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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Donald C. Cook Nuclear Plant Units 1 and 2
2017 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

In accordance with Technical Specification 5.6.3, Indiana Michigan Power Company, the licensee for Donald C. Cook Nuclear Plant (CNP) Units 1 and 2, is providing the Annual Radioactive Effluent Release Report as Enclosure 1 to this letter. This report covers the period January 1, 2017, through December 31, 2017. Additionally, this letter provides updated revisions to the 2013, 2014, 2015, and 2016 Annual Radioactive Effluent Release Reports (Enclosures 2 through 5), which incorporate changes to reported tritium values and their associated liquid dose. Revisions to the reports were necessitated when it was identified that the method used to analyze tritium values produced non-conservative results due to equipment limitations of the liquid scintillation counters. This condition was entered into CNP's corrective action program and all affected sample results were identified and corrected.

This letter contains no new or modified regulatory commitments. Should you have any questions, please contact me at (269) 466-2649.

Sincerely,

Michael K. Scarpello
Regulatory Affairs Director

MDS/kmh

IE48
NRR

Enclosures:

1. Donald C. Cook Nuclear Plant Units 1 and 2 - 2017 Annual Radioactive Effluent Release Report
2. Donald C. Cook Nuclear Plant Units 1 and 2 - 2016 Annual Radioactive Effluent Release Report, Revision 1
3. Donald C. Cook Nuclear Plant Units 1 and 2 - 2015 Annual Radioactive Effluent Release Report, Revision 1
4. Donald C. Cook Nuclear Plant Units 1 and 2 - 2014 Annual Radioactive Effluent Release Report, Revision 1
5. Donald C. Cook Nuclear Plant Units 1 and 2 - 2013 Annual Radioactive Effluent Release Report, Revision 1

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ENCLOSURE 1 to AEP-NRC-2018-35

**DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2017 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

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I. INTRODUCTION

This report discusses the radioactive discharges from Unit 1 and Unit 2 of the Donald C. Cook Nuclear Plant (CNP) during 2017. This is in accordance with the requirements of CNP Technical Specification (TS) 5.6.3.

The table below summarizes the pertinent statistics concerning the Plant's operation during the period from January 1, 2017, to December 31, 2017. The data in this table and the descriptive information on plant operation are based upon the respective unit's Monthly Operating Reports, Performance Indicators, and Control Room Logs for 2017.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	7,497,698	10,638,976
Unit Service Factor (Percent (%))	79.1	99.5
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	80.5	101.0

Unit 1 entered the reporting period in Mode 1 at Nominal Full Power (NFP). Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit performed a normal downpower and was manually tripped on September 13, 2017, entering refueling outage U1C28. The unit attained criticality on November 26, 2017, and attained NFP on December 2, 2017. The unit exited the reporting period at NFP.

Unit 2 entered the reporting period in Mode 5 preparing for startup. Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit attained criticality on January 1, 2017, and attained NFP on January 14, 2017. The unit exited the reporting period at NFP.

II. RADIOACTIVE RELEASES AND RADIOLOGICAL IMPACT ON MAN

Since a number of release points are common to both units, the release data from both units are combined to form this two-unit, Annual Radioactive Effluent Release Report (ARERR). Appendix A1.1 through A2.4 of this report present the information in accordance with Section 5.6.3 of Appendix A to the Facility Operating Licenses, as specified in the Technical Specifications, Regulatory Guide 1.21, and 10 CFR Part 50, Appendix I.

The "MIDAS System" is a computer code that calculates doses due to radionuclides that were released from the CNP.

All liquid and gaseous releases were well within Offsite Dose Calculation Manual (ODCM) limits and federal limits.

There were no abnormal liquid or gaseous releases in 2017. There were no spills or leaks of radioactive liquids requiring voluntary notifications per the Industry Groundwater

Protection Initiative or site procedures.

The Independent Spent Fuel Storage Installation (ISFSI) impacts are included with Unit 1 and Unit 2 statistics. The ISFSI cask system does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Technical Specifications for the HI-Storm 100 Cask System, Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the ISFSI.

Liquid Releases

During 2017 there were 79 liquid batch releases performed. The number of liquid batch releases for the 1st, 2nd, 3rd, and 4th quarters in 2017 were 15, 10, 25, and 29, respectively.

Estimated doses (in mrem) to maximally exposed individuals via the liquid release pathways are given in Appendix A1.2 of this report.

Gaseous Releases

During the first quarter of 2017 there were four batch releases from Gas Decay Tanks (GDT) and 138 Containment Pressure Reliefs (CPR). During the second quarter there was one batch release from GDTs and 91 CPR. During the third quarter there were three batch releases from GDTs, one containment purge, one system tank vent, and 78 CPR. During the fourth quarter there were seven batch releases from GDTs and 60 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89017 (DRSS); 50-316/89016 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There were a total of 15 GDT releases, one containment purge, one system tank vent, and 367 CPR gaseous batch releases made during 2017.

In calculating the dose consequences for continuous and batch gaseous releases during 2017, the meteorological data measured at the time of the release were used.

The estimated doses (in mrem) to maximally exposed individuals via the gaseous release pathways are given in Appendix A1.2 of this report. For individuals that are within the site boundary, the occupancy time is sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary.

Solid Waste Disposition

There were 31 shipments of radioactive waste made during 2017. These included shipments made from the site to various radioactive waste processors for ultimate disposal.

III. METEOROLOGICAL

Appendices A2.1, A2.2, A2.3, and A2.4 of this report contain the cumulative joint

frequency distribution tables of wind speed and wind direction, corresponding to the various atmospheric stability classes for the first, second, third, and fourth quarters of 2017. Hourly meteorological data is available for review and/or inspection upon request.

IV. OFFSITE DOSE CALCULATION MANUAL (ODCM) CHANGES

The ODCM, PMP-6010-OSD-001, was not revised during the report period.

V. TOTAL DOSE

Section 3.2.5 of the ODCM requires that the dose or dose commitment to a real individual from all uranium fuel cycle sources in Berrien County be limited to no more than 25 mrem to the total body or any organ (except the thyroid, which is limited to no more than 75 mrem) over a period of 12 consecutive months to show conformance with the requirements of 40 CFR Part 190. The maximum cumulative dose to an individual from liquid and gaseous effluents during 2017 was well within the ODCM limits. Measurements using thermoluminescent dosimeters (TLD) at 12 onsite stations indicate that the dose due to direct radiation is consistent with preoperational and current control (background) levels. This is fully evaluated in CNP's 2017 Annual Radiological Environmental Operating Report. Additional TLD dosimetry installed by Radiation Protection department programs monitor dose received by individuals on site as visitors.

The annual dose to the maximum individual will be estimated by first, summing the quarterly total body air dose, the quarterly skin air dose, the quarterly critical organ dose from iodines and particulates (I&P), the quarterly total body dose from liquid effluents, the quarterly critical organ dose from liquid effluents, and the Radiological Environmental Monitoring Program onsite direct radiation TLD data. These quarterly values are summed with the annual Carbon-14 dose and compared to the annual total body limit for conservative reasons. The table that follows here represents the above written description:

Dose (mrem)	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
I & P	1.43E-02	2.11E-02	2.92E-02	2.86E-02
Total Body Air	2.50E-04	7.50E-04	1.40E-03	3.30E-04
Skin	4.10E-04	1.20E-03	2.50E-03	9.10E-04
Liquid TB	2.71E-03	5.34E-03	2.89E-02	2.37E-02
Liquid Organ	2.80E-03	5.37E-03	2.89E-02	2.39E-02
C14 (Annual)				2.25E+00
Direct Radiation	0	0	0	0
Total	2.05E-02	3.38E-02	9.09E-02	2.33E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.47E+00
Annual Dose Limit (mrem)				25
Percent of limit				9.89E+00

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2017 annual dose data, and 2017 annual dose data with C-14 added. This indicates that 2017 annual dose was 'typical' for a single unit outage year in regards to

radioactive effluents. The table is presented as follows:

	Annual Dose (mrem)	% of limit
2009	2.60E-01	1.04
2017	2.23E-01	0.89
2017 with C-14	2.47	9.89

VI. **RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS**

There were no release pathways unmonitored for greater than 30 days.

VII. **NOTEWORTHY CONDITIONS IDENTIFIED IN 2017**

There was an issue identified where the accuracy of tritium analyses was found to be adversely impacted due to liquid scintillation counter problems. Investigations determined that the problem affected all high level tritium samples dating back to 2013. Corrective Action 2017-4835 was initiated and resolved the counter problem. One of the actions taken was to revise the ARERRs performed during the affected period and to submit "Errata" for any impacted years. Those revised ARERRs have been enclosed in this report as noted in Section IX.

Carbon-14 Supplemental Information for the 2017 Annual Radioactive Effluent Release Report.

C-14 has a 5730 year half-life and is a naturally occurring radionuclide produced by cosmic ray interactions in the atmosphere. C-14 is a relatively low energy beta emitter. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally, from weapons testing, or coal burning power plants. The inventory of C-14 in Earth's biosphere is about 300 million Curies, of which most is in the oceans.

Since the U.S. Nuclear Regulatory Commission (NRC) published Regulatory Guide (RG) 1.21, Revision 1, in 1974, the analytical methods for determining C-14 have improved. Coincidentally, the radioactive effluents from commercial nuclear power plants over the same period have decreased to the point that C-14 is likely to be a principal radionuclide in gaseous effluents. Based on these reasons and a desire to adjust policy to align with international standards, the nuclear industry was required to report, starting in 2010, the quantity and dose impact of C-14 here in the United States. The dose will be reported both with and without C-14 so a comparison to 2009 can be made, keeping in mind the differing standards.

The quantity of C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. RG 1.21, Revision 2). A recent study recommends a source term scaling factor of approximately 9.0 to 9.8 Curies/GWe-yr for a

Westinghouse Pressurized Water Reactor (Ref. EPRI 1021106, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents", dated December 23, 2010). A scaling factor of 9.4 Curies/GWe-yr was assumed for this report. Using this source term scaling factor and actual electrical generation (in MWH) produced during 2017 results in a site total of 19.5 Curies produced.

C-14 releases from Pressurized Water Reactors (PWR) occur primarily as a mix of organic carbon (methane) and inorganic carbon (carbon dioxide). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as gas. Any time the primary coolant is exposed to an oxidizing environment (during shutdown or refueling), a slow transformation from an organic to an inorganic species occurs. Various studies documenting measured C-14 releases from PWRs suggest an average 80% organic fraction with the remainder being carbon dioxide, of which 70% is assumed to be released from gaseous batch releases. This equates to 2.73 Curies released as carbon dioxide which is available for the food pathway through photosynthesis to vegetation.

Dose is calculated utilizing the methodology prescribed in RG 1.109, Appendix C, with the vegetation dose being the predominant. A 'p' factor of 0.33 is determined utilizing the time of batch gaseous releases performed during 2017 and the time available for photosynthesis in plants. A further reduction to the vegetation and leafy vegetable dose is warranted due to the limited growing season in Michigan, which was conservatively limited to nine months.

The final results indicated a calculated organ dose from C-14 to a child at the site boundary of 1.88 mrem to the bone and a whole body dose of 0.374 mrem, for a combined total C-14 dose of 2.25 mrem. This is less than the dose limit of 15 mrem/unit to any organ prescribed in 10 CFR 50, Appendix I, and the 40 CFR Part 190 limit of 25 mrem for total body and for any organ (≤ 75 mrem for thyroid).

VIII. CONCLUSION

Based on the information presented in this report, it is concluded that CNP Units 1 and 2 performed their intended design function with no demonstrable adverse effect on the health and safety of the general public.

IX. ERRATA

There are errata documents attached for 2017. The errata includes updated revisions of the 2013, 2014, 2015, and 2016 reports, incorporating changes to reported tritium values and their associated liquid dose. Changes were necessitated due to problems associated with liquid scintillation counters, and all affected sample results were identified and corrected per our Corrective Actions Program. These revisions do not show any adverse impact on the health and safety of the general public.

2017 Effluent and Waste Disposal Annual Report

SUPPLEMENTAL INFORMATION

Facility: Donald C. Cook Nuclear Plant
Licensee: Indiana Michigan Power Company

1 REGULATORY LIMITS

1.1 Noble Gases

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be limited to the following:

1.1.1 During any calendar quarter, to ≤ 5 mrad/unit for gamma radiation and ≤ 10 mrad/unit for beta radiation.

1.1.2 During any calendar year, to ≤ 10 mrad/unit for gamma radiation and ≤ 20 mrad/unit for beta radiation.

1.2 Iodines - Particulates

The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to unrestricted areas shall be limited to the following:

1.2.1 During any calendar quarter to ≤ 7.5 mrem/unit to any organ.

1.2.2 During any calendar year to ≤ 15 mrem/unit to any organ.

1.3 Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited:

1.3.1 During any calendar quarter to ≤ 1.5 mrem/unit to the total body and to ≤ 5 mrem/unit to any organ.

1.3.2 During any calendar year to ≤ 3 mrem/unit to the total body and to ≤ 10 mrem/unit to any organ.

2017 Effluent and Waste Disposal Annual Report

1.4 Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2 MAXIMUM PERMISSIBLE CONCENTRATIONS

2.1 Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site shall be limited to the following:

2.1.1 For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.

2.1.2 For all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days: ≤ 1500 mrem/yr to any organ.

The above limits are provided to insure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits in 10 CFR Part 20, Appendix B, Table 2, Column 1.

2.2 Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

2017 Effluent and Waste Disposal Annual Report

3 AVERAGE ENERGY

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public. Release rates are calculated using an isotopic mix from actual samples rather than average energy.

4 MEASUREMENTS and APPROXIMATIONS of TOTAL RADIOACTIVITY

4.1 Fission and Activation Gases

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters.

4.2 Iodines

Sampled on iodine adsorbing media, and analyzed on an 8192 channel analyzer and HpGe detector.

4.3 Particulates

Sampled on a glass filter and analyzed on an 8192 channel analyzer and HpGe detector. Sr-89 and Sr-90 analyses are performed by offsite vendor.

4.4 Liquid Effluents

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters. Fe-55, Sr-89 and Sr-90 analyses are performed by an offsite vendor. Ni-63 is also currently being analyzed by the offsite vendor in response to evaluation of the 10 CFR 61 sample results.

