slightly Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

	Wind Speed (in mph)						
Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	0	0	0	2
NNE	0	0	2	0	0	0	2
NE	0	0	5	1	1	0	7
ENE	0	0	17	10	1	0	28
E	0	0	11	3	0	0	14
ESE	0	1	9	2	0	0	12
SE	0	1	17	4	2	0	24
SSE	0	1	13	8	8	0	30
S	0	0	3	14	2	0	19
SSW	0	1	2	6	0	0	9
SW	0	3	5	2	1	0	11
WSW	0	2	6	8	0	0	16
W	0	0	1	1	0	0	2
WNW	0	0	1	1	0	0	2
NW	0	0	0	1	0	0	1
NNW	0	0	5	4	0	0	9
Variable	0	0	0	0	0	0	0
Total	0	9	99	65	15	0	188

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Neutral - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	6	9	5	1	0	22
NNE	0	6	7	8	0	0	21
NE	2	9	27	53	17	2	110
ENE	0	16	39	33	16	41	145
E	3	16	33	21	19	16	108
ESE	2	15	21	4	3	2	47
SE	2	9	25	14	29	3	82
SSE	1	3	33	18	28	3	86
S	0	6	21	40	10	0	77
SSW	0	5	21	61	19	0	106
SW	2	10	13	20	3	0	48
WSW	0	11	17	14	1	0	43
W	2	9	16	13	1	0	41
WNW	0	9	17	13	0	0	39
NW	1	9	13	2	0	1	26
NNW	0	7	9	13	1	0	30
Variable	0	0	0	0	0	0	0
Total	16	146	321	332	148	68	1031

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Slightly Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	3	4	3	0	0	10
NNE	2	3	15	2	1	0	23
NE	0	3	14	7	3	0	27
ENE	3	10	17	16	6	0	52
E	2	1	20	7	2	0	32
ESE	1	7	8	1	0	0	17
SE	0	5	9	3	0	0	17
SSE	1	1	9	2	0	0	13
S	2	4	11	8	1	0	26
SSW	1	6	24	59	8	0	98
SW	0	3	10	58	8	0	79
WSW	0	1	9	14	27	0	51
W	2	1	4	16	8	0	31
WNW	1	1	3	8	0	0	13
NW	1	3	6	3	5	0	18
NNW	2	4	1	12	2	0	21
Variable	0	0	0	0	0	0	0
Total	18	56	164	219	71	0	528

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Moderately Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	0	2	1	2	0	5
NNE	1	3	4	2	0	0	10
NE	1	3	12	0	0	0	16
ENE	0	8	3	0	0	0	11
E	1	2	5	0	0	0	8
ESE	0	5	2	0	0	0	7
SE	1	1	4	0	0	0	6
SSE	0	2	3	0	0	0	5
S	0	4	1	3	0	0	8
SSW	2	4	3	1	0	0	10
SW	2	2	9	11	6	0	30
WSW	0	1	6	23	16	0	46
W	1	0	1	8	12	0	22
WNW	0	0	1	9	4	0	14
NW	1	1	2	4	4	0	12
NNW	1	0	1	2	11	0	15
Variable	0	0	0	0	0	0	0
Total	11	36	59	64	55	0	225

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 6 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, July – September, 2018

Oyster Creek Alpha

Period of Record: July - September 2018
Stability Class - Extremely Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	5	2	6	0	16
NNE	1	7	4	0	0	0	12
NE	1	1	6	0	0	0	8
ENE	0	0	2	0	0	0	2
E	1	3	2	0	0	0	6
ESE	2	1	1	0	0	0	4
SE	0	1	8	0	0	0	9
SSE	0	2	5	3	0	0	10
S	0	3	6	0	0	0	9
SSW	2	0	3	2	0	0	7
SW	2	2	3	4	0	0	11
WSW	0	0	1	12	2	0	15
W	0	1	3	8	8	0	20
WNW	0	4	1	8	2	0	15
NW	1	0	4	2	1	0	8
NNW	0	0	3	3	2	0	8
Variable	0	0	0	0	0	0	0
Total	10	28	57	44	21	0	160

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	1	0	0	0	1
NNE	0	1	1	0	0	0	2
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	2	0	0	0	0	2
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	1	0	0	0	0	1
S	0	0	4	0	0	0	4
SSW	0	5	3	0	0	0	8
SW	0	1	1	0	0	0	2
WSW	0	6	4	0	0	0	10
W	0	1	8	1	0	0	10
WNW	0	4	6	0	0	0	10
NW	0	4	28	3	0	0	35
NNW	0	1	10	2	0	0	13
Variable	0	0	0	0	0	0	0
Total	0	26	66	6	0	0	98

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	0	1	0	0	3
NNE	0	0	0	0	0	0	0
NE	0	3	0	0	0	0	3
ENE	0	2	0	0	0	0	2
E	0	6	1	0	0	0	7
ESE	0	2	1	0	0	0	3
SE	0	1	0	0	0	0	1
SSE	0	0	0	0	0	0	0
S	0	2	3	1	0	0	6
SSW	0	0	4	2	0	0	6
SW	0	1	2	0	0	0	3
WSW	0	4	1	0	0	0	5
W	0	9	8	4	0	0	21
WNW	0	2	19	7	0	0	28
NW	0	9	21	6	0	0	36
NNW	0	1	3	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	0	44	63	21	0	0	128

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	0	0	0	0	2
NNE	0	1	1	0	0	0	2
NE	1	2	0	0	0	0	3
ENE	0	0	1	0	0	0	1
E	0	2	1	1	0	0	4
ESE	0	4	1	0	0	0	5
SE	0	4	0	0	0	0	4
SSE	0	1	0	0	0	0	1
S	0	0	3	0	0	0	3
SSW	0	2	4	1	0	0	7
SW	0	4	0	0	0	0	4
WSW	1	4	1	0	0	0	6
W	0	4	5	0	0	0	9
WNW	0	4	8	5	0	0	17
NW	0	4	7	2	0	0	13
NNW	0	3	2	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	2	41	34	9	0	0	86

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	2	8	0	0	0	14
NNE	2	15	6	1	0	0	24
NE	4	11	18	2	0	0	35
ENE	2	12	8	25	3	0	50
E	8	13	17	2	0	0	40
ESE	2	15	13	1	0	0	31
SE	1	14	15	1	0	0	31
SSE	3	14	5	1	0	0	23
S	1	16	19	10	0	0	46
SSW	2	13	19	9	0	0	43
SW	5	17	1	1	0	0	24
WSW	5	26	6	1	0	0	38
W	10	18	21	1	0	0	50
WNW	2	21	37	22	0	0	82
NW	2	15	27	4	1	0	49
NNW	10	15	10	2	2	0	39
Variable	0	0	0	0	0	0	0
Total	63	237	230	83	6	0	619

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	10	0	0	0	0	12
NNE	7	6	0	0	0	0	13
NE	4	3	1	0	0	0	8
ENE	16	6	3	0	0	0	25
E	4	19	2	0	0	0	25
ESE	5	15	8	0	0	0	28
SE	1	10	3	2	0	0	16
SSE	7	8	5	3	0	0	23
S	4	26	7	0	0	0	37
SSW	10	25	16	9	0	0	60
SW	7	39	7	0	0	0	53
WSW	10	27	7	0	0	0	44
W	13	40	13	0	0	0	66
WNW	9	55	22	1	0	0	87
NW	12	31	14	0	0	0	57
NNW	14	24	11	0	0	0	49
Variable	0	0	0	0	0	0	0
Total	125	344	119	15	0	0	603

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	3	0	0	0	0	6
NNE	1	1	0	0	0	0	2
NE	3	1	0	0	0	0	4
ENE	3	0	0	0	0	0	3
E	1	2	0	0	0	0	3
ESE	0	0	0	0	0	0	0
SE	1	1	0	0	0	0	2
SSE	5	1	0	0	0	0	6
S	7	2	0	0	0	0	9
SSW	4	3	0	0	0	0	7
SW	2	1	0	0	0	0	3
WSW	17	12	0	0	0	0	29
W	21	35	0	0	0	0	56
WNW	17	24	0	0	0	0	41
NW	9	12	0	0	0	0	21
NNW	7	6	0	0	0	0	13
Variable	0	0	0	0	0	0	0
Total	101	104	0	0	0	0	205

Hours of calm in this stability class: 4
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 7 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	1	0	0	0	0	5
NNE	2	0	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	2	0	0	0	0	0	2
ESE	5	1	0	0	0	0	6
SE	1	0	0	0	0	0	1
SSE	1	0	0	0	0	0	1
S	3	0	0	0	0	0	3
SSW	7	0	0	0	0	0	7
SW	13	0	0	0	0	0	13
WSW	95	10	0	0	0	0	105
W	141	24	0	0	0	0	165
WNW	58	1	0	0	0	0	59
NW	42	1	0	0	0	0	43
NNW	14	4	0	0	0	0	18
Variable	0	0	0	0	0	0	0
Total	389	42	0	0	0	0	431

Hours of calm in this stability class: 27
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Extremely Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Moderately Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	2	0	0	2
W	0	0	0	0	0	0	0
WNW	0	0	0	2	0	0	2
NW	0	0	1	3	5	1	10
NNW	0	0	0	0	3	0	3
Variable	0	0	0	0	0	0	0
Total	0	0	1	7	8	1	17

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Slightly Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	1	0	0	0	1
NNE	0	0	0	1	0	0	1
NE	0	0	1	0	0	0	1
ENE	0	0	3	0	0	0	3
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	3	1	0	0	4
SSW	0	0	2	3	0	0	5
SW	0	0	1	0	0	0	1
WSW	0	0	3	3	0	0	6
W	0	0	0	3	5	1	9
WNW	0	0	4	6	1	4	15
NW	0	0	1	10	16	7	34
NNW	0	0	1	3	1	0	5
Variable	0	0	0	0	0	0	0
Total	0	0	20	30	23	12	85

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Neutral - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	7	7	8	5	2	32
NNE	0	5	5	12	3	1	26
NE	2	6	4	13	9	14	48
ENE	1	3	9	8	1	28	50
E	0	10	12	4	12	12	50
ESE	3	12	12	7	9	5	48
SE	0	4	8	12	9	0	33
SSE	1	3	10	2	3	0	19
S	0	7	12	6	1	6	32
SSW	0	0	13	30	21	18	82
SW	0	2	15	16	2	2	37
WSW	0	7	18	21	5	0	51
W	0	5	22	27	33	9	96
WNW	0	3	11	37	52	41	144
NW	0	6	10	44	30	16	106
NNW	1	5	4	10	10	5	35
Variable	0	0	0	0	0	0	0
Total	11	85	172	257	205	159	889

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Slightly Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	6	11	1	0	19
NNE	1	7	4	5	0	0	17
NE	1	2	2	4	1	0	10
ENE	1	2	4	0	3	2	12
E	1	0	6	8	7	2	24
ESE	1	3	3	11	14	2	34
SE	0	1	3	8	3	6	21
SSE	0	0	4	6	8	4	22
S	0	1	10	18	8	5	42
SSW	0	5	11	35	19	4	74
SW	0	0	6	23	31	1	61
WSW	0	0	5	22	12	0	39
W	0	6	8	14	17	1	46
WNW	1	0	4	38	43	4	90
NW	1	0	7	22	29	3	62
NNW	0	1	3	23	6	0	33
Variable	0	0	0	0	0	0	0
Total	7	29	86	248	202	34	606

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Moderately Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	5	14	7	0	26
NNE	1	0	8	3	1	0	13
NE	0	3	1	3	0	0	7
ENE	0	0	2	0	0	0	2
E	0	1	3	2	1	0	7
ESE	1	2	2	1	0	0	6
SE	1	1	1	4	0	0	7
SSE	1	0	2	1	0	0	4
S	1	0	1	2	1	0	5
SSW	0	3	6	14	1	0	24
SW	2	5	2	9	1	0	19
WSW	0	3	3	4	1	0	11
W	0	1	5	14	18	9	47
WNW	0	2	3	18	48	9	80
NW	0	1	6	18	10	2	37
NNW	1	2	7	18	5	0	33
Variable	0	0	0	0	0	0	0
Total	8	24	57	125	94	20	328

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 8 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, October – December, 2018

Oyster Creek Alpha

Period of Record: October - December2018
Stability Class - Extremely Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	7	9	2	0	20
NNE	0	5	8	10	1	0	24
NE	2	4	2	2	0	0	10
ENE	1	2	1	0	0	0	4
E	1	2	2	1	1	0	7
ESE	1	2	1	3	0	0	7
SE	0	3	10	3	0	0	16
SSE	1	1	8	1	0	0	11
S	2	6	4	1	0	0	13
SSW	1	8	12	11	1	0	33
SW	0	2	4	9	0	0	15
WSW	1	2	2	2	3	0	10
W	1	1	3	14	5	0	24
WNW	1	1	9	16	10	0	37
NW	0	3	5	21	6	0	35
NNW	0	1	4	6	0	0	11
Variable	0	0	0	0	0	0	0
Total	12	45	82	109	29	0	277

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 6

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class - All Stabilities - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0 Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0	
N	2	37	30	24	56	34	11	6	1	1	0	202
NNE	6	37	34	36	46	36	13	2	1	0	0	211
NE	1	32	56	63	130	129	79	23	0	0	0	513
ENE	0	24	54	57	138	134	73	50	56	5	0	591
E	1	18	32	55	125	81	56	16	6	0	0	390
ESE	3	14	22	33	102	64	29	5	0	1	0	273
SE	1	15	25	27	88	113	62	17	4	1	0	353
SSE	1	27	33	39	77	73	63	29	17	0	0	359
S	2	43	45	45	106	111	117	59	29	2	0	559
SSW	3	51	60	55	155	159	87	49	46	0	0	665
SW	3	54	77	90	183	99	33	13	3	0	0	555
WSW	2	106	192	158	178	81	31	15	2	0	0	765
W	2	201	238	161	171	94	64	59	11	0	0	1001
WNW	6	142	116	96	169	129	91	80	62	0	0	891
NW	11	97	120	73	116	172	116	57	42	1	0	805
NNW	3	57	89	71	104	103	66	28	23	2	1	547
Tot	47	955	1223	1083	1944	1612	991	508	303	13	1	8680

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Hours of Calm . . . . . . .        62
Hours of Variable Direction         0
Hours of Valid Data . . . .      8742
Hours of Missing Data . . .        18
Hours in Period . . . . . .      8760
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Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0 Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0	
N	0	0	0	0	3	8	2	4	0	1	0	18
NNE	0	0	0	0	2	4	0	0	0	0	0	6
NE	0	0	0	0	3	14	8	0	0	0	0	25
ENE	0	0	0	0	16	48	18	8	6	0	0	96
E	0	0	0	0	18	33	5	4	1	0	0	61
ESE	0	0	0	0	15	31	3	0	0	0	0	49
SE	0	0	0	0	9	54	30	7	1	0	0	101
SSE	0	0	0	0	4	11	24	10	3	0	0	52
S	0	0	0	0	3	15	37	28	8	1	0	92
SSW	0	0	0	2	6	6	10	5	2	0	0	31
SW	0	0	0	3	14	11	11	6	1	0	0	46
WSW	0	0	0	1	18	28	15	12	0	0	0	74
W	0	0	0	0	12	8	22	21	3	0	0	66
WNW	0	0	1	0	6	20	20	26	4	0	0	77
NW	0	0	0	0	5	32	40	25	6	0	0	108
NNW	0	0	0	0	9	29	22	5	5	0	0	70
Tot	0	0	1	6	143	352	267	161	40	2	0	972

```
Hours of Calm . . . . . . .        0
Hours of Variable Direction        0
Hours of Valid Data . . . .      972
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
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Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)											
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	4	10	5	0	1	0	0	0	20
NNE	0	0	0	3	9	0	0	0	0	0	0	12
NE	0	0	0	1	10	9	4	0	0	0	0	24
ENE	0	0	0	1	15	13	2	3	6	0	0	40
E	0	0	0	4	17	13	4	0	0	0	0	38
ESE	0	0	0	1	27	5	3	0	0	0	0	36
SE	0	0	3	1	18	13	2	3	0	0	0	40
SSE	0	0	0	1	1	13	8	5	3	0	0	31
S	0	0	0	0	3	13	14	6	1	1	0	38
SSW	0	0	0	1	3	12	11	5	3	0	0	35
SW	0	0	0	2	5	10	4	2	1	0	0	24
WSW	0	0	1	4	11	12	4	0	0	0	0	32
W	0	0	0	3	13	17	6	14	5	0	0	58
WNW	0	0	0	4	9	18	8	15	6	0	0	60
NW	0	0	1	6	17	28	15	12	11	0	0	90
NNW	0	0	0	0	3	9	8	5	1	0	0	26
Tot	0	0	5	36	171	190	93	71	37	1	0	604

Hours of Calm	0
Hours of Variable Direction	0
Hours of Valid Data	604
Hours of Missing Data . . .	18
Hours in Period	8760

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	2	1	3	1	0	0	0	0	7
NNE	0	0	2	2	2	0	1	0	0	0	0	7
NE	0	0	2	0	9	12	4	0	0	0	0	27
ENE	0	0	1	2	8	8	8	3	3	0	0	33
E	0	0	0	1	9	5	2	0	1	0	0	18
ESE	0	0	0	8	12	5	1	0	0	0	0	26
SE	0	0	0	2	9	7	0	0	0	0	0	18
SSE	0	0	0	3	4	9	2	4	0	0	0	22
S	0	0	0	0	1	9	11	4	1	0	0	26
SSW	0	0	0	0	1	10	6	2	4	0	0	23
SW	0	0	0	1	8	5	0	0	0	0	0	14
WSW	0	0	1	2	9	3	1	1	0	0	0	17
W	0	0	0	0	6	5	4	1	0	0	0	16
WNW	0	0	0	1	8	3	7	6	6	0	0	31
NW	0	0	0	3	6	13	6	7	1	0	0	36
NNW	0	0	1	4	7	2	3	2	0	0	0	19
Tot	0	0	7	31	100	99	57	30	16	0	0	340

Hours of Calm	0
Hours of Variable Direction	0
Hours of Valid Data	340
Hours of Missing Data . . .	18
Hours in Period	8760

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	8	9	10	24	17	7	1	1	0	0	77
NNE	0	5	11	21	26	25	12	2	1	0	0	103
NE	0	11	20	41	82	78	58	22	0	0	0	312
ENE	0	5	26	34	73	51	43	35	40	5	0	312
E	0	4	15	24	53	25	42	12	4	0	0	179
ESE	0	1	11	19	29	13	19	4	0	1	0	97
SE	1	2	8	11	36	28	28	4	1	1	0	120
SSE	0	2	9	12	48	29	24	10	6	0	0	140
S	0	2	6	15	45	48	42	15	13	0	0	186
SSW	0	3	10	13	39	52	33	21	18	0	0	189
SW	0	4	12	9	39	21	10	3	0	0	0	98
WSW	1	6	12	13	46	25	7	2	1	0	0	113
W	0	3	20	18	30	34	23	14	3	0	0	145
WNW	0	14	12	17	36	46	40	23	35	0	0	223
NW	0	6	11	7	26	65	37	13	20	1	0	186
NNW	0	5	17	24	41	34	24	13	9	2	1	170
Tot	2	81	209	288	673	591	449	194	152	10	1	2650

```
Hours of Calm . . . . . . .        1
Hours of Variable Direction        0
Hours of Valid Data . . . .     2651
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	1	10	8	4	17	1	1	0	0	0	0	42
NNE	2	18	15	9	6	7	0	0	0	0	0	57
NE	0	8	30	21	25	16	5	1	0	0	0	106
ENE	0	13	26	17	24	14	2	1	1	0	0	98
E	1	11	13	24	28	5	3	0	0	0	0	85
ESE	0	7	7	5	19	9	3	1	0	0	0	51
SE	0	6	11	10	15	11	2	3	2	0	0	60
SSE	0	12	14	22	15	10	5	0	5	0	0	83
S	0	16	23	24	51	26	13	6	6	0	0	165
SSW	0	19	32	32	104	79	27	16	19	0	0	328
SW	1	13	31	58	106	51	8	2	1	0	0	271
WSW	0	11	33	53	82	13	4	0	1	0	0	197
W	0	12	25	39	81	29	9	9	0	0	0	204
WNW	2	10	23	28	95	42	16	10	11	0	0	237
NW	1	12	24	21	59	34	18	0	4	0	0	173
NNW	0	9	23	22	32	29	9	3	8	0	0	135
Tot	8	187	338	389	759	376	125	52	58	0	0	2292

```
Hours of Calm . . . . . . .        1
Hours of Variable Direction        0
Hours of Valid Data . . . .     2293
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	9	6	3	1	0	0	0	0	0	0	19
NNE	2	7	4	1	1	0	0	0	0	0	0	15
NE	0	7	4	0	1	0	0	0	0	0	0	12
ENE	0	4	0	2	2	0	0	0	0	0	0	8
E	0	3	1	2	0	0	0	0	0	0	0	6
ESE	0	3	2	0	0	0	0	0	0	0	0	5
SE	0	4	2	2	1	0	0	0	0	0	0	9
SSE	0	8	7	0	5	1	0	0	0	0	0	21
S	0	12	15	4	2	0	0	0	0	0	0	33
SSW	1	11	15	7	2	0	0	0	0	0	0	36
SW	0	14	15	11	11	1	0	0	0	0	0	52
WSW	0	13	41	43	12	0	0	0	0	0	0	109
W	0	15	37	50	27	1	0	0	0	0	0	130
WNW	1	18	22	35	14	0	0	0	0	0	0	90
NW	1	12	31	27	2	0	0	0	0	0	0	73
NNW	0	14	19	10	11	0	0	0	0	0	0	54
Tot	5	154	221	197	92	3	0	0	0	0	0	672

```
Hours of Calm . . . . . . .        7
Hours of Variable Direction        0
Hours of Valid Data . . . .      679
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 9 Wind Speed by Direction Measured at 33 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	1	10	7	1	0	0	0	0	0	0	0	19
NNE	2	7	2	0	0	0	0	0	0	0	0	11
NE	1	6	0	0	0	0	0	0	0	0	0	7
ENE	0	2	1	1	0	0	0	0	0	0	0	4
E	0	0	3	0	0	0	0	0	0	0	0	3
ESE	3	3	2	0	0	1	0	0	0	0	0	9
SE	0	3	1	1	0	0	0	0	0	0	0	5
SSE	1	5	3	1	0	0	0	0	0	0	0	10
S	2	13	1	2	1	0	0	0	0	0	0	19
SSW	2	18	3	0	0	0	0	0	0	0	0	23
SW	2	23	19	6	0	0	0	0	0	0	0	50
WSW	1	76	104	42	0	0	0	0	0	0	0	223
W	2	171	156	51	2	0	0	0	0	0	0	382
WNW	3	100	58	11	1	0	0	0	0	0	0	173
NW	9	67	53	9	1	0	0	0	0	0	0	139
NNW	3	29	29	11	1	0	0	0	0	0	0	73
Tot	32	533	442	136	6	1	0	0	0	0	0	1150

Hours of Calm 53
Hours of Variable Direction 0
Hours of Valid Data 1203
Hours of Missing Data . . . 18
Hours in Period 8760

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – All Stabilities - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	7	13	19	28	45	41	107	48	11	319
NNE	0	6	9	13	45	58	49	46	64	18	4	312
NE	0	4	12	15	40	68	71	78	137	108	101	634
ENE	0	3	8	17	40	75	83	89	99	57	110	581
E	0	3	8	15	51	66	81	55	47	49	46	421
ESE	0	3	12	14	66	51	56	22	33	27	25	309
SE	0	3	3	11	27	59	86	43	55	44	22	353
SSE	0	4	2	6	28	47	85	75	65	56	23	391
S	0	2	4	12	31	47	66	98	150	74	58	542
SSW	1	1	5	8	27	53	73	116	266	173	110	833
SW	0	4	10	10	30	39	59	75	210	148	68	653
WSW	0	2	4	11	34	40	50	79	160	145	50	575
W	0	2	6	6	32	35	48	68	167	200	126	690
WNW	0	2	4	9	28	26	39	71	214	287	192	872
NW	0	3	3	8	17	43	41	67	217	239	150	788
NNW	0	2	6	6	25	24	36	59	144	113	54	469
Tot	1	44	103	174	540	759	968	1082	2135	1786	1150	8742

```
Hours of Calm . . . . . . .        0
Hours of Variable Direction        0
Hours of Valid Data . . . .     8742
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Extremely Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	1	0	2	3	4	0	10
ENE	0	0	0	0	0	0	0	1	5	1	0	7
E	0	0	0	0	0	1	0	0	0	0	0	1
ESE	0	0	0	0	0	0	1	0	0	0	0	1
SE	0	0	0	0	0	0	0	0	1	0	0	1
SSE	0	0	0	0	0	0	0	0	1	0	0	1
S	0	0	0	0	0	0	2	1	3	1	0	7
SSW	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	2	0	0	2
WSW	0	0	0	0	0	0	0	0	4	3	1	8
W	0	0	0	0	0	0	0	0	4	7	2	13
WNW	0	0	0	0	0	0	0	0	2	6	5	13
NW	0	0	0	0	0	0	0	0	3	2	0	5
NNW	0	0	0	0	0	0	0	0	2	1	0	3
Tot	0	0	0	0	0	2	3	4	30	25	8	72