2017 Effluent and Waste Disposal Annual Report

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

15 releases in the 1st quarter, 2017
10 releases in the 2nd quarter, 2017
25 releases in the 3rd quarter, 2017
29 releases in the 4th quarter, 2017

5.1.2 Total time period for batch releases:

46,897 minutes

5.1.3 Maximum time for a batch release:

1,648 minutes

5.1.4 Average time period for batch release:

594 minutes

5.1.5 Minimum time period for a batch release:

150 minutes

5.1.6 Average stream flow during periods of release of effluent into a flowing stream:

7.59E+5 gpm circulating water

2017 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

142 releases in the 1st quarter, 2017
92 releases in the 2nd quarter, 2017
83 releases in the 3rd quarter, 2017
67 releases in the 4th quarter, 2017

5.2.2 Total time period for batch releases:

11,315 minutes

5.2.3 Maximum time for a batch release:

354 minutes

5.2.4 Average time period for batch release:

29.5 minutes

5.2.5 Minimum time period for a batch release:

5 minutes

2017 Effluent and Waste Disposal Annual Report

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.1.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2 Gaseous

6.2.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.67E+01	1.67E+01	1.69E+01	2.66E+01
AR41	Ci	-----	-----	-----	-----
KR85	Ci	-----	-----	-----	-----
XE133	Ci	-----	-----	-----	-----
XE135	Ci	-----	-----	-----	-----
XE131m	Ci	-----	-----	-----	-----
XE133m	Ci	-----	-----	-----	-----
XE135m	Ci	-----	-----	-----	-----
Total for Period	Ci	2.67E+01	1.67E+01	1.69E+01	2.66E+01

2. IODINES					
I131	Ci	3.59E-06	6.31E-06	1.93E-05	3.07E-05
I132	Ci	-----	-----	-----	-----
I133	Ci	3.87E-05	9.03E-05	1.52E-04	9.81E-05
Total for Period	Ci	4.23E-05	9.66E-05	1.71E-04	1.29E-04

3. PARTICULATES					
MN54	Ci	-----	-----	-----	-----
CO60	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPEs

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	1.06E-01	1.05E-01	1.69E-01	8.20E-02
AR41	Ci	3.61E-01	4.88E-01	4.41E-01	1.50E-01
KR85	Ci	6.45E-01	1.03E-01	4.48E-01	4.48E-01
XE131M	Ci	-----	-----	-----	1.32E-04
XE133M	Ci	-----	-----	-----	-----
XE133	Ci	8.52E-02	1.62E-01	1.31E-01	3.39E-02
XE135m	Ci	-----	-----	-----	-----
XE135	Ci	1.11E-03	2.28E-03	1.59E-04	-----
Total for Period	Ci	1.20E+00	8.60E-01	1.19E+00	7.14E-01
2. IODINES					
I131	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----
3. PARTICULATES					
CS137	Ci	-----	-----	-----	-----
* BR82	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION GASES						

1. Total Release	Ci	1.09E+00	7.55E-01	1.02E+00	6.31E-01	11.4

2. Average release rate for period	uCi/sec	1.40E-01	9.61E-02	1.28E-01	7.94E-02	

3. Percent of applicable limit*	% Gamma Beta	1.11E-02 5.16E-03	2.63E-02 5.07E-03	5.01E-02 1.19E-02	1.10E-02 7.75E-03	

B. IODINES						

1. Total I-131	Ci	3.59E-06	6.31E-06	1.93E-05	3.07E-05	22.9

2. Average release rate for period	uCi/sec	4.62E-07	8.02E-07	2.42E-06	3.86E-06	

3. Percent of applicable limit*	%	1.32E-06	2.29E-06	6.90E-06	1.10E-05	

C. PARTICULATES						

1. Particulates with half lives > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit*	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

4. Gross alpha radioactivity	Ci	<7.65E-07	<5.30E-07	<7.14E-07	<9.03E-07	

D. TRITIUM						

1. Total Release	Ci	2.68E+01	1.68E+01	1.71E+01	2.67E+01	14.5

2. Average release rate for period	uCi/sec	3.45E+00	2.13E+00	2.15E+00	3.36E+00	

3. Percent of applicable limit*	%	1.96E-02	1.21E-02	1.23E-02	1.92E-02	

* Applicable limits are expressed in terms of dose. See Appendices A1.2-1 through A1.2-4

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	1.04E+02	2.06E+02	1.11E+03	8.31E+02
CR51	Ci	-----	-----	-----	-----
MN54	Ci	-----	-----	4.13E-07	-----
FE55	Ci	-----	-----	-----	-----
CO58	Ci	1.73E-05	1.14E-05	4.06E-05	2.12E-04
CO60	Ci	5.24E-06	4.66E-05	1.86E-05	2.03E-05
NI63	Ci	-----	-----	3.77E-04	-----
*KR85	Ci	-----	-----	-----	-----
ZR95	Ci	-----	-----	-----	-----
NB95	Ci	-----	-----	-----	1.08E-06
MO99	Ci	-----	-----	-----	-----
TC99m	Ci	-----	-----	3.67E-06	-----
AG110m	Ci	-----	-----	-----	1.17E-06
SB124	Ci	-----	-----	-----	-----
SB125	Ci	3.81E-06	-----	-----	8.14E-06
CS134	Ci	6.49E-06	-----	3.60E-07	2.62E-05
CS137	Ci	2.97E-05	9.01E-06	8.23E-06	3.97E-05
I131	Ci	-----	-----	-----	-----
*XE133	Ci	-----	-----	1.07E-04	1.87E-04
*XE133m	Ci	-----	-----	-----	3.47E-06
*XE135	Ci	-----	-----	2.20E-06	1.36E-06

* DENOTES SUPPLEMENTAL ISOTOPES

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
BATCH MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	6.25E-05	6.70E-05	4.49E-04	3.09E-04	12.6

2. Average diluted concentration during period	uCi/ml	4.74E-12	3.77E-12	8.70E-12	5.96E-12	

3. Percent of applicable limit	%	3.00E-04	1.41E-04	4.00E-05	1.67E-04	

B. TRITIUM						

1. Total Release	Ci	1.04E+02	2.06E+02	1.11E+03	8.31E+02	10.1

2. Average diluted concentration during period	uCi/ml	7.86E-06	1.16E-05	2.16E-05	1.60E-05	

3. Percent of applicable limit	%	7.86E-01	1.16E+00	2.16E+00	1.60E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	1.09E-04	1.89E-04	11.8

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	2.11E-12	3.64E-12	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	1.06E-06	1.82E-06	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

	Ci	<8.11E-05	<5.35E-05	<1.37E-04	<1.59E-04	N/A

E. VOLUME OF WASTE RELEASED						

	Liters	8.74E+05	5.77E+05	1.48E+06	1.71E+06	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

	Liters	1.32E+10	1.78E+10	5.16E+10	5.18E+10	3.48

2017 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
CONTINUOUS MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

B. TRITIUM						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

E. VOLUME OF WASTE RELEASED	Liters	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48

2017 Effluent and Waste Disposal Annual Report Solid Waste and Irradiated Fuel Shipments

Solid Waste Shipped Offsite for Burial or Disposal

1) Type of Waste	Unit	Estimated amount	Estimated Total Error, %
a) Spent resins, filters, sludge, evaporator bottoms, etc.	m ³ Curies	1.54E+01 1.20E+02	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m ³ Curies	7.40E+02 5.80E+00	1.00E+00 6.48E+00
c) Irradiated components, control rods, etc.	m ³ Curies		
d) Other (contaminated soil)	m ³ Curies		

2) Estimate of Principle Radionuclide Composition

a)	H-3	10 %	Co-58	1 %	Sb-125	1.5 %	Cs-137	1 %
	Mn-54	1 %	Co-60	10.5 %	Cs-134	0.5 %		
	Fe-55	9.0 %	Ni-63	65 %	C-14	0.5 %		
b)	Ni-59	1 %	Co-58	1 %	Sb-125	1.5 %		
	Mn-54	1.5 %	Co-60	43 %	Zr/Nb-95	0.5 %		
	Fe-55	35.5 %	Ni-63	14 %	Cs-137	1.5 %	C-14	0.5 %

3) Solid Waste Disposition

No. of Shipments	Mode of Transportation	Destination
30	Truck	Oak Ridge, TN
1	Truck	Erwin, TN

4) Type of Containers used for Shipment: Containers used are excepted packages, Type A, Sea Land, metal boxes, drums, tankers, and high integrity containers (HICs).

5) Solidification Agent: There were no solidifications performed during this report period.

2017 Effluent and Waste Disposal Annual Report Yearly Release Rates
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GASES		
Fission and Activation Gases	Total Release	3.50E+00 Curies
	Average Release Rate	1.11E-01 μ Ci/sec
	% of Applicable Limits*	γ 2.46E-02 % β 7.47E-03 %
Iodines	Total I-131 Release	5.99E-05 Curies
	Average Release Rate	1.90E-06 μ Ci/sec
	% of Applicable Limit*	3.11E-01 %
Particulates	Total Release	0.00E-00 Curies
	Average Release Rate	0.00E-00 μ Ci/sec
	% of Applicable Limit*	0.00E-00 %
LIQUIDS		
Fission and Activation Products	Total Release	8.88E-04 Curies
	Average Diluted Concentration	6.60E-12 μ Ci/ml
	% of Applicable Limits*	Total Body 1.01E+00 % Organ 3.05E-01 %

* Applicable limits are expressed in terms of the annual 10 CFR 50, Appendix I, dose limits.

Site Boundary and Nearest Residence Listing

The following distances were used in the calculation of the maximum individual doses:

<u>Sector</u>	<u>Direction</u>	<u>Boundary (Meters)</u>	<u>Nearest Residence (Meters)</u>
A	N	651	659
B	NNE	617	660
C	NE	789	943
D	ENE	1497	1747
E	E	1274	1716
F	ESE	972	1643
G	SE	629	1640
H	SSE	594	964
J	S	594	997
K	SSW	629	942

Summary of Maximum Individual Doses

First Quarter 2017

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.71E-03	Child	Receptor 1	1.81E-01	1.5E+0
Liquid	Liver	2.80E-03	Child	Receptor 1	5.59E-02	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	5.54E-04	Any Age	594 (S)	1.11E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	5.16E-04	Any Age	629 (SSW)	5.16E-03	1.0E+1
Iodines and Particulates	Thyroid	1.43E-02	Child	659 (N)	1.91E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2017

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	5.34E-03	Child	Receptor 1	3.56E-01	1.5E+0
Liquid	Liver	5.37E-03	Child	Receptor 1	1.07E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	1.31E-03	Any Age	617 (NNE)	2.63E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	5.07E-04	Any Age	617 (NNE)	5.07E-03	1.0E+1
Iodines and Particulates	Thyroid	2.11E-02	Child	660 (NNE)	2.81E-01	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2017

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.89E-02	Child	Receptor 1	1.92E+00	1.5E+0
Liquid	Liver	2.89E-02	Child	Receptor 1	5.77E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	2.51E-03	Any Age	651 (N)	5.01E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.19E-03	Any Age	651 (N)	1.19E-02	1.0E+1
Iodines and Particulates	Thyroid	2.92E-02	Child	659 (N)	3.89E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2017

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.37E-02	Child	Receptor 1	1.58E+00	1.5E+0
Liquid	Liver	2.39E-02	Child	Receptor 1	4.78E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	5.52E-04	Any Age	651 (N)	1.10E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	7.75E-04	Any Age	651 (N)	7.75E-03	1.0E+1
Iodines and Particulates	Thyroid	2.86E-02	Child	659 (N)	3.82E-01	7.5E+0

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-22D	MW-22M	MW-22S	MW-24D	MW-24M	MW-24S	MW-25D	MW-25M
01/18/2017	<LLD*							
01/19/2017		<LLD	<LLD					
03/30/2017				<LLD	<LLD	<LLD	<LLD	<LLD
04/21/2017				<LLD	<LLD	<LLD*		
04/24/2017							<LLD	<LLD
05/05/2017	<LLD	<LLD	<LLD					
08/07/2017				<LLD	<LLD	<LLD	<LLD	<LLD
09/23/2017	<LLD	<LLD	<LLD*					
10/07/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
11/17/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
11/25/2017							<LLD	<LLD

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-25S	MW-26D	MW-26M	MW-26S	MW-27D	MW-27M	MW-27S
03/30/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/24/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/07/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/25/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD*	<LLD

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)

Lower Limit of Detection = LLD

Date	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
01/03/2017							<LLD	<LLD
01/09/2017				<LLD	<LLD	<LLD		
01/16/2017	<LLD		<LLD					
01/19/2017		<LLD						
02/02/2017						<LLD		
03/09/2017						<LLD		
04/03/2017	<LLD							<LLD
04/04/2017			<LLD				<LLD	
04/05/2017		<LLD						
04/17/2017				<LLD	1.11e-6	<LLD		
05/19/2017					<LLD			
06/09/2017						<LLD		
07/13/2017		<LLD	<LLD					
07/14/2017	<LLD						<LLD	
07/19/2017				<LLD	<LLD	<LLD		
08/08/2017				<LLD				
09/13/2017				<LLD				
10/03/2017			<LLD					
10/05/2017	<LLD						<LLD	<LLD
10/07/2017		<LLD						
10/10/2017				<LLD	<LLD	<LLD		
11/21/2017				<LLD				
12/04/2017						<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	SG-1	SG-2	SG-4	SG-5	EW-19	MW-20	MW-21	EW-18
01/11/2017					<LLD			
01/19/2017	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
04/04/2017	<LLD	<LLD	<LLD	<LLD	<LLD			
04/05/2017						<LLD	<LLD	
07/11/2017					<LLD			
07/13/2017	<LLD	<LLD	<LLD	<LLD				
07/14/2017						<LLD	<LLD	
10/02/2017					<LLD			
10/03/2017							<LLD	
10/05/2017						<LLD		
11/26/2017								<LLD

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	OW-1	OW-2	OW-4	MW-28	MW-29			
01/03/2017	<LLD		<LLD	1.14e-6	<LLD			
02/02/2017	<LLD		<LLD	1.53e-6*	<LLD			
03/07/2017	<LLD	<LLD	<LLD	1.69e-6	<LLD			
04/24/2017	<LLD	<LLD	<LLD	1.10e-6	<LLD			
05/19/2017		<LLD						
05/31/2017				9.84e-7	<LLD			
06/09/2017	<LLD	<LLD	<LLD	1.07e-6	<LLD			
08/08/2017	<LLD	<LLD	<LLD	<LLD*	<LLD			
09/21/2017	<LLD	<LLD	<LLD	9.86e-7	<LLD			
11/08/2017	<LLD			<LLD	<LLD			
11/21/2017		<LLD						
12/04/2017	<LLD	<LLD		<LLD	<LLD			

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2017 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-9	W-10	W-11	W-12	W-13	W-14	W-15
01/03/2017					<LLD	<LLD	
01/16/2017	<LLD	<LLD	<LLD				
01/18/2017							<LLD
01/19/2017				<LLD			
04/03/2017		<LLD	<LLD				
04/04/2017					<LLD	<LLD	
04/05/2017	<LLD			<LLD			<LLD
07/13/2017	<LLD						
07/14/2017		<LLD	<LLD	<LLD	<LLD	<LLD	
07/19/2017							<LLD
10/05/2017	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
10/07/2017							<LLD

(Note: A “*” symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2017 indicates no groundwater contamination in excess of the reporting threshold of 2.00E-5 uCi/mL for tritium. Gamma spectroscopy was performed on all Radiological Environmental Monitoring Program wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP’s 2017 Annual Radiological Environmental Operating Report. There were no positively identified gamma radionuclides from plant effluents detected in any of the GPI well samples, and two wells with trace levels of tritium just above detection limits.

The LLD value used for tritium counting of the samples varied between 9.42E-7 and 9.98E-7uCi/mL, depending on which scintillation counter was used. This is well below the required maximum LLD value of 2.00E-6 uCi/mL per the ODCM.

No tritium values were found significantly above LLD for 2017, though values found above the LLD are not abnormal, unexpected, or inconsistent with past sampling history. The samples observed above LLD historically were expected results from the release of tritiated water into the Absorption Pond, a licensed pathway and part of plant design, or the result of recapture deposition of tritium from licensed radioactive gaseous release points. The 2017 results were within expected parameters considering the reduction in tritium released to the Absorption Pond and typical rainfall recapture of tritium experienced.

Wells located inside the Protected Area of the plant are subject to recapture deposition of tritium and may show occasional sample results above LLD values following rainfalls and snow melt. The results observed in 2017 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed in 2017. Well MW-28 lies close to the vent stacks in the predominant wind direction, so it is expected to observe recaptured tritium from precipitation periodically. Well W-5 lies just west of the turbine building also in close proximity to the plant vent stacks, and indicated low level tritium a single time during a period of snow melt.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2017 impacting groundwater. The sample results indicate proper well placement to ensure the protection of the groundwater and early identification of any abnormal conditions involving groundwater. This is validated by the demonstrated ability to monitor percolation from the Absorption Pond and recaptured tritium in precipitation, with flow direction and behavior acting as described in the plant licensing documents.

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	5	12	9	5	0	31	
NNE	0	3	3	0	0	0	6	
NE	0	6	3	0	0	0	9	
ENE	0	2	3	0	0	0	5	
E	0	1	1	4	2	0	8	
ESE	0	1	3	6	1	0	11	
SE	0	1	4	15	1	0	21	
SSE	0	4	13	4	3	0	24	
S	0	2	10	4	4	0	20	
SSW	0	2	2	2	1	0	7	
SW	0	4	0	0	7	0	11	
WSW	0	6	10	11	4	7	38	
W	2	8	9	5	5	0	29	
WNW	0	5	11	12	5	1	34	
NW	0	4	5	32	5	0	46	
NNW	0	1	16	16	8	0	41	
Total	2	55	105	120	51	8	341	
Calm Hours not Included above for :							Total Period	11
Valid Hours for this Stability Class for:							Total Period	341
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	5	2	1	0	11
NNE	0	2	7	1	0	0	10
NE	1	1	1	0	0	0	3
ENE	0	0	2	0	0	0	2
E	0	2	1	4	0	0	7
ESE	0	0	3	2	1	0	6
SE	1	1	5	2	0	0	9
SSE	0	3	3	2	0	0	8
S	1	6	3	2	0	0	12
SSW	0	5	2	4	0	0	11
SW	1	2	1	0	0	0	4
WSW	1	4	3	0	1	2	11
W	0	1	4	3	3	0	11
WNW	1	3	1	20	15	1	41
NW	0	0	2	11	5	0	18
NNW	1	0	2	8	0	0	11
Total	7	33	45	61	26	3	175
Calm Hours not Included above for :							Total Period 11
Valid Hours for this Stability Class for:							Total Period 175
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	9	22	3	6	0	40
NNE	1	4	4	2	1	0	12
NE	0	2	2	0	0	0	4
ENE	2	1	7	2	0	0	12
E	0	2	4	4	2	0	12
ESE	0	5	9	1	2	0	17
SE	1	2	5	1	0	0	9
SSE	0	1	5	5	0	0	11
S	1	1	7	8	5	0	22
SSW	0	2	3	2	1	0	8
SW	0	2	1	0	0	0	3
WSW	0	1	4	4	0	1	10
W	1	0	4	9	3	0	17
WNW	0	1	7	26	4	1	39
NW	0	0	6	30	20	0	56
NNW	1	0	7	20	4	0	32
Total	7	33	97	117	48	2	304
Calm Hours not Included above for :							11
Valid Hours for this Stability Class for:							304
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	3	11	15	8	2	0	39
NNE	1	10	5	3	4	0	23
NE	2	2	7	3	0	0	14
ENE	0	8	13	0	0	0	21
E	0	11	8	12	1	1	33
ESE	0	7	13	21	4	1	46
SE	3	6	11	14	9	0	43
SSE	1	3	16	31	11	1	63
S	1	4	18	29	17	5	74
SSW	2	3	12	23	2	0	42
SW	0	1	16	29	14	4	64
WSW	0	1	11	20	7	8	47
W	4	4	9	12	6	2	37
WNW	1	4	6	43	11	0	65
NW	0	1	8	33	19	8	69
NNW	1	0	11	13	6	0	31
Total	19	76	179	294	113	30	711
Calm Hours not Included above for :							11
Valid Hours for this Stability Class for:							711
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	0	0	1	0	0	1
NNE	1	0	3	0	0	0	4
NE	1	1	3	0	0	0	5
ENE	0	1	3	1	0	0	5
E	0	0	3	6	0	0	9
ESE	0	5	7	2	0	0	14
SE	1	5	7	4	0	0	17
SSE	0	4	10	6	0	0	20
S	0	1	11	12	0	0	24
SSW	0	1	8	7	0	0	16
SW	0	1	1	5	2	0	9
WSW	1	1	0	2	1	0	5
W	0	1	2	1	1	0	5
WNW	2	0	1	2	0	0	5
NW	1	2	5	0	0	0	8
NNW	1	2	1	0	0	0	4
Total	8	25	65	49	4	0	151
Calm Hours not Included above for :							11
Valid Hours for this Stability Class for:							151
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	0	0	0	0	0
NNE	0	2	0	0	0	0	2
NE	0	1	1	0	0	0	2
ENE	1	0	2	1	0	0	4
E	0	2	0	3	0	0	5
ESE	1	0	1	1	0	0	3
SE	0	2	4	3	0	0	9
SSE	0	0	2	1	0	0	3
S	0	1	4	2	0	0	7
SSW	1	1	2	1	0	0	5
SW	0	1	0	0	0	0	1
WSW	0	0	1	0	0	0	1
W	0	0	0	0	0	0	0
WNW	1	0	0	0	0	0	1
NW	0	4	0	0	0	0	4
NNW	0	0	1	0	0	0	1
Total	4	14	18	12	0	0	48
Calm Hours not Included above for :							11
Valid Hours for this Stability Class for:							48
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2017 - 3/31/2017
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	2	1	0	0	0	0	3
ENE	0	0	1	1	0	0	2
E	0	1	2	0	0	0	3
ESE	0	0	1	1	0	0	2
SE	0	0	5	1	0	0	6
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	3	0	0	0	0	3
WSW	1	2	1	0	0	0	4
W	0	0	1	0	0	0	1
WNW	0	4	0	0	0	0	4
NW	1	3	2	0	0	0	6
NNW	0	0	0	0	0	0	0
Total	4	15	13	3	0	0	35
Calm Hours not Included above for :							11
Valid Hours for this Stability Class for:							35
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

1/1/2017 - 3/31/2017

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	3	29	54	23	14	0	123
NNE	3	21	22	6	5	0	57
NE	6	14	17	3	0	0	40
ENE	3	12	31	5	0	0	51
E	0	19	19	33	5	1	77
ESE	1	18	37	34	8	1	99
SE	6	17	41	40	10	0	114
SSE	1	15	49	49	14	1	129
S	3	15	53	57	26	5	159
SSW	3	14	29	39	4	0	89
SW	1	14	19	34	23	4	95
WSW	3	15	30	37	13	18	116
W	7	14	29	30	18	2	100
WNW	5	17	26	103	35	3	189
NW	2	14	28	106	49	8	207
NNW	4	3	38	57	18	0	120
Total	51	251	522	656	242	43	1765

Calm Hours not Included above for :	Total Period	11
Variable Direction Hours for:	Total Period	0
Invalid Hours for:	Total Period	384
Valid Hours for this Stability Class for:	Total Period	1765
Total Hours for Period		2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	4	23	23	2	0	52	
NNE	0	3	1	0	1	0	5	
NE	1	5	0	0	0	0	6	
ENE	0	1	0	0	0	0	1	
E	0	2	0	0	0	0	2	
ESE	0	0	5	7	0	0	12	
SE	0	2	3	5	0	0	10	
SSE	0	0	2	7	5	0	14	
S	0	1	3	9	4	2	19	
SSW	0	0	0	3	3	0	6	
SW	0	0	4	7	5	0	16	
WSW	0	3	20	13	1	0	37	
W	0	14	28	9	4	0	55	
WNW	1	20	25	4	0	0	50	
NW	1	10	15	4	1	1	32	
NNW	0	9	25	12	7	4	57	
Total	3	74	154	103	33	7	374	
Calm Hours not Included above for :							Total Period	1
Valid Hours for this Stability Class for:							Total Period	374
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	0	1	6	1	0	2	10	
NNE	0	0	0	0	0	0	0	
NE	0	2	0	0	0	0	2	
ENE	0	0	0	1	0	0	1	
E	1	1	0	0	0	0	2	
ESE	0	0	1	1	0	0	2	
SE	0	1	1	0	0	0	2	
SSE	0	1	2	0	0	0	3	
S	1	1	0	2	1	0	5	
SSW	0	0	1	0	0	0	1	
SW	0	1	0	4	0	0	5	
WSW	0	6	3	5	0	0	14	
W	0	5	2	1	0	0	8	
WNW	1	7	3	5	0	0	16	
NW	0	4	2	0	1	0	7	
NNW	0	5	2	1	0	2	10	
Total	3	35	23	21	2	4	88	
Calm Hours not Included above for :							Total Period	1
Valid Hours for this Stability Class for:							Total Period	88
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	2	1	1	3	8
NNE	0	0	1	0	0	0	1
NE	0	0	1	0	0	0	1
ENE	0	0	1	1	0	0	2
E	0	0	1	1	0	0	2
ESE	1	0	4	5	0	0	10
SE	0	1	1	0	0	0	2
SSE	0	3	1	1	0	0	5
S	0	1	2	0	1	0	4
SSW	0	1	1	2	1	0	5
SW	0	1	3	7	0	0	11
WSW	0	1	4	4	0	0	9
W	0	5	3	2	0	0	10
WNW	1	2	3	1	1	0	8
NW	1	0	2	1	0	0	4
NNW	1	1	2	0	1	2	7
Total	4	17	32	26	5	5	89
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							89
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	6	11	6	4	6	34
NNE	2	3	2	2	0	0	9
NE	1	5	6	5	2	0	19
ENE	1	4	3	3	0	0	11
E	0	1	11	7	0	0	19
ESE	0	0	6	8	0	0	14
SE	0	2	4	6	0	0	12
SSE	1	2	5	2	0	0	10
S	0	2	6	15	14	0	37
SSW	0	6	17	26	9	0	58
SW	3	3	15	17	6	0	44
WSW	3	3	9	9	1	0	25
W	4	5	4	3	3	0	19
WNW	3	7	7	15	5	0	37
NW	1	5	4	5	1	0	16
NNW	1	1	3	2	5	1	13
Total	21	55	113	131	50	7	377
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 377
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	4	4	3	1	0	0	12
NNE	0	4	10	0	0	0	14
NE	0	8	19	1	0	0	28
ENE	1	4	8	3	0	0	16
E	0	2	9	3	0	0	14
ESE	0	2	9	5	0	0	16
SE	1	2	11	9	0	0	23
SSE	1	2	5	12	1	0	21
S	1	2	15	18	1	0	37
SSW	0	5	14	17	0	0	36
SW	1	1	9	13	0	0	24
WSW	0	0	9	4	0	0	13
W	0	4	7	2	0	0	13
WNW	0	3	7	15	0	0	25
NW	0	7	5	6	0	0	18
NNW	1	1	5	2	0	0	9
Total	10	51	145	111	2	0	319
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							319
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	1	0	0	0	1
NNE	0	1	3	0	0	0	4
NE	1	2	4	1	0	0	8
ENE	0	3	4	1	0	0	8
E	0	0	0	0	0	0	0
ESE	1	1	1	2	0	0	5
SE	1	3	8	0	0	0	12
SSE	0	2	8	3	0	0	13
S	2	1	7	5	0	0	15
SSW	0	3	4	2	0	0	9
SW	0	1	6	2	0	0	9
WSW	0	2	6	0	0	0	8
W	0	1	1	1	0	0	3
WNW	0	2	1	0	0	0	3
NW	0	3	1	0	0	0	4
NNW	0	0	2	0	0	0	2
Total	5	25	57	17	0	0	104
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 104
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2017 - 6/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	2	4	0	0	0	8
NNE	3	3	5	0	0	0	11
NE	0	3	4	0	0	0	7
ENE	2	3	10	0	0	0	15
E	3	4	7	1	0	0	15
ESE	0	7	9	0	0	0	16
SE	2	6	6	0	0	0	14
SSE	0	7	15	3	0	0	25
S	0	5	8	9	0	0	22
SSW	2	2	5	2	0	0	11
SW	0	3	14	1	0	0	18
WSW	0	2	2	2	0	0	6
W	0	7	0	0	0	0	7
WNW	0	2	0	0	0	0	2
NW	1	0	0	0	0	0	1
NNW	0	1	0	0	0	0	1
Total	15	57	89	18	0	0	179
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 179
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

4/1/2017 - 6/30/2017

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	7	18	50	32	7	11	125
NNE	5	14	22	2	1	0	44
NE	3	25	34	7	2	0	71
ENE	4	15	26	9	0	0	54
E	4	10	28	12	0	0	54
ESE	2	10	35	28	0	0	75
SE	4	17	34	20	0	0	75
SSE	2	17	38	28	6	0	91
S	4	13	41	58	21	2	139
SSW	2	17	42	52	13	0	126
SW	4	10	51	51	11	0	127
WSW	3	17	53	37	2	0	112
W	4	41	45	18	7	0	115
WNW	6	43	46	40	6	0	141
NW	4	29	29	16	3	1	82
NNW	3	18	39	17	13	9	99
Total	61	314	613	427	92	23	1530
Calm Hours not Included above for :							Total Period 1
Variable Direction Hours for:							Total Period 0
Invalid Hours for:							Total Period 653
Valid Hours for this Stability Class for:							Total Period 1530
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	8	31	28	0	0	67
NNE	0	0	2	0	0	0	2
NE	0	4	8	0	0	0	12
ENE	0	1	8	0	0	0	9
E	0	8	12	2	0	0	22
ESE	0	4	6	0	0	0	10
SE	0	11	9	0	0	0	20
SSE	0	5	13	0	0	0	18
S	0	0	7	0	0	0	7
SSW	0	2	1	1	0	0	4
SW	0	0	2	1	0	0	3
WSW	1	4	17	1	0	0	23
W	0	12	14	0	0	0	26
WNW	0	33	17	5	0	0	55
NW	0	34	27	10	0	0	71
NNW	0	15	38	24	0	0	77
Total	1	141	212	72	0	0	426
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	6	4	2	0	0	12
NNE	0	0	0	0	0	0	0
NE	2	1	0	0	0	0	3
ENE	0	0	0	0	0	0	0
E	1	2	0	0	1	0	4
ESE	0	4	3	0	0	0	7
SE	1	4	1	0	0	0	6
SSE	0	14	4	0	0	0	18
S	0	2	6	1	0	0	9
SSW	0	3	1	0	0	0	4
SW	1	2	3	0	0	0	6
WSW	0	7	10	3	0	0	20
W	0	4	4	0	0	0	8
WNW	1	9	2	0	0	0	12
NW	0	6	4	3	0	0	13
NNW	0	3	5	1	0	0	9
Total	6	67	47	10	1	0	131
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 131
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	2	4	2	0	0	8
NNE	1	0	0	1	0	0	2
NE	1	2	0	0	0	0	3
ENE	0	1	1	0	0	0	2
E	1	3	0	0	0	0	4
ESE	1	8	3	0	0	0	12
SE	0	3	5	0	0	0	8
SSE	1	4	4	0	0	0	9
S	0	1	6	0	0	0	7
SSW	0	3	2	0	0	0	5
SW	0	6	1	0	0	0	7
WSW	1	5	4	1	0	0	11
W	0	1	2	1	0	0	4
WNW	0	2	2	1	0	0	5
NW	0	5	3	1	0	0	9
NNW	0	2	3	1	0	0	6
Total	6	48	40	8	0	0	102
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							102
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	16	23	12	0	0	53
NNE	2	5	4	1	0	0	12
NE	3	3	1	2	0	0	9
ENE	1	2	8	1	0	0	12
E	3	4	5	1	0	0	13
ESE	1	8	4	1	0	0	14
SE	5	9	5	0	0	0	19
SSE	1	10	7	3	0	0	21
S	5	14	16	5	0	0	40
SSW	1	9	6	1	0	0	17
SW	1	9	7	6	2	1	26
WSW	2	10	6	12	5	0	35
W	1	5	4	8	3	1	22
WNW	5	6	5	6	2	0	24
NW	3	4	2	7	0	0	16
NNW	3	8	9	9	0	0	29
Total	39	122	112	75	12	2	362
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							362
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	3	18	30	6	0	0	57
NNE	0	11	17	2	0	0	30
NE	1	5	13	0	0	0	19
ENE	0	7	7	2	0	0	16
E	1	9	8	5	0	0	23
ESE	1	7	7	0	0	0	15
SE	1	9	15	1	0	0	26
SSE	0	9	30	5	0	0	44
S	0	7	42	12	0	0	61
SSW	2	1	16	6	0	0	25
SW	1	8	7	9	0	0	25
WSW	0	3	6	6	0	0	15
W	0	2	10	7	0	0	19
WNW	0	2	5	6	2	0	15
NW	2	0	13	13	5	0	33
NNW	3	5	27	5	0	0	40
Total	15	103	253	85	7	0	463
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 463
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	5	0	0	0	8
NNE	1	7	10	0	0	0	18
NE	2	9	11	0	0	0	22
ENE	1	2	15	0	0	0	18
E	2	5	18	0	0	0	25
ESE	3	4	20	1	0	0	28
SE	2	10	27	1	0	0	40
SSE	2	10	12	15	0	0	39
S	0	6	12	2	0	0	20
SSW	1	3	10	2	0	0	16
SW	1	2	13	3	0	0	19
WSW	0	1	2	0	0	0	3
W	0	2	1	0	0	0	3
WNW	0	1	1	0	0	0	2
NW	1	1	2	0	0	0	4
NNW	3	1	7	1	0	0	12
Total	19	67	166	25	0	0	277
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							277
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2017 - 9/30/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	4	6	4	0	0	0	14
NNE	0	8	7	0	0	0	15
NE	5	8	17	0	0	0	30
ENE	5	15	21	1	0	0	42
E	6	4	30	1	0	0	41
ESE	0	10	34	1	0	0	45
SE	6	10	36	4	0	0	56
SSE	7	13	35	17	0	0	72
S	3	12	16	10	0	0	41
SSW	1	1	10	7	0	0	19
SW	1	4	11	2	0	0	18
WSW	1	5	2	0	0	0	8
W	1	2	2	0	0	0	5
WNW	2	2	2	0	0	0	6
NW	1	2	0	0	0	0	3
NNW	2	2	1	0	0	0	5
Total	45	104	228	43	0	0	420
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							420
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