```
Hours of Calm . . . . . . .      0
Hours of Variable Direction      0
Hours of Valid Data . . . .     72
Hours of Missing Data . . .     18
Hours in Period . . . . . .   8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Moderately Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	0	0	0	1	0	0	1	0	2
NNE	0	0	0	0	0	0	0	1	1	0	0	2
NE	0	0	0	0	0	0	4	3	7	2	1	17
ENE	0	0	0	0	0	4	6	9	4	1	0	24
E	0	0	0	0	0	0	12	4	0	0	0	16
ESE	0	0	0	0	0	1	5	2	0	0	0	8
SE	0	0	0	0	0	2	6	10	5	1	0	24
SSE	0	0	0	0	0	0	5	5	9	1	0	20
S	0	0	0	0	0	0	1	6	15	4	0	26
SSW	0	0	0	0	0	0	1	1	0	3	2	7
SW	0	0	0	0	0	1	1	3	6	3	3	17
WSW	0	0	0	0	1	1	0	3	7	6	1	19
W	0	0	0	0	0	1	0	4	5	7	7	24
WNW	0	0	0	1	0	0	0	3	5	9	4	22
NW	0	0	0	0	0	0	0	7	13	8	6	34
NNW	0	0	0	0	0	0	0	0	4	6	3	13
Tot	0	0	0	1	1	10	42	61	81	52	27	275

```
Hours of Calm . . . . . . .        0
Hours of Variable Direction        0
Hours of Valid Data . . . .      275
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Slightly Unstable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	0	0	2	1	3	0	1	0	7
NNE	0	0	0	0	0	0	2	2	1	0	0	5
NE	0	0	0	0	0	4	9	3	5	5	0	26
ENE	0	0	0	0	1	6	17	12	10	1	1	48
E	0	0	0	0	1	7	10	7	2	0	0	27
ESE	0	0	0	0	1	6	9	5	2	0	0	23
SE	0	0	0	1	1	8	21	9	3	4	0	47
SSE	0	0	0	0	2	0	7	14	13	6	2	44
S	0	0	0	0	1	0	6	7	20	6	3	43
SSW	0	0	0	0	1	1	3	1	10	2	1	19
SW	0	0	0	0	2	4	4	6	7	7	2	32
WSW	0	0	0	0	2	3	12	13	6	4	3	43
W	0	0	0	0	1	2	3	0	12	13	8	39
WNW	0	0	0	0	1	0	4	8	11	12	8	44
NW	0	0	0	0	0	2	8	7	26	21	19	83
NNW	0	0	0	0	0	0	8	11	12	3	3	37
Tot	0	0	0	1	14	45	124	108	140	85	50	567

```
Hours of Calm . . . . . . .        0
Hours of Variable Direction        0
Hours of Valid Data . . . .      567
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Neutral - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	5	6	14	14	19	12	29	13	8	120
NNE	0	0	1	7	24	26	20	23	41	13	3	158
NE	0	0	8	11	26	39	26	43	93	87	98	431
ENE	0	0	3	9	20	38	32	47	52	42	106	349
E	0	1	4	7	39	29	28	31	25	36	40	240
ESE	0	2	4	9	42	34	28	9	16	12	15	171
SE	0	1	1	4	17	26	30	14	29	35	10	167
SSE	0	1	1	4	11	22	43	36	20	36	8	182
S	0	0	0	7	10	21	30	52	60	27	13	220
SSW	0	0	0	2	5	21	28	49	102	68	47	322
SW	0	1	4	1	13	21	26	28	56	27	4	181
WSW	0	1	1	6	20	20	23	24	48	14	6	163
W	0	1	2	3	18	20	22	24	57	50	56	253
WNW	0	0	3	3	17	16	20	33	75	87	122	376
NW	0	0	2	6	9	23	17	25	72	93	70	317
NNW	0	2	0	3	12	11	14	22	43	40	39	186
Tot	0	10	39	88	297	381	406	472	818	680	645	3836

```
Hours of Calm . . . . . . .       0
Hours of Variable Direction       0
Hours of Valid Data . . . .    3836
Hours of Missing Data . . .      18
Hours in Period . . . . . .    8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Slightly Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0 Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0	
N	0	0	2	6	1	6	12	10	30	1	0	68
NNE	0	4	5	4	7	19	11	7	8	2	1	68
NE	0	2	2	2	4	18	13	14	20	10	2	87
ENE	0	3	4	4	12	14	21	11	25	12	3	109
E	0	0	3	4	3	14	21	12	16	10	6	89
ESE	0	0	3	3	11	6	7	5	12	15	10	72
SE	0	1	1	5	6	9	12	6	7	4	12	63
SSE	0	2	0	2	11	17	16	6	13	8	10	85
S	0	0	3	3	11	12	16	22	31	22	36	156
SSW	1	0	2	3	9	11	25	42	124	91	57	365
SW	0	1	2	4	7	5	17	27	101	84	39	287
WSW	0	1	1	2	3	8	11	21	48	74	10	179
W	0	1	1	3	8	8	10	17	43	69	17	177
WNW	0	1	0	3	6	2	6	16	60	95	14	203
NW	0	1	1	1	5	6	8	11	42	73	33	181
NNW	0	0	2	0	7	4	5	9	40	25	3	95
Tot	1	17	32	49	111	159	211	236	620	595	253	2284

```
Hours of Calm . . . . . . . .      0
Hours of Variable Direction        0
Hours of Valid Data . . . .     2284
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Moderately Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)											
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	0	0	0	4	7	23	20	1	55
NNE	0	2	1	1	3	4	8	6	4	2	0	31
NE	0	1	0	0	7	2	11	9	3	0	0	33
ENE	0	0	0	2	7	8	5	4	0	0	0	26
E	0	1	1	1	2	11	6	1	2	2	0	27
ESE	0	0	3	2	8	3	4	0	1	0	0	21
SE	0	1	1	0	1	3	6	0	6	0	0	18
SSE	0	1	0	0	2	4	4	5	2	4	0	22
S	0	1	0	0	5	4	4	7	16	10	5	52
SSW	0	0	1	2	7	10	9	12	19	5	1	66
SW	0	2	3	2	6	4	8	6	22	26	19	98
WSW	0	0	1	1	4	5	2	10	32	35	23	113
W	0	0	2	0	2	4	8	14	23	35	31	119
WNW	0	0	0	1	1	2	3	5	36	56	27	131
NW	0	1	0	1	0	5	4	6	32	22	16	87
NNW	0	0	4	1	2	4	3	7	27	30	1	79
Tot	0	10	17	14	57	73	89	99	248	247	124	978

```
Hours of Calm . . . . . . .        0
Hours of Variable Direction        0
Hours of Valid Data . . . .      978
Hours of Missing Data . . .       18
Hours in Period . . . . . .     8760
```

Table D – 10 Wind Speed by Direction Measured at 380 Feet for various Stability Classes for the Oyster Creek Generating Station, January – December, 2018

Oyster Creek Alpha

Period of Record: January - December 2018
Stability Class – Extremely Stable - 380Ft-33Ft Delta-T (F)
Winds Measured at 380 Feet

Wind	Wind Speed Range (m/s)										
Direction		0.5-	1.1-	1.6-	2.1-	3.1-	4.1-	5.1-	6.1-	8.1-	>10.0	Total
Sector	<0.50	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0		
N	0	0	0	1	4	6	8	9	25	12	2	67
NNE	0	0	2	1	11	9	8	7	9	1	0	48
NE	0	1	2	2	3	4	8	4	6	0	0	30
ENE	0	0	1	2	0	5	2	5	3	0	0	18
E	0	1	0	3	6	4	4	0	2	1	0	21
ESE	0	1	2	0	4	1	2	1	2	0	0	13
SE	0	0	0	1	2	11	11	4	4	0	0	33
SSE	0	0	1	0	2	4	10	9	7	1	3	37
S	0	1	1	2	4	10	7	3	5	4	1	38
SSW	0	1	2	1	5	10	7	11	11	4	2	54
SW	0	0	1	3	2	4	3	5	16	1	1	36
WSW	0	0	1	2	4	3	2	8	15	9	6	50
W	0	0	1	0	3	0	5	9	23	19	5	65
WNW	0	1	1	1	3	6	6	6	25	22	12	83
NW	0	1	0	0	3	7	4	11	29	20	6	81
NNW	0	0	0	2	4	5	6	10	16	8	5	56
Tot	0	7	15	21	60	89	93	102	198	102	43	730

```
Hours of Calm . . . . . . .         0
Hours of Variable Direction         0
Hours of Valid Data . . . .       730
Hours of Missing Data . . .        18
Hours in Period . . . . . .      8760
```

Appendix E
ERRATA

No corrections were made to the 2017 ARERR.

Appendix F
ODCM Revisions

Revision 8 of the ODCM, CY-OC-170-301, was implemented 11/15/2018. The revision supported PDTS (Permanently Defueled Technical Specifications) implementation following final shut down 17 September 2018 and the facility in a permanently defueled condition. See the complete copy of CY-OC-170-301 Revision 8 attached as part of this report.

OFFSITE DOSE CALCULATION MANUAL

FOR

OYSTER CREEK GENERATING STATION

Revision of this document requires PORC approval and changes are controlled by CY-AA-170-3100

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BASES FOR SECTIONS 3.0 AND 4.0

APPENDIX E – RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM – SAMPLE TYPE AND LOCATION

OYSTER CREEK GENERATING STATION
OFFSITE DOSE CALCULATION MANUAL

INTRODUCTION

The Oyster Creek Offsite Dose Calculation Manual (ODCM) is an implementing document to the Oyster Creek Technical Specifications. The previous Limiting Conditions for Operations that were contained in the Radiological Effluent Technical Specifications (RETS) are now included in the ODCM as Radiological Effluent Controls (REC). The ODCM contains two parts: Part I – Radiological Effluent Controls, and Part II – Calculational Methodologies.

Part I includes the following:

- The Radiological Effluent Controls and the Radiological Environmental Monitoring Programs required by Technical Specification 6.8.4.
- Descriptions of the information that should be included in the Annual Radioactive Effluent Release Report and the Annual Radiological Environmental Operating Report required by Technical Specifications 6.9.1.a and 6.9.1.b, respectively.

Part II describes methodologies and parameters used for:

- The calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip set points; and
- The calculation of radioactive liquid and gaseous concentrations, dose rates, cumulative yearly doses, and projected doses.

Part II also contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program (REMP), and the liquid and gaseous waste treatment systems and discharge points.

PART I - RADIOLOGICAL EFFLUENT CONTROLS

1.0 DEFINITIONS

The following terms are defined so that uniform interpretation of these CONTROLS may be achieved. The defined terms appear in capitalized type and are applicable throughout these CONTROLS.

1.1 OPERABLE – OPERABILITY

A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it can perform its specified function(s). Implicit in the definition shall be the assumption that all necessary attendant instrumentation, controls, normal and emergency electrical power sources, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

A verification of OPERABILITY is an administrative check, by examination of appropriate plant records (logs, surveillance test records) to determine that a system, subsystem, train, component or device is not inoperable. Such verification does not preclude the demonstration (testing) of a given system, subsystem, train, component or device to determine OPERABILITY.

1.2 ACTION

ACTION shall be that part of a CONTROL that prescribes remedial measures required under designated conditions.

1.3 CHANNEL CALIBRATION

A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds, with acceptable range and accuracy, to known values of the parameter that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including equipment actuation, alarm, or trip.

1.4 CHANNEL CHECK

A CHANNEL CHECK shall be a qualitative determination of acceptable operability by observation of channel behavior during operation. This determination shall include, where possible, comparison of the channel with other independent channels measuring the same variable.

1.5 CHANNEL FUNCTIONAL TEST

CHANNEL FUNCTIONAL TEST shall be the injection of a simulated signal into the channel to verify its proper response including, where applicable, alarm and/or trip initiating actions.

1.6 CONTROL

The Limiting Conditions for Operation (LCOs) that were contained in the Radiological Effluent Technical Specifications were transferred to the OFFSITE DOSE CALCULATION MANUAL (ODCM) and were renamed CONTROLS. This is to distinguish between those LCOs that were retained in the Technical Specifications and those LCOs or CONTROLS that were transferred to the ODCM.

1.7 FREQUENCY NOTATION

The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table 1.1.

1.8 SOURCE CHECK

SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

1.9 OFFSITE DOSE CALCULATION MANUAL (ODCM)

The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of Offsite doses due to radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Set points, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification Section 6.8.4 and (2) descriptions of the information that should be included in the Annual Radioactive Effluent Release Report and Annual Radiological Environmental Operating Report required by Technical Specification Sections 6.9.1.a and 6.9.1.b, respectively.

1.10 <u>DEPOSITION (D/Q)</u>

The direct removal of gaseous and particulate species on land or water surfaces. DEPOSITION is expressed as a quantity of material per unit area (e.g. m^{-2}).

1.11 <u>DOSE CONVERSION FACTOR (DCF)</u>

A parameter calculated by the methods of internal dosimetry, which indicates the committed dose equivalent (to the whole body or organ) per unit activity inhaled or ingested. This parameter is specific to the isotope and the dose pathway. DOSE CONVERSION FACTORS are commonly tabulated in units of mrem/hr per picocurie/m^3 in air or water. They can be found in Reg Guide 1.109 appendices.

1.12 <u>EFFLUENT CONCENTRATION (EC)</u>

The liquid and air concentration levels which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem. LEC refers to liquid EFFLUENT CONCENTRATION.

1.13 <u>ELEVATED RELEASE (STACK)</u>

An airborne effluent plume whose release point is higher than twice the height of the nearest adjacent solid structure and well above any building wake effects to be essentially unentrained. Regulatory Guide 1.111 is the basis of the definition of an ELEVATED RELEASE. Elevated releases generally will not produce any significant ground level concentrations within the first few hundred yards of the source. ELEVATED RELEASES generally have less dose consequence to the public due to the greater downwind distance to the ground concentration maximum compared to ground releases. All main stack releases at the OCGS are ELEVATED RELEASES.

1.14 FINITE PLUME MODEL

Atmospheric dispersion and dose assessment model which is based on the assumption that the horizontal and vertical dimensions of an effluent plume are not necessarily large compared to the distance that gamma rays can travel in air. It is more realistic than the semi-infinite plume model because it considers the finite dimensions of the plume, the radiation build-up factor, and the air attenuation of the gamma rays coming from the cloud. This model can estimate the dose to a receptor who is not submerged in the radioactive cloud. It is particularly useful in evaluating doses from an elevated plume or when the receptor is near the effluent source.

1.15 GROUND LEVEL RELEASE

An airborne effluent plume which contacts the ground essentially at the point of release either from a source located at ground elevation or from a source well above the ground elevation which has significant building wake effects to cause the plume to be entrained in the wake and driven to the ground elevation. GROUND LEVEL RELEASES are treated differently than ELEVATED RELEASES in that the X/Q calculation results in significantly higher concentrations at the ground elevation near the release point.

1.16 RAGEMS (RADIATION GAS EMISSIONS MONITORING SYSTEM)

A plant system that monitors gaseous effluent releases from monitored points. The RAGEMS system for the main stack (RAGEMS I) monitors particulates, iodine, and noble gases.

1.17 SEMI-INFINITE PLUME MODEL

Dose assessment model with the following assumptions. The ground is considered to be an infinitely large flat plate and the receptor is located at the origin of a hemispherical cloud of infinite radius. The radioactive cloud is limited to the space above the ground plane. The semi-infinite plume model is limited to immersion dose calculations.

1.18 SOURCE TERM

The activity release rate, or concentration of an actual release or potential release. The common units for the source term are curies, curies per second, and curies per cubic centimeter, or multiples thereof (e.g., micro curies).

1.19 X/Q - ("CHI over Q")

The dispersion factor of a gaseous release in the environment calculated by a point source Gaussian dispersion model. Normal units of X/Q are sec/m^3. The X/Q is used to determine environmental atmospheric concentrations by multiplying the source term, represented by Q (in units of μCi/sec or Ci/sec). Thus, the plume dispersion, X/Q (seconds/cubic meter) multiplied by the source term, Q (μCi/seconds) yields an environmental concentration, X (μCi/m^3). X/Q is a function of many parameters including wind speed, stability class, release point height, building size, and release velocity.

1.20 SEEDS (Simplified Effluent Environmental Dosimetry System)

A routine effluent dosimetry computer program that uses Regulatory Guides 1.109 and 1.111 methodologies.

TABLE 1.1: SURVEILLANCE FREQUENCY NOTATION *

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
3X	At least 3 times per 7 days
W	At least once per 7 days.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
A	At least once per 366 days.
18m	At least once per 18 months (550 days).
24m	At least once per 24 months (733 days).
P	Prior to each radioactive release.
N.A.	Not applicable.

* Each surveillance requirement shall be performed within the specified time interval with a maximum allowable extension not to exceed 25% of the surveillance interval.

3/4 CONTROLS AND SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY

CONTROLS

3.0.1 Compliance with the CONTROLS contained in the succeeding CONTROLS is required during the OPERATIONAL CONDITIONS or other conditions specified therein; except that upon failure to meet the CONTROL, the associated ACTION requirements shall be met.

3.0.2 Noncompliance with a CONTROL shall exist when the requirements of the CONTROL and associated ACTION requirements are not met within the specified time intervals. If the CONTROL is restored prior to expiration of the specified time intervals, completion of the ACTION requirements is not required.

3.0.4 Entry into an OPERATIONAL CONDITION or other specified condition may be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time. This provision shall not prevent passage through or to OPERATIONAL CONDITIONS as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual CONTROLS.

3.0.5 Equipment removed from service or declared inoperable to comply with ACTIONS may be returned to service under administrative control solely to perform testing to demonstrate its OPERABILITY or the OPERABILITY of other equipment. This is an exception to CONTROL 3.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate OPERABILITY.

3 /4.0 APPLICABILITY

SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the OPERATIONAL CONDITIONS or other conditions specified for individual CONTROLS unless otherwise stated in an individual Surveillance Requirement.

4.0.2 Each Surveillance Requirement shall be performed within the specified surveillance interval with a maximum allowable extension not to exceed 25 percent of the specified surveillance interval.

4.0.3 Failure to perform a Surveillance Requirement within the allowed surveillance interval, defined by CONTROL 4.0.2, shall constitute a failure to meet the OPERABILITY requirements for a CONTROL. The time limits of the ACTION requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The ACTION requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowed outage time limits of the ACTION requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

4.0.4 Entry into an OPERATIONAL CONDITION or other specified applicable condition shall not be made unless the Surveillance Requirement(s) associated with the CONTROLS have been performed within the applicable surveillance interval or as otherwise specified. This provision shall not prevent passage through or to OPERATIONAL CONDITIONS as required to comply with ACTION requirements.

3/4.3 INSTRUMENTATION

3/4.3.3.10 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.10 In accordance with Oyster Creek Technical Specifications 6.8.4.a.1, the radioactive liquid effluent monitoring instrumentation channels shown in Table 3.3.3.10-1 shall be OPERABLE with their Alarm/Trip set points set to ensure that the limits of CONTROL 3.11.1.1 are not exceeded. The Alarm/Trip set points of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM Part II section 1.2.1.

APPLICABILITY: During all liquid releases via these pathways.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel Alarm/Trip set point less conservative than required by the above CONTROL, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the set point so it is acceptably conservative or provide for manual initiation of the Alarm/Trip function(s).

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3.3.10-1. Make every reasonable effort to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report pursuant to Technical Specification 6.9.1.a why the inoperability was not corrected in a timely manner.

c. The provisions of CONTROL 3.0.4 are not applicable. Report all deviations in the Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

4.3.3.10 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST at the Frequencies shown in Table 4.3.3.10-1.

TABLE 3.3.3.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Reactor Building Service Water System Effluent Line	1	112
3. FLOW RATE MEASUREMENT DEVICES		
b. Groundwater Release Path	1	115

TABLE 3.3.3.10-1 (Continued)

TABLE NOTATIONS

ACTION 112 With no channels OPERABLE, effluent releases via this pathway may continue provided that, at least once per 24 hours, grab samples are collected and analyzed for radioactivity at a limit of detection specified by Table 4.11.1.1.1-1.

ACTION 115 With no channel OPERABLE, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves may be used to estimate flow. Secure effluent release via this pathway when flow rate cannot be estimated in the specified time.

TABLE 4.3.3.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS[a]

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Reactor Building Service Water System Effluent Line	D	M	18m[e]	Q[d]
3. FLOW RATE MEASUREMENT DEVICES				
b. Groundwater Release path	Q[f]	N/A	18m[f]	N/A

TABLE 4.3.3.10-1 (Continued)

TABLE NOTATIONS

a. Instrumentation shall be **OPERABLE** and in service except that a channel may be taken out of service for the purpose of a check, calibration, test or maintenance without declaring it to be inoperable.

d. The **CHANNEL FUNCTIONAL TEST** shall also demonstrate that Control Room alarm annunciation occurs if any of the following conditions exists:

1. Instrument indicates measured levels above the alarm set point.
2. Instrument indicates a downscale failure.
3. Instrument controls not set in operate mode.
4. Instrument electrical power loss.

e. The **CHANNEL CALIBRATION** shall be performed according to established calibration procedures.

f. While actively discharging through this pathway.

3/4.3 INSTRUMENTATION

3/4.3.3.11 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.11 In accordance with Oyster Creek Technical Specifications 6.8.4.a.1, the radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3.3.11-1 shall be OPERABLE with their alarm/trip set points set to ensure that the limits of CONTROL 3.11.2.1 are not exceeded. The alarm/trip set points of these channels meeting CONTROLS 3.11.2.1 shall be determined and adjusted in accordance with the methodology and parameters in the ODCM Part II Section 2.2.

APPLICABILITY: As shown in Table 3.3.3.11-1

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip set point less conservative than required by the above CONTROL, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the set point so it is acceptably conservative.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3.3.11-1. Exert best efforts to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report pursuant to Technical Specification 6.9.1.a why this inoperability was not corrected in a timely manner.

c. The provisions of CONTROLS 3.0.4 are not applicable. Report all deviations in the Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

4.3.3.11 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3.3.11-1.

TABLE 3.3.3.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE[a]	APPLICABILITY	ACTION
2. STACK MONITORING SYSTEM			
a. Radioactive Noble Gas Monitor (Low Range)	1	b	124
b. Iodine Sampler	1	b	127
c. Particulate Sampler	1	b	127
d. Effluent Flow Measuring Device	1	b	122
e. Sample Flow Measuring Device	1	b	128

TABLE 3.3.3.11-1 (Continued)

TABLE NOTATIONS

a. Channels shall be OPERABLE and in service as indicated except that a channel may be taken out of service for a check, calibration, test maintenance or sample media change without declaring the channel to be inoperable.

b. During releases via this pathway

ACTION 122 With no channel OPERABLE, effluent releases via this pathway may continue provided the flow rate is estimated whenever the exhaust fan combination in this system is changed.

ACTION 124 With no channel OPERABLE, effluent releases via this pathway may continue provided a grab sample is taken at least once per 8 hours and analyzed for gross radioactivity within 24 hours or provided an alternate monitoring system with local display is utilized.

ACTION 127 With no channel OPERABLE, effluent releases via this pathway may continue provided the required sampling is initiated with auxiliary sampling equipment as soon as reasonable after discovery of inoperable primary sampler(s).

ACTION 128 With no channel OPERABLE, effluent releases via the sampled pathway may continue provided the sampler air flow is estimated and recorded at least once per day.

TABLE 4.3.3.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVIELLANCE REQUIRED[a]
2. MAIN STACK MONITORING SYSTEM					
a. Radioactive Noble Gas Monitor (Low Range)	D	M	24m[f]	Q[h]	b
b. Iodine Sampler	W	N.A.	N.A.	N.A.	b
c. Particulate Sampler	W	N.A.	N.A.	N.A.	b
d. Effluent Flow Measuring Device	3X	N.A.	24m	Q	b
e. Sample Flow Measuring Device	3X	N.A.	18m	Q	b

TABLE 4.3.3.11-1 (Continued)

TABLE NOTATIONS

a. Instrumentation shall be OPERABLE and in service except that a channel may be taken out of service for a check calibration, test or maintenance without declaring it to be inoperable.

b. During releases via this pathway.

f. The CHANNEL CALIBRATION shall be performed according to established calibration procedures.

h. The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

    1. Instrument indicates measured levels above the alarm set point.
    2. Instrument indicates a low count rate/monitor failure.
    3. Switch cover alarm shall be verified to alarm when the cover is opened; and clear when the cover is closed after the faceplate switches are verified in their correct positions.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

CONTROLS

3.11.1.1 In accordance with the Oyster Creek Technical Specifications 6.8.4.a.2 and 3, the concentration of radioactive material, other than noble gases, in liquid effluent in the discharge canal at the Route 9 bridge (See Figure E-4) shall not exceed the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. The concentration of noble gases dissolved or entrained in liquid effluent in the discharge canal at the Route 9 bridge shall not exceed 2E-4 microcuries/milliliter.

APPLICABILITY: At all times.

ACTION:

a. In the event the concentration of radioactive material in liquid effluent released into the Offsite area beyond the Route 9 bridge exceeds either of the concentration limits above, reduce the release rate without delay to bring the concentration below the limit.

b. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program in Table 4.11.1.1.1-1.

Alternately, pre-release analysis of batches(es) of radioactive liquid waste may be by gross beta or gamma counting provided a maximum concentration limit of 1E-8 μCi/ml in the discharge canal at the Route 9 bridge is applied.

4.11.1.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM Part II Section 1.2 to assure that the concentrations at the point of release are maintained within the limits of CONTROL 3.11.1.1 and 3.11.1.2.

4.11.1.1.3 The alarm or trip set point of each radioactivity monitoring channel in Table 3.3.3.10-1 shall be determined on the basis of sampling and analyses results obtained according to Table 4.11.1.1.1-1 and the set point method in ODCM Part II 1.2.1 and set to alarm or trip before exceeding the limits of CONTROL 3.11.1.1.

TABLE 4.11.1.1.1-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit Detection[a] (LLD) (μCi/ml)
1. Batch Waste Release Tanks	P Each Batch[b]	P[c] Each Batch	Principal Gamma Emitters	5E-07
			I-131	5E-07
	P One Batch/M[b]	M	Dissolved and Entrained Gases (Gamma Emitters)	1E-05
	P Each Batch[b]	M Composite[d]	H-3	1E-05
			Gross Alpha	1E-07
	P Each Batch[b]	Q Composite[d]	Sr-89, Sr-90	5E-08
			Fe-55	1E-06
2. Continuous Release a. Reactor Building Service Water Effluent	W Grab Sample[e]	W	Principal Gamma Emitters	5E-07
			I-131	5E-07
	(note f)	M Composite[g]	H-3	1E-05
			Gross Alpha	1E-07
			Fe-55	1E-06
3. Groundwater Release Path a. Continuous	Continuous	Q	Principal Gamma Emitters	5E-07
			H-3	1E-05
	Q	Q	Gross Alpha	1E-07
			Sr-89, Sr-90	5E-08
			Fe-55	1E-06
			Ni-63	1E-06
b. Batch Release Tank	P Each Batch[b]	P Each Batch	Principal Gamma Emitters	5E-07
			H-3	1E-05
	P Each Batch[b]	Q Composite[d]	Gross Alpha	1E-07
			Sr-89, Sr-90	5E-08
			Fe-55	1E-06
			Ni-63	1E-06

TABLE 4.11.1.1-1 (CONTINUED)

TABLE NOTATIONS

a. The Lower Limit of Detection (LLD) is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a “real” signal.

The LLD is applicable to the capability of a measurement system under typical conditions and not as a limit for the measurement of a particular sample in the radioactive liquid waste sampling and analyses program.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * Sb}{E * V * 2.22\text{E}6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the lower limit of detection as defined above (microcurie per unit mass or volume),

S_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E is the counting efficiency,

V is the sample size (units of mass or volume),

2.22E+6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt is the elapsed time between the end of the sample collection and the time of counting.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions with typical values of E, V, Y, and t for the radionuclides Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Ce-141, Cs-134, Cs-137; and an LLD of 5E-6 μCi/ml should typically be achieved for Ce-144.

TABLE 4.11.1.1.1-1 (CONTINUED)

TABLE NOTATIONS

Occasionally, background fluctuations, interfering radionuclides, or other uncontrollable circumstances may render these LLD's unachievable.

When calculating the LLD for a radionuclide determined by gamma ray spectrometry, the background may include the typical contributions of other radionuclides normally present in the sample. The background count rate of a semiconductor detector (e.g. HPGe) is determined from background counts that are determined to be within the full width of the specific energy band used for the quantitative analysis for the radionuclide.

The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall be identified and reported. The LLD for Ce-144 is 5E-6 μCi/mL whereas the LLD for Mo-99 and the other gamma emitters is 5E-7 μCi/mL. Nuclides that are below the LLD for the analysis should not be reported.

b. A batch release is the discharge of liquid wastes of a discrete volume. Before sampling for analysis, each batch should be thoroughly mixed.

c. In the event a gross radioactivity analysis is performed in lieu of an isotopic analysis before a batch is discharged, a sample will be analyzed for principal gamma emitters afterwards.

d. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

e. Analysis may be performed after release.

f. In the event a grab sample contains more than 5E-7 μCi/mL of I-131 and principal gamma emitters or in the event the Reactor Building Service Water radioactivity monitor indicates more than 5E-7 μCi/mL radioactivity in the effluent, as applicable, sample the elevated activity effluent daily until analysis confirms the activity concentration in the effluent does not exceed 5E-7 μCi/mL. In addition, a composite sample must be made up for further analysis for all samples taken when the activity was > 5E-7 μCi/mL.

g. A composite sample is produced combining grab samples, each having a defined volume, collected routinely from the sump or stream being sampled

3/ 4.11 RADIOACTIVE EFFLUENTS

3/ 4.11.1.2 DOSE

CONTROLS

3.11.1.2 In accordance with Oyster Creek Technical Specifications 6.8.4.a.4 and 5, the dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas (see Figure E-4) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the Total Body and to less than or equal to 5 mrem to any body organ, and

b. During any calendar year to less than or equal to 3 mrem to the Total Body and to less than or equal to 10 mrem to any body organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days from the end of the quarter a report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken and/or will be taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROL 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.2 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM Part II Section 1.5 at least once per 31 days in accordance with Technical Specification 6.8.4.a.5.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1.3 LIQUID WASTE TREATMENT SYSTEM

CONTROLS

3.11.1.3 In accordance with the Oyster Creek Technical Specifications 6.8.4.a.6, the liquid radwaste treatment system shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when projected doses due to the liquid effluent to unrestricted areas (see Figure E-4) would exceed 0.06 mrem to the Total Body or 0.2 mrem to any organ in a 31 day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above, prepare and submit to the Commission within 30 days a report that includes the following information:

   1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,

   2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

   3. Summary description of action(s) taken to prevent a recurrence.

b. The provisions of CONTROL 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.3.1 Doses due to liquid releases to unrestricted areas shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM Part II Section 1.5 in accordance with Technical Specifications 6.8.4.a.5.

4.11.1.3.2 The installed liquid radwaste treatment system shall be demonstrated OPERABLE by meeting CONTROLS 3.11.1.1, 3.11.1.2, and 3.11.1.3.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

CONTROLS

3.11.2.1 In accordance with the Oyster Creek Technical Specifications 6.8.4.a.5 and 7, the dose rate due to radioactive materials released in gaseous effluents in the unrestricted area (see Figure E-4) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and

b. For iodine-131, iodine-133, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any body organ.

APPLICABILITY: At all times.

ACTION:

a. With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

4.11.2.1.1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM Part II Section 2.3.1.

4.11.2.1.2 The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM Part II Section 2.3.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.11.2.1.2-1.

4.11.2.1.3 Dose rates due to tritium, Sr-89, Sr-90, and alpha-emitting radionuclides are averaged over no more than 3 months and the dose rate due to other radionuclides is averaged no more than 31 days.

TABLE 4.11.2.1.2-1: RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit Detection[a] (LLD) (μCi/ml)
Stack	Q Grab Sample[f]	Q	H-3	1E-06
	M Grab Sample c,f	M	Principal Gamma Emitters[b] (Noble Gases)	1E-04
	Continuous[f]	W Charcoal Sample	I-131	1E-12
			I-133	1E-10
	Continuous[f]	W Particulate Sample	Principal Gamma Emitters[b] (particulates)	1E-11
	Continuous[f]	M[e] Composite Particulate Sample	Gross Alpha	1E-11
	Continuous	Q[e] Composite Particulate Sample	Sr-89, Sr-90	1E-11
	Continuous	Noble Gas Monitor	Noble Gases Gamma Radioactivity	1E-06

TABLE 4.11.2.1.2-1 (Continued)

TABLE NOTATIONS

a. The Lower Limit of Detection (LLD) is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal.

The LLD is applicable to the capability of a measurement system under typical conditions and not as a limit for the measurement of a particular sample in the radioactive liquid waste sampling and analyses program.

For a particular measurement system which may include radiochemical separation:

$$LLD = \frac{4.66 * Sb}{E * V * 2.22\text{E}6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the lower limit of detection as defined above (microcurie per unit mass or volume),

S_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E is the counting efficiency,

V is the sample size (units of mass or volume),

2.22E+6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt is the elapsed time between the end of the sample collection and the time of counting.

Analyses shall be performed in such a manner that the stated LLD's will be achieved under routine conditions with typical values of E, V, Y, and t for the radionuclides Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, Cs-137, and Ce-141. Occasionally background fluctuations or other uncontrollable circumstances may render these LLD's unachievable.

When calculating the LLD for a radionuclide determined by gamma ray spectrometry, the background may include the typical contributions of other radionuclides normally present in the samples. The background count rate of a HPGe detector is determined from background counts that are determined to be within the full width of the specific energy band used for the quantitative analysis for that radionuclide

TABLE 4.11.2.1.2-1 (Continued)

TABLE NOTATIONS

b. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report consistent with CONTROL 3.11.2.1. The LLD for Mo-99 and Ce-144 is 1E-10 μCi/ml whereas the LLD for other principal gamma emitting particulates is 1E-11 μCi/ml. Radionuclides which are below the LLD for the analysis should not be reported.

c. The noble gas radionuclides in gaseous effluent may be identified by taking a grab sample of effluent and analyzing it.

e. A composite particulate sample shall include an equal fraction of at least one particulate sample collected during each week of the compositing period.

f. In the event a sample is collected for 24 hours or less, the LLD may be increased by a factor of 10.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.2 DOSE - NOBLE GASES

CONTROLS

3.11.2.2 In accordance with the Oyster Creek Technical Specification 6.8.4.a.5 and 8, the air dose due to noble gases released in gaseous effluents in the unrestricted area (see Figure E-4) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation and,

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

APPLICABILITY: At all times.

ACTION:

a. With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days from the end of the quarter during which the release occurred a report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the release and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.2 Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in the ODCM Part II Section 2.4.1 at least once per 31 days in accordance with Technical Specification 6.8.4.a.5.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.3 DOSE - IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

CONTROLS

3.11.2.3 In accordance with Oyster Creek Technical Specification 6.8.4.a.5 and 9, the dose to a member of the public from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released in the unrestricted area (see Figure E-4) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any body organ and,

b. During any calendar year: Less than or equal to 15 mrem to any body organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of iodine-131, iodine-133 and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days a report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.3 Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters in the ODCM Part II Section 2.5 at least once per 31 days in accordance with Technical Specification 6.8.4.a.5.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4.1 In accordance with Oyster Creek Technical Specifications 6.8.4.a.10, the annual (calendar year) dose commitment to any MEMBER OFTHE PUBLIC due to radioactive material in the effluent and direct radiation from the OCGS in the unrestricted area shall be limited to less than or equal to 75 mrem to the thyroid or less than or equal to 25 mrem to the total body or any other organ.

APPLICABILITY: At all times

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of CONTROLS 3.11.1.2a, 3.11.1.2b, 3.11.2.2a, 3.11.2.2b, 3.11.2.3a, or 3.11.2.3b, perform an assessment to determine whether the limits of CONTROL 3.11.4.1 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days a report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This report shall include information specified in 10CFR20.2203. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

b. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.4.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with SURVEILLANCE REQUIREMENT 4.11.1.2, 4.11.2.2, 4.11.2.3, and in accordance with the methodology and parameters in the ODCM Part II Section 3.0 at least once per year.

4.11.4.2 Cumulative dose contributions from direct radiation from the facility shall be determined in accordance with the methodology and parameters in the ODCM Part II Section 3.2. This requirement is applicable only under conditions set forth in CONTROL 3.11.4.1, ACTION a.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

3.12.1. In accordance with Oyster Creek Technical Specifications 6.8.4.b, the radiological environmental monitoring program shall be conducted as specified in Table 3.12.1-1. For specific sample locations see Table E-1. Revisions to the non-ODCM required portions of the program may be implemented at any time. Non-ODCM samples are those taken in addition to the minimum required samples listed in Table 3.12.1-1.

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table 3.12.1-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 6.9.1.b, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table 3.12.1-2 when averaged over any calendar quarter, prepare and submit to the Commission within 60 days of the end of the quarter a report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to a member of the public is less than the calendar year limits of CONTROLS 3.11.1.2, 3.11.2.2, and 3.11.2.3. When more than one of the radionuclides in Table 3.12.1-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots \geq 1.0$$

When radionuclides other than those in Table 3.12.1-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose* to a member of the public from all radionuclides is equal to or greater than the calendar year limits of CONTROLS 3.11.1.2, 3.11.2.2, and 3.11.2.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report pursuant to Section 6.1.2.1.

*The methodology used to estimate the potential annual dose to a member of the public shall be indicated in this report.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS (Continued)

ACTION: (Continued)

c. If garden vegetation samples are unobtainable due to any legitimate reason, it is NOT ACCEPTABLE to substitute vegetation from other sources. The missed sample will be documented in the annual report, with no further actions necessary. If a permanent sampling location becomes unavailable, follow Table 3.12.1-1 Table Notation (1) to replace the location.

d. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.1 The radiological environmental monitoring samples shall be collected pursuant to Table 3.12.1-1 from the specific locations given in Table E-1, and shall be analyzed pursuant to the requirements of Table 3.12.1-1, and the detection capabilities required by Table 4.12.1-1.

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTAIVE SAMPLES AND SAMPLE LOCATIONS[(1)]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. DIRECT RADIATION[(2)]	Routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations one in each meteorological sector in the general area of the site boundary (At least 16 locations); An outer ring of stations, one in each land-based meteorological sector in the approximately 6- to 8-km range from the site (At least 14 locations); and At least 8 stations to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Quarterly	Gamma dose quarterly

TABLE 3.12.1-1(Cont'd)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. AIRBORNE			
Radioiodine and Particulates	Samples from 5 locations: Three samples from close to the site boundary in different sectors of the highest calculated annual average ground-level D/Q One sample from the vicinity of a community having the highest calculated annual average ground-level D/Q; and One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction (6)	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading	Radioiodine Canister: I-131 analysis weekly Particulate Sampler Gross beta radioactivity analysis following filter change(3); Gamma isotopic analysis(4) of composites (by location) quarterly

TABLE 3.12.1-1(Cont'd)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
3. WATERBORNE			
a. Surface	One sample upstream One sample downstream	Grab sample weekly, Combine into monthly composite.	Gamma isotopic and tritium analysis(4)
b. Ground(5)	Samples from one or two sources if likely to be affected	Grab sample quarterly	Gamma isotopic and tritium analysis(4)
c. Drinking	1 sample of each of 1 to 3 of the nearest water supplies that could be affected by its discharge	Grab sample weekly, combine into a 2-week composite if I-131 analysis Is required; composite monthly otherwise	Gross beta, gamma isotopic and tritium analysis monthly (4)(7)
	One sample from a background location		
d. Sediment	One sample from downstream area with existing or potential recreational value	Semiannually	Gamma isotopic analysis(4) semiannually

TABLE 3.12.1-1(Cont'd)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
4. INGESTION			
a. Milk (6)	No milking animals	Semimonthly when on pasture;	Gamma isotopic (4) and Iodine -131
	If milk animals are identified: Samples from milking animals in three locations within 5km having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 5 an 8 km distant where doses are calculated to be greater than 1 mrem per year. One sample from milking animal at a control location 15 to 30 km distant and in the least prevalent wind direction	Monthly at other times	Semimonthly when animals are on pasture; monthly at other times

TABLE 3.12.1-1(Cont'd)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
b. Fish	One sample of available species consumed by man in plant discharge canal	Semiannually, when available	Gamma isotopic analysis (4) on edible portions
	One sample of available species consumed by man not influenced by plant discharge		
c. Clams	One sample of available species consumed by man within the influence of the facility discharge.	Semiannually, when available	Gamma isotopic analysis (4) on edible portions.
	One sample of available species consumed by man not influenced by plant discharge.		

TABLE 3.12.1-1(Cont'd)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
d. Vegetation (8)	3 samples of broad leaf vegetation grown nearest each of two different Offsite locations of highest predicted annual average combined elevated and ground level release D/Q One sample of each of the similar broad leaf vegetation grown at least 15 to 30 km (9.3-18.6 miles) distant in the least prevalent wind direction.	Monthly during growing season	Gamma isotopic analysis (4) and I-131 on edible portion.

TABLE 3.12.1-1 (Continued)

TABLE NOTATIONS

1 Specific parameters of distance and direction sector from the centerline of the reactor, and additional description where pertinent, are provided for each and every sample location in Table 3.12.1-1 and Table E-1. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment, and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.1.2.4. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable specific alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Program given in the ODCM. Pursuant to Technical specification 6.19, submit in the next Radioactive Effluent Release Report documentation for a change in the ODCM including revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for the pathway and justifying the selection of the new location(s) for obtaining samples. This applies to changes/deletions/additions of permanent sampling locations. This does not apply to one-time deviations from the sampling schedule. In those cases, it is NOT ACCEPTABLE to substitute sample media from other sources. The missed sample will be documented in the annual report, with no further actions necessary.

2 One or more instruments, such as pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. The number of direct radiation monitoring stations has been reduced from the NUREG 1302 recommendation due to geographical limitations; e.g., some sectors are over water and some sectors cannot be reached due to lack of highway access, therefore the number of dosimeters has been reduced accordingly.

3 Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

4 Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

5 Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination. Extensive studies of geology and groundwater in the vicinity of the OCGS (Reference 21 and 31) have demonstrated that there is no plausible pathway for effluents from the facility to contaminate offsite groundwater, including the local drinking water supplies. Samples of groundwater, including local drinking water wells, are collected in order to provide assurance to the public that these water resources are not impacted.

6 The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites which provide valid background data may be substituted .

7 I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year. If garden vegetation samples are unobtainable due to any legitimate reason (see (1) above), it is <u>NOT</u> ACCEPTABLE to substitute vegetation from other sources. The missed sample will be documented in the annual report, with no further actions necessary.

TABLE 3.12.1-2: REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES - REPORTING LEVELS

Analysis	Surface and Ground Water(pCi/l)	Airborne Particulate and Iodine (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Vegetation (pCi/Kg, wet)
H-3	20000*				
Mn-54	1000		30000		
Fe-59	400		10000		
Co-58	1000		30000		
Co-60	300		10000		
Zn-65	300		20000		
Zr-Nb-95	400				
I-131	2**	0.9		3	100
Cs-134	30	10	1000	60	1000
Cs-137	50	20	2000	70	2000
Ba-La-140	200			300	

*For drinking water samples (this is the 40 CFR Part 141 value).
If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

**If no drinking water pathway exists, a value of 20 pCi/L may be used.

TABLE 4.12.1-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS(1),(2) - LOWER LIMITS OF DETECTION (LLD) (3)

Analysis	Surface and Ground Water (pCi/l)	Air Particulate and Air Iodine (pCi/m^3)	Vegetation (pCi/Kg, wet)	Sediment (pCi/Kg, dry)	Fish, Clams and Crabs (pCi/Kg, wet)
Gross Beta	4	0.01			
H-3	2000(4)				
Mn-54	15				130
Fe-59	30				260
Co-58, 60	15				130
Zn-65	30				260
Zr-95	30				
Nb-95	15				
I-131	1(4)	0.07(5)	60		
Cs-134	15	0.05(6)	60	150	130
Cs-137	18	0.06(6)	80	180	150
La-140	15				
Ba-140	60(7)				

TABLE 4.12.1-1 (Continued)

TABLE NOTATIONS

1. This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.1.2.3.

2. Required detection capabilities for dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

3. The LLD is defined, for purposes of these CONTROLS as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

   For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 * Sb}{E * V * 2.22 * Y * \exp(-\lambda \Delta t)}$$

   Where:

   LLD is the "a priori" lower limit of detection as defined above, as picocuries per unit mass or volume,

   Sb is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute,

   E is the counting efficiency, as counts per disintegration,

   V is the sample size in units of mass or volume,

   2.22 is the number of disintegrations per minute per Pico curie,

   Y is the fractional radiochemical yield, when applicable,

   λ is the radioactive decay constant for the particular radionuclide (sec^{-1}), and

   Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting (sec).

   Typical values of E, V, Y, and Δt should be used in the calculation.

TABLE 4.12.1-1 (Continued)

TABLE NOTATIONS

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally, background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant Technical Specification 6.9.1.b and Control 6.1.2.6.4.

4. If no drinking water pathway exists, a value of 3000 pCi/L for tritium and 15 pCi/L for iodine-131 may be used.

5. For the air iodine sample

6. For the air particulate sample

7. Ba-140 and La-140 are in equilibrium

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.2 LAND USE CENSUS

CONTROLS

3.12.2 A land use census shall be conducted and shall identify within a distance of 5 miles the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden* of greater than 500 ft^2 producing broad leaf vegetation. The census shall also identify within a distance of 3 miles the location in each of the 16 meteorological sectors all milk animal and all gardens greater than 500 square feet producing broadleaf vegetation.

APPLICABILITY: At all times.

ACTION:

a. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in SURVEILLANCE REQUIREMENT 4.11.2.3, identify the new location(s) in the next Radioactive Effluent Release Report, pursuant to Control 6.2.2.4.

b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with CONTROL 3.12.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may then be deleted from this monitoring. Pursuant to CONTROL 6.2.2.4, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

c. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.2 The land use census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by door-to-door survey, visual survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.1.2.2.

*Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two different direction sectors with the highest predicted elevated release D/Q's in lieu of the garden census. Controls for broadleaf vegetation sampling in Table 3.12.1-1, Part 4.c shall be followed, including analysis of control samples.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROLS

3.12.3 Analyses shall be performed on radioactive materials supplied as part of an interlaboratory comparison program which has been approved by the Commission.

APPLICABILITY: At all times.

ACTION:

a. With analyses not being performed as required above, report the reason and corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.1.2.6.3.

b. The provisions of CONTROLS 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.3 A summary of the results obtained as part of the above-required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.1.2.6.3.

3 /4 .12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.4 METEOROLOGICAL MONITORING PROGRAM

CONTROLS

3.12.4 The meteorological monitoring instrumentation channels shown in Table 3.12.4.-1 shall be operable.

APPLICABILITY: At all times.

ACTION:

a. With less than the minimum required instrumentation channels OPERABLE for more than 7 days, initiate an Issue Report outlining the cause of the malfunction and the plans for restoring the instrumentation to OPERABLE status.

b. The provisions of CONTROLS 3.0.4 are not applicable.

TABLE 3.12.4-1

METEOROLOGICAL MONITORING INSTRUMENTATION

INSTRUMENT		ELEVATION	MINIMUM INSTRUMENT OPERABLE
1.	Wind Speed		
	a	380 feet	1
	b.	150 feet	1
	c.	33 feet	1
2.	Wind Direction		
	a.	380 feet	1
	b.	150 feet	1
	c.	33 feet	1
3.	ΔT		
	a.	380-33	1
	b.	150-33	1

BASES FOR SECTIONS 3.0 AND 4.0

CONTROLS AND SURVEILLANCE REQUIREMENTS

NOTE: The BASES contained in the succeeding pages summarize the reasons for the CONTROLS of Sections 3.0 and 4.0, but are not considered a part of these CONTROLS.

3/4.3 INSTRUMENTATION

BASES

3/4.3.3.10 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The reactor service water system discharge line radioactivity monitor initiates an alarm in the Control Room when the alarm set point is exceeded. The alarm/trip set points for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

3/4.3.3.11 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip set points for each of the noble gas monitors shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM. This will ensure the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The radioactive gas monitor for the stack effluent exhaust ventilation has an alarm which reports in the Reactor Control Room. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

3/4.11 RADIOACTIVE EFFLUENTS

BASES

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

This CONTROL is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to unrestricted areas will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in unrestricted areas will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a member of the public and (2) the limits of 10 CFR Part 20.106(a) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its concentration limit in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The value 1E-8 is the limit for unidentified gross gamma or beta releases as per 10 CFR 20 Appendix B, Table 2, Column 2 "any single radionuclide... other than alpha or spontaneous fission ... half life greater than 2 hours". This provides operational flexibility while providing reasonable assurance that dose will remain less than 0.1 rem/yr.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in references 25, 26, and 27.

Weekly grab samples for Service Water Effluent are composited for monthly tritium and gross alpha analysis and quarterly Sr-89/90 and Fe-55 analysis if activity is detected.

While discharging groundwater via the continuous release pathway, the grab sample will be analyzed quarterly for principal gamma emitters and tritium. A quarterly grab sample is analyzed for gross alpha, Sr-89/90, Fe-55, and Ni-63.

While discharging groundwater via the batch release mode pathway, a grab sample is collected from each tank and analyzed for principal gamma emitters and tritium, a composite sample is analyzed quarterly for gross alpha, Sr-89/90, Fe-55, and Ni-63.

Circulating Water Effluent is not included in Table 4.11.1.1.1-1, Radioactive Liquid Waste Sampling and Analysis Program since the Circulating Water is sampled as part of the Radiological Environmental Monitoring Program, Table 3.12.1-1, 3a, Waterborne, Surface downstream sample.