7/1/2017 - 9/30/2017

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	9	59	101	50	0	0	219
NNE	4	31	40	4	0	0	79
NE	14	32	50	2	0	0	98
ENE	7	28	60	4	0	0	99
E	14	35	73	9	1	0	132
ESE	6	45	77	3	0	0	131
SE	15	56	98	6	0	0	175
SSE	11	65	105	40	0	0	221
S	8	42	105	30	0	0	185
SSW	5	22	46	17	0	0	90
SW	5	31	44	21	2	1	104
WSW	5	35	47	23	5	0	115
W	2	28	37	16	3	1	87
WNW	8	55	34	18	4	0	119
NW	7	52	51	34	5	0	149
NNW	11	36	90	41	0	0	178
Total	131	652	1058	318	20	2	2181

Calm Hours not Included above for :

Total Period

1

Variable Direction Hours for:

Total Period

0

Invalid Hours for:

Total Period

26

Valid Hours for this Stability Class for:

Total Period

2181

Total Hours for Period

2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record =

10/1/2017 - 12/31/2017

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Stability Class A

Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	5	9	3	1	0	18
NNE	1	4	9	5	0	0	19
NE	2	4	4	0	0	0	10
ENE	0	3	2	0	0	0	5
E	0	8	4	1	0	0	13
ESE	0	2	1	0	0	0	3
SE	0	0	3	0	0	0	3
SSE	0	0	5	4	0	0	9
S	0	0	3	2	0	0	5
SSW	0	0	0	0	0	0	0
SW	0	0	0	3	2	0	5
WSW	0	1	3	6	1	0	11
W	0	1	4	3	4	0	12
WNW	0	2	2	2	0	0	6
NW	0	5	2	2	1	0	10
NNW	0	5	1	2	1	0	9
Total	3	40	52	33	10	0	138
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							1
Total Hours for Period							Total Period
							138
							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	5	0	0	0	5
NNE	0	0	0	0	0	0	0
NE	0	1	1	0	0	0	2
ENE	0	1	0	0	0	0	1
E	0	2	0	0	0	0	2
ESE	0	2	2	2	0	0	6
SE	0	2	3	3	0	0	8
SSE	0	3	3	3	0	0	9
S	0	0	6	4	3	0	13
SSW	0	0	2	0	0	0	2
SW	0	0	1	3	0	0	4
WSW	0	0	2	6	1	0	9
W	0	1	4	3	1	0	9
WNW	0	1	1	1	1	1	5
NW	0	1	0	1	4	0	6
NNW	1	0	1	1	0	0	3
Total	1	14	31	27	10	1	84
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							84
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	3	0	0	0	4
NNE	0	0	1	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	0	1	0	0	0	1
E	1	0	0	1	0	0	2
ESE	0	1	2	0	0	0	3
SE	0	1	7	1	0	0	9
SSE	0	3	8	3	0	0	14
S	0	1	5	5	2	0	13
SSW	0	0	1	5	0	0	6
SW	0	1	1	3	1	0	6
WSW	0	1	2	1	0	2	6
W	1	1	4	2	1	0	9
WNW	0	1	1	3	1	0	6
NW	0	0	2	2	2	0	6
NNW	1	1	1	1	0	0	4
Total	3	13	39	27	7	2	91
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	9	21	9	10	1	50
NNE	1	4	5	4	1	0	15
NE	0	4	3	1	0	0	8
ENE	1	14	19	4	1	0	39
E	3	10	25	8	6	0	52
ESE	5	6	13	12	0	0	36
SE	0	15	25	5	0	0	45
SSE	1	18	42	24	11	1	97
S	0	17	40	28	10	5	100
SSW	1	8	41	27	17	1	95
SW	1	5	20	47	13	0	86
WSW	1	9	11	28	12	14	75
W	2	4	18	42	46	17	129
WNW	2	5	21	63	41	1	133
NW	1	1	16	44	46	6	114
NNW	2	8	13	32	12	13	80
Total	21	137	333	378	226	59	1154
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							1154
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	1	7	0	0	0	10
NNE	0	2	4	0	0	0	6
NE	0	5	11	2	0	0	18
ENE	1	4	13	2	0	0	20
E	1	1	12	3	0	0	17
ESE	0	3	10	2	0	0	15
SE	1	8	21	11	0	0	41
SSE	0	4	24	35	2	0	65
S	1	9	35	27	6	0	78
SSW	1	7	34	22	8	2	74
SW	1	3	5	17	2	0	28
WSW	1	1	6	3	0	1	12
W	0	3	7	6	0	0	16
WNW	0	2	7	16	10	0	35
NW	0	2	7	15	4	1	29
NNW	0	1	9	7	5	0	22
Total	9	56	212	168	37	4	486
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							486
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	1	0	0	0	0	1
NNE	0	2	1	0	0	0	3
NE	0	2	1	0	0	0	3
ENE	1	0	6	0	0	0	7
E	0	0	5	4	0	0	9
ESE	0	1	4	1	0	0	6
SE	1	0	9	6	0	0	16
SSE	0	1	10	7	0	0	18
S	1	5	13	9	0	0	28
SSW	0	2	6	14	0	0	22
SW	0	2	6	0	0	0	8
WSW	0	4	3	0	0	0	7
W	0	0	2	0	0	0	2
WNW	0	0	0	0	0	0	0
NW	1	0	0	0	0	0	1
NNW	0	1	0	0	0	0	1
Total	4	21	66	41	0	0	132
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 132
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2017 - 12/31/2017
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	0	0	0	0	1
NNE	0	1	0	0	0	0	1
NE	0	0	1	0	0	0	1
ENE	0	2	2	0	0	0	4
E	0	4	0	0	0	0	4
ESE	0	2	4	0	0	0	6
SE	1	5	8	2	0	0	16
SSE	1	6	6	8	0	0	21
S	1	2	13	6	0	0	22
SSW	1	4	10	4	0	0	19
SW	2	5	2	0	0	0	9
WSW	1	4	1	0	0	0	6
W	0	2	0	0	0	0	2
WNW	0	2	1	0	0	0	3
NW	0	3	0	0	0	0	3
NNW	3	1	0	0	0	0	4
Total	10	44	48	20	0	0	122
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 122
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

10/1/2017 - 12/31/2017

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	18	45	12	11	1	89
NNE	2	13	20	9	1	0	45
NE	2	17	21	3	0	0	43
ENE	3	24	43	6	1	0	77
E	5	25	46	17	6	0	99
ESE	5	17	36	17	0	0	75
SE	3	31	76	28	0	0	138
SSE	2	35	98	84	13	1	233
S	3	34	115	81	21	5	259
SSW	3	21	94	72	25	3	218
SW	4	16	35	73	18	0	146
WSW	3	20	28	44	14	17	126
W	3	12	39	56	52	17	179
WNW	2	13	33	85	53	2	188
NW	2	12	27	64	57	7	169
NNW	7	17	25	43	18	13	123
Total	51	325	781	694	290	66	2207
Calm Hours not Included above for :							Total Period
Variable Direction Hours for:							Total Period
Invalid Hours for:							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2207
							2208

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was not revised during this 2017 reporting period.

ENCLOSURE 2 to AEP-NRC-2018-35

DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2016 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT, Revision 1

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I. INTRODUCTION

This report discusses the radioactive discharges from Unit 1 and Unit 2 of the Donald C. Cook Nuclear Plant (CNP) during 2016. This is in accordance with the requirements of CNP Technical Specification (TS) 5.6.3.

The table below summarizes the pertinent statistics concerning the Plant's operation during the period from January 1, 2016, to December 31, 2016. The data in this table and the descriptive information on plant operation are based upon the respective unit's Monthly Operating Reports, Performance Indicators, and Control Room Logs for 2016.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	8,586,842	7,272,912
Unit Service Factor (Percent (%))	90.1	74.1
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	91.9	74.5

Unit 1 entered the reporting period in Mode 1 at Nominal Full Power (NFP). Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit performed a normal downpower and was manually tripped on March 23, 2016, entering refueling outage U1C27. The unit attained criticality on April 27, 2016, and attained NFP on May 2, 2016. The unit exited the reporting period at NFP.

Unit 2 entered the reporting period in Mode 1 at NFP. Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit was manually tripped on July 6, 2016, entering a forced outage due to a steam leak. The unit attained criticality on July 12, 2016, and attained NFP on July 14, 2016. On July 21, 2016, the unit performed a controlled downpower to 48% power at the request of grid operators due to grid conditions, returning to NFP on August 2, 2016. The unit performed a normal downpower and was manually tripped on October 5, 2016, entering refueling outage U2C23. The unit exited the reporting period shutdown.

II. RADIOACTIVE RELEASES AND RADIOLOGICAL IMPACT ON MAN

Since a number of release points are common to both units, the release data from both units are combined to form this two-unit, Annual Radioactive Effluent Release Report. Appendix A1.1 through A2.4 of this report present the information in accordance with Section 5.6.3 of Appendix A to the Facility Operating Licenses, as specified in the Technical Specifications, Regulatory Guide 1.21, and 10 CFR Part 50, Appendix I.

The "MIDAS System" is a computer code that calculates doses due to radionuclides that were released from the CNP.

All liquid and gaseous releases were well within Offsite Dose Calculation Manual (ODCM) limits and federal limits.

There was one abnormal liquid release and no abnormal gaseous releases in 2016. The abnormal liquid release occurred on October 31, 2016, with approximately 1,500 gallons of water leaking past boundary valves on the normal licensed steam generator drainage pathway over a 24 hour period. The water was Secondary side water contained inside a steam generator, which acts as a heat transfer medium from the Reactor Coolant filled Primary side piping. This steam generator water was subsequently discharged to Lake Michigan via the Circulating Water system. This water contained tritium at 15,000 picocuries per liter, which is below the 20,000 picocurie per liter drinking water limit. Though the nuclide level was low, the leakage was unplanned and met the criteria for being an abnormal release of liquid effluent. The total curies of tritium released from the event were 1.71E-04 curies, assuming a conservative 3000 gallons of released water to bound the event. This curie content was added to the liquid release totals and the associated public dose accounted for. Action Request AR# 2016-12597 documented this event and subsequent repairs.

The Independent Spent Fuel Storage Installation (ISFSI) impacts are included with Unit 1 and Unit 2 statistics. The ISFSI cask system does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the ISFSI.

Liquid Releases

During 2016 there were 89 liquid batch releases performed. The number of liquid batch releases for the four quarters in 2016 was 14, 20, 22, and 33, respectively.

Estimated doses (in mrem) to maximally exposed individuals via the liquid release pathways are given in Appendix A1.2 of this report.

Gaseous Releases

During the first quarter of 2016 there were seven batch releases from Gas Decay Tanks (GDT), one containment purge, one system tank venting, and 134 Containment Pressure Reliefs (CPR). During the second quarter there were three batch releases from GDTs, one system tank venting, and 130 CPR. During the third quarter there were four batch releases from GDTs and 150 CPR. During the fourth quarter there were two batch releases from GDTs, one containment purge, one system tank venting, and 86 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89017 (DRSS); 50-316/89016 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There were a total of 16 GDT releases, two containment purges, three system tank vents, and 500 CPR gaseous batch releases made during 2016.

In calculating the dose consequences for continuous and batch gaseous releases during 2016, the meteorological data measured at the time of the release were used.

The estimated doses (in mrem) to maximally exposed individuals via the gaseous release pathways are given in Appendix A1.2 of this report. For individuals that are within the site boundary, the occupancy time is sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary.

Solid Waste Disposition

There were 33 shipments of radioactive waste made during 2016. These included shipments made from the site to various radioactive waste processors for ultimate disposal.

III. **METEOROLOGICAL**

Appendices A2.1, A2.2, A2.3, and A2.4 of this report contain the cumulative joint frequency distribution tables of wind speed and wind direction, corresponding to the various atmospheric stability classes for the first, second, third, and fourth quarters of 2016. Hourly meteorological data is available for review and/or inspection upon request.

IV. **OFFSITE DOSE CALCULATION MANUAL (ODCM) CHANGES**

The ODCM, PMP-6010-OSD-001, was not revised during the report period.

V. **TOTAL DOSE**

Section 3.2.5 of the ODCM requires that the dose or dose commitment to a real individual from all uranium fuel cycle sources in Berrien County be limited to no more than 25 mrem to the total body or any organ (except the thyroid, which is limited to no more than 75 mrem) over a period of 12 consecutive months to show conformance with the requirements of 40 CFR Part 190. The maximum cumulative dose to an individual from liquid and gaseous effluents during 2016 was well within the ODCM limits. Measurements using thermoluminescent dosimeters (TLD) at 12 onsite stations indicate that the dose due to direct radiation is consistent with preoperational and current control (background) levels. This is fully evaluated in CNP's 2016 Annual Radiological Environmental Operating Report. Additional TLD dosimetry installed by Radiation Protection department programs monitor dose received by individuals on site as visitors.

The annual dose to the maximum individual will be estimated by first, summing the quarterly total body air dose, the quarterly skin air dose, the quarterly critical organ dose from iodines and particulates (I&P), the quarterly total body dose from liquid effluents, the quarterly critical organ dose from liquid effluents, and the Radiological Environmental Monitoring Program onsite direct radiation TLD data. These quarterly values are summed with the annual Carbon-14 dose and compared to the annual total body limit for conservative reasons. The table that follows here represents the above written description:

Dose (mrem)	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
I & P	1.15E-02	4.46E-01	4.58E-02	9.34E-02
Total Body Air	1.00E-03	2.30E-04	7.60E-04	5.50E-04
Skin	2.20E-03	4.60E-04	2.60E-03	1.10E-03
Liquid TB	1.27E-02	1.32E-02	3.47E-02	1.05E-02
Liquid Organ	1.27E-02	1.32E-02	3.47E-02	1.12E-02
C14 (Annual)				1.97E+00
Direct Radiation	0	0	0	0
Total	4.01E-02	4.73E-01	1.18E-01	2.09E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.72E+00
Annual Dose Limit (mrem)				25
Percent of limit				1.09E+01

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2016 annual dose data, and 2016 annual dose data with C-14 added. This indicates that 2016 annual dose was 'typical' for a dual unit outage year with an extended outage duration in regards to radioactive effluents. The table is presented as follows:

	Annual Dose (mrem)	% of limit
2009	2.60E-01	1.04
2016	7.48E-01	2.99
2016 with C-14	2.72	10.9

VI. RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS

There were no release pathways unmonitored for greater than 30 days.

VII. NOTEWORTHY CONDITIONS IDENTIFIED IN 2016

The Inadvertent draining of a steam generator in 2016 was discussed in Section II above as an abnormal release. While noteworthy, it had minimal impact on effluent releases or public dose exposure due to the very low tritium curie content of the water.

In addition, it is considered noteworthy that in 2016 two small fuel rodlet defects were identified to have the potential to impact effluents. These defects increased the release of fission product gasses and iodine isotopes into the reactor coolant, which in turn increased activity levels in the effluent streams. The increases contributed to a small impact to the site overall public dose exposure by approximately 1.2% of the limit over the course of the year (2015 was 2.42mRem/ 9.68% of limit vice 2.72mRem/ 10.9% of limit in 2016). The public dose due to operations at CNP remain a small fraction of the legal limits and efforts to keep public dose As Low As Reasonably Achievable (ALARA) were largely successful.

Carbon-14 Supplemental Information for the 2016 Annual Radioactive Effluent Release Report.

C-14 has a 5730 year half-life and is a naturally occurring radionuclide produced by cosmic ray interactions in the atmosphere. C-14 is a relatively low energy beta emitter. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally, from weapons testing, or coal burning power plants. The inventory of C-14 in Earth's biosphere is about 300 million Curies, of which most is in the oceans.

Since the U.S. Nuclear Regulatory Commission (NRC) published Regulatory Guide (RG) 1.21, Revision 1, in 1974, the analytical methods for determining C-14 have improved. Coincidentally, the radioactive effluents from commercial nuclear power plants over the same period have decreased to the point that C-14 is likely to be a principal radionuclide in gaseous effluents. Based on these reasons and a desire to adjust policy to align with international standards, the nuclear industry was required to report, starting in 2010, the quantity and dose impact of C-14 here in the United States. The dose will be reported both with and without C-14 so a comparison to 2009 can be made, keeping in mind the differing standards.