3/4.11.1.2 DOSE

This CONTROL is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. The CONTROL implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to unrestricted areas will be kept "as low as is reasonably achievable." The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109 and Regulatory Guide 1.113.

3/4.11.1.3 LIQUID RADWASTE TREATMENT

The OPERABILITY of a liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to their release to the environment. The requirement that the appropriate portions of this system be used, when specified, provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable". This CONTROL implements the requirements of General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents. Figure D-1-1a, Liquid Radwaste Treatment Chem Waste and Floor Drain System and Figure D-1-1b, Liquid Radwaste Treatment – High Purity and Equipment Drain System provides details of the Liquid Radwaste Treatment system.

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

This CONTROL is provided to ensure that the dose at any time at and beyond the site boundary from gaseous effluents will be within the annual dose limits of 10 CFR Part 20 to unrestricted areas. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table 2, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a member of the public in an unrestricted area either within or outside the site boundary, to annual average concentrations exceeding the limits specified in Appendix B, Table 2 of 10 CFR Part 20. For members of the public who may at times be within the site boundary, the occupancy of the individual will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary. Examples of calculations for such members of the public with the appropriate occupancy factors shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a member of the public at or beyond the site boundary to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/yr to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in references 25, 26 and 27.

Tritium is sampled quarterly for gaseous effluents. Based on the consistency of the data from the quarterly sampling, the sampling frequency is adequate.

3/4.11.2.2 DOSE - NOBLE GASES

This CONTROL is provided to implement the requirements of Section II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROL implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable." The SURVEILLANCE REQUIREMENTS implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109 and Regulatory Guide 1.111. The ODCM equations provided for determining the air doses at and beyond the site boundary are based upon the historical average atmospheric conditions.

3/4.11.2.3 DOSE - IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

This CONTROL is provided to implement the requirements of Section II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROLS are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to unrestricted areas will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in SURVEILLANCE REQUIREMENTS implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, and Regulatory Guide 1.111. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate controls for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-life greater than 8 days are dependent on the existing radionuclide pathways to man, in the areas at and beyond the site boundary. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

3/4.11.4 TOTAL DOSE

This CONTROL is provided to meet the dose limitations of 40 CFR Part 190 that have now been incorporated into 10 CFR Part 20 by 46 FR 18525. The CONTROL requires the preparation and submittal of a report whenever the calculated doses from plant radioactive effluents exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. It is highly unlikely that the resultant dose to a member of the public will exceed the dose limits of 40 CFR Part 190 if the doses remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the unit, including outside storage no, etc. are kept small. The report will describe a course of action that should result in the limitation of the annual dose to a member of the public to within the 40 CFR Part 190 limits. For purposes of the report, it may be assumed that the dose commitment to the member of the public from other uranium fuel cycle sources is negligible. If the dose to any member of the public is estimated to exceed the requirements of 40 CFR Part 190, the report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR Part 190 and 10 CFR Part 20, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in CONTROLS 3.11.1.1 and 3.11.2.1. An individual is not considered a member of the public during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

BASES

3/4.12.1 MONITORING PROGRAM

The radiological environmental monitoring program required by this CONTROL provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of members of the public resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Position on Environmental Monitoring, Revision 1, November 1979.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 4.12.1-1 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD, and other detection limits in references 25, 26, and 27.

Site-specific research, which included the installation of a groundwater monitoring well network, has demonstrated that the groundwater pathway is not a potential pathway to man from the OCGS. The surface water into which the OCGS discharges is a marine estuary containing saline water that is not used as drinking water or irrigation water by man.

3/4.12.2 LAND USE CENSUS

This CONTROL is provided to ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey, from visual survey or consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 (500 ft^2) provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: 1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and 2) a vegetation yield of 2 kg/m^2.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

BASES

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

The requirement for participation in an approved Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.5.0

5.0 DESIGN FEATURES / SITE MAP

5.1 Site map which will allow identification of structures and release points shall be as shown in Figure E-4.

6.0 ADMINISTRATIVE CONTROLS

6.1 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)

6.1.1 In accordance with Oyster Creek Technical Specifications 6.9.1.b, a routine radiological environmental operating report covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of the following year.

6.1.2 The Annual Radiological Environmental Operating Reports shall include:

6.1.2.1 Summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities (Radiological Environmental Monitoring Program – REMP) for the report period. This will include a comparison with preoperational studies, with operational controls (as appropriate), and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment.

6.1.2.2 The reports shall also include the results of land use censuses required by CONTROL 3.12.2. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

6.1.2.3 The Annual Radiological Environmental Operating Reports shall include summarized and tabulated results similar in format to that in Regulatory Guide 4.8, December 1975 of all the radiological environmental samples taken during the report period.

6.1.2.4 Deviations from the sampling program identified in CONTROL 3.12.1 shall be reported.

6.1.2.5 In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

6.1.2.6 The reports shall also include the following:

a. A summary description of the radiological environmental monitoring Program;

b. Map(s), covering sampling locations, keyed to a table giving distances and directions from the reactor;

c. The results of licensee participation in the Interlaboratory Comparison Program, as required by CONTROL 3.12.3;

d. Identification of environmental samples analyzed when the analysis instrumentation was not capable of meeting the detection capabilities in Table 4.12.1-1.

6.2 ANNUAL ROUTINE RADIOACTIVE EFFLUENT RELEASE REPORT (ARERR)

6.2.1 Routine radioactive effluent release reports covering the operation of the unit shall be submitted prior to May 1 of each year and in accordance with the requirements of 10CFR50.36a and section IV.B.1 of 10CFR 50 Appendix I.

6.2.2 The Radioactive Effluent Release Report shall include:

6.2.2.1 A summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21. "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof.

6.2.2.2 An annual summary of hourly meteorological data collected over the previous year. This annual summary may be in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. Alternatively, summary meteorological data may be retained and made available to the NRC upon request.

6.2.2.3 An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. The historical annual average meteorology or the meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents (as determined by sampling frequency and measurement) shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with this OFFSITE DOSE CALCULATION MANUAL (ODCM).

6.2.2.4 Identify those radiological environmental sample parameters and locations where it is not possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In addition, the cause of the unavailability of samples for the pathway and the new location(s) for obtaining replacement samples should be identified. The report should also include a revised figure(s) and table(s) for the ODCM reflecting the new location(s).

6.2.2.5 An assessment of radiation doses to the likely most exposed member of the public from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation. The assessment of radiation doses shall be performed in accordance with this ODCM Part II Sections 1.5, 2.4, 2.5 and 3.2.

6.2.2.6 The Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped Offsite during the report period (see Figure D-1-2):

a. Total volume shipped,

b. Total curie quantity (specify whether determined by measurement or estimate),

c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Type of waste (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms).

6.2.2.7 Unplanned releases from the site to unrestricted areas of radioactive materials in gaseous and liquid effluents on a quarterly basis.

6.2.2.8 Changes to the PROCESS CONTROL PROGRAM (PCP).

6.2.2.9 Changes to the ODCM in the form of a complete, legible copy of the ODCM.

6.3 RESPONSIBILITIES:

6.3.1 Chemistry / Radwaste - Responsible for:

6.3.1.1 Implementing approval.

6.3.1.2 Compliance with specifications regarding routine dose assessment.

6.3.1.3 Radiological Environmental Monitoring Program

6.3.1.4 Technical consultation and review

6.3.2 Operations - Responsible for compliance with specifications regarding operation of the OCGS.

6.3.3 Engineering - Responsible for compliance with specifications regarding set point determination and implementation

6.3.4 Radiological Engineering - Responsible for technical consultation and review.

PART II - CALCULATIONAL METHODOLOGIES

1.0 LIQUID EFFLUENTS

1.1 RADIATION MONITORING INSTRUMENTATION AND CONTROLS

The liquid effluent monitoring instrumentation and controls at Oyster Creek for controlling and monitoring normal radioactive material releases in accordance with the Oyster Creek Radiological Effluent Technical Specifications are summarized as follows:

Reactor Building Service Water Effluent - The Reactor Building Service Water Effluent Line Monitor provides an alarm function only for releases into the environment.

Liquid radioactive waste flow diagrams are presented in Figures D-1-1a, D-1-1b, and D-1-1c.

1.2 LIQUID EFFLUENT MONITOR SET POINT DETERMINATION

Per the requirements of CONTROL 3.3.3.10, alarm set points shall be established for the liquid monitoring instrumentation to ensure that the release concentration limits of CONTROL 3.11.1.1 are met (i.e., the concentration of radioactive material released in liquid effluents to unrestricted areas at the U.S. route 9 bridge over the discharge canal shall not exceed the concentrations specified in 10 CFR 20 Appendix B Table 2, Column 2, for radionuclides and 2E-04 μCi/ml for dissolved or entrained noble gases).

1.2.1 LIQUID EFFLUENT MONITORS

The set points for the liquid effluent monitors at the Oyster Creek Generating Station are determined by the following equation:

$$S = \frac{A}{FLEC} g \frac{F2}{F1} + BKG$$

Where:

S = radiation monitor alarm set point (cpm)

A = activity concentration (μCi/ml) of sample in laboratory: $A = \Sigma C_i$

g = the primary conversion factor for the instrument – the ratio of effluent radiation monitor counting rate to laboratory activity concentration in a sample of liquid (cpm per μCi/mL).

F_1 = flow in the batch release line (e.g. gal/min). Value not greater than the discharge line flow alarm maximum set point.

F_2 = flow in the discharge canal (e.g. gal/min). Value not less than the discharge canal minimum flow.

BKG = Monitoring instrument background (cpm)

FLEC = fraction or multiple of unrestricted area LEC in aqueous effluent based on sample analysis. FLEC is the ratio between the LECi and Ci. FLEC is unitless. For example: LEC for Co-60 is 3E-6 μCi/mL. If the concentration in an expected release is 6E-6 μCi/mL; then FLEC is 6E-6/3E-6 = 2.

The term $\frac{A}{FLEC}$ represents the count rate of a solution having the same nuclide distribution as the sample and the LEC of that mixture.

Ci = concentration of radionuclide i in effluent, i.e., in a liquid radwaste sample tank, in reactor building service water (μCi/mL).

LEC_i = the unrestricted area liquid effluent concentration (LEC) of radionuclide i, i.e., 10 CFR 20, Appendix B, Table 2, Column 2 quantity for radionuclide i (μCi/mL).

In the event gross radioactivity analysis alone is used to determine the radioactivity in an effluent stream or batch, FLEC is C/1E-8 (see 4.11.1.1.1),

Where:

C = the gross radioactivity concentration in effluent (μCi/mL).

1E-8 = the unrestricted area LEC for unidentified radionuclides (μCi/mL) from 4.11.1.1.1.

If the gross activity concentration, C, is below the lower limit of detection for gross activity, the value, 1E-8 μCi/mL, or the equivalent counting rate (cpm/mL) may be substituted for the factor $\frac{A}{FLEC}$

$$\frac{A}{FLEC} = 1\text{E-8 } \mu\text{Ci/mL}$$

1.2.2 SAMPLE RESULT SET POINTS

Usually, when the concentration of specific radionuclides is determinable in a sample(s), i.e., greater than the LLD, the alarm/trip set point of each liquid effluent radioactivity monitor is based upon the measurement of radioactive material in a batch of liquid to be released or in a continuous aqueous discharge.

1.2.3 ASSUMED DISTRIBUTION SET POINTS

Alternatively, a radionuclide distribution that represents the distribution expected to be in the effluent if the concentration were high enough to be detectable, i.e., greater than the LLD, may be assumed. The representative distribution may be based upon past measurements of the effluent stream or upon a computed distribution.

1.3 BATCH RELEASES

A sample of each batch of liquid radwaste is analyzed for I-131 and other principal gamma emitters or for gross beta or gross gamma activity before release. The result of the analyses are used to calculate the total activity released or the trip set point of the radioactivity monitor on the liquid radwaste effluent line to apply to release of the batch.

1.4 CONTINUOUS RELEASES

The Reactor Building Service Water Effluent is sampled and analyzed weekly for I-131, other principal gamma emitters. Results of analyses for the preceding week or for a period as long as the preceding 3 months are used to calculate the alarm/trip set point of the corresponding effluent radioactivity monitor in order to determine a representative value. In each case, whether batch or continuous, the monitor alarm/trip set point may be set at lower activity concentration than the calculated set point.

1.5 LIQUID EFFLUENT DOSE CALCULATION - 10 CFR 50

Doses resulting from the release of radioiodines and particulates must be calculated to show compliance with Appendix I of 10CFR50. Calculations will be performed at least monthly for all liquid effluents as stated in SURVEILLANCE REQUIREMENT 4.11.1.2 and SURVEILLANCE REQUIREMENT 4.11.1.3.1 to verify that the dose to members of the public is maintained below the limits specified in CONTROL 3.11.1.2

The maximum dose to an individual from radioiodines, tritium, and radioactive particulates with half-lives of greater than eight days in liquid effluents released to unrestricted areas is determined as described in Reg. Guide 1.109. Environmental pathways that radioiodine, tritium, and particulates in liquid effluent follow to the maximally exposed member of the public are assumed to be: exposure to shoreline deposits, ingestion of fish, and ingestion of shellfish. To assess compliance with CONTROL 3.11.1.2, the dose due to radioactive iodine, tritium, and particulates in liquid effluent is calculated to a person at the Route 9 bridge who consumes fish and shellfish harvested at that location.

1.5.1 MEMBER OF THE PUBLIC DOSE - LIQUID EFFLUENTS

CONTROL 3.11.1.2 limits the dose or dose commitment to members of the public from radioactive materials in liquid effluents from Oyster Creek Generating Station to those listed in Table 1.5.1-1.

TABLE 1.5.1-1 LIQUID PATHWAY DOSE LIMITS

During Any Calendar Quarter	During Any Calendar Year
≤ 1.5 mrem to total body	≤ 3.0 mrem to total body
≤ 5.0 mrem to any organ	≤ 10.0 mrem to any organ

Per the SURVEILLANCE REQUIREMENTS of 4.11.1.2, the following calculation methods shall be used for determining the dose or dose commitment due to the liquid radioactive effluents from Oyster Creek. Applicable liquid pathways to man for Oyster Creek include shoreline exposure, and ingestion of saltwater fish and shellfish. The receptor location is provided in Table A-4.

1.5.2 SHORELINE DEPOSIT DOSE

The shoreline exposure pathway dose is calculated generally in the form (based on Reg. Guide 1.109):

$$Rapj = 110000\frac{UapWM}{F}\sum_{i} QiTiDaipj(1-\exp(-\lambda iTb))$$

Where:

110000 = a conversion factor to convert from Ci y^{-1} ft^3 s^{-1} to pCi L^{-1} and account for a proportionality constant used in the sediment radioactivity model (100 L m^{-2} d^{-1})

Rapj = the annual dose to organ j (including the total body), through pathway p, to age group a

Uap = the age dependent usage factor for the specific pathway. Usage factors for shoreline exposure are residence time on the shoreline (h y^{-1}). Usage factors are provided in Reg. Guide 1.109 Table E-5. Usage factors specifically selected for Oyster Creek are presented in Table B-1.

W = the shore width factor. This adjusts the infinite plane gamma or beta dose factors for the finite size and shape of the shoreline. A factor of 0.1 is used for the discharge canal bank.

M = the recirculation factor of 1.2 to account for recirculation of discharge water back into the intake.

F = the flow rate in the discharge canal (ft^3 s^{-1})

Qi = the activity of the ith isotope in the release in curies

Ti = the half life of the ith isotope in days

Daipj = the age a, isotope i, pathway p, and organ j, specific dose conversion factor. Pathway, isotope, age, and organ specific dose factors are obtained from Regulatory Guide 1.109 Appendix E, Tables E-6 through E-14 (mrem h^{-1} pCi^{-1} m^2)

λi = the decay constant of the ith isotope in years

Tb = the long term buildup time, assumed to be 30 years

Note: λi and Tb can use any time units as long as they are both the same. No transit delay (Tp from Reg. Guide 1.109) is assumed.

1.5.3 SHORELINE DOSE EXAMPLE

Dilution flow rate is 5,000 gpm = 11.14 $ft^3\ s^{-1}$
Discharge 30,000 gal of water at 4.20 x 10^{-8} $\mu Ci\ mL^{-1}$ ^{60}Co
Calculate teen shoreline whole body dose

Uap	≡	67 hour in a year (teenager)
F	≡	5,000 gpm = 11.14 $ft^3\ s^{-1}$
Qi	≡	4.20 x 10^{-8} $\mu Ci\ mL^{-1}$ x 30,000 gal x 3.785 x 10^3 mL gal^{-1} x 10^{-6} Ci μCi^{-1} = 4.77 x 10^{-6} Ci
Ti	≡	5.271 y x 365.25 d y^{-1} = 1.93 x 10^3 d
Daipj	≡	1.70 x 10^{-8} mrem h^{-1} pCi^{-1} m^2 (Regulatory Guide 1.109 Table E-6)
$1\text{-}exp^{(-liTb)}$	≡	$(1 - exp^{(-0.131 \times 30)})$= 0.98

$$Rapj = 110000 \frac{67\ x\ 0.1\ x\ 1.2}{11.14} \sum_{i}^{n} 4.77\ x\ 10 - 6\ x\ 1930\ x\ 1.70\ x\ 10 - 8\ x\ 0.98)$$

Rapj = 1.2 x 10^{-5} mrem teen shoreline whole body dose

1.5.4 INGESTION DOSE - LIQUID

Ingestion dose pathway calculations are like those for the shoreline dose, with minor changes in constants, removal of the shore width factor, and inclusion of the bioaccumulation factor:

$$Rapj = 1100 \frac{UapM}{F} \sum_{i} QiBipDaipj$$

Where:

Bip = the stable element bioaccumulation factor for pathway p for the ith isotope (pCi kg^{-1} pCi^{-1} L)

No transit delay is assumed

Pathway, isotope, age, and organ specific dose factors are obtained from Regulatory Guide 1.109 Appendix E Tables E-7 through E-14. Bioaccumulation factors are provided in Reg. Guide 1.109 Table A-1. Usage factors are provided in Reg. Guide 1.109 Table E-5. Usage factors specifically selected for Oyster Creek are presented in Table B-1.

The radionuclides included in the periodic dose assessment per the requirements of CONTROL 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of CONTROL 3/4.11.1.1, Table 4.11.1.1.1-1.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of Table 4.11.1.1.1-1.

1.5.5 INGESTION DOSE CALCULATION EXAMPLE

Dilution flow rate is 5,000 gpm = 11.14 $ft^3\ s^{-1}$
Discharge 30,000 gal of water at 4.20 x 10^{-8} µCi mL^{-1} ^{60}Co
Calculate adult GI-LLI dose from saltwater fish ingestion

Uap	≡	21 kg y^{-1} (adult)
F	≡	5,000 gpm = 11.14 $ft^3\ s^{-1}$
Qi	≡	4.20 x 10^{-8} µCi mL^{-1} x 30,000 gal x 3.785 x 10^3 mL gal^{-1} x 10^{-6} Ci μCi^{-1}
		= 4.77 x 10^{-6} Ci
Bip	≡	100 pCi kg^{-1} pCi^{-1} L (Regulatory Guide 1.109 Table A-1)
Daipj	≡	4.02 x 10^{-5} mrem pCi^{-1} (Regulatory Guide 1.109 Table E-11)

$$Rapj = 1100\frac{21\ x\ 1.2}{11.14}\sum_{i}^{n} 4.77\ x\ 10-6\ x\ 100\ x\ 4.02\ x\ 10-5$$

Rapj = 4.8 x 10^{-5} mrem adult GI-LLI dose from saltwater fish ingestion

1.5.6 PROJECTED DOSE – LIQUID

The projected doses in a 31 day period are equal to the calculated doses from the current 31 day period.

1.6 REPRESENTATIVE SAMPLES

A sample should be representative of the bulk stream or volume of effluent from which it is taken. Prior to sampling, large volumes of liquid waste should be mixed in as short a time interval as practicable to assure that any sediments or particulate solids are distributed uniformly in the waste mixture. Recirculation pumps for liquid waste tanks (collection or sample test tanks) should be capable of recirculating at a rate of not less than two tank volumes in eight hours. Minimum recirculation times and methods of recirculation are controlled by specific plant procedures.

2.0 GASEOUS EFFLUENTS

2.1 RADIATION MONITORING INSTRUMENTATION AND CONTROLS

The gaseous effluent monitoring instrumentation and controls at Oyster Creek for controlling and monitoring normal radioactive material releases in accordance with the Radiological Effluent CONTROLS are summarized as follows:

(1) Main Stack

The main stack receives normal ventilation flow from the reactor building, new radwaste, old radwaste, and normal ventilation flow from portions of the turbine building. Reactor building and turbine building flow is not normally processed or filtered. Reactor Building flow may be directed through the Standby Gas Treatment System (SBGTS) which has particulate and charcoal filtration. Flow from the 'new' and 'old' radwaste buildings is HEPA filtered. Releases through the main stack are monitored for noble gases using the RAGEMS I system and sampled for iodine, particulates and tritium. The plant stack is an elevated release point.

Gaseous radioactive waste flow diagram is presented in Figure D-2-2.

2.2 GASEOUS EFFLUENT MONITOR SET POINT DETERMINATION

2.2.1 PLANT VENT

Per the requirements of CONTROL 3.3.3.11, alarm set points shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed the limits of CONTROL 3.11.2.1, which corresponds to a dose rate at the site boundary of 500 mrem/year to the total body or 3000 mrem/year to the skin. Based on a grab sample analysis of the applicable release (e.g., of the Stack), the radiation monitoring alarm set points may be established by the following calculation methods. A set point of a monitor of an elevated release, e.g., from the stack, may be calculated using the equation:

$$S = 1.06\left(\frac{h}{f}\right)\frac{\sum Ci}{\sum (CiDFSi)} + Bkg$$

Where:

S = the alarm set point (cpm)

h = primary conversion factor of the instrument - monitor response to activity concentration of effluent being monitored, cpm/(μCi/cm³). Each monitoring channel has a unique response, h, which is determined by the instrument calibration.

Ci = relative concentration of noble gas radionuclide i in effluent at the point of monitoring (μCi/cm³)

1.06 = 500 mrem/year /472 (conversion of cfm to cc/sec)

DFSi = factor converting elevated release rate of radionuclide i to total body dose equivalent rate at the location of potential exposure. Units are: mrem/(yr(μCi/sec)). From Table A-1.

f = flow of gaseous effluent stream being monitored, i.e., stack flow, vent flow, etc. (ft³/min)

BKG = Monitoring instrument background (cpm or mR/hr)

2.2.2 OTHER RELEASE POINTS

The set point of a monitor of a ground-level or vent release may be calculated with the equation:

$$S = 1.06\left(\frac{h}{f\frac{X}{Q}}\right)\frac{\sum Ci}{\sum(CiDFVi)} + Bkg$$

Where:

DFVi = factor converting ground-level or vent release of radionuclide i to the total body dose equivalent rate at the location of potential exposure. Units are: mrem-m^3/μCi-year From Table A-1.

X/Q = atmospheric dispersion from point of ground-level or vent release to the location of potential exposure (sec/m^3) from Table 2.2.2-1.

The atmospheric dispersion, X/Q, and the dose conversion factor, DFSi, depend upon local conditions. For the purpose of calculating radioactive noble gas effluent monitor alarm set points appropriate for the OCGS, the locations of maximum potential Offsite exposure and the reference atmospheric dispersion factors applicable to the derivation of set points are given in Table 2.2.2-1.

Symbols for this equation were defined in Section 2.2.1.

TABLE 2.2.2-1 RECEPTOR LOCATIONS AND DISPERSION FOR GASEOUS MONITOR SET POINTS

Discharge Point	Receptor Location		Atm. Dispersion
	Sector	Distance(m)	(sec/m^3)
Ground-level or vent	ENE	338	4.59 E-5
Stack	SW	229	N/A

2.2.3 RADIONUCLIDE MIX FOR SET POINTS

For the purpose of deriving a set point, the distribution of radioactive noble gases in an effluent stream may be determined in one of the following ways:

2.2.3.1 Preferably, the radionuclide distribution is obtained by gamma isotopic analysis of identifiable noble gases in effluent gas samples. Results of the analyses of one or more samples may be averaged to obtain a representative spectrum.

2.2.3.2 In the event a representative distribution is unobtainable from recent measurements by the radioactive gaseous waste sampling and analysis program, it may be based upon past measurements.

2.2.3.3 Alternatively, the total activity concentration of radioactive noble gases may be assumed to be Xenon-133 as found in Reg Guide 1.97.

2.3 GASEOUS EFFLUENT INSTANTANEOUS DOSE RATE CALCULATIONS - 10 CFR 20

2.3.1 SITE BOUNDARY DOSE RATE - NOBLE GASES

CONTROL 3.11.2.la limits the dose rate at the site boundary due to noble gas releases to $\leq$ 500 mrem/yr, total body and $\leq$ 3000 mrem/yr, skin. Radiation monitor alarm set points are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in an alarm set point (as determined in Section 2.2) being exceeded, an evaluation of the site boundary dose rate resulting from the release shall be performed.

2.3.1.1 TOTAL BODY DOSE RATE

The total body dose equivalent rate from radioactive noble gases discharged from an elevated point (stack above building wake) is calculated with the equation:

$$DG = \sum_i QiP\gamma Si$$

From a ground-level release (building vent) the total body dose equivalent rate is:

$$DG = \frac{X}{Qv}\sum_i QiP\gamma Vi$$

Where:

DG = total body dose equivalent rate due to irradiation by radioactive noble gas (mrem/hr)

Qi = average discharge rate of noble gas radionuclide i released during the averaging time (μCi/hr)

PγVi = factor converting time integrated ground-level concentration of noble gas nuclide i to total body dose $\frac{\text{mrem} - \text{m}^3}{\mu\text{Ci} - \text{sec}}$. See Table A-2.

$\frac{X}{Qv}$ = atmospheric dispersion factor from the OCGS to the Offsite location of interest (sec/m^3) from Table 2.3.1.3-1

PγSi = factor converting unit noble gas nuclide i stack release to total body dose at ground level received outdoors from the overhead plume (mrem/μCi). See Table A-2

The noble gas plume gamma-to-total body dose factors, PγSi at designated locations are derived from meteorological dispersion data with the USNRC RABFIN software computer code or similar computer program implementing Reg Guide 1.109, Appendix B. The noble gas semi-infinite cloud gamma-to-total body dose factors, PγVi, are derived from Reg Guide 1.109, Revision 1, Table B-1, Column 5.

2.3.1.2 EXAMPLE TOTAL BODY DOSE RATE

Calculate the dose from a release of 100 Ci of Xe-133 in 1 hour from a ground level release

$$DG = \frac{X}{Qv} \sum_i QiP\gamma Vi$$

X/Qv = 4.59E-5 sec/m3 (Table 2.3.1.3-1)
Qi = 1E8 μCi/hr [100Ci*1E6 μCi/Ci]
PγVi = 9.33E-6 mrem-m³ / μCi-sec

$$DG = 4.59E-5 \sum_i 1E8 * 9.33E-6$$

$$DG = 0.043 \quad mrem/hr$$

2.3.1.3 SKIN DOSE RATE

The dose equivalent rate to skin from radioactive noble gases is calculated by assuming a person at ground level is immersed in and irradiated by a semi-infinite cloud of the noble gases originating in airborne effluent. It is calculated for each air effluent discharge point with the equation:

$$DB = \frac{X}{Q} \sum_i Qi(SBi + 1.11A\gamma Vi)$$

where:

DB = dose rate to skin from radioactive noble gases (mrem/hr)

$\frac{X}{Q}$ = Atmospheric dispersions from gaseous effluent discharge point to ground-level location of interest (sec/m³) from Table 2.3.1.3-1.

Q_i = discharge rate of noble gas radionuclide i (μCi/hr)

SBi = factor converting time integrated ground-level concentration of noble gas radionuclide i to skin dose from beta radiation $\frac{mrem - m^3}{\mu Ci * sec}$ from Table A-2.

AγVi = factor for converting time integrated, semi-infinite concentration of noble gas radionuclide i to air dose from its gamma $\frac{mrad - m^3}{\mu Ci * sec}$ from Table A-2.

The noble gas beta radiation-to-skin-dose factors, SB_i and the noble gas gamma-to-air dose factors, $A\gamma V_i$, are derived from Reg Guide 1.109, Revision 1, Table B-1, columns 3 and 4 respectively. A tabulation of these factors used to compute noble gas-to-dose equivalent rate at 338 meters ENE for ground-level or vent and 544 meters SE for stack from the OCGS is in Table A-2.

The dose equivalent rate is calculated with the meteorological dispersion data given in Table 2.3.1.3-1.

TABLE 2.3.1.3-1 RECEPTOR LOCATIONS AND DISPERSION FOR SITE BOUNDARY DOSE RATES

Discharge Point	Receptor Location Sector	Receptor Location Distance (m)	Atm. Dispersion (sec/m^3)
Ground Level or Vent	ENE	338	4.59 E-5
Stack	SE	544	1.05 E-8

Alternatively, an approved computer code (e.g., "SEEDS" or "Open EMS") that implements the requirements of Regulatory Guide 1.109 may be used.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented above may be used for evaluating the gaseous effluent dose rate.

2.3.1.4 EXAMPLE SKIN DOSE RATE

Calculate the skin dose from a release of 100 Ci of Xe133 in 1 hour from a ground level release:

$$DB = \frac{X}{Q}\sum_i Qi(SBi + 1.11A\gamma Vi)$$

X/Q	= 4.59 E-5 sec/m3
Qi	= 1E8 μCi/hr
SBi	= 9.71E-6 mrem/μCi/ m3/sec
AγVi	= 1.12E-5 mrad/yr per μCi/m^3

$$DB = 4.59E-5\sum_i 1E8(9.71E-6+1.11*1.12E-5)$$

$$DB = 0.102 mrad / hr$$

2.3.2 SITE BOUNDARY DOSE RATE - RADIOIODINE AND PARTICULATES

2.3.2.1 METHOD - SITE BOUNDARY DOSE RATE - RADIOIODINE AND PARTICULATES

The dose rate Offsite due to the airborne release of I-131, I-133, tritium, and particulates with half-lives greater than 8 days is limited to no more than 1500 mrem/yr to any organ in CONTROL 3.11.2.1b. Evaluation of compliance with CONTROL 3.11.2.1b is based on the sampling and analyses specified in TABLE 4.11.2.1.2-1. Since the dose rate cannot be resolved within less than the sample integration or compositing time, the contribution of each radionuclide to the calculated dose rate will be averaged no more than 3 months for H-3, Sr-89, Sr-90, and alpha-emitting radionuclides and no more than 31 days for other radionuclides. These are their usual sample integration or compositing times. The equation used to assess compliance of radioiodine, tritium, and radioactive particulate releases with the dose rate limit is:

$$DRp = 1E6\sum_{e}\sum_{i}^{n} RaDFAijaQei\frac{\overline{X}}{Qe}$$

Where:

1E6 = conversion pCi/μCi

DR_p = the average dose rate to an organ via exposure pathway, p (mrem/yr).

DFAija = inhalation dose factors due to intake of radionuclide i, to organ j age group a (mrem/pCi) from Reg. Guide 1.109 Appendix E.

Ra = age group dependent inhalation respiratory rate (usage factor) m^3/yr from Table B-1

$\frac{\overline{X}}{Qe}$ = annual average relative airborne concentration at an Offsite location due to a release from either the Stack or a vent, i.e. release point, e (sec/m^3) from Table 2.3.2.1-1.

Q_{ei} = release rate of radionuclide i from release point, e during the period of interest (μCi/sec).

For real-time meteorology and on an annual average basis, the location of the maximum ground-level concentration originating from a vent release will differ from the maximum ground-level concentration from a stack release. When assessing compliance with CONTROL 3.11.2.1b for tritium, iodine, and particulate, the air dispersion (X/Q) values are provided in Table 2.3.2.1-1.

TABLE 2.3.2.1-1 LOCATION OF MAXIMUM EXPOSURE RE BY INHALATION

Discharge Point	Receptor Location		Atm. Dispersion
	Sector	Distance (m)	(sec/m3)
Ground Level or Vent	ENE	338	4.59 E-5
Stack	SE	937	1.25 E-8

Alternatively, inhalation exposure to effluent from the stack may be evaluated at the closest hypothetical individual located at:

Stack	SE	805	1.29 E-8

Alternatively, an approved computer code (e.g., "SEEDS" or "Open EMS") that implements the methods of Regulatory Guide 1.109, may be used.

2.3.2.2 EXAMPLE IODINE AND PARTICULATES DOSE RATE CALCULATION

Calculate the child thyroid dose rate from a release of 100 μCi/hr of I-131 from a ground level release:

$$DRp = 1E6\sum_{e}\sum_{i}^{n} RaDFAijaQei\frac{\overline{X}}{Qe}$$

Ra = 3700 m^3/yr
DFAija = 4.39E-3 mrem/pCi
Qei = 0.028 μCi/sec [100μCi/hr /3600 sec/hr = 0.02778]
X/Qe = 4.59 E-5 sec/m^3

$$DRp = 1E6\sum_{i}^{n} 3700 * 4.39E-3 * 0.028 * 4.59E-5$$

$$DRp = 20.9 mrem / yr$$

2.4 NOBLE GAS EFFLUENT DOSE CALCULATIONS - 10 CFR 50

Doses resulting from the release of noble gases must be calculated to show compliance with Appendix I of 10CFR50. Calculations will be performed at least monthly for all gaseous effluents as stated in SURVEILLANCE REQUIREMENT 4.11.2.2 to verify that the dose to air is kept below the limits specified in CONTROL 3.11.2.2 and the dose to members of the public is maintained below the limits specified in CONTROL 3.11.2.3.

2.4.1 UNRESTRICTED AREA DOSE - NOBLE GASES

CONTROL 3.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly air dose limits shown in Table 2.4.1-1.

TABLE 2.4.1-1 ANNUAL AIR DOSE LIMITS

During any calendar quarter	During any calendar year
≤ 5 mrad gamma-air	≤ 10 mrad gamma-air
≤ 10 mrad beta-air	≤ 20 mrad beta-air

The method used to calculate the air dose at the critical location due to noble gas is described by the following equations. The limits are provided in CONTROL 3.11.2.2 for air dose Offsite due to gamma and beta radiations from effluent noble gas.

2.4.1.1 AIR DOSE METHOD

For Gamma Radiation:

$$Dose\gamma = \sum_{i=1}^{n} A\gamma Vi\frac{\overline{X}}{Q}vQvi + A\gamma SiQsi$$

For Beta Radiation

$$Dose.\beta = \sum_{e} \sum_{i=1}^{n} A\beta.i\frac{\overline{X}}{Q}eQei$$

Where:

Dose γ =the gamma dose during any specified time period (mrad).

Dose β = the beta dose during any specified time period (mrad).

$A\gamma V_i$ = the air dose factor due to ground level gamma emissions for each identified noble gas radionuclide, i; (mrad/yr per μCi/m^3). Table A-2

$A\gamma S_i$ = the factor for air dose at ground level due to irradiation for an airborne plume resulting from a Stack release (mrad per μCi), Table A-3.

$A\beta_i$ = the air dose factor due to beta emissions for each identified noble gas radionuclide, i (mrad/yr per μCi/m^3). Table A-3

$\frac{\overline{X}}{Q}e$ $\frac{\overline{X}}{Q}v$ = the annual average relative concentration for areas at or beyond the site boundary for releases from either the Stack or ground vent at the critical location (sec/m^3), Table 2.4.1.1-1

Qvi = amount of radionuclide i released from vents (μCi).

Qsi = amount of radionuclide i released from the Stack (μCi).

Qei = amount of radionuclide i released from release point e(μCi).

Noble gases may be released from the ground level vents and stack. The quantity of noble gas radionuclides released will be determined from the continuous noble gas monitors and periodic isotopic analyses. The maximum Offsite gamma radiation dose rate to air from noble gases discharged from either the stack or from building vents occurs at 805 meters SE of the OCGS for the stack and 338 meters ENE of the OCGS for building vents. Values of AγSi depend upon the meteorological conditions and the location of exposure and are calculated using the NRC RABFIN code or similar one in accordance with Reg. Guide 1.109, Appendix B, Section 1. AγVi and ABi are derived from Reg. Guide 1.109, Table B-1 for a semi-infinite cloud, independent of meteorology or location. Values of AγSi, AγVi and ABi used to calculate the noble gas radiation dose to air at 805 meters SE of the OCGS for the stack and 338 meters ENE of the OCGS for building vents are in Table A-3. Reference atmospheric dispersion from the OCGS to 805 meters SE for the stack and 338 meters ENE for building vents is given in Table 2.4.1.1-1.

TABLE 2.4.1.1-1 RECEPTOR LOCATIONS AND DISPERSION FOR AIR DOSE

Discharge Point	Receptor Location		Atm. Dispersion
	Sector	Distance (m)	(sec/m3)
Ground Level or Vent	ENE	338	4.59 E-5
Stack	SE	805	1.29 E-8

Alternatively, an approved computer code (e.g., "SEEDS" or “Open EMS”) that implements the requirements of Reg. Guide 1.109 may be used.

2.4.1.2 EXAMPLE NOBLE GAS AIR DOSE CALCULATION

Calculate the gamma air dose from a release of 1 Ci per hour of Xe-133 for 10 hours from a ground level release and 100Ci per hour for 10 hours from an elevated release:

$$Dose\gamma = \sum_{i=1}^{n} A\gamma Vi \frac{\overline{X}}{Q} vQvi + A\gamma SiQsi$$

AγVi	= 1.12E-5 mrad – m^3 /μCi – sec	
X/Q	= 4.59 E-5 sec/m^3	
Qvi	= 1E7 μCi	[1Ci/hr*10hrs*1E6 μCi/Ci]
AγSi	= 1.03E-12 mrad / μCi	
Qsi	= 1E9 μCi	[100Ci/hr*10hrs*1E6 μCi/Ci]

$$Dose\gamma = \sum_{i=1}^{n} 1.12E-5 * 4.59E-5 * 1E7 + 1.03E\text{-}12 * 1E9$$

$$Dose\gamma = \sum_{i=1}^{n} 5.14E-3 + 1.03E-3$$

$$Dose\gamma = 6.17E-3 mrad$$

Note how the ground level portion has a higher dose contribution per unit activity than the elevated portion.

2.4.1.3 INDIVIDUAL PLUME DOSE METHOD

The method for dose to an individual from noble gases is essentially identical with the air dose method except that different dose factors apply. Also, since dose to the skin combines the contribution from gamma and beta emissions, the gamma dose must be added to the beta dose to obtain a total skin dose.

<u>For Total Body:</u>

$$Dose(t) = \sum_{i=1}^{n} P\gamma Vi \frac{\overline{X}}{Q} vQvi + P\gamma .SiQsi$$

For Skin

$$Dose(s) = \sum_{e} \sum_{i=1}^{n} S\beta i \frac{\overline{X}}{Q} e Qei + Dose(t)$$

Where:

Dose(t) =the total body dose during any specified time period (mrem).

Dose(s) = the skin dose during any specified time period (mrem).

$P\gamma V_i$ = the plume dose factor due to ground level gamma emissions for each identified noble gas radionuclide, i; (mrad/yr per $\mu Ci/m^3$). Table A-5

$P\gamma S_i$ = the factor for plume dose at ground level due to irradiation for an airborne plume resulting from a Stack release (mrad per μCi), Table A-5.

$S\beta_i$ = the skin dose factor due to beta emissions for each identified noble gas radionuclide, i (mrad/yr per $\mu Ci/m^3$) from Table A-5.

$\frac{\overline{X}}{Q}e$ $\frac{\overline{X}}{Q}v$ = the annual average relative concentration for areas at or beyond the site boundary for releases from either the Stack or ground vent at the critical location (sec/m^3) from Table 2.5.1.

Qvi = amount of radionuclide i released from vents (μCi).

Q_{si} = amount of radionuclide i released from the Stack (μCi).

Q_{ei} = amount of radionuclide i released from release point e (μCi).

2.5 RADIOIODINE, PARTICULATE AND OTHER RADIONUCLIDES DOSE CALCULATIONS - 10 CFR 50

Doses resulting from the release of radioiodines and particulates must be calculated to show compliance with Appendix I of 10CFR50. Calculations will be performed at least monthly for all gaseous effluents as stated in SURVEILLANCE REQUIREMENT 4.11.2.2 and SURVEILLANCE REQUIREMENT 4.11.2.3 to verify that the dose to air is kept below the limits specified in CONTROL 3.11.2.2 and the dose to members of the public is maintained below the limits specified in CONTROL 3.11.2.3.

The maximum dose to an individual from radioiodines, tritium, and radioactive particulates with half-lives of greater than eight days in gaseous effluents released to unrestricted areas is determined as described in Reg. Guide 1.109. Environmental pathways that radioiodine, tritium, and particulates in airborne effluent follow to the maximally exposed member of the public as determined by the annual land use survey and reference meteorology will be evaluated. The seasonality of exposure pathways may be considered. For instance, if the most exposed receptor has a garden, fresh and stored vegetables are assumed to be harvested and eaten during April through October. Fresh vegetables need not be considered as an exposure pathway during November through March. To assess compliance with CONTROL 3.11.2.3, the dose due to radioactive iodine, tritium, and particulates in airborne effluent is calculated to a person residing 972 meters ESE of the OCGS for ground-level or vent and 937 meters SE of the OCGS for stack. Reference atmospheric dispersion and deposition factors are given in Table 2.5-1.

TABLE 2.5-1 DISPERSION FOR 10CFR50 DOSES

Discharge Point	Dispersion X/Q (sec/m^3)	Deposition D/Q($1/m^2$)
Ground Level or Vent	5.13 E-6	1.68 E-8
Stack	1.25 E-8	2.39 E-9

The environmental pathways of exposure to be evaluated are: inhalation, irradiation from ground deposition, and ingestion of milk (cow and goat are treated separately), meat, and vegetables. Eight organs are considered: Bone, Liver, Total Body, Thyroid, Kidney, Lung, GI-LLI (Gastro-Intestinal tract / Lower Large Intestine), and Skin. Four different age groups are considered: Infants, Children, Teens, and Adults. Doses are calculated to a 'receptor' – a person who inhales the airborne activity and resides in a location with ground deposition, and eats and drinks the foodstuffs produced. The maximally exposed individual is conservatively assumed to reside at the location of the highest sum of the inhalation and ground plane doses, while eating and drinking foodstuffs transported from the locations that are highest for those pathways. Receptor locations are provided in Table A-4.

Alternatively, an approved computer code (e.g., "SEEDS" or "Open EMS") that implements the requirements of Reg Guide 1.109 may be used.

2.5.1 INHALATION OF RADIOIODINES, TRITIUM, PARTICULATES, AND OTHER RADIONUCLIDES.

Dose from the inhalation pathway is generally in the form:

$$Dja = RaT\sum_{i}\frac{X}{Q}QiDFAijaExp(-\lambda iTr)$$

Where:

Dja = the dose to the organ j (of eight) of age group a (of four)

Ra = the respiration rate for age group a from Table B-1

T = the duration of the release in fraction of a year

$\frac{X}{Q}$ = The atmospheric dispersion to the point of interest (the 'receptor') in sec/m^3 from Table 2.5-1

Qi = The release rate of radionuclide i (pCi/sec)

DFAija = The inhalation dose conversion factor (mrem per pCi) for radionuclide i to organ j of age group a from Reg. Guide 1.109 Appendix E.

λi = decay constant of isotope i: 0.693/ Half life in years

Tr = plume transit time from release to receptor in years

λi and Tr may be in any time units as long as they are the same

Note that a 'depleted X/Q' (dX/Q) is applicable to particulates only, which accounts for the natural settling and lack of surface reflection of particulates to estimate the downwind concentration accounting for these removal processes. Depleted X/Q will be slightly smaller than the X/Q. This is not used in the ODCM for simplicity. Using the X/Q is therefore slightly conservative compared to the dX/Q.

2.5.2 EXAMPLE CALCULATION - INHALATION OF RADIOIODINES, TRITIUM, PARTICULATES, AND OTHER RADIONUCLIDES

Calculate the dose to child lung from inhalation from a ground level release of 100 μCi of Co-60 in 10 hours. Plume transit decay time is ignored (exp(-λiTr)=1).

$$Dja = RaT\sum_i \frac{X}{Q} QiDFAija$$

Dja	= the dose to the organ j (of eight) of age group a (of four)
Ra	= 3700 m^3/yr
T	= 0.00114 yrs [10 hrs / 8760 hrs / yr]
$\frac{X}{Q}$	= 5.13 E-6 sec/m^3
Qi	= 2.78E3 pCi/sec [100 μCi * 1E6 pCi/μCi / (10 hrs*3600 sec / hr)]
DFAija	=1.91E-3 mrem / pCi

$$Dja = 3700 * 0.00114 * 5.13E-6 * 2.78E3 * 1.91E-3$$

$$Dja = 1.15E-4 mrem$$

2.5.3 INGESTION OF RADIOIODINES, PARTICULATES AND OTHER RADIONUCLIDES

Dose from the ingestion pathways is more complex and is broken out here into multiple steps.

2.5.3.1 CONCENTRATION OF THE RADIONUCLIDE IN ANIMAL FORAGE AND VEGETATION – OTHER THAN TRITIUM

The concentration of a radionuclide in a foodstuff (other than tritium – see section 2.5.3.3 for tritium) is dependent on the atmospheric deposition, the biological uptake into the food, various decay times (plume travel, harvest to table, etc.) and is generally of the form:

$$Civ = \frac{D}{Q} Qi \left\{ \frac{r(1 - EXP(-\lambda EiTe))}{Yv\lambda Ei} + \frac{Biv(1 - EXP(-\lambda iTb))}{P\lambda i} \right\} EXP(-\lambda iTh) EXP(-\lambda iTr)$$

Where:

Civ = the concentration (pCi/kg) of radionuclide i in vegetation

Qi = the release rate of isotope i in pCi/hr

$\frac{D}{Q}$ = The atmospheric deposition to the point of interest (the 'receptor') in $1/m^2$ from Table 2.5-1.

r = the retention coefficient for deposition onto vegetation surfaces (1.0 for iodines, 0.2 for particulates)

λi = the decay constant of radionuclide i; 0.693/half life in hours

λEi = the effective removal constant which is the sum of λi + λw where λw is the weathering constant, 0.0021/hr

Te = duration of crop exposure during the growing season in hours. This is not the entire duration of the growing season, and is different for leafy vegetable and fruit/grain/vegetables. Provided in Table E-15 of Reg. Guide 1.109 or Table B-1.

Yv = agricultural yield Kg of vegetation per m^2, typically 0.7 kg/m^2

Biv = soil uptake concentration factor for transfer of the radionuclide i from the soil to the vegetation through normal root uptake processes in pCi/kg in vegetation per pCi/Kg in soil. Values are provided in Reg. Guide 1.109 Table E-1.

Tb = the length of time the soil is exposed to contaminated inputs – nominally 30 years (2.63E5 hr)

P = effective soil density in kg/m^2 normally 240 kg/m^2

Th = holdup time, the time the foodstuff is in transit between harvest and consumption in hours

Tr = plume transit time from release to receptor in hours

2.5.3.2 EXAMPLE CALCULATION OF CONCENTRATION OF THE RADIONUCLIDE IN ANIMAL FORAGE AND VEGETATION – OTHER THAN TRITIUM.

Calculate the forage and vegetation concentration from a ground level release of 100 µCi of Co-60 in 10 hours (plume transit time is ignored Tr=0, EXP(-λiTr)=1):

$$Civ = \frac{D}{Q} Qi \left\{ \frac{r(1-EXP(-\lambda EiTe))}{Yv\lambda Ei} + \frac{Biv(1-EXP(-\lambda iTb))}{P\lambda i} \right\} EXP(-\lambda iTh) EXP(-\lambda iTr)$$

D/Q	= 1.67E-8 m^2	
Qi	= 1E7 pCi/hr	[100µCi * 1E6 pCi/µCi / 10 hr]
r	= 0.2	
λi	= 1.5E-5/hr	[0.693 / (5.27yr * 8760 hr/yr)]
λEi	= 2.12E-3 /hr	[1.5E-5 + 0.0021]
Te	= 720 hr [grass-cow-milk-man pathway value]	
Yv	= 0.7 kg/m^2	
Biv	= 9.4E-3	
Tb	= 2.63E5 hr	
P	= 240 kg/m^2	
Th	= 24.1 hours	

$$Civ = 1.67E-8*1E7 \left\{ \begin{array}{l} \dfrac{0.2*(1-EXP(-2.12E-3*720))}{0.7*2.12E-3} + \\ \dfrac{9.4E-3*(1-EXP(-1.5E-5*2.63E5))}{240*1.5E-5} \end{array} \right\} EXP(-1.5E-5*0)$$

$$Civ = 1.67E-8*1E7 \left\{ \begin{array}{l} \dfrac{0.2*(1-EXP(-1.53))}{1.48E-3} + \\ \dfrac{9.4E-3*(1-EXP(-3.95))}{3.6E-3} \end{array} \right\} EXP(-0)$$

$$Civ = 1.67E-1 \left\{ \begin{array}{l} 105.9 + \\ 2.56 \end{array} \right\} *1$$

$$Civ = 18.0\, pCi / Kg$$

2.5.3.3 CONCENTRATION OF TRITIUM IN ANIMAL FORAGE AND VEGETATION

Since tritium is assumed to be released as tritiated water (HTO), the concentration of tritium in a foodstuff is dependent on atmospheric dispersion like a gas, rather than particulate deposition as for other radionuclides for foodstuff uptake. Further, the concentration of tritium in food is assumed to be based on equilibrium between the concentration of the tritium in the atmospheric water and the concentration of tritium in the water in the food. Concentration of tritium in vegetation can be calculated generally in the form (a plume transit decay term: EXP(-λiTr) is ignored since plume travel times are very short compared to the half life):

$$Ctv = 1000Qt\frac{X}{Q} * 0.75 * \frac{0.5}{H}$$

Where:

Ctv = the concentration (pCi/kg) of tritium in vegetation

1000 = g per kg

Qt = the release rate of the tritium in pCi/ sec

X/Q = the atmospheric dispersion at the vegetation point, sec/m^3 from Table 2.5-1

0.75 = the fraction of vegetation that is water

0.5 = the effective ratio between the atmospheric water concentration and the vegetation concentration

H = the absolute humidity g/m^3. Absolute humidity is seasonally dependent, varying from as little as 1 in the winter to as much as 20 in the summer. Monthly average values derived from historical data are provided in Table B-2.