The quantity of C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. RG 1.21, Revision 2). A recent study recommends a source term scaling factor of approximately 9.0 to 9.8 Curies/GWe-yr for a Westinghouse Pressurized Water Reactor (Ref. EPRI 1021106, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents", dated December 23, 2010). A scaling factor of 9.4 Curies/GWe-yr was assumed for this report. Using this source term scaling factor and actual electrical generation (in MWH) produced during 2016 results in a site total of 17.0 Curies produced.

C-14 releases from Pressurized Water Reactors (PWR) occur primarily as a mix of organic carbon (methane) and inorganic carbon (carbon dioxide). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as gas. Any time the primary coolant is exposed to an oxidizing environment (during shutdown or refueling), a slow transformation from an organic to an inorganic species occurs. Various studies documenting measured C-14 releases from PWRs suggest an average 80% organic fraction with the remainder being carbon dioxide. This equates to 2.38 Curies released as carbon dioxide which is available for the food pathway through photosynthesis to vegetation.

Dose is calculated utilizing the methodology prescribed in RG 1.109, Appendix C, with the vegetation dose being the most predominant. A 'p' factor of 0.33 is determined utilizing the time of batch gaseous releases performed during 2016, the time available for photosynthesis in plants, and the assumption that 70% of the C-14 released is from gaseous batch releases. A further reduction to the vegetation and leafy vegetable dose is warranted due to the limited growing season in Michigan, which was conservatively limited to nine months.

The final results indicated a calculated organ dose from C-14 to a child at the site boundary of 1.64 mrem to the bone and a whole body dose of 0.326 mrem, for a combined total C-14 dose of 1.97 mrem. This is less than the dose limit of 15 mrem/unit to any organ prescribed in 10 CFR 50, Appendix I, and the 40 CFR Part 190 limit of 25 mrem for total body and for any organ (≤ 75 mrem for thyroid).

VIII. CONCLUSION

Based on the information presented in this report, it is concluded that CNP Units 1 and 2 performed their intended design function with no demonstrable adverse effect on the health and safety of the general public.

IX. ERRATA

There are no errata attached for 2016.

Note: This entire document is Revision 1 submitted as "Errata" attached to the 2017 Annual Radioactive Effluent Release Report per Corrective Action 2017-4835. This new revision completely replaces the previously submitted report. This errata was necessitated due to problems identified with equipment utilized for counting tritium samples dating back to 2013. The alterations changed the overall public dose calculated from 2.71 millirems (10.8% of the 40 CFR190 allowable dose limits) to 2.72 millirems (10.9% of the 40CFR190 allowable dose limits). There were no adverse impacts to public health or safety by this minor change to dose.

2016 Effluent and Waste Disposal Annual Report

SUPPLEMENTAL INFORMATION

Facility: Donald C. Cook Nuclear Plant
Licensee: Indiana Michigan Power Company

1 REGULATORY LIMITS

1.1 Noble Gases

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be limited to the following:

1.1.1 During any calendar quarter, to ≤ 5 mrad/unit for gamma radiation and ≤ 10 mrad/unit for beta radiation.

1.1.2 During any calendar year, to ≤ 10 mrad/unit for gamma radiation and ≤ 20 mrad/unit for beta radiation.

1.2 Iodines - Particulates

The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to unrestricted areas shall be limited to the following:

1.2.1 During any calendar quarter to ≤ 7.5 mrem/unit to any organ.

1.2.2 During any calendar year to ≤ 15 mrem/unit to any organ.

1.3 Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited:

1.3.1 During any calendar quarter to ≤ 1.5 mrem/unit to the total body and to ≤ 5 mrem/unit to any organ.

1.3.2 During any calendar year to ≤ 3 mrem/unit to the total body and to ≤ 10 mrem/unit to any organ.

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1.4 Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2 MAXIMUM PERMISSIBLE CONCENTRATIONS

2.1 Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site shall be limited to the following:

2.1.1 For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.

2.1.2 For all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days: ≤ 1500 mrem/yr to any organ.

The above limits are provided to insure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits in 10 CFR Part 20, Appendix B, Table 2, Column 1.

2.2 Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

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3 AVERAGE ENERGY

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public. Release rates are calculated using an isotopic mix from actual samples rather than average energy.

4 MEASUREMENTS and APPROXIMATIONS of TOTAL RADIOACTIVITY

4.1 Fission and Activation Gases

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters.

4.2 Iodines

Sampled on iodine adsorbing media, and analyzed on an 8192 channel analyzer and HpGe detector.

4.3 Particulates

Sampled on a glass filter and analyzed on an 8192 channel analyzer and HpGe detector. Sr-89 and Sr-90 analyses are performed by offsite vendor.

4.4 Liquid Effluents

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters. Fe-55, Sr-89 and Sr-90 analyses are performed by an offsite vendor. Ni-63 is also currently being analyzed by the offsite vendor in response to evaluation of the 10 CFR 61 sample results.

2016 Effluent and Waste Disposal Annual Report

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

14 releases in the 1st quarter, 2016

20 releases in the 2nd quarter, 2016

22 releases in the 3rd quarter, 2016

33 releases in the 4th quarter, 2016

5.1.2 Total time period for batch releases:

61,822 minutes

5.1.3 Maximum time for a batch release:

1,814 minutes

5.1.4 Average time period for batch release:

695 minutes

5.1.5 Minimum time period for a batch release:

91 minutes

5.1.6 Average stream flow during periods of release of effluent into a flowing stream:

6.44E+5 gpm circulating water

2016 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

143 releases in the 1st quarter, 2016
134 releases in the 2nd quarter, 2016
154 releases in the 3rd quarter, 2016
90 releases in the 4th quarter, 2016

5.2.2 Total time period for batch releases:

7,392 minutes

5.2.3 Maximum time for a batch release:

354 minutes

5.2.4 Average time period for batch release:

14 minutes

5.2.5 Minimum time period for a batch release:

1 minutes

2016 Effluent and Waste Disposal Annual Report

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	1*

6.1.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	1.71e-04

6.2 Gaseous

6.2.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

* Discussed on page 2 of this document.

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	1.91E+01	1.92E+01	2.51E+01	6.18E+01
AR41	Ci	3.00E-01	8.12E-07	-----	-----
KR85	Ci	7.12E-06	3.65E-02	-----	-----
XE133	Ci	1.03E+01	4.00E+00	3.61E-02	1.55E+00
XE135	Ci	2.68E-01	2.92E-01	-----	-----
XE131m	Ci	-----	7.05E-03	-----	-----
XE133m	Ci	-----	4.67E-04	-----	-----
XE135m	Ci	-----	-----	-----	-----
Total for Period	Ci	3.00E+01	2.35E+01	2.51E+01	6.34E+01

2. IODINES					
I131	Ci	6.68E-05	1.05E-03	2.83E-05	9.69E-04
I132	Ci	-----	5.76E-06	-----	2.52E-03
I133	Ci	6.79E-05	1.44E-04	2.21E-04	1.08E-05
Total for Period	Ci	1.35E-04	1.20E-03	2.49E-04	3.50E-03

3. PARTICULATES					
MN54	Ci	-----	-----	-----	-----
CO60	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.83E-01	1.28E-01	1.17E-01	2.32E-01
AR41	Ci	2.86E-01	1.33E-01	2.24E-01	2.18E-01
KR85	Ci	4.57E-01	8.70E-01	9.24E-01	3.97E-01
XE131M	Ci	1.98E-02	5.55E-03	-----	-----
XE133M	Ci	7.01E-03	-----	-----	3.04E-03
XE133	Ci	1.67E+00	1.99E-01	3.24E-01	3.81E-01
XE135m	Ci	-----	2.83E-04	-----	7.16E-04
XE135	Ci	2.24E-03	5.57E-03	8.02E-03	2.20E-02
Total for Period	Ci	2.73E+00	1.34E+00	1.60E+00	1.25E+00
2. IODINES					
I131	Ci	1.33E-08	1.28E-02	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	1.33E-08	1.28E-02	-----	-----
3. PARTICULATES					
CS137	Ci	-----	-----	-----	-----
* BR82	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION GASES						

1. Total Release	Ci	1.34E+01	5.56E+00	1.52E+00	2.57E+00	11.4

2. Average release rate for period	uCi/sec	1.71E+00	7.07E-01	1.91E-01	3.23E-01	

3. Percent of applicable limit*	% Gamma Beta	6.77E-02 4.95E-02	1.34E-02 9.26E-03	2.60E-02 7.22E-02	3.11E-02 3.22E-02	

B. IODINES						

1. Total I-131	Ci	6.39E-05	1.38E-02	1.48E-04	9.69E-04	12.8

2. Average release rate for period	uCi/sec	8.12E-06	1.76E-03	1.86E-05	1.22E-04	

3. Percent of applicable limit*	%	2.31E-05	5.02E-03	5.31E-05	3.48E-04	

C. PARTICULATES						

1. Particulates with half lives > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit*	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

4. Gross alpha radioactivity	Ci	<7.98E-07	<6.25E-07	<8.16E-07	<8.91E-07	

D. TRITIUM						

1. Total Release	Ci	1.94E+01	1.93E+01	2.52E+01	6.19E+01	12.6

2. Average release rate for period	uCi/sec	2.47E+00	2.46E+00	3.17E+00	7.79E+00	

3. Percent of applicable limit*	%	1.41E-02	1.40E-02	1.81E-02	4.44E-02	

* Applicable limits are expressed in terms of dose. See Appendices A1.2-1 through A1.2-4

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	-----	7.63E-03	-----	-----
CS137	Ci	-----	-----	-----	-----

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	3.67E+02	4.19E+02	1.26E+03	2.88E+02
CR51	Ci	-----	-----	-----	-----
MN54	Ci	-----	2.32E-06	1.28E-06	1.69E-06
FE55	Ci	-----	-----	-----	-----
CO58	Ci	8.56E-06	7.38E-05	2.30E-05	2.09E-04
CO60	Ci	9.00E-05	1.39E-04	2.33E-05	6.86E-05
NI63	Ci	3.00E-04	-----	-----	-----
*KR85	Ci	-----	-----	-----	-----
ZR95	Ci	-----	-----	-----	-----
NB95	Ci	-----	-----	-----	-----
MO99	Ci	-----	-----	-----	-----
TC99m	Ci	-----	5.43E-07	-----	1.94E-06
AG110m	Ci	1.36E-05	2.64E-05	7.88E-06	1.11E-06
SB124	Ci	-----	-----	-----	8.49E-06
SB125	Ci	3.79E-06	6.86E-06	8.18E-06	4.62E-05
CS134	Ci	-----	-----	-----	4.59E-05
CS137	Ci	4.05E-06	8.27E-06	2.13E-06	1.74E-04
I131	Ci	-----	2.05E-05	-----	3.69E-06
*XE133	Ci	4.60E-04	3.67E-03	3.88E-03	4.80E-03
*XE133m	Ci	-----	1.18E-05	1.84E-05	2.86E-05
*XE131m	Ci	-----	1.38E-04	-----	5.78E-05

* DENOTES SUPPLEMENTAL ISOTOPES

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
BATCH MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	4.20E-04	2.78E-04	6.57E-05	5.61E-04	12.6

2. Average diluted concentration during period	uCi/ml	2.16E-11	9.58E-12	9.95E-13	1.55E-11	

3. Percent of applicable limit	%	2.05E-04	2.88E-04	1.92E-05	7.32E-04	

B. TRITIUM						

1. Total Release	Ci	3.67E+02	4.19E+02	1.26E+03	2.88E+02	10.1

2. Average diluted concentration during period	uCi/ml	1.88E-05	1.44E-05	1.91E-05	7.95E-06	

3. Percent of applicable limit	%	1.88E+00	1.44E+00	1.91E+00	7.95E-01	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	4.60E-04	3.82E-03	3.90E-03	4.89E-03	11.4

2. Average diluted concentration during period	uCi/ml	2.36E-11	2.12E-11	1.16E-11	1.35E-10	

3. Percent of applicable limit	%	1.18E-05	1.06E-05	5.80E-06	6.74E-05	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

E. VOLUME OF WASTE RELEASED	Liters	1.34E+06	7.47E+06	1.67E+06	1.92E+06	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	1.95E+10	1.80E+11	3.36E+11	3.63E+10	3.48

2016 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
CONTINUOUS MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

B. TRITIUM						

1. Total Release	Ci	0.00E+00	7.63E-03	0.00E+00	0.00E+00	22.8

2. Average diluted concentration during period	uCi/ml	0.00E+00	5.07E-11	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	5.07E-06	0.00E+00	0.00E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

1. Total Release	Ci	0.00E+00	<5.69E-04	0.00E+00	0.00E+00	N/A

E. VOLUME OF WASTE RELEASED						

1. Total Release	Liters	0.00E+00	6.36E+06	0.00E+00	0.00E+00	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

1. Total Release	Liters	0.00E+00	1.51E+11	0.00E+00	0.00E+00	3.48

**2016 Effluent and Waste Disposal Annual Report
Solid Waste and Irradiated Fuel Shipments**

Solid Waste Shipped Offsite for Burial or Disposal			
1) Type of Waste	Unit	Estimated amount	Estimated Total Error, %
a) Spent resins, filters, sludge, evaporator bottoms, etc.	m ³ Curies	1.34E+01 1.26E+02	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m ³ Curies	1.09E+03 1.87E+00	1.00E+00 6.48E+00
c) Irradiated components, control rods, etc.	m ³ Curies		
d) Other (contaminated soil)	m ³ Curies		

2) Estimate of Principle Radionuclide Composition								
a)	H-3	9 %	Co-58	1 %	Sb-125	1 %	Cs-137	1 %
	Mn-54	0.5 %	Co-60	19 %	Cs-134	0.5 %		
	Fe-55	13 %	Ni-63	54 %	C-14	1 %		
b)	Ni-59	1 %	Co-58	1 %	Sb-125	4 %		
	Mn-54	1 %	Co-60	39.5 %	Zr/Nb-95	2 %		
	Fe-55	36 %	Ni-63	12.5 %	Cs-137	2.5 %	C-14	0.5 %

3) Solid Waste Disposition		
No. of Shipments	Mode of Transportation	Destination
25	Truck	Oak Ridge, TN
1	Truck	Erwin, TN
2	Truck	Clive, UT
5	Truck	Wampum, PA

4) Type of Containers used for Shipment: Containers used are excepted packages, Type A, Sea Land, metal boxes, drums, tankers, and high integrity containers (HICs).

5) Solidification Agent: There were no solidifications performed during this report period.

2016 Effluent and Waste Disposal Annual Report Yearly Release Rates

GASES		
Fission and Activation Gases	Total Release	2.31E+01 Curies
	Average Release Rate	7.31E-01 μ Ci/sec
	% of Applicable Limits*	γ 3.46E-02 % β 4.08E-02 %
Iodines	Total I-131 Release	1.50E-02 Curies
	Average Release Rate	4.75E-04 μ Ci/sec
	% of Applicable Limit*	1.99E+00 %
Particulates	Total Release	0.00E-00 Curies
	Average Release Rate	0.00E-00 μ Ci/sec
	% of Applicable Limit*	0.00E-00 %
LIQUIDS		
Fission and Activation Products	Total Release	1.32E-03 Curies
	Average Diluted Concentration	8.78E-12 μ Ci/ml
	% of Applicable Limits*	Total Body 1.07E+00 % Organ 3.23E-01 %

* Applicable limits are expressed in terms of the annual 10 CFR 50, Appendix I, dose limits.