2.5.3.4 EXAMPLE CALCULATION OF CONCENTRATION OF TRITIUM IN ANIMAL FORAGE AND VEGETATION.

Calculate the forage and vegetation concentration from a ground level release of 100 µCi of H-3 in 10 hours. Plume transit decay time is ignored (exp(-λiTr)=1):

$$Ctv = 1000Qt\frac{X}{Q} * 0.75 * \frac{0.5}{H}$$

Qt	= 2778 pCi/sec [100uCi * 1E6 pCi/uCi / (10hrs*3600sec/hr)]
X/Q	= 5.13E-6 sec/m^3
H	= 5 g/m^3 (assumed for this example)

$$Ctv = 2778 * 1000 * 5.13E - 6 * 0.75 * \frac{0.5}{5}$$

$$Ctv = 1.07 pCi/kg$$

2.5.3.5 CONCENTRATION OF THE RADIONUCLIDE IN MILK AND MEAT

Meat and milk animals are assumed to eat both pasture grass and stored feed. During a fraction of the year, they may be assumed to be exclusively on stored feed, outside of the growing season. If using annual average release, the fraction of stored and fresh feed must be accounted for with fractions, otherwise (as in this ODCM), the fresh pasture pathway is turned on or off depending on the growing season.

The concentration of a radionuclide in the animal feed is calculated as follows:

$$Civ = FpCis + (1 - Fp)Cis(1 - Fs) + CipFs(1 - Fp)$$

Where:

Fp = the growing season pasture factor: 1 if not growing season, 0 if in growing season

Fs = the fraction of the daily feed from fresh pasture from Table B-1 or Exhibit E-15 from Reg. Guide 1.109.

Cip = the concentration in the fresh pasture feed (Civ from section 2.5.3.2 with Th = 0 for immediate consumption)

Cis = the concentration in stored feed (Civ from section 2.5.3.2 with Th = 90 days)

The concentration in the milk is then based on this feed concentration:

$$Cim = FmCivQfEXP(-\lambda iTf)$$

Where:

Cim = the concentration in milk pCi/l

Fm = the transfer coefficient of intake to concentration in the milk (d/l) from Reg. Guide 1.109 Table E-1.

Qf = feed intake rate Kg/d from Reg. Guide 1.109 Table E-3.

λi = radionuclide i decay constant in 1/days

Tf = transport time from milk production to consumption (2 days for milk)

The Goat milk pathway may be similarly evaluated:

$$Cim = FgCivQfEXP(-\lambda iTf)$$

Where:

Fg = the transfer coefficient of intake to concentration in the milk (d/l) for goats from Reg. Guide 1.109 Table E-2.

And for meat:

$$Cif = FfCivQfEXP(-\lambda iTs)$$

Where:

Ff = the transfer coefficient of intake to concentration in the meat d/kg from Reg. Guide 1.109 Table E-1.

Ts = the transport time from slaughter to consumption (20 days)

2.5.3.6 EXAMPLE CALCULATION OF CONCENTRATION OF THE RADIONUCLIDE IN MILK AND MEAT

Calculate the concentration in cow milk from a ground level release of 100 μCi of Co-60 in 10 hours. Plume transit decay time is ignored (exp(-λiTr)=1):

$$Civ = FpCis + (1 - Fp)Cis(1 - Fs) + CipFs(1 - Fp)$$

Assume animals are on pasture and receive half of their food from stored feed.

Cip = 18.0 pCi/kg as previously calculated in section 2.5.3.2
Fp = 0
Fs = 0.5

Cis is calculated by applying a 90 day decay term to the Cip value previously calculated, since the previous decay correction was for 0 time as shown in 2.5.3.2.

$$Cis = 18.0 * (\exp(-0.693 * 90/(5.27 * 365)))$$

$$Cis = 17.4 pCi/kg$$

Civ is then:

$$Civ = 0 * 17.4 + (1-0)17.4 * (1-0.5) + 18.0 * 0.5 * (1-0)$$

$$Civ = 17.7 pCi/kg$$

The concentration in milk is given by:

$$Cim = FmCivQfEXP(-\lambda iTf)$$

Fm =1.0E-3 d/l
Qf = 50 Kg/d
λi = 3.6E-4/d [0.693 / (5.27 yrs*365 days/yr)]

$$Cim = 1.0E-3 * 17.7 * 50 * EXP(-3.6E-4 * 2)$$

$$Cim = 0.88 pCi/l$$

The concentration in meat given by:

$$Cif = FfCivQfEXP(-\lambda iTs)$$

Ff =1.3E-2 d/kg
Qf = 50 Kg/d
λi = 3.6E-4/d

$$Cif = 1.3E-2 * 17.7 * 50 * EXP(-3.6E-4 * 20)$$

$$Cif = 11.5 pCi/kg$$

2.5.3.7 DOSE FROM CONSUMPTION OF MILK, MEAT, AND VEGETABLES

The environmental pathway ingestion dose is the sum of the milk, meat, and vegetation ingestion pathways. There are two separate pathways for vegetation: fresh leafy vegetables and a combination of fruits, non-leafy vegetables, and grains. These differ only in the decay and buildup processes applied to account for the environmental exposure, and transportation delay decay represented by Te and Th as shown in section 2.5.3.1. For long half-life isotopes (e.g. Co-60) the decay differences have little impact on the dose.

Dose from the environmental ingestion pathways is generally of the form:

$$Dja = T\sum_{i} DFIija[UavFgCiv + UamCim + UafCif + UalFlCil]$$

Where:

Dja = the dose to organ j of age group a - mrem

T = fraction of year of release duration

DFIija = the ingestion dose factor for isotope i to organ j for age group a - mrem/pCi from Reg. Guide 1.109 Appendix E

Uav = Ingestion rate (usage factor) for non-leafy vegetables, grains, and fruits for age group a from Reg. Guide 1.109 Table E-5 or Table B-1.

Fg = the fraction of vegetables, grains, and fruits from the location of interest : 0.76 in Reg. Guide 1.109.

Civ = the concentration of isotope i in the vegetables, fruits, and grains calculated from section 2.5.3.2.

Uam = Ingestion rate (usage factor) for milk for age group a: from Table B-1 or Reg. Guide 1.109 Table E-5.

Cim = the concentration of isotope i in milk calculated from section 2.5.3.5.

Uaf = the ingestion rate for meat for age group a: from Table B-1 or Reg. Guide 1.109 Table E-5.

Cif = the concentration of isotope i in meat calculated from section 2.5.3.2.

Ual = the ingestion rate for leafy vegetables for age group a: from Table B-1 or Reg. Guide 1.109 Table E-5.

Fl = the fraction of annual leafy vegetable ingestion from the location of interest : 1.0 in Reg. Guide 1.109.

Cil = concentration of isotope i in the leafy vegetables for direct human consumption: Civ calculated from section 2.5.3.2 with Th=0.

2.5.3.8 EXAMPLE CALCULATION - DOSE FROM CONSUMPTION OF MILK, MEAT, AND VEGETABLES

Calculate the ingestion dose to child whole body from a ground level release of 100 μCi of Co-60 in 10 hours. Plume transit decay time is ignored (exp(-λiTr)=1):

$$Dja = T\sum_{i} DFIija[UavFgCiv + UamCim + UafCif + UalFlCil]$$

Where:

T	= 0.00114 yr [10hrs / 8760 hrs/yr)	
DFIija	= 1.56E-5 mrem/pCi	
Uav	= 520	
Fg	= 0.76	
Civ	= 17.6	[18.0*EXP(-λ*60) using 60 day delay for ingestion]
Uam	= 330	
Cim	= 0.88	
Uaf	= 41	
Cif	= 11.5	
Ual	= 26	
Fl	= 1	
Cil	= 17.7	

$$Dja = .00114\sum_{i} 1.56E-5[520*0.76*17.6 + 330*0.88 + 41*11.5 + 26*1*17.7]$$

$$Dja = .00114\sum_{i} 1.56E-5[6956 + 290 + 472 + 460]$$

$$Dja = 1.45E-4 mrem : child : wholebody$$

2.5.4 GROUND PLANE DEPOSITION IRRADIATION

Dose from ground plane deposition is estimated by determining the surface activity resulting from the release.

2.5.4.1 GROUND PLANE CONCENTRATION

The ground surface activity is estimated as:

$$Cig = \frac{D}{Q}\frac{Qi}{\lambda i}(1 - EXP(-\lambda iTb))$$

Where:

Cig = ground plane concentration of radionuclide i in pCi/m²

$\frac{D}{Q}$ = local atmospheric release deposition factor in 1/m² from Table 2.5-1

Qi = release rate in pCi/sec

λi = radiological decay constant in 1/sec

Tb = long term buildup time 30 years (9.46E8 sec)

Note: Qi, λi and Tb can utilize any time units as long as they are all the same

2.5.4.2 EXAMPLE GROUND PLANE CONCENTRATION CALCULATION

Calculate the ground plane concentration from a 100 μCi release of Co-60 over 10 hours from a ground level release point.

$$Cig = \frac{D}{Q}\frac{Qi}{\lambda i}(1 - EXP(-\lambda iTb))$$

$\frac{D}{Q}$ = 1.67E-8 /m²

Qi = 2778 pCi/sec [100μCi/10hrs/3600sec/hr]

λi = 4.17E-9/sec [0.693/(5.27yr*8760hr/yr*3600sec/hr)]

Tb = 9.46E8 sec

$$Cig = 1.67E-8\frac{2778}{4.17E-9}(1 - EXP(-4.17E-9*9.46E8))$$

$$Cig = 1.09E4 pCi/m2$$

2.5.4.3 GROUND PLANE DOSE

Annual dose from the ground plane deposition is of the form:

$$Djg = 8760 * T * Sf \sum_i CigDFGij$$

Where:

Djg = the annual dose (mrem) from ground plane pathway (g) to the total body or skin (j)

8760 = hours in a year

T = fraction of year release is in progress

Sf = shielding factor accounting for shielding from dwelling from Table B-1

DFGij = Ground plane dose factor for skin or total body (j) for radionuclide i from Table E-6 of Reg. Guide 1.109 in mrem/hr / pCi/m^2.

2.5.4.4 EXAMPLE GROUND PLANE DOSE

Calculate the ground plane Total Body dose from a 100 μCi release of Co-60 over 10 hours from a ground level release point.

$$Djg = 8760 * T * Sf \sum_i CigDFGij$$

T = 0.00114 [10/8760]
Sf = 0.7
DFGij = 1.7E-8
Cig = 1.09E4

$$Djg = 8760 * 0.00114 * 0.7 \sum_i 1.09E4 * 1.7E-8$$

$$Djg = 1.30E-3 mrem Total Body$$

2.6 PROJECTED DOSES – GASEOUS

The projected doses in a 31 day period are equal to the calculated doses from the current 31 day period.

3.0 TOTAL DOSE TO MEMBERS OF THE PUBLIC - 40 CFR 190

The Radiological Environmental Monitoring Report (REMP) submitted by May 1st of each year shall include an assessment of the radiation dose to the likely most exposed member of the public for reactor releases and other nearby uranium fuel cycle sources (including dose contributions from effluents and direct radiation from on-site sources). For the likely most exposed member of the public near Oyster Creek, the sources of exposure need only consider the Oyster Creek Generating Station. No other fuel cycle facilities would contribute significantly to the member of the public dose for the Oyster Creek vicinity, however, both plant operation and ISFSI sources must be included in the dose assessment.

To assess compliance with CONTROL 3.11.4, calculated organ and total body doses from effluents from liquid pathways and atmospheric releases as well as any dose from direct radiation will be summed.

As appropriate for demonstrating/evaluating compliance with the limits of CONTROL 3.11.4 (40 CFR 190), the results of the environmental monitoring program may be used for providing data on actual measured levels of radiation and / or radioactive material and resultant dose to the member of the public in the actual pathways of exposure.

3.1 EFFLUENT DOSE CALCULATIONS

For purposes of implementing the surveillance requirements of CONTROL 3/4.11.4 and the reporting requirements of Technical Specification 6.9.1.a (ARERR), dose calculations for the Oyster Creek Generating Station may be performed using the calculation methods contained within the ODCM; the conservative controlling pathways and locations from the ODCM or the actual pathways and locations as identified by the land use census (CONTROL 3/4.12.1) may be used. Average annual meteorological dispersion parameters provided herein or meteorological conditions concurrent with the release period under evaluation may be used.

3.2 DIRECT EXPOSURE DOSE DETERMINATION

Any potentially significant direct exposure contribution to off-site individual doses may be evaluated based on the results of environmental measurements (e.g., dosimeter) and/or by the use of radiation transport and shielding calculation methodologies.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of CONTROL 3.12.1. The objectives of the program are:

- To determine whether any significant increases occur in the concentration of radionuclides in the critical pathways of exposure in the vicinity of Oyster Creek
- To determine if the operation of the Oyster Creek Generating Station has resulted in any increase in the inventory of long lived radionuclides in the environment;
- To detect any changes in the ambient gamma radiation levels; and
- To verify that OCGS operations have no detrimental effects on the health and safety of the public or on the environment.

The REMP sample locations are presented in Appendix E.

APPENDIX A - DERIVED DOSE FACTORS AND RECEPTOR LOCATIONS

Table A-1 Dose Conversion Factors for Deriving Radioactive Noble Gas Radionuclide-to-Dose Equivalent Rate Factors*

Radionuclide	Factor DFSi for Stack Release* (mrem-sec / µCi-year)	Factor DFVi for Ground-level or Vent Release** (mrem-m^3 / µCi-year)
Kr83m	9.21E-10	7.56E-02
Kr85m	1.46E-04	1.17E+03
Kr85	2.58E-06	1.61E+01
Kr87	8.65E-04	5.92E+03
Kr88	2.16E-03	1.47E+04
Kr89	2.06E-03	1.66E+04
Kr90	-	1.56E+04
Xe131m	3.13E-05	9.15E+01
Xe133m	2.50E-05	2.51E+02
Xe133	2.15E-05	2.94E+02
Xe135m	4.81E-04	3.12E+03
Xe135	2.51E-04	1.81E+03
Xe137	1.79E-04	1.42E+03
Xe138	1.37E-03	8.83E+03
Xe139	2.14E-04	5.02E+03
Ar41	1.67E-03	8.84E+03

* Based on meteorology applicable at 229 meters SW of stack.

** For exposure to a semi-infinite cloud of noble gas.

Table A-2 Noble Gas Radionuclide-to-Dose Equivalent Rate Factors*

Radionuclide	PγSi** mrem / μCi	PγVi*** mrem-m³ / μCi-sec (K_i)	AγVi*** mrad-m³ / μCi-sec (M_i)	SBi*** mrem-m³ / μCi-sec (L_i)
Kr83m	2.92E-17	2.40E-09	6.13E-07	-
Kr85m	4.64E-12	3.71E-05	3.90E-05	4.63E-05
Kr85	8.18E-14	5.11E-07	5.46E-07	4.25E-05
Kr87	2.74E-11	1.88E-04	1.96E-04	3.09E-04
Kr88	6.84E-11	4.67E-04	4.83E-04	7.52E-05
Kr89	6.53E-11	5.27E-04	5.49E-04	3.21E-04
Kr90	-	4.95E-04	5.17E-04	2.31E-04
Xe131m	9.92E-13	2.90E-06	4.95E-06	1.51E-05
Xe133m	7.94E-13	7.97E-06	1.04E-05	3.16E-05
Xe133	6.83E-13	9.33E-06	1.12E-05	9.71E-06
Xe135m	1.53E-11	9.90E-05	1.07E-04	2.26E-05
Xe135	7.97E-12	5.75E-05	6.10E-05	5.90E-05
Xe137	5.69E-12	4.51E-05	4.79E-05	3.87E-04
Xe138	4.34E-11	2.80E-04	2.92E-04	1.31E-04
Xe139	6.79E-12	-	-	-
Ar41	5.30E-11	2.81E-04	2.95E-04	8.54E-05

* All of these dose factors apply out-of-doors.
** Based on meteorology at 229 meters SW of effluent stack.
*** Derived from Reg Guide 1.109, Revision 1, Table B-1.

Table A-3 Air Dose Conversion Factors for Effluent Noble Gas

Radionuclide	AγSi** mrad / μCi	AγVi*** mrad-m3 / μCi-sec(M_i)	Aβi*** mrad-m3 / μCi-sec (N_i)
Kr83m	1.33E-16	6.13E-07	9.14E-06
Kr85m	6.89E-12	3.90E-05	6.25E-05
Kr85	1.24E-13	5.46E-07	6.19E-05
Kr87	4.13E-11	1.96E-04	3.27E-04
Kr88	1.03E-10	4.83E-04	9.30E-05
Kr89	9.82E-11	5.49E-04	3.37E-04
Kr90	-	5.17E-04	2.49E-04
Xe131m	1.50E-12	4.95E-06	3.52E-05
Xe133m	1.23E-12	1.04E-05	4.70E-05
Xe133	1.03E-12	1.12E-05	3.33E-05
Xe135m	2.31E-11	1.07E-04	2.35E-05
Xe135	1.20E-11	6.10E-05	7.81E-05
Xe137	8.59E-12	4.79E-05	4.03E-04
Xe138	6.51E-11	2.92E-04	1.51E-04
Xe139	1.02E-11	-	-
Ar41	7.94E-11	2.95E-04	1.04E-04

** Based on meteorology at 229 meters SW of effluent stack.
*** Derived from Reg Guide 1.109, Revision 1, Table B-1.

Table A-4 Locations Associated with Maximum Exposure of a Member of the Public*

Effluent	Location	
	Distance (meters)	Direction (to)
Liquid	U.S. Route 9 Bridge at Discharge Canal	
Airborne Iodine and Particulates	937	SE
Tritium	937	SE
Noble Gases	937	SE
Irradiation by OCGS	Site Boundary	All
Noble Gas g Air Dose	937	SE
Noble Gas B Air Dose	937	SE

Note: the nearby resident experiencing the maximum exposure to airborne effluent from the Station is located 937 meters SE of the OCGS. The nearby resident (part-time) experiencing the maximum exposure to gamma radiation directly from the Station is located 618 meters WSW of the OCGS. The most exposed member of the public is assumed to be exposed by irradiation from the OCGS, by inhaling airborne effluent, by irradiation by the airborne effluent, by irradiation by the airborne plume of the noble gas, by radionuclides deposited onto the ground, by irradiation by shoreline deposits, and by eating fish and shellfish caught in the discharge canal.

*The age group of the most exposed member of the public is based on Reg. Guide 1.109, Revision 1.

Table A-5 Critical Receptor Noble Gas Dose Conversion Factors*

Radionuclide	PγSi** mrem/μCi	PγVi*** mrem-m³/μCi-sec(Ki)	AγVi*** mrad-m³/μCi-sec(Mi)	AγSi** mrad/μCi	SBi*** mrem-m³/μCi-sec(Li)
Kr83m	4.61E-17	2.40E-09	6.13E-07	1.77E-14	-
Kr85m	2.13E-12	3.71E-05	3.90E-05	3.16E-12	4.63E-05
Kr85	3.38E-14	5.11E-07	5.46E-07	5.12E-14	4.25E-05
Kr87	1.08E-11	1.88E-04	1.96E-04	1.63E-11	3.09E-04
Kr88	2.76E-11	4.67E-04	4.83E-04	4.14E-11	7.52E-05
Kr89	2.02E-11	5.27E-04	5.49E-04	3.03E-11	3.21E-04
Kr90	-	4.95E-04	5.17E-04	-	2.31E-04
Xe131m	5.05E-13	2.90E-06	4.95E-06	8.03E-13	1.51E-05
Xe133m	3.95E-13	7.97E-06	1.04E-05	6.50E-13	3.16E-05
Xe133	3.88E-13	9.33E-06	1.12E-05	6.13E-13	9.71E-06
Xe135m	5.82E-12	9.90E-05	1.07E-04	8.80E-12	2.26E-05
Xe135	3.51E-12	5.75E-05	6.10E-05	5.25E-12	5.90E-05
Xe137	1.74E-12	4.51E-05	4.79E-05	2.64E-12	3.87E-04
Xe138	1.72E-11	2.80E-04	2.92E-04	2.58E-11	1.31E-04
Xe139	9.30E-13	-	-	1.40E-12	-
Ar41	2.07E-11	2.81E-04	2.95E-04	3.10E-11	8.54E-05

* All of these dose factors apply out-of-doors.

** Based on meteorology at 937 meters SE of effluent stack.

*** Derived from Reg Guide 1.109, Revision 1, Table B-1

APPENDIX B - MODELING PARAMETERS

Table B-1- OCGS Usage Factors For Individual Dose Assessment

Effluent Ingestion Parameters	Usage Factor
Fraction Of Produce From Local Garden	7.6E-1
Soil Density In Plow Layer (Kg/m^2)	2.4E+2
Fraction Of Deposited Activity Retained On Vegetation	2.5E-1
Shielding Factor For Residential Structures	7.0E-1
Period Of Buildup Of Activity In Soil (hr)	1.31E+5
Period of Pasture Grass Exposure to Activity (hr)	7.2E+2
Period Of Crop Exposure to Activity (hr)	1.44E+3
Delay Time For Ingestion Of Stored Feed By Animals (hr)	2.16E+3
Delay Time For Ingestion Of Leafy Vegetables By Man (hr)	2.4E+1
Delay Time For Ingestion Of Other Vegetables By Man (hr)	1.44E+3
Transport Time Milk-Man (hr)	4.8E+1
Time Between Slaughter and Consumption of Meat Animal (hr)	4.8E+2
Grass Yield Wet Weight (Kg/m^2)	7.0E-1
Other Vegetation Yield Wet-Weight (Kg/m^2)	2.0
Weathering Rate Constant For Activity on Veg. (hr^{-1})	2.1E-3
Milk Cow Feed Consumption Rate (Kg/day)	5.0E+1
Goat Feed Consumption Rate (Kg/day)	6.0
Beef Cattle Feed Consumption Rate (Kg/day)	5.0E+1
Milk Cow Water Consumption Rate (L/day)	6.0E+1
Goat Water Consumption Rate (L/day)	8.0
Beef Cattle Water Consumption Rate (L/day)	5.0E+1
Environmental Transit Time For Water Ingestion (hr)	1.2E+1
Environmental Transit Time For Fish Ingestion (hr)	2.4E+1
Environmental Transit Time For Shore Exposure (hr)	0
Environmental Transit Time For Invertebrate Ingestion (hr)	2.4E+1

Table B-1(Continued)
OCGS Usage Factors for Individual Dose Assessment

Effluent Ingestion Parameters	Usage Factor
Water Ingestion (L/yr)	
a. Adult	7.3E+2
b. Teen	5.1E+2
c. Child	5.1E+2
d. Infant	3.3E+2
Shore Exposure (hr/yr)	
a. Adult	1.2E+1
b. Teen	6.7E+1
c. Child	1.4E+1
d. Infant	0
Salt Water Sport Fish Ingestion (Kg/yr)	
a. Adult	2.1E+1
b. Teen	1.6E+1
c. Child	6.9
d. Infant	0
Salt Water Commercial Fish Ingestion (Kg/yr)	
a. Adult	2.1E+1
b. Teen	1.6E+1
c. Child	6.9
d. Infant	0
Salt Water Invertebrate Ingestion (Kg/yr)	
a. Adult	5.0
b. Teen	3.8
c. Child	1.7
d. Infant	0
Irrigated Leafy Vegetable Ingestion (Kg/yr)	
a. Adult	6.4E+1
b. Teen	4.2E+1
c. Child	2.6E+1
d. Infant	0

Table B-1 (Continued)
OCGS Usage Factors for Individual Dose Assessment

Effluent Ingestion Parameters	Usage Factor
Irrigated Other Vegetable Ingestion (Kg/yr)	
a. Adult	5.2E+2
b. Teen	6.3E+2
c. Child	5.2E+2
d. Infant	0
Irrigated Root Vegetable Ingestion (Kg/yr)	
a. Adult	5.2E+2
b. Teen	6.3E+2
c. Child	5.2E+2
d. Infant	0
Irrigated Cow and Goat Milk Ingestion (L/yr)	
a. Adult	3.1E+2
b. Teen	4.0E+2
c. Child	3.3E+2
d. Infant	3.3E+2
Irrigated Beef Ingestion (Kg/yr)	
a. Adult	1.1E+2
b. Teen	6.5E+1
c. Child	4.1E+1
d. Infant	0
Inhalation (m^3/yr)	
a. Adult	8.0E+3
b. Teen	8.0E+3
c. Child	3.7E+3
d. Infant	1.4E+3
Cow and Goat Milk Ingestion (L/yr)	
a. Adult	3.1E+2
b. Teen	4.0E+2
c. Child	3.3E+2
d. Infant	3.3E+2
Meat Ingestion (Kg/yr)	
a. Adult	1.1E+2
b. Teen	6.5E+1
c. Child	4.1E+1
d. Infant	0

Table B-1 (Continued)
OCGS Usage Factors for Individual Dose Assessment

Effluent Ingestion Parameters	Usage Factor
Leafy Vegetable Ingestion (Kg/yr)	
a. Adult	6.4E+1
b. Teen	4.2E+1
c. Child	2.6E+1
d. Infant	0
Fruits, Grains, & Other Vegetable Ingestion (Kg/yr)	
a. Adult	5.2E+2
b. Teen	6.3E+2
c. Child	5.2E+2
d. Infant	0

Table B-2 Monthly Average Absolute Humidity g/m^3
(derived from historical climatological data)

Month	Average Absolute Humidity (g/m^3)
January	3.3
February	3.3
March	4.5
April	6.1
May	9.4
June	12.8
July	15.2
August	15.6
September	12.4
October	7.9
November	5.9
December	3.8

APPENDIX C - REFERENCES

Table C-1 - REFERENCES

1) Oyster Creek Updated Final Safety Analysis Report

2) Oyster Creek Facility Description and Safety Analysis Report

3) Oyster Creek Operating License and Technical Specifications

4) NUREG 1302 "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors" – Generic Letter 89-10, Supplement No. 1,April 1991

5) Reg Guide 1.21 "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of radioactive materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants" Rev.1, June 1974

6) Reg Guide 1.23

7) Reg Guide 1.97

8) Reg Guide 1.109 "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR 50, Appendix I", Rev 1, October, 1977

9) Reg Guide 1.111 "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light-Water-Cooled Reactors", Rev.1, July, 1977

10) Reg Guide 4.8 " Environmental Technical Specifications for Nuclear Power Plants"

11) NRC Radiological Assessment Branch Technical Position, Rev 1, November 1979 (Appendix A to NUREG1302)

12) NUREG-0016

13) NUREG-0133

14) Licensing Application, Amendment 13, Meteorological Radiological Evaluation for the Oyster Creek Nuclear Power Station Site.

15) Licensing Application, Amendment 11, Question IV-8.

16) Evaluation of the Oyster Creek Nuclear Generating Station to Demonstrate Conformance to the Design Objectives of 10CFR50, Appendix I, May, 1976, Tables 3-10

17) XOQDOQ Output Files for Oyster Creek Meteorology, Murray and Trettle, Inc.

18) Hydrological Information and Liquid Dilution Factors Determination to Conform with Appendix I Requirements: Oyster Creek, correspondence from T. Potter, Pickard, Lowe and Garrick, Inc. to Oyster Creek, July, 1976.

19) Carpenter, J. J. "Recirculation and Effluent Distribution for Oyster Creek Site", Pritchard-Carpenter Consultants, Baltimore, Maryland, 1964.

20) Nuclear Regulatory Commission, Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section and Relocation of the Procedural Details of RETS to the ODCM or PCP", January, 1989.

21) Ground Water Monitoring System (Final Report), Woodward-Clyde Consultants, March, 1984.

22) Meteorology and Atomic Energy, Department of Energy, 1981.

23) SEEDS Code Documentation through V & V of Version 98.8F (Radiological Engineering Calculation No. 2820-99-005, Dated 3/23/99)

24) Lynch, Giuliano, and Associates, Inc., Drawing Entitled, "Minor Subdivision, Lots 4 and 4.01 Block 1001", signed 13 Sep 99.

25) Currie, L. A., “Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements” .

26) NUREG/CR-4007 (September 1984).

27) HASL Procedures Manual, HASL-300 (revised annually).

28) Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purposes of Implementing Appendix I," April 1977

29) Reg. Guide 4.13

30) 10CFR20, Appendix B, Table 2, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage

31) Conestoga Rovers and Associates, Hydrogeologic Investigation Report, Fleet wide Assessment, Oyster Creek Generating Station, Forked River, New Jersey, Ref. No. 045136(18), September, 2006.

32) Letter date April 23, 2013 from Murray and Trettel, Incorporated

33) Letter dated January 10, 2013 titled “Meteorology and Dose Factor Update – ODCM Revision 6”

APPENDIX D – SYSTEM DRAWINGS

FIGURE D-1-1a: LIQUID RADWASTE TREATMENT CHEM WASTE AND FLOOR DRAIN SYSTEM

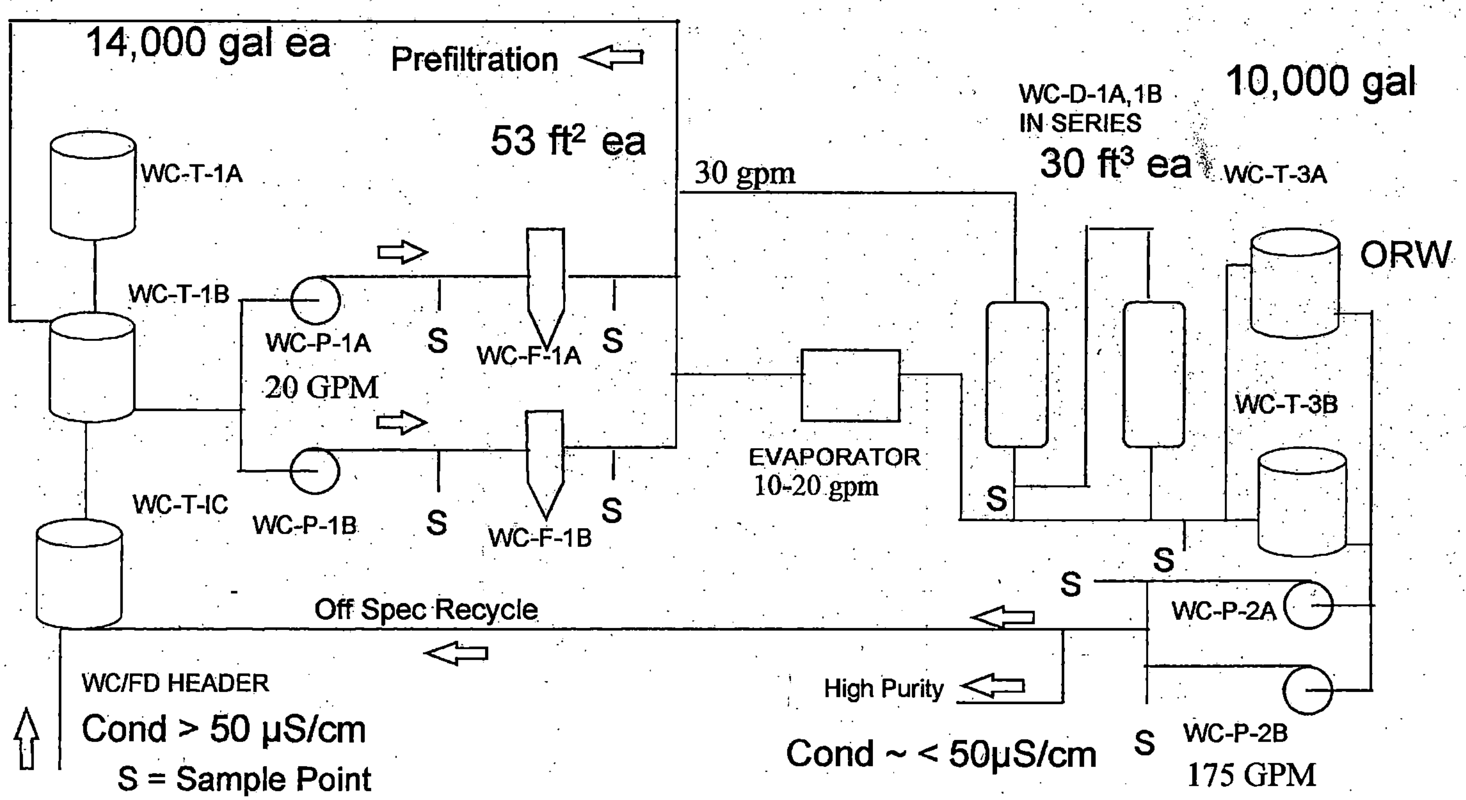

FIGURE D-1-1b: LIQUID RADWASTE TREATMENT - HIGH PURITY AND EQUIPMENT DRAIN SYSTEM

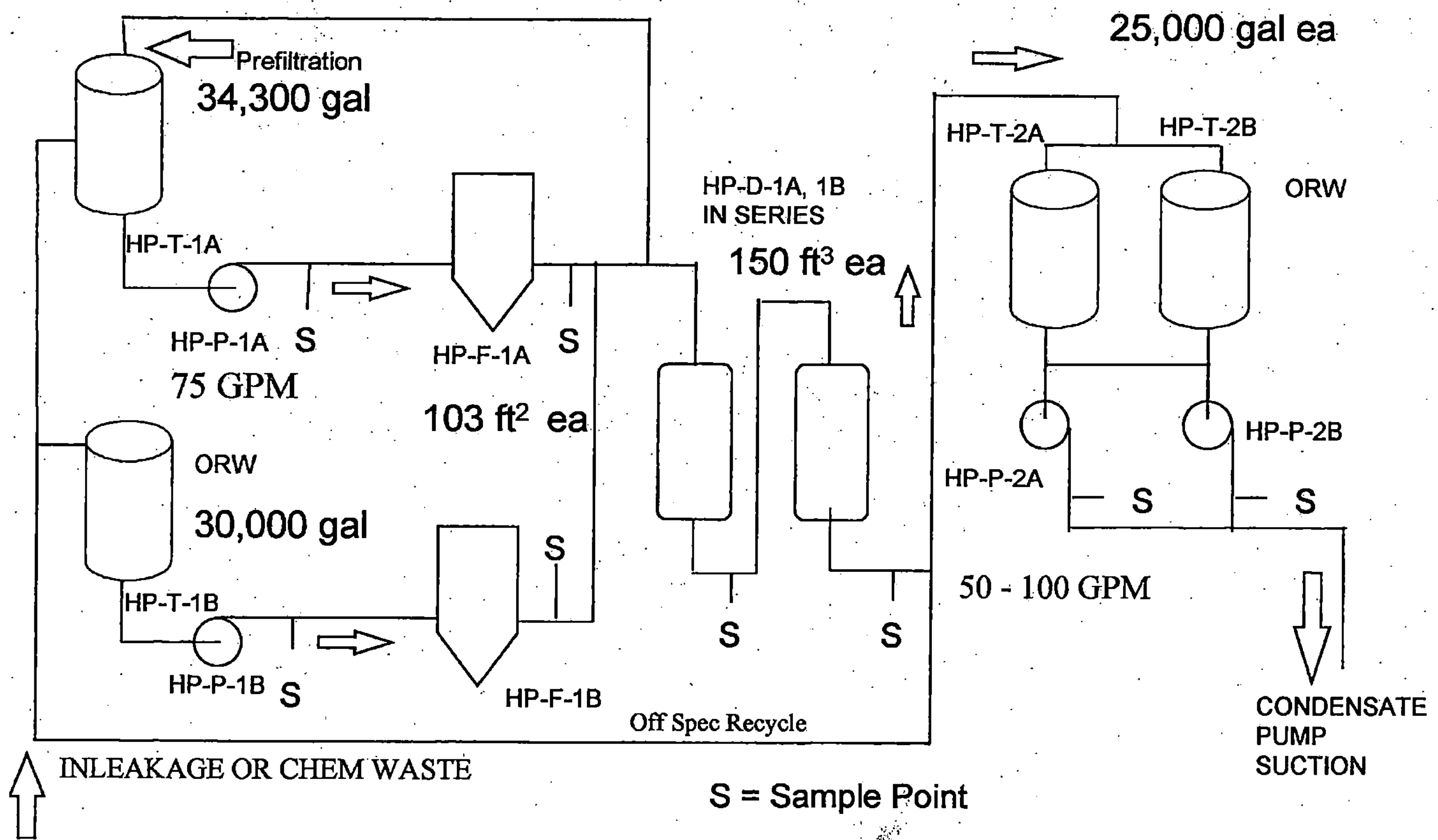

FIGURE D-1-1c: GROUNDWATER RELEASE SYSTEM

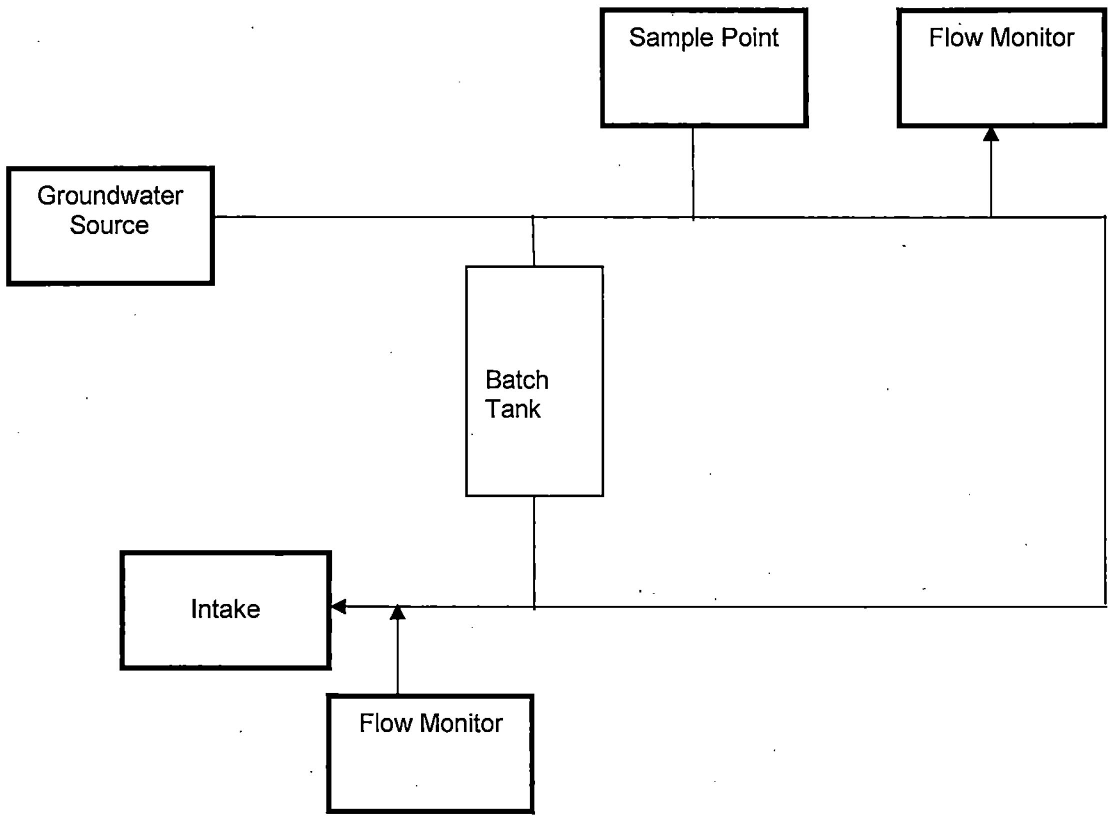

FIGURE D-1-2: SOLID RADWASTE PROCESSING SYSTEM

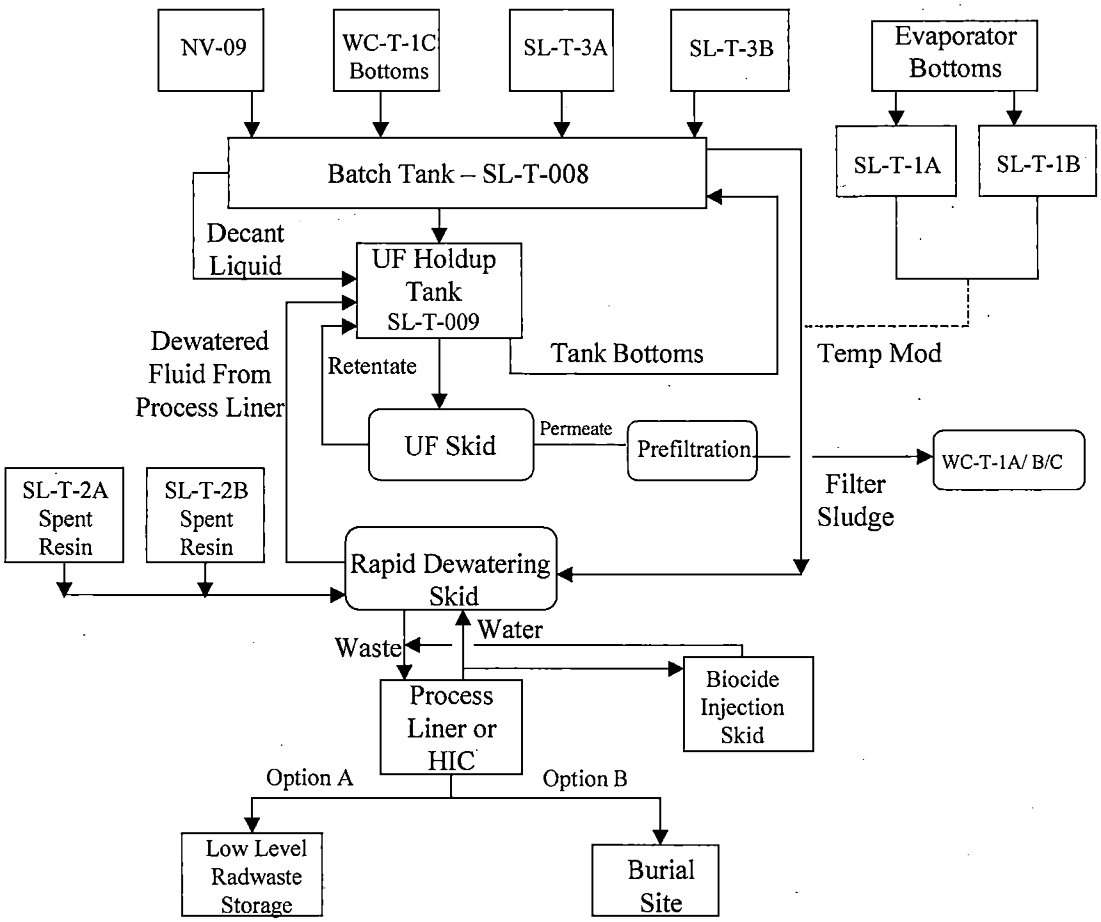

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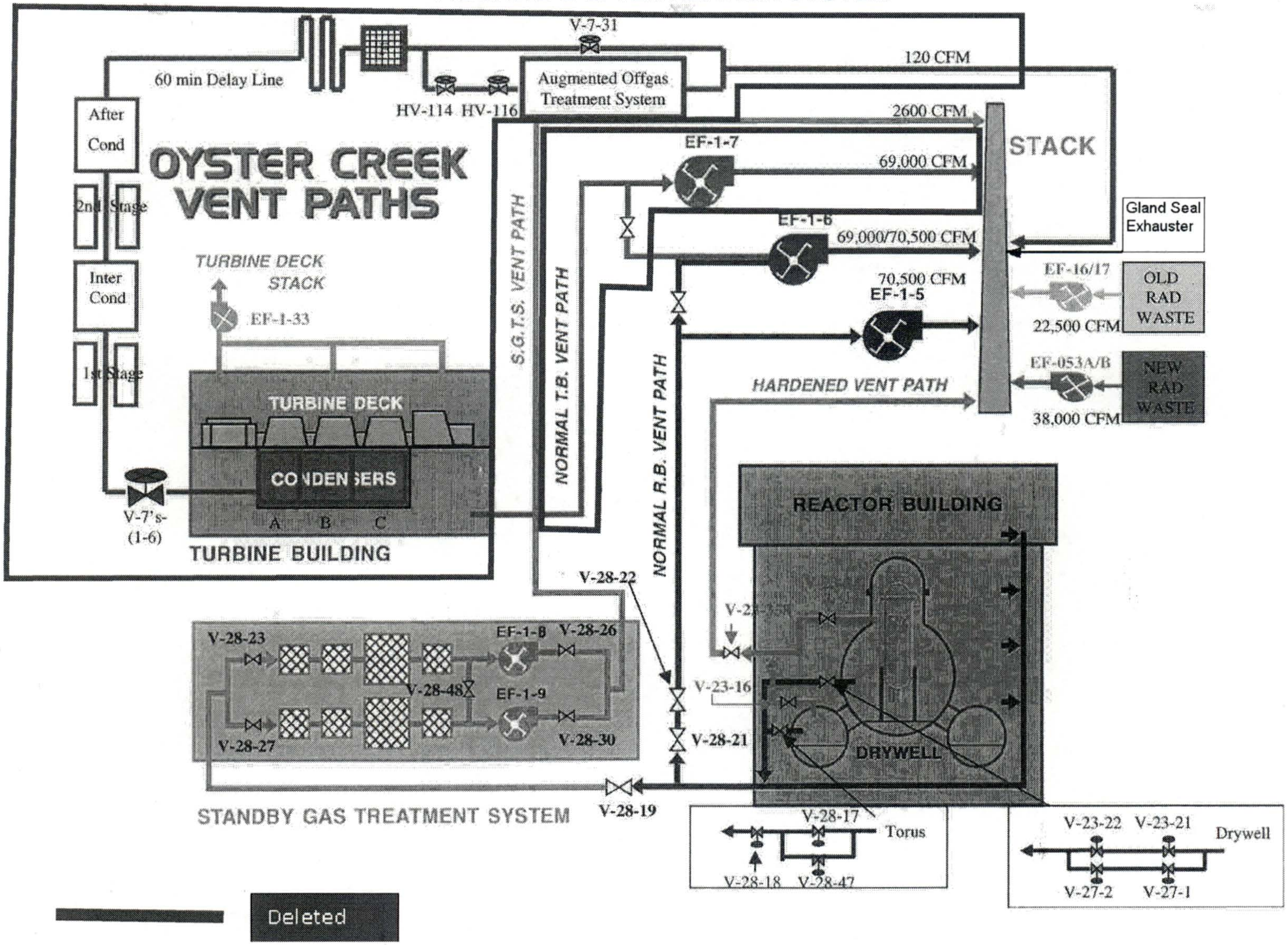
FIGURE D-2-2: VENTILATION SYSTEM



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APPENDIX E - RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - SAMPLE TYPE AND LOCATION

All sampling locations and specific information about the individual locations are given in Table E-1. Figures E-1, E-2 and E-3 show the locations of sampling stations with respect to the site. Figure E-4 shows the site layout.