Site Boundary and Nearest Residence Listing

The following distances were used in the calculation of the maximum individual doses:

<u>Sector</u>	<u>Direction</u>	<u>Boundary (Meters)</u>	<u>Nearest Residence (Meters)</u>
A	N	651	659
B	NNE	617	660
C	NE	789	943
D	ENE	1497	1747
E	E	1274	1716
F	ESE	972	1643
G	SE	629	1640
H	SSE	594	964
J	S	594	997
K	SSW	629	942

Summary of Maximum Individual Doses

First Quarter 2016

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.27E-02	Child	Receptor 1	8.47E-01	1.5E+0
Liquid	Liver	1.27E-02	Child	Receptor 1	2.55E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	3.39E-03	Any Age	594 (SSE)	6.77E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	4.95E-03	Any Age	594 (SSE)	4.95E-02	1.0E+1
Iodines and Particulates	Thyroid	1.15E-02	Child	659 (N)	1.53E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2016

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.32E-02	Child	Receptor 1	8.80E-01	1.5E+0
Liquid	Liver	1.32E-02	Child	Receptor 1	2.65E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	6.70E-04	Any Age	594 (S)	1.34E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	9.26E-04	Any Age	594 (S)	9.26E-03	1.0E+1
Iodines and Particulates	Thyroid	4.46E-01	Child	997 (S)	5.95E+00	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2016

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	3.47E-02	Child	Receptor 1	2.31E+00	1.5E+0
Liquid	Liver	3.47E-02	Child	Receptor 1	6.95E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	1.30E-03	Any Age	651 (N)	2.60E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	7.22E-03	Any Age	594 (SSE)	7.22E-02	1.0E+1
Iodines and Particulates	Thyroid	4.58E-02	Child	659 (N)	6.11E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2016

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.05E-02	Child	Receptor 1	6.98E-01	1.5E+0
Liquid	Liver	1.12E-02	Child	Receptor 1	2.24E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	1.55E-03	Any Age	594 (S)	3.11E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	3.22E-03	Any Age	594 (S)	3.22E-02	1.0E+1
Iodines and Particulates	Thyroid	9.34E-02	Child	659 (N)	1.25E+00	7.5E+0

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-22D	MW-22M	MW-22S	MW-24D	MW-24M	MW-24S	MW-25D	MW-25M
03/10/2016	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/29/2016	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/06/2016				<LLD	<LLD	<LLD	<LLD	<LLD
12/12/2016	<LLD	<LLD	<LLD					

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-25S	MW-26D	MW-26M	MW-26S	MW-27D	MW-27M	MW-27S
03/10/2016	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/06/2016	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)

Lower Limit of Detection = LLD

Date	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
01/05/2016			<LLD					<LLD
01/06/2016		<LLD						
01/08/2016	<LLD						<LLD	
01/15/2016				<LLD	<LLD	<LLD		
02/03/2016						<LLD		
03/11/2016						<LLD		
03/31/2016			<LLD				<LLD	
04/07/2016	<LLD							<LLD
04/14/2016		<LLD		<LLD	<LLD	<LLD		
05/05/2016						<LLD		
06/28/2016	<LLD						<LLD	
06/29/2016		<LLD	<LLD					<LLD
06/30/2016				<LLD	<LLD	<LLD		
08/11/2016						<LLD		
09/01/2016				<LLD				
10/07/2016				<LLD	<LLD	<LLD		
10/19/2016								<LLD
10/20/2016	<LLD						<LLD	
10/21/2016		<LLD	<LLD					
11/18/2016						<LLD		
12/09/2016						<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	SG-1	SG-2	SG-4	SG-5	EW-19	MW-20	MW-21	EW-18
01/06/2016	<LLD	<LLD	<LLD	<LLD	<LLD			
01/07/2016						<LLD	<LLD	
03/10/2016								<LLD
03/31/2016						<LLD	<LLD	
04/05/2016					<LLD			
04/07/2016	<LLD	<LLD	<LLD	<LLD				
06/28/2016						<LLD	<LLD	
06/29/2016	<LLD	<LLD	<LLD	<LLD				
07/11/2016					<LLD			
08/05/2016					<LLD			
10/20/2016						<LLD	<LLD	
10/21/2016	<LLD	<LLD	<LLD	<LLD				
12/07/2016					<LLD			

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	OW-1	OW-2	OW-4	MW-28	MW-29
02/03/2016	<LLD	<LLD	<LLD	1.25e-6	<LLD
03/11/2016	<LLD	<LLD	<LLD	1.22e-6	<LLD
04/14/2016		<LLD			
04/21/2016	<LLD		<LLD	1.34e-6	<LLD
05/05/2016	<LLD		<LLD	1.22e-6	<LLD
06/06/2016	<LLD		<LLD	1.33e-6 *	<LLD *
07/22/2016	<LLD	<LLD	<LLD	1.08e-6	<LLD
08/09/2016	<LLD		<LLD	1.15e-6	<LLD
09/15/2016	<LLD	<LLD	<LLD	<LLD	
09/21/2016					<LLD
10/07/2016		<LLD			
11/21/2016	<LLD		<LLD	<LLD	<LLD
12/06/2016	<LLD			9.48e-7	<LLD
12/13/2016			<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2016 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-9	W-10	W-11	W-12	W-13	W-14	W-15
01/06/2016	<LLD						<LLD
01/07/2016		<LLD	<LLD	<LLD			<LLD
01/08/2016					<LLD	<LLD	
03/31/2016		<LLD	<LLD	<LLD	<LLD	<LLD	
04/07/2016	<LLD						<LLD
06/28/2016		<LLD	<LLD	<LLD	<LLD	<LLD	
06/29/2016	<LLD						<LLD
10/19/2016		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/21/2016	<LLD						

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2016 indicates no groundwater contamination in excess of the reporting threshold of $2.00E-5$ uCi/mL for tritium. Gamma spectroscopy was performed on all Radiological Environmental Monitoring Program wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP's 2016 Annual Radiological Environmental Operating Report. There were no positively identified gamma radionuclides from plant effluents detected in any of the GPI well samples, and a single well with trace levels of tritium just above detection limits.

The LLD value used for tritium counting of the samples varied between $9.42E-7$ and $9.59E-7$ uCi/mL, depending on which scintillation counter was used. This is well below the required maximum LLD value of $2.00E-6$ uCi/mL per the ODCM.

No tritium values were found significantly above LLD for 2016, though values found above the LLD are not abnormal, unexpected, or inconsistent with past sampling history. The samples observed above LLD historically were expected results from the release of tritiated water into the Absorption Pond, a licensed pathway and part of plant design, or the result of recapture deposition of tritium from licensed radioactive gaseous release points. The 2016 results were within expected parameters considering the reduction in tritium released to the Absorption Pond and typical rainfall recapture of tritium experienced.

Wells located inside the Protected Area of the plant are subject to recapture deposition of tritium and may show occasional sample results above LLD values following rainfalls and snow melt. The results observed in 2016 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed in 2016. Well MW-28 lies close to the vent stacks in the predominant wind direction, so it is expected to observe recaptured tritium from precipitation periodically.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2016 impacting groundwater. The sample results indicate proper well placement to ensure the protection of the groundwater and early identification of any abnormal conditions involving groundwater. This is validated by the demonstrated ability to monitor percolation from the Absorption Pond and recaptured tritium in precipitation, with flow direction and behavior acting as described in the plant licensing documents.

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	1	4	19	9	1	3	37
NNE	0	1	2	1	0	0	4
NE	0	2	6	2	0	0	10
ENE	0	1	8	3	0	0	12
E	0	6	12	1	0	0	19
ESE	1	5	7	4	0	0	17
SE	0	3	8	7	1	0	19
SSE	0	4	16	12	0	0	32
S	0	2	17	14	2	0	35
SSW	0	1	5	18	3	0	27
SW	0	2	5	16	1	1	25
WSW	0	10	15	13	3	3	44
W	0	6	14	16	1	0	37
WNW	1	9	10	10	8	0	38
NW	1	9	20	14	6	3	53
NNW	1	9	22	7	0	0	39
Total	5	74	186	147	26	10	448
Calm Hours not Included above for :							Total Period 2
Valid Hours for this Stability Class for:							Total Period 448
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	4	7	3	0	0	14
NNE	0	1	0	1	0	0	2
NE	0	3	2	1	0	0	6
ENE	1	1	2	2	1	0	7
E	0	3	4	3	2	0	12
ESE	0	1	0	1	0	0	2
SE	0	2	1	0	0	0	3
SSE	1	1	6	2	0	0	10
S	0	4	3	3	3	0	13
SSW	0	1	3	2	5	1	12
SW	0	5	3	9	2	0	19
WSW	1	1	7	9	4	1	23
W	1	4	3	15	18	0	41
WNW	1	0	4	11	13	0	29
NW	0	1	5	6	7	5	24
NNW	0	2	10	8	1	1	22
Total	5	34	60	76	56	8	239
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	3	10	13	4	0	31	
NNE	0	1	6	3	1	0	11	
NE	1	1	2	5	5	0	14	
ENE	1	2	1	0	0	0	4	
E	0	2	2	1	1	0	6	
ESE	0	1	3	9	2	1	16	
SE	1	6	6	9	0	0	22	
SSE	0	1	15	4	0	0	20	
S	0	3	8	6	0	1	18	
SSW	0	3	3	7	4	1	18	
SW	0	1	5	4	0	0	10	
WSW	0	4	2	3	5	1	15	
W	0	1	6	21	12	3	43	
WNW	0	1	7	41	24	3	76	
NW	1	3	5	16	20	2	47	
NNW	0	2	1	28	24	5	60	
Total	5	35	82	170	102	17	411	
Calm Hours not Included above for :							Total Period	2
Valid Hours for this Stability Class for:							Total Period	411
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	11	15	2	2	3	33
NNE	0	6	17	4	2	0	29
NE	0	1	6	5	0	0	12
ENE	1	2	3	1	0	0	7
E	2	3	3	9	2	0	19
ESE	1	5	12	6	8	2	34
SE	2	4	19	9	4	1	39
SSE	1	5	22	9	5	2	44
S	0	6	20	40	11	3	80
SSW	1	5	16	56	15	0	93
SW	1	4	16	21	12	3	57
WSW	0	3	19	14	15	13	64
W	1	1	1	11	4	1	19
WNW	0	3	3	16	7	1	30
NW	1	3	9	14	5	1	33
NNW	2	2	13	16	16	7	56
Total	13	64	194	233	108	37	649
Calm Hours not Included above for :							2
Valid Hours for this Stability Class for:							649
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	2	0	4	0	0	0	6
NNE	0	5	8	0	0	0	13
NE	0	10	7	3	0	0	20
ENE	1	6	7	1	0	0	15
E	0	1	13	0	0	0	14
ESE	0	3	14	1	1	0	19
SE	0	9	15	11	0	0	35
SSE	0	2	24	16	0	0	42
S	0	3	14	18	1	1	37
SSW	0	0	20	18	4	0	42
SW	1	2	9	1	5	0	18
WSW	1	2	6	3	0	3	15
W	0	0	1	1	0	0	2
WNW	0	1	3	0	0	0	4
NW	1	1	1	0	0	0	3
NNW	0	5	2	0	0	1	8
Total	6	50	148	73	11	5	293
Calm Hours not Included above for :							Total Period 2
Valid Hours for this Stability Class for:							Total Period 293
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	1	0	0	0	0	1
NNE	1	2	2	0	0	0	5
NE	0	0	3	0	0	0	3
ENE	0	1	1	0	0	0	2
E	0	1	3	0	0	0	4
ESE	0	2	7	0	0	0	9
SE	0	2	7	2	0	0	11
SSE	0	3	4	4	0	0	11
S	0	4	5	2	0	0	11
SSW	0	2	0	6	0	0	8
SW	0	0	0	1	0	0	1
WSW	1	0	1	0	0	0	2
W	0	0	0	0	0	0	0
WNW	0	2	0	0	0	0	2
NW	0	1	0	0	0	0	1
NNW	0	1	1	0	0	0	2
Total	2	22	34	15	0	0	73
Calm Hours not Included above for :							Total Period 2
Valid Hours for this Stability Class for:							Total Period 73
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	0	1	0	0	0	0	1
ENE	0	1	0	1	0	0	2
E	0	2	2	0	0	0	4
ESE	0	3	5	0	0	0	8
SE	0	2	3	1	0	0	6
SSE	0	0	1	2	0	0	3
S	1	0	1	0	0	0	2
SSW	0	0	4	1	0	0	5
SW	0	1	5	0	0	0	6
WSW	2	0	1	0	0	0	3
W	0	1	1	0	0	0	2
WNW	1	1	0	0	0	0	2
NW	0	1	2	0	0	0	3
NNW	0	1	0	0	0	0	1
Total	5	14	25	5	0	0	49
Calm Hours not Included above for :							Total Period
							2
Valid Hours for this Stability Class for:							Total Period
							49
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 01/01/2016 - 03/31/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	5	23	55	27	7	6	123
NNE	1	16	35	9	3	0	64
NE	1	18	26	16	5	0	66
ENE	4	14	22	8	1	0	49
E	2	18	39	14	5	0	78
ESE	2	20	48	21	11	3	105
SE	3	28	59	39	5	1	135
SSE	2	16	88	49	5	2	162
S	1	22	68	83	17	5	196
SSW	1	12	51	108	31	2	205
SW	2	15	43	52	20	4	136
WSW	5	20	51	42	27	21	166
W	2	13	26	64	35	4	144
WNW	3	17	27	78	52	4	181
NW	4	19	42	50	38	11	164
NNW	3	22	49	59	41	14	188
Total	41	293	729	719	303	77	2162
Calm Hours not Included above for :							Total Period 2
Variable Direction Hours for:							Total Period 0
Invalid Hours for:							Total Period 20
Valid Hours for this Stability Class for:							Total Period 2162
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A **Delta Temperature** Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	23	24	2	1	53
NNE	0	0	0	1	0	0	1
NE	0	0	5	2	0	0	7
ENE	0	2	0	2	0	0	4
E	0	5	5	15	2	0	27
ESE	2	3	15	8	1	0	29
SE	0	6	6	8	3	0	23
SSE	0	1	11	8	0	0	20
S	0	2	6	3	2	1	14
SSW	0	0	1	2	2	0	5
SW	0	0	3	4	3	0	10
WSW	0	2	11	12	0	0	25
W	0	4	11	5	0	1	21
WNW	0	3	5	4	0	1	13
NW	0	6	15	11	7	0	39
NNW	0	9	37	20	7	8	81
Total	2	46	154	129	29	12	372
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	12	11	3	1	30
NNE	0	1	4	0	0	0	5
NE	0	0	4	1	0	0	5
ENE	1	0	1	2	0	0	4
E	0	1	6	2	0	0	9
ESE	0	2	1	14	2	0	19
SE	0	2	4	2	1	0	9
SSE	0	4	4	1	0	0	9
S	0	2	1	2	1	0	6
SSW	0	0	2	3	1	0	6
SW	0	1	1	2	3	0	7
WSW	1	1	10	6	1	1	20
W	0	2	5	0	0	0	7
WNW	0	4	1	0	0	0	5
NW	1	4	7	6	3	0	21
NNW	0	0	8	11	10	5	34
Total	3	27	71	63	25	7	196
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							196
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	6	11	6	8	1	33
NNE	0	2	2	0	0	0	4
NE	0	1	2	1	0	0	4
ENE	0	2	11	4	0	0	17
E	0	0	11	4	0	0	15
ESE	0	3	8	6	1	0	18
SE	1	2	9	2	3	0	17
SSE	0	3	6	4	2	0	15
S	0	1	7	2	0	0	10
SSW	0	0	0	3	0	0	3
SW	0	0	7	3	0	0	10
WSW	0	2	9	1	1	0	13
W	0	1	6	3	0	1	11
WNW	0	1	2	2	0	0	5
NW	0	2	9	5	2	0	18
NNW	0	5	10	15	5	3	38
Total	2	31	110	61	22	5	231
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 231
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	9	35	12	2	0	60
NNE	0	11	13	3	0	0	27
NE	0	6	11	1	0	0	18
ENE	1	6	9	4	0	0	20
E	2	7	12	4	1	0	26
ESE	0	11	27	22	6	0	66
SE	1	3	28	12	1	0	45
SSE	0	4	18	13	2	0	37
S	0	3	22	16	4	0	45
SSW	2	1	20	12	1	1	37
SW	2	4	18	19	4	1	48
WSW	1	8	26	7	2	0	44
W	0	16	14	11	1	0	42
WNW	1	21	10	5	1	0	38
NW	2	14	19	12	7	1	55
NNW	0	16	32	6	0	0	54
Total	14	140	314	159	32	3	662
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							662
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	21	8	0	0	0	30	
NNE	0	10	9	0	0	0	19	
NE	1	6	11	1	0	0	19	
ENE	1	4	4	0	0	0	9	
E	0	4	6	0	0	0	10	
ESE	0	4	19	9	0	0	32	
SE	3	7	10	9	0	0	29	
SSE	0	2	19	6	0	0	27	
S	1	7	14	13	0	0	35	
SSW	2	7	13	10	0	0	32	
SW	0	6	12	4	1	0	23	
WSW	1	12	14	10	2	0	39	
W	2	11	7	4	1	0	25	
WNW	1	10	2	3	0	0	16	
NW	0	5	2	0	0	0	7	
NNW	2	10	5	0	0	0	17	
Total	15	126	155	69	4	0	369	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	369
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	1	0	0	0	3	
NNE	0	2	4	0	0	0	6	
NE	2	6	13	0	0	0	21	
ENE	1	5	9	1	0	0	16	
E	2	0	5	2	0	0	9	
ESE	1	2	10	1	0	0	14	
SE	2	0	12	3	0	0	17	
SSE	0	1	6	3	0	0	10	
S	0	1	7	7	0	0	15	
SSW	2	1	4	7	0	0	14	
SW	0	1	4	1	0	0	6	
WSW	0	1	1	0	0	0	2	
W	1	4	3	0	0	0	8	
WNW	0	6	0	0	0	0	6	
NW	1	1	1	0	0	0	3	
NNW	0	1	1	0	0	0	2	
Total	12	34	81	25	0	0	152	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	152
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	5	2	0	0	0	8	
NNE	2	2	6	0	0	0	10	
NE	0	2	7	0	0	0	9	
ENE	0	6	17	3	0	0	26	
E	3	2	13	5	0	0	23	
ESE	0	4	12	2	0	0	18	
SE	0	4	13	2	0	0	19	
SSE	1	1	5	12	0	0	19	
S	1	2	5	5	0	0	13	
SSW	0	2	6	2	0	0	10	
SW	0	5	10	0	0	0	15	
WSW	1	5	1	0	0	0	7	
W	1	8	1	0	0	0	10	
WNW	1	4	2	0	0	0	7	
NW	0	2	0	0	0	0	2	
NNW	0	2	1	0	0	0	3	
Total	11	56	101	31	0	0	199	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	199
Total Hours for Period								2184