TABLE E-1: REMP SAMPLE LOCATIONS[(1)]

1. Direct Radiation

DOS - Inner Ring at or near site boundary

Code	(miles)	(degrees)	Description
1	0.4	219	SW of site at OCGS Fire Pond, Forked River, NJ
51	0.4	358	North of site, on the access road to Forked River Site, Forked River, NJ
52	0.3	333	NNW of site, on the access road to Forked River Site, Forked River, NJ
53	0.3	309	NW of site, at sewage lift station on the access road to the Forked River Site, Forked River, NJ
54	0.3	288	WNW of site, on the access road to Forked River Site, Forked River, NJ
55	0.3	263	West of site, on Southern Area Stores security fence, west of OCGS Switchyard, Forked River, NJ
56	0.3	249	WSW of site, on utility pole east of Southern Area Stores, west of the OCGS Switchyard, Forked River, NJ
57	0.2	206	SSW of site, on Southern Area Stores access road, Forked River, NJ
58	0.2	188	South of site, on Southern Area Stores access road, Forked River, NJ
59	0.3	166	SSE of site, on Southern Area Stores access road, Waretown, NJ
61	0.3	104	ESE of site, on Route 9 south of OCGS Main Entrance, Forked River, NJ
62	0.2	83	East of site, on Route 9 at access road to OCGS Main Gate, Forked River, NJ
63	0.2	70	ENE of site, on Route 9, between main gate and OCGS North Gate access road, Forked River, NJ
64	0.3	42	NE of site, on Route 9 North at entrance to Finninger Farm, Forked River, NJ
65	0.4	19	NNE of site, on Route 9 at Intake Canal Bridge, Forked River, NJ
66	0.4	133	SE of site, east of Route 9 and south of the OCGS Discharge Canal, inside fence, Waretown, NJ
112	0.2	178	S of site, along Southern access road, Lacey Township, NJ

TABLE E-1: REMP SAMPLE LOCATIONS (CONTINUED)

1. Direct Radiation (Continued)

DOS - Inner Ring at or near site boundary

Code	(miles)	(degrees)	Description
113	0.3	90	E of site, along Rt. 9 North, Lacey Township, NJ
T1	0.4	219	SW of site, at OCGS Fire Pond, Lacey Township, NJ
DOS - Outer Ring at 6 - 8 km			
4	4.6	213	SSW of Site, Garden State Parkway and Route 554, Barnegat, NJ
5	4.2	353	North of Site, Garden State Parkway Rest Area, Forked River, NJ
6	2.1	13	NNE of site, Lane Place, behind St. Pius Church, Forked River, NJ
8	2.3	177	South of site, Route 9 at the Waretown Substation, Waretown, NJ
9	2.5	230	WSW of site, where Route 532 and the Garden State Parkway meet, Waretown, NJ
22	1.6	145	SE of site, on Long John Silver Way, Skippers Cove, Waretown, NJ
46	5.6	323	NW of Site, on Lacey Road adjacent to Utility Pole BT 259 65
47	4.6	26	NNE of Site, Route 9 and Harbor Inn Road, Berkeley Township, NJ
48	4.5	189	South of Site, Intersection of Brook and School Streets, Barnegat, NJ
68	1.3	266	West of site, on Garden State Parkway North at mile marker 71.7, Lacey Township, NJ
73	1.8	108	ESE of site, on Bay Parkway, Sands Point Harbor, Waretown, NJ
74	1.8	88	East of site, Orlando Drive and Penguin Court, Forked River, NJ
75	2.0	71	ENE of site, Beach Blvd. and Maui Drive, Forked River, NJ
78	1.8	2	North of site, 1514 Arient Road, Forked River, NJ
79	2.9	160	SSE of site, Hightide Drive and Bonita Drive, Waretown, NJ
82	4.4	36	NE of site, Bay Way and Clairmore Avenue, Lanoka Harbor, NJ
84	4.4	332	NNW of site, on Lacey Road, 1.3 miles west of the Garden State Parkway on siren pole, Lacey Township, NJ

TABLE E-1: REMP SAMPLE LOCATIONS (CONTINUED)

1. Direct Radiation (continued)

DOS - Outer Ring at 6 - 8 km (continued)

Code	(miles)	(degrees)	Description
85	3.9	250	WSW of site, on Route 532, just east of Wells Mills Park, Waretown, NJ
86	5.0	224	SW of site, on Route 554, 1 mile west of the Garden State Parkway, Barnegat, NJ
98	1.6	318	NW of site, on Garden State Parkway at mile marker 73.0, Lacey Township, NJ
99	1.5	310	NW of site, on Garden State Parkway at mile marker 72.8, Lacey Township, NJ
100	1.4	43	NE of site, Yacht Basin Plaza South off Lakdeside Dr., Lacey Township, NJ
101	1.7	49	NE of site, end of Lacey Rd., East, Lacey Township, NJ
102	1.6	344	NNW of site, end of Sheffield Dr., Barnegat Pines, Lacey Township, NJ
103	2.4	337	NNW of site, Llewellyn Parkway, Barnegat Pines, Lacey Township, NJ
104	1.8	221	SW of site, Rt. 532 West, before Garden State Parkway, Ocean Township, NJ
105	2.8	222	SW of site, Garden State Parkway North, beside mile marker 69.6, Ocean Township, NJ
106	1.2	288	WNW of site, Garden State Parkway North, beside mile marker 72.2 Lacey Township, NJ
107	1.3	301	WNW of Site, Garden State Parkway North, beside mile marker 72.5, Lacey Township, NJ
109	1.2	141	SE of site, Lighthouse Dr., Waretown, Ocean Township, NJ
110	1.5	127	SE of site, Tiller Drive and Admiral Way, Waretown, Ocean Township, NJ
DOS - Special Interest			
11	8.2	152	SSE of site, 80th and Anchor Streets, Harvey Cedars, NJ
71	1.6	164	SSE of site, on Route 532 at the Waretown Municipal Building, Waretown, NJ
72	1.9	25	NNE of site, on Lacey Road at Knights of Columbus Hall, Forked River, NJ

TABLE E-1: REMP SAMPLE LOCATIONS (CONTINUED)

1. Direct Radiation (continued)

DOS - Special Interest (continued)

Code	(miles)	(degrees)	Description
81	3.5	201	SSW of site, on Rose Hill Road at intersection with Barnegat Boulevard, Barnegat, NJ
88	6.6	125	SE of site, eastern end of 3rd Street, Barnegat Light, NJ
89	6.1	108	ESE of site, Job Francis residence, Island Beach State Park
90	6.3	75	ENE of site, parking lot A-5, Island Beach State Park
92	9.0	46	NE of site, at Guard Shack/Toll Booth, Island Beach State Park
3	6.0	97	East of site, near old Coast Guard Station, Island Beach State Park Special Interest Area

DOS - Background

Code	(miles)	(degrees)	Description
C	24.7	313	NW of site, JCP&L office in rear parking lot, Cookstown, NJ
14	20.8	2	North of site, Larrabee Substation on Randolph Road, Lakewood, NJ

2. Airborne - Radioiodines and Particulates

APT, AIO - At or near site boundary in highest D/Q Sectors

Code	(miles)	(degrees)	Description
20	0.7	95	East of site, on Finninger Farm on south side of access road, Forked River, NJ
66	0.4	133	SE of site, east of Route 9 and south of the OCGS Discharge Canal, inside fence, Waretown, NJ
111	0.3	64	ENE of site, Finninger Farm property along access road, Lacey Township, NJ

APT, AIO -Special Interest

Code	(miles)	(degrees)	Description
71	1.6	164	SSE of site, on Route 532 at the Waretown Municipal Building, Waretown, NJ
72	1.9	25	NNE of site, on Lacey Road at Knights of Columbus Hall, Forked River, NJ
73	1.8	108	ESE of site, on Bay Parkway, Sands Point Harbor, Waretown, NJ
3	6.0	97	East of site, near old Coast Guard Station, Island Beach State Park Special Interest Area

TABLE E-1: REMP SAMPLE LOCATIONS (CONTINUED)

2. Airborne - Radioiodines and Particulates (continued)

APT, AIO – Backgound(continued)

Code	(miles)	(degrees)	Description
C	24.7	313	NW of site, JCP&L office in rear parking lot, Cookstown, NJ

3. Waterborne

SWA - Surface			
23	3.6	64	ENE of site, Barnegat Bay off Stouts Creek, approximately 400 yards SE of "Flashing Light 1"
24	2.1	101	East of site, Barnegat Bay, approximately 250 yards SE of "Flashing Light 3"
33	0.4	123	ESE of site, east of Route 9 Bridge in OCGS Discharge Canal
SWA - Backgound			
94	20.0	198	SSW of site, in Great Bay/Little Egg Harbor
GW - Ground			
W-3C	0.4	112	ESE of site on Finninger Farm adjacent to Station 35, Lacey Township, NJ
MW-24-3A	0.8	97	E of site on Finninger Farm on South side of access road, Lacey Township, NJ
DW - Drinking			
1S	0.1	209	On-site southern domestic well at OCGS, Forked River, NJ
1N	0.2	349	On-site northern domestic well at OCGS, Forked River, NJ
38	1.6	197	SSW of Site, on Route 532, at Ocean Township MUA Pumping Station, Waretown, NJ
114	0.8	267	Well at Bldg 25 on Forked River site
DW - Backgound			
37	2.2	18	NNE of Site, off Boox Road at Lacey MUA Pumping Station, Forked River, NJ
AQS - Sediment			
23	3.6	64	ENE of site, Barnegat Bay off Stouts Creek, approximately 400 yards SE of "Flashing Light 1"

24	2.1	101	East of site, Barnegat Bay, approximately 250 yards SE of "Flashing Light 3"
33	0.4	123	ESE of site, east of Route 9 Bridge in OCGS Discharge Canal

TABLE E-1: REMP SAMPLE LOCATIONS (CONTINUED)

3. Waterborne (continued)

AQS - Backgound

Code	(miles)	(degrees)	Description
94	20.0	198	SSW of site, in Great Bay/Little Egg Harbor

4. Ingestion

FISH - Fish			
93	0.1	242	WSW of site, OCGS Discharge Canal between Pump Discharges and Route 9, Forked River, NJ
FISH - Backgound			
94	20.0	198	SSW of site, in Great Bay/Little Egg Harbor
CLAM - Clams			
23	3.6	64	ENE of site, Barnegat Bay off Stouts Creek, approximately 400 yards SE of "Flashing Light 1"
24	2.1	101	East of site, Barnegat Bay, approximately 250 yards SE of "Flashing Light 3"
CLAM - Backgound			
94	20.0	198	SSW of site, in Great Bay/Little Egg Harbor
CRAB - Crabs			
33	0.4	123	ESE of site, east of Route 9 Bridge in OCGS Discharge Canal
93	0.1	242	WSW of site, OCGS Discharge Canal between Pump Discharges and Route 9, Forked River, NJ
VEG - Vegetation			
35	0.4	111	ESE of site, east of Route 9 and north of the OCGS Discharge Canal, Forked River, NJ
66	0.4	133	SE of site, east of Route 9 and south of the OCGS Discharge Canal, inside fence, Waretown, NJ
115	0.3	96	East of Site, on Finninger Farm
VEG - Backgound			
36	23.1	319	NW of site, at "U-Pick" Farm, New Egypt, NJ

SAMPLE MEDIUM IDENTIFICATION KEY

APT = Air Particulate	SWA = Surface Water	DOS = Dosimeter
AIO = Air Iodine	AQS = Aquatic Sediment	FISH = Fish
	CLAM = Clams	CRAB =Crab
VEG = Vegetables	DW = Drinking Water	GW = Ground Water

(1) Samples may not be collected from some locations listed in this table, as long as the minimum number of samples listed in Table 3.12.1-1 is collected.

FIGURE E-1

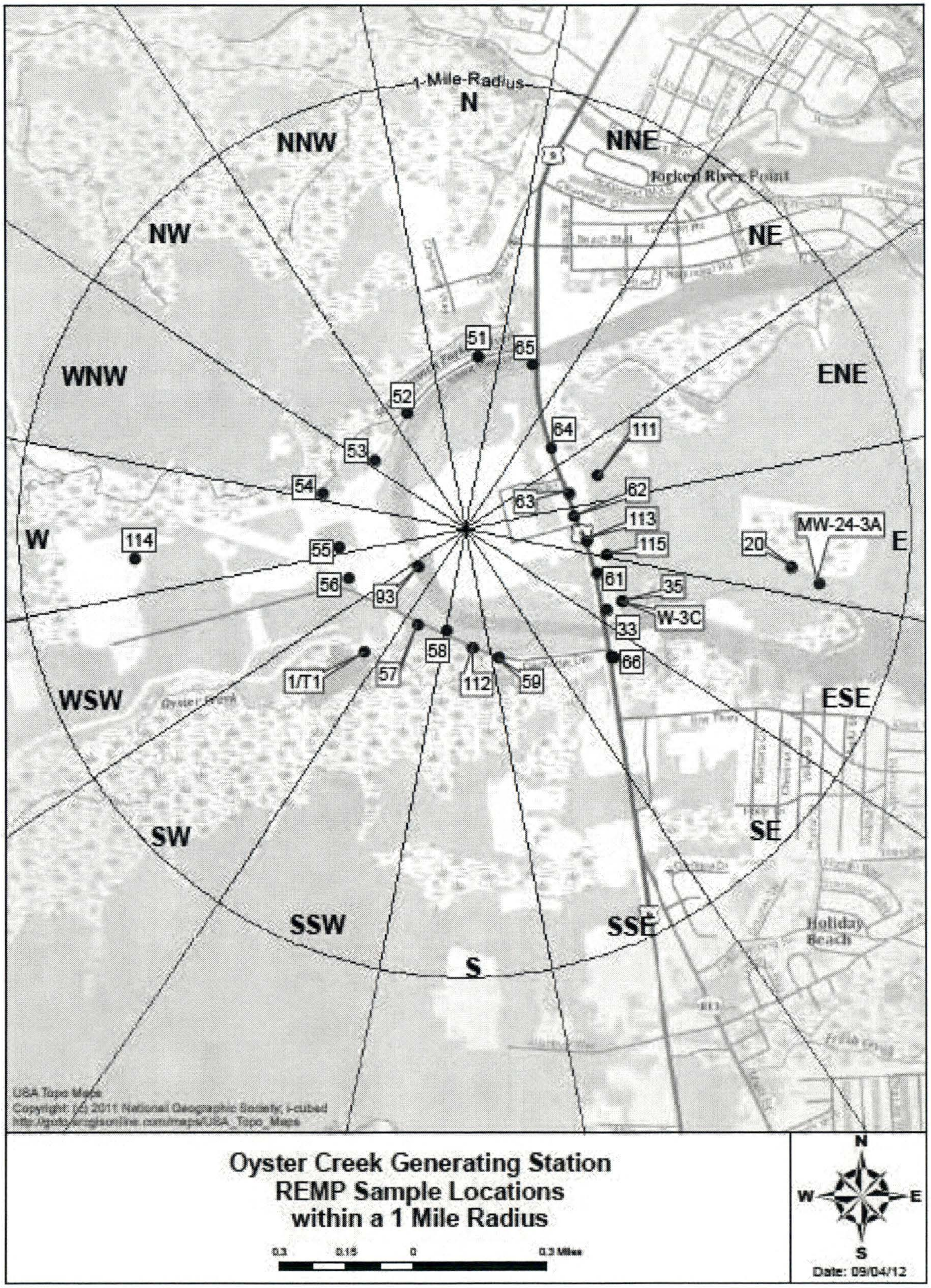
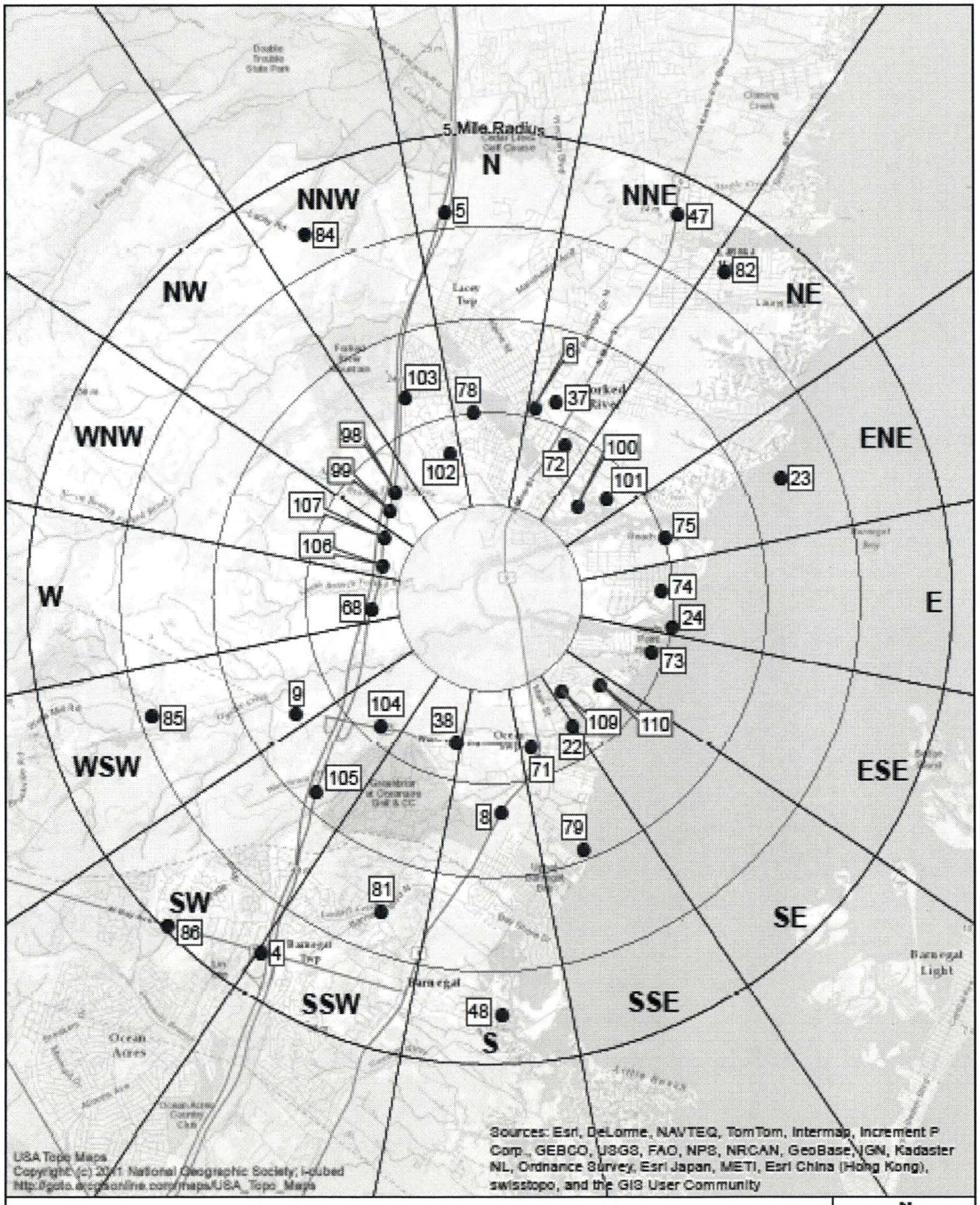

1-Mile-Radius
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
Forked River Point
Holiday Beach
51
85
52
64
111
53
54
63
62
113
115
114
55
20
MW-24-3A
56
93
61
35
W-3C
33
58
86
1/T1
57
112
59
USA Topo Maps
Copyright: (c) 2011 National Geographic Society, i-cubed
Oyster Creek Generating Station
REMP Sample Locations
within a 1 Mile Radius
0.3
0.15
0
0.3 Miles
N
W
E
S
Date: 09/04/12

FIGURE E-2



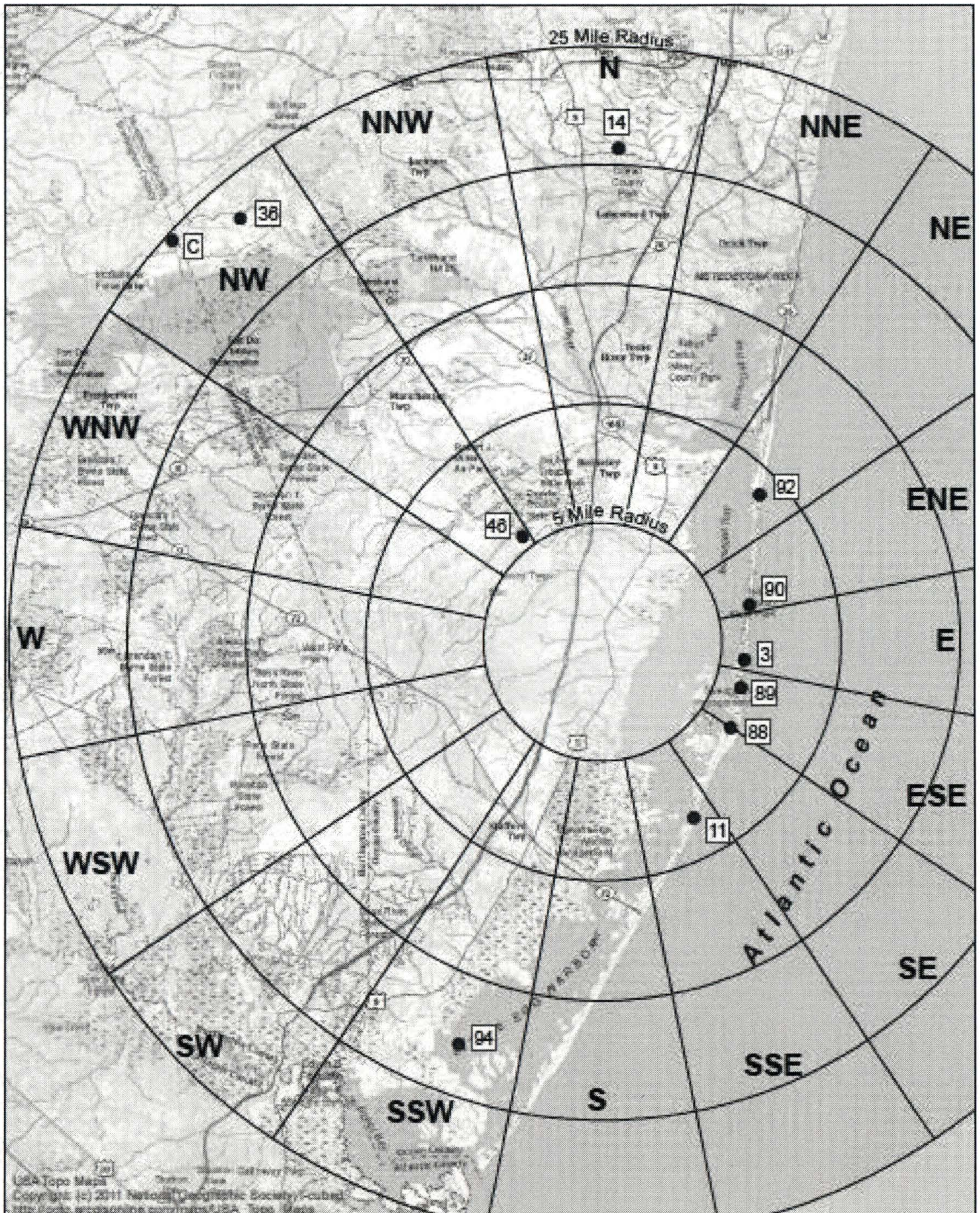
Oyster Creek Generating Station
REMP Sample Locations
within a 1 to 5 Mile Radius

1.5 0.75 0 1.5 Miles

N W E S

Date: 08/26/15

FIGURE E-3



Oyster Creek Generating Station
REMP Sample Locations
over a 5 Mile Radius

5.5 2.75 0 5.5 Miles

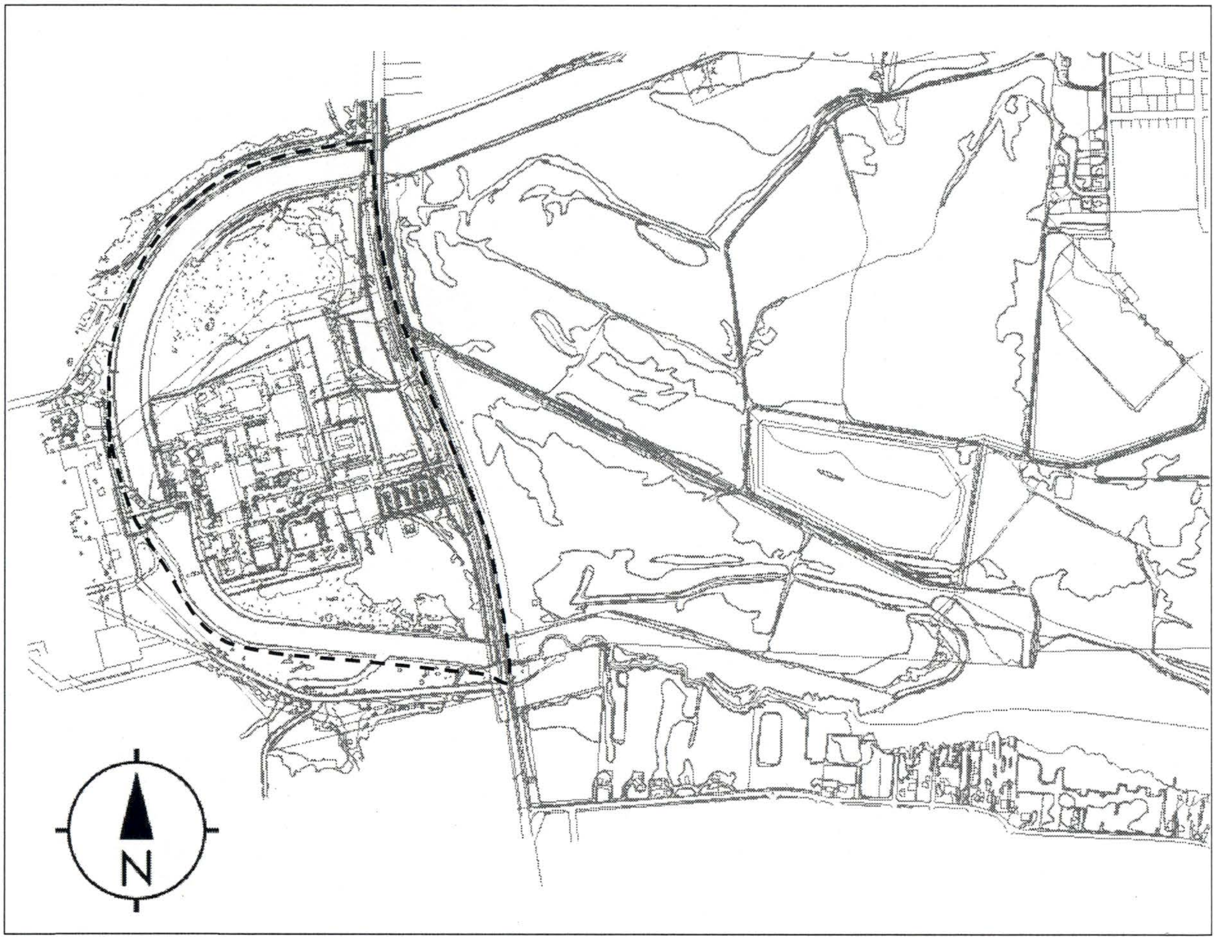
N W E S

Date: 08/27/12

FIGURE E-4

AREA PLOT PLAN OF SITE

SITE MAP DEFINING UNRESTRICTED AREAS AND SITE BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS



Site Boundary Distances

Sector	Distance in meters	Sector	Distance in meters
S	348	N	584
SSW	291	NNE	621
SW	229	NE	373
WSW	260	ENE	338
W	239	E	360
WNW	284	ESE	491
NW	364	SE	544
NNW	474	SSE	395