Joint Frequency Distribution

1 Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 04/01/2016 - 06/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	5	49	92	53	15	3	217
NNE	2	28	38	4	0	0	72
NE	3	21	53	6	0	0	83
ENE	4	25	51	16	0	0	96
E	7	19	58	32	3	0	119
ESE	3	29	92	62	10	0	196
SE	7	24	82	38	8	0	159
SSE	1	16	69	47	4	0	137
S	2	18	62	48	7	1	138
SSW	6	11	46	39	4	1	107
SW	2	17	55	33	11	1	119
WSW	4	31	72	36	6	1	150
W	4	46	47	23	2	2	124
WNW	3	49	22	14	1	1	90
NW	4	34	53	34	19	1	145
NNW	2	43	94	52	22	16	229
Total	59	460	986	537	112	27	2181

Calm Hours not Included above for :	Total Period	0
Variable Direction Hours for:	Total Period	0
Invalid Hours for:	Total Period	3
Valid Hours for this Stability Class for:	Total Period	2181
Total Hours for Period		2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class Δ Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	7	18	0	0	25
NNE	0	0	2	0	0	0	2
NE	0	1	3	3	0	0	7
ENE	0	3	3	4	0	0	10
E	0	1	5	2	0	0	8
ESE	0	1	8	1	0	0	10
SE	0	1	10	0	0	0	11
SSE	0	0	3	4	0	0	7
S	0	1	4	3	2	0	10
SSW	0	0	0	0	0	0	0
SW	0	0	2	2	0	0	4
WSW	0	0	5	5	5	0	15
W	0	0	5	3	1	0	9
WNW	0	4	2	4	1	0	11
NW	0	6	1	1	0	0	8
NNW	0	5	13	10	0	0	28
Total	0	23	73	60	9	0	165
Calm Hours not Included above for :							Total Period 3
Valid Hours for this Stability Class for:							Total Period 165
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	2	1	3	0	0	6
NNE	1	0	2	0	0	0	3
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	1	3	1	0	0	5
SE	0	0	2	0	0	0	2
SSE	0	1	2	1	0	0	4
S	0	0	2	9	1	0	12
SSW	0	0	2	2	0	0	4
SW	0	0	6	4	0	0	10
WSW	0	1	9	1	1	0	12
W	0	0	2	3	1	1	7
WNW	0	1	0	1	0	0	2
NW	0	0	2	0	0	0	2
NNW	0	1	6	6	0	0	13
Total	1	7	39	33	3	1	84
Calm Hours not Included above for :							3
Valid Hours for this Stability Class for:							84
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	10	5	0	0	16
NNE	0	0	0	0	0	0	0
NE	1	2	3	1	0	0	7
ENE	0	2	0	0	0	0	2
E	0	1	3	0	0	0	4
ESE	0	2	3	0	0	0	5
SE	0	0	2	3	0	0	5
SSE	0	4	4	0	0	0	8
S	0	3	1	2	0	1	7
SSW	0	0	4	2	0	0	6
SW	0	1	9	3	0	0	13
WSW	0	0	3	3	1	0	7
W	0	0	2	3	1	0	6
WNW	0	4	2	2	0	0	8
NW	0	1	0	0	0	0	1
NNW	0	2	8	3	0	0	13
Total	1	23	54	27	2	1	108

Calm Hours not Included above for :	Total Period	3
Valid Hours for this Stability Class for:	Total Period	108
Total Hours for Period		2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	11	36	7	0	0	56
NNE	1	4	9	0	0	0	14
NE	1	5	26	14	0	0	46
ENE	1	2	24	2	0	0	29
E	0	4	22	1	0	0	27
ESE	0	6	10	0	0	0	16
SE	0	8	20	1	0	0	29
SSE	1	9	29	6	0	0	45
S	0	5	44	10	2	0	61
SSW	0	6	26	17	1	0	50
SW	2	9	39	33	0	0	83
WSW	1	6	32	20	5	1	65
W	0	8	14	9	11	0	42
WNW	1	20	15	23	4	0	63
NW	1	11	14	4	0	0	30
NNW	1	16	22	2	0	0	41
Total	12	130	382	149	23	1	697

Calm Hours not Included above for :	Total Period	3
Valid Hours for this Stability Class for:	Total Period	697
Total Hours for Period		2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	5	23	9	1	0	0	38
NNE	5	17	12	2	0	0	36
NE	4	14	28	6	0	0	52
ENE	6	8	19	1	0	0	34
E	5	7	20	2	0	0	34
ESE	4	9	14	1	0	0	28
SE	4	7	15	3	0	0	29
SSE	3	13	11	5	0	0	32
S	2	9	49	7	0	0	67
SSW	0	8	38	4	0	1	51
SW	3	14	9	4	0	0	30
WSW	1	22	19	1	0	1	44
W	3	9	4	3	0	0	19
WNW	6	20	3	10	3	0	42
NW	3	19	3	3	2	0	30
NNW	3	19	7	1	0	0	30
Total	57	218	260	54	5	2	596
Calm Hours not Included above for :							Total Period 3
Valid Hours for this Stability Class for:							Total Period 596
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	2	2	0	0	0	4
NNE	1	6	5	0	0	0	12
NE	3	4	8	0	0	0	15
ENE	1	3	17	0	0	0	21
E	0	0	19	1	0	0	20
ESE	0	4	13	2	0	0	19
SE	2	2	22	1	0	0	27
SSE	2	5	17	7	0	0	31
S	3	9	18	12	1	0	43
SSW	2	2	11	2	0	0	17
SW	1	7	12	0	0	0	20
WSW	2	3	4	0	0	0	9
W	1	1	0	0	0	0	2
WNW	0	1	2	0	0	0	3
NW	1	0	0	0	0	0	1
NNW	1	0	3	0	0	0	4
Total	20	49	153	25	1	0	248
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2016 - 09/30/2016
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	3	10	3	0	0	0	16
NNE	0	4	6	0	0	0	10
NE	5	5	3	1	0	0	14
ENE	2	13	12	1	0	0	28
E	2	9	15	2	0	0	28
ESE	3	10	18	1	0	0	32
SE	0	8	25	2	0	0	35
SSE	0	12	16	11	0	0	39
S	1	7	16	7	0	0	31
SSW	2	4	8	1	0	0	15
SW	1	8	6	0	0	0	15
WSW	3	7	2	1	0	0	13
W	3	3	0	0	0	0	6
WNW	1	4	0	0	0	0	5
NW	0	3	2	0	0	0	5
NNW	0	7	1	0	0	0	8
Total	26	114	133	27	0	0	300
Calm Hours not Included above for :							Total Period 3
Valid Hours for this Stability Class for:							Total Period 300
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

07/01/2016 - 09/30/2016

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	10	49	68	34	0	0	161
NNE	8	31	36	2	0	0	77
NE	14	31	71	25	0	0	141
ENE	10	31	75	10	0	0	126
E	7	22	84	8	0	0	121
ESE	7	33	69	6	0	0	115
SE	6	26	96	10	0	0	138
SSE	6	44	82	34	0	0	166
S	6	34	134	50	6	1	231
SSW	4	20	89	28	1	1	143
SW	7	39	83	46	0	0	175
WSW	7	39	74	31	12	2	165
W	7	21	27	21	14	1	91
WNW	8	54	24	40	8	0	134
NW	5	40	22	8	2	0	77
NNW	5	50	60	22	0	0	137
Total	117	564	1094	375	43	5	2198

Calm Hours not Included above for :

Total Period 3

Variable Direction Hours for:

Total Period 0

Invalid Hours for:

Total Period 7

Valid Hours for this Stability Class for:

Total Period 2198

Total Hours for Period

2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	7	29	2	0	0	0	38	
NNE	1	9	2	0	0	0	12	
NE	2	2	0	0	0	0	4	
ENE	1	0	0	0	0	0	1	
E	0	1	0	0	0	0	1	
ESE	1	6	0	0	0	0	7	
SE	2	7	1	0	0	0	10	
SSE	0	20	4	0	0	0	24	
S	1	19	7	0	0	0	27	
SSW	0	5	6	0	0	0	11	
SW	0	8	12	1	0	0	21	
WSW	1	13	9	0	0	0	23	
W	2	11	6	0	0	0	19	
WNW	0	13	1	0	0	0	14	
NW	3	7	0	0	0	0	10	
NNW	3	12	0	0	0	0	15	
Total	24	162	50	1	0	0	237	
Calm Hours not Included above for :							Total Period	4
Valid Hours for this Stability Class for:							Total Period	237
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record =

10/01/2016 - 12/31/2016

Elevation: Speed: SP10M

Direction: DIR10M Lapse: DT60M

Stability Class B

Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	7	3	0	0	0	12
NNE	1	3	0	0	0	0	4
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	3	0	0	0	0	0	3
ESE	3	1	0	0	0	0	4
SE	0	4	1	0	0	0	5
SSE	1	9	1	0	0	0	11
S	2	12	5	0	0	0	19
SSW	3	6	6	1	0	0	16
SW	0	11	5	1	0	0	17
WSW	1	6	5	0	0	0	12
W	1	6	17	0	0	0	24
WNW	1	11	4	0	0	0	16
NW	3	12	3	0	0	0	18
NNW	1	7	0	0	0	0	8
Total	22	95	50	2	0	0	169
Calm Hours not Included above for :							Total Period 4
Valid Hours for this Stability Class for:							Total Period 169
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: D160M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	9	3	0	0	0	13
NNE	3	2	0	0	0	0	5
NE	1	0	0	0	0	0	1
ENE	1	1	0	0	0	0	2
E	2	0	0	0	0	0	2
ESE	2	8	2	0	0	0	12
SE	2	15	3	0	0	0	20
SSE	3	17	4	0	0	0	24
S	3	13	7	0	0	0	23
SSW	1	12	10	0	0	0	23
SW	1	3	4	0	0	0	8
WSW	1	7	20	2	0	0	30
W	3	15	30	2	0	0	50
WNW	3	21	12	1	0	0	37
NW	3	15	14	3	0	0	35
NNW	3	7	5	0	0	0	15
Total	33	145	114	8	0	0	300
Calm Hours not Included above for :							Total Period 4
Valid Hours for this Stability Class for:							Total Period 300
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	13	59	11	0	0	0	83
NNE	25	30	1	0	0	0	56
NE	12	5	0	0	0	0	17
ENE	5	2	0	0	0	0	7
E	17	3	0	0	0	0	20
ESE	22	19	2	0	0	0	43
SE	14	39	7	0	0	0	60
SSE	18	37	20	1	0	0	76
S	13	48	33	0	0	0	94
SSW	5	39	50	16	0	0	110
SW	0	26	39	0	0	0	65
WSW	6	27	19	2	0	0	54
W	8	25	18	1	0	0	52
WNW	6	50	12	1	0	0	69
NW	10	41	21	0	0	0	72
NNW	11	27	10	0	0	0	48
Total	185	477	243	21	0	0	926
Calm Hours not Included above for :							Total Period 4
Valid Hours for this Stability Class for:							Total Period 926
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	9	2	0	0	0	0	11
NNE	10	1	0	0	0	0	11
NE	20	1	0	0	0	0	21
ENE	11	0	0	0	0	0	11
E	8	0	0	0	0	0	8
ESE	16	1	0	0	0	0	17
SE	21	8	0	0	0	0	29
SSE	37	15	4	0	0	0	56
S	21	47	6	0	0	0	74
SSW	9	19	3	0	0	0	31
SW	6	12	1	0	0	0	19
WSW	1	2	0	0	0	0	3
W	1	3	0	0	0	0	4
WNW	0	0	0	0	0	0	0
NW	2	0	0	0	0	0	2
NNW	3	4	0	0	0	0	7
Total	175	115	14	0	0	0	304
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SPI0M Direction: DIR10M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	0	0	0	0	0	0	
NNE	2	0	0	0	0	0	2	
NE	7	0	0	0	0	0	7	
ENE	8	0	0	0	0	0	8	
E	20	0	0	0	0	0	20	
ESE	23	0	0	0	0	0	23	
SE	9	0	0	0	0	0	9	
SSE	19	0	0	0	0	0	19	
S	29	7	0	0	0	0	36	
SSW	5	1	0	0	0	0	6	
SW	2	0	0	0	0	0	2	
WSW	1	1	0	0	0	0	2	
W	0	0	0	0	0	0	0	
WNW	1	0	0	0	0	0	1	
NW	1	0	0	0	0	0	1	
NNW	0	0	0	0	0	0	0	
Total	127	9	0	0	0	0	136	
Calm Hours not Included above for :							Total Period	4
Valid Hours for this Stability Class for:							Total Period	136
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	0	0	0	0	0	1	
NNE	4	0	0	0	0	0	4	
NE	2	0	0	0	0	0	2	
ENE	6	0	0	0	0	0	6	
E	6	0	0	0	0	0	6	
ESE	15	0	0	0	0	0	15	
SE	23	0	0	0	0	0	23	
SSE	28	0	0	0	0	0	28	
S	27	1	0	0	0	0	28	
SSW	8	3	0	0	0	0	11	
SW	4	0	0	0	0	0	4	
WSW	3	0	0	0	0	0	3	
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	1	0	0	0	0	0	1	
Total	128	4	0	0	0	0	132	
Calm Hours not Included above for :							Total Period	4
Valid Hours for this Stability Class for:							Total Period	132
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 10/01/2016 - 12/31/2016
 Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M
 Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	33	106	19	0	0	0	158
NNE	46	45	3	0	0	0	94
NE	44	8	0	0	0	0	52
ENE	32	3	0	0	0	0	35
E	56	4	0	0	0	0	60
ESE	82	35	4	0	0	0	121
SE	71	73	12	0	0	0	156
SSE	106	98	33	1	0	0	238
S	96	147	58	0	0	0	301
SSW	31	85	75	17	0	0	208
SW	13	60	61	2	0	0	136
WSW	14	56	53	4	0	0	127
W	15	60	71	3	0	0	149
WNW	11	95	29	2	0	0	137
NW	22	75	38	3	0	0	138
NNW	22	57	15	0	0	0	94
Total	694	1007	471	32	0	0	2204
Calm Hours not Included above for :							Total Period 4
Variable Direction Hours for:							Total Period 0
Invalid Hours for:							Total Period 0
Valid Hours for this Stability Class for:							Total Period 2204
Total Hours for Period							2208

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was not revised during this 2016 reporting period.

ENCLOSURE 3 to AEP-NRC-2018-35

DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2015 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT, Revision 1

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A3.0	Offsite Dose Calculation Manual (ODCM) Changes

I. INTRODUCTION

This report discusses the radioactive discharges from Unit 1 and Unit 2 of the Donald C. Cook Nuclear Plant (CNP) during 2015. This is in accordance with the requirements of CNP Technical Specification (TS) 5.6.3.

The table below summarizes the pertinent statistics concerning the Plant's operation during the period from January 1, 2015, to December 31, 2015. The data in this table and the descriptive information on plant operation are based upon the respective unit's Monthly Operating Reports, Performance Indicators, and Control Room Logs for 2015.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	8,079,912	8,971,844
Unit Service Factor (Percent (%))	83.9	90.7
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	86.7	92.2

Unit 1 entered the reporting period in Mode 1 at Nominal Full Power (NFP). Small power adjustments were made to facilitate main turbine valve testing throughout the year. On June 1, 2015, the unit performed a normal downpower and was manually tripped to enter a forced maintenance outage. The unit attained criticality on July 29, 2015, and attained NFP on July 30, 2015. The unit exited the reporting period at NFP.

Unit 2 entered the reporting period in Mode 1 at NFP. Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit performed a normal downpower and was manually tripped on March 25, 2015, entering refueling outage U2C22. The unit attained criticality on April 22, 2015, however the reactor was manually tripped on April 23, 2015 to support additional maintenance. The unit attained criticality on April 27, 2015, and attained NFP on May 1, 2015. The unit commenced a normal planned downpower to 95% on November 6, 2015, to support online maintenance work. The unit returned to NFP on November 19, 2015. The unit exited the reporting period at NFP.

II. RADIOACTIVE RELEASES AND RADIOLOGICAL IMPACT ON MAN

Since a number of release points are common to both units, the release data from both units are combined to form this two-unit, Annual Radioactive Effluent Release Report. Appendix A1.1 through A2.4 of this report present the information in accordance with Section 5.6.3 of Appendix A to the Facility Operating Licenses, as specified in the Technical Specifications, Regulatory Guide 1.21, and 10 CFR Part 50, Appendix I.

The "MIDAS System" is a computer code that calculates doses due to radionuclides that were released from the CNP.

All liquid and gaseous releases were well within Offsite Dose Calculation Manual (ODCM) limits and federal limits.

There were no abnormal liquid releases and no abnormal gaseous releases in 2015.

The Independent Spent Fuel Storage Installation (ISFSI) impacts are included with Unit 1 and Unit 2 statistics. The ISFSI cask system does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the ISFSI.

Liquid Releases

During 2015 there were 69 liquid batch releases performed. The number of liquid batch releases for the four quarters in 2015 was 20, 27, 15, and 7, respectively.

Estimated doses (in mrem) to maximally exposed individuals via the liquid release pathways are given in Appendix A1.2 of this report.

Gaseous Releases

During the first quarter of 2015 there were four batch releases from Gas Decay Tanks (GDT), one containment purge, one system tank venting, and 80 Containment Pressure Reliefs (CPR). During the second quarter there was one containment purge and 84 CPR. During the third quarter there were four batch releases from GDTs and 95 CPR. During the fourth quarter there were two batch releases from GDTs and 127 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89017 (DRSS); 50-316/89016 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There were a total of 10 GDT releases, two containment purge, one system tank vent, and 386 CPR gaseous batch releases made during 2015.

In calculating the dose consequences for continuous and batch gaseous releases during 2015, the meteorological data measured at the time of the release were used.

The estimated doses (in mrem) to maximally exposed individuals via the gaseous release pathways are given in Appendix A1.2 of this report. For individuals that are within the site boundary, the occupancy time is sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary.

Solid Waste Disposition

There were 37 shipments of radioactive waste made during 2015. These included shipments made from the site to various radioactive waste processors for ultimate disposal.

III. METEOROLOGICAL

Appendices A2.1, A2.2, A2.3, and A2.4 of this report contain the cumulative joint frequency distribution tables of wind speed and wind direction, corresponding to the various atmospheric stability classes for the first, second, third, and fourth quarters of 2015. Hourly meteorological data is available for review and/or inspection upon request.

IV. OFFSITE DOSE CALCULATION MANUAL (ODCM) CHANGES

The ODCM, PMP-6010-OSD-001, was revised during the report period. The new revision has been attached to this report.

V. TOTAL DOSE

Section 3.2.5 of the ODCM requires that the dose or dose commitment to a real individual from all uranium fuel cycle sources in Berrien County be limited to no more than 25 mrem to the total body or any organ (except the thyroid, which is limited to no more than 75 mrem) over a period of 12 consecutive months to show conformance with the requirements of 40 CFR Part 190. The maximum cumulative dose to an individual from liquid and gaseous effluents during 2015 was well within the ODCM limits. Measurements using thermoluminescent dosimeters (TLD) at 12 onsite stations indicate that the dose due to direct radiation is consistent with preoperational and current control (background) levels. This is fully evaluated in CNP's 2015 Annual Radiological Environmental Operating Report. Additional TLD dosimetry installed by Radiation Protection department programs monitor dose received by individuals on site as visitors.

The annual dose to the maximum individual will be estimated by first, summing the quarterly total body air dose, the quarterly skin air dose, the quarterly critical organ dose from iodines and particulates (I&P), the quarterly total body dose from liquid effluents, the quarterly critical organ dose from liquid effluents, and the Radiological Environmental Monitoring Program onsite direct radiation TLD data. These quarterly values are summed with the annual Carbon-14 dose and compared to the annual total body limit for conservative reasons. The table that follows here represents the above written description:

Dose (mrem)	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
I & P	1.62E-02	1.95E-02	4.61E-02	1.57E-02
Total Body Air	2.50E-04	2.20E-04	5.00E-04	3.10E-04
Skin	4.10E-04	3.50E-04	2.20E-03	5.10E-04
Liquid TB	1.69E-02	1.19E-02	1.27E-02	2.47E-03
Liquid Organ	1.69E-02	1.20E-02	1.27E-02	2.48E-03
C14 (Annual)				2.23E+00
Direct Radiation	0	0	0	0
Total	5.07E-02	4.40E-02	7.42E-02	2.25E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.42E+00
Annual Dose Limit (mrem)				25
Percent of limit				9.68E+00

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2015 annual dose data, and 2015 annual dose data with C-14 added. This indicates that 2015 was a 'typical' single unit outage year with respect to radioactive effluents and allows for easier comparison. The table is presented as follows:

	Annual Dose (mrem)	% of limit
2009	2.60E-01	1.04
2015	1.90E-01	0.76
2015 with C-14	2.42	9.68

VI. **RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS**

There were no release pathways unmonitored for greater than 30 days.

VII. **NOTEWORTHY CONDITIONS IDENTIFIED IN 2015**

There were no new noteworthy conditions identified in 2015.

Carbon-14 Supplemental Information for the 2015 Annual Radioactive Effluent Release Report.

C-14 has a 5730 year half-life and is a naturally occurring radionuclide produced by cosmic ray interactions in the atmosphere. C-14 is a relatively low energy beta emitter. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally, from weapons testing, or coal burning power plants. The inventory of C-14 in Earth's biosphere is about 300 million Curies, of which most is in the oceans.

Since the U.S. Nuclear Regulatory Commission (NRC) published Regulatory Guide (RG) 1.21, Revision 1, in 1974, the analytical methods for determining C-14 have improved. Coincidentally, the radioactive effluents from commercial nuclear power plants over the same period have decreased to the point that C-14 is likely to be a principal radionuclide in gaseous effluents. Based on these reasons and a desire to adjust policy to align with international standards, the nuclear industry was required to report, starting in 2010, the quantity and dose impact of C-14 here in the United States. The dose will be reported both with and without C-14 so a comparison to 2009 can be made, keeping in mind the differing standards.

The quantity of C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. RG 1.21, Revision 2). A recent study recommends a source term scaling factor of approximately 9.0 to 9.8 Curies/GWe-yr for a Westinghouse Pressurized Water Reactor (Ref. EPRI 1021106, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents", dated December 23, 2010). A scaling factor of 9.4 Curies/GWe-yr was assumed for this report. Using this source term scaling factor and actual electrical generation (in MWH) produced during 2015 results in a site total of 18.3 Curies produced.

C-14 releases from Pressurized Water Reactors (PWR) occur primarily as a mix of organic carbon (methane) and inorganic carbon (carbon dioxide). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as gas. Any time the primary coolant is exposed to an oxidizing environment (during shutdown or refueling), a slow transformation from an organic to an inorganic species occurs. Various studies documenting measured C-14 releases from PWRs suggest an average 80% organic fraction with the remainder being carbon dioxide. This equates to 2.56 Curies released as carbon dioxide which is available for the food pathway through photosynthesis to vegetation.

Dose is calculated utilizing the methodology prescribed in RG 1.109, Appendix C, with the vegetation dose being the most predominant. A 'p' factor of 0.33 is determined utilizing the time of batch gaseous releases performed during 2015, the time available for photosynthesis in plants, and the assumption that 70% of the C-14 released is from gaseous batch releases. A further reduction to the vegetation and leafy vegetable dose is warranted due to the limited growing season in Michigan, which was conservatively limited to nine months.

The final results indicated a calculated organ dose from C-14 to a child at the site boundary of 1.76 mrem to the bone and a whole body dose of 0.468 mrem, for a combined total C-14 dose of 2.23 mrem. This is less than the dose limit of 15 mrem/unit to any organ prescribed in 10 CFR 50, Appendix I, and the 40 CFR Part 190 limit of 25 mrem for total body and for any organ (≤ 75 mrem for thyroid).

VIII. CONCLUSION

Based on the information presented in this report, it is concluded that CNP Units 1 and 2 performed their intended design function with no demonstrable adverse effect on the health and safety of the general public.

IX. ERRATA

Corrections were made on the 2014 Annual Radioactive Release Report, page A1.1-8, correcting an exponent typographic error. There were no changes in dose to the public. This was documented in Action Request 2015-6149. The corrected page is attached to this report on the following page.

Note: This entire document is Revision 1 submitted as "Errata" attached to the 2017 Annual Radioactive Effluent Release Report per Corrective Action 2017-4835. This new revision completely replaces the previously submitted report. This errata was necessitated due to problems identified with equipment utilized for counting tritium samples dating back to 2013. The alterations made no impact to the overall public dose calculated of 2.42 millirems (9.68% of the 40 CFR190 allowable dose limits) but are included for accuracy. There were no adverse impacts to public health or safety.

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
 GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.37E-02	2.95E-02	5.45E-02	3.20E-02
AR41	Ci	3.58E-01	3.60E-01	4.53E-01	1.55E-01
KR85	Ci	3.18E-01	-----	9.81E-01	2.45E-01
XE131M	Ci	-----	-----	-----	-----
XE133M	Ci	-----	-----	-----	-----
XE133	Ci	5.87E-02	7.53E-02	1.17E-01	1.46E-03
XE135	Ci	-----	-----	8.11E-07	2.56E-05
Total for Period	Ci	7.58E-01	4.65E-01	1.61E+00	4.33E-01
2. IODINES					
I131	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----
3. PARTICULATES					
* BR80	Ci	-----	-----	-----	-----
* BR82	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2015 Effluent and Waste Disposal Annual Report

SUPPLEMENTAL INFORMATION

Facility: Donald C. Cook Nuclear Plant
Licensee: Indiana Michigan Power Company

1 REGULATORY LIMITS

1.1 Noble Gases

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be limited to the following:

1.1.1 During any calendar quarter, to ≤ 5 mrad/unit for gamma radiation and ≤ 10 mrad/unit for beta radiation.

1.1.2 During any calendar year, to ≤ 10 mrad/unit for gamma radiation and ≤ 20 mrad/unit for beta radiation.

1.2 Iodines - Particulates

The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to unrestricted areas shall be limited to the following:

1.2.1 During any calendar quarter to ≤ 7.5 mrem/unit to any organ.

1.2.2 During any calendar year to ≤ 15 mrem/unit to any organ.

1.3 Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited:

1.3.1 During any calendar quarter to ≤ 1.5 mrem/unit to the total body and to ≤ 5 mrem/unit to any organ.

1.3.2 During any calendar year to ≤ 3 mrem/unit to the total body and to ≤ 10 mrem/unit to any organ.

2015 Effluent and Waste Disposal Annual Report

1.4 Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2 **MAXIMUM PERMISSIBLE CONCENTRATIONS**

2.1 Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site shall be limited to the following:

2.1.1 For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.

2.1.2 For all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days: ≤ 1500 mrem/yr to any organ.

The above limits are provided to insure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits in 10 CFR Part 20, Appendix B, Table 2, Column 1.

2.2 Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

2015 Effluent and Waste Disposal Annual Report

3 AVERAGE ENERGY

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public. Release rates are calculated using an isotopic mix from actual samples rather than average energy.

4 MEASUREMENTS and APPROXIMATIONS of TOTAL RADIOACTIVITY

4.1 Fission and Activation Gases

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters.

4.2 Iodines

Sampled on iodine adsorbing media, and analyzed on an 8192 channel analyzer and HpGe detector.

4.3 Particulates

Sampled on a glass filter and analyzed on an 8192 channel analyzer and HpGe detector. Sr-89 and Sr-90 analyses are performed by offsite vendor.

4.4 Liquid Effluents

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters. Fe-55, Sr-89 and Sr-90 analyses are performed by an offsite vendor. Ni-63 is also currently being analyzed by the offsite vendor in response to evaluation of the 10 CFR 61 sample results.

2015 Effluent and Waste Disposal Annual Report

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

20 releases in the 1st quarter, 2015
27 releases in the 2nd quarter, 2015
15 releases in the 3rd quarter, 2015
7 releases in the 4th quarter, 2015

5.1.2 Total time period for batch releases:

50,145 minutes

5.1.3 Maximum time for a batch release:

1,638 minutes

5.1.4 Average time period for batch release:

727 minutes

5.1.5 Minimum time period for a batch release:

160 minutes

5.1.6 Average stream flow during periods of release of effluent into a flowing stream:

6.85E+5 gpm circulating water

2015 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

86 releases in the 1st quarter, 2015
85 releases in the 2nd quarter, 2015
99 releases in the 3rd quarter, 2015
129 releases in the 4th quarter, 2015

5.2.2 Total time period for batch releases:

7,560 minutes

5.2.3 Maximum time for a batch release:

354 minutes

5.2.4 Average time period for batch release:

19 minutes

5.2.5 Minimum time period for a batch release:

5 minutes

2015 Effluent and Waste Disposal Annual Report

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.1.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2 Gaseous

6.2.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	3.13E+01	2.41E+01	2.30E+01	2.46E+01
XE135m	Ci	-----	-----	-----	-----
KR85	Ci	-----	-----	-----	-----
XE131m	Ci	-----	-----	-----	-----
XE133m	Ci	-----	-----	-----	-----
XE133	Ci	-----	-----	-----	-----
XE135	Ci	-----	-----	-----	-----
Total for Period	Ci	3.13E+01	2.41E+01	2.30E+01	2.46E+01
2. IODINES					
I131	Ci	-----	4.08E-07	-----	-----
I132	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	2.63E-07	1.83E-10
Total for Period	Ci	-----	4.08E-07	2.63E-07	1.83E-10
3. PARTICULATES					
MN54	Ci	-----	-----	-----	-----
CO60	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	5.00E-02	6.57E-02	6.56E-02	6.50E-02
AR41	Ci	2.41E-01	1.92E-01	1.21E-01	2.04E-01
KR85	Ci	4.86E-01	-----	2.67E-01	1.16E-01
XE131M	Ci	-----	-----	-----	-----
XE133M	Ci	-----	-----	-----	-----
XE133	Ci	9.09E-03	4.28E-02	1.40E-01	2.29E-01
XE135	Ci	-----	2.62E-04	6.79E-04	3.80E-04
Total for Period	Ci	7.86E-01	3.01E-01	5.94E-01	6.14E-01
2. IODINES					
I131	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----
3. PARTICULATES					
CS137	Ci	2.18E-09	-----	-----	-----
* BR82	Ci	5.02E-06	3.07E-06	-----	-----
Total for Period	Ci	5.02E-06	3.07E-06	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION GASES						
1. Total Release	Ci	7.37E-01	2.35E-01	5.29E-01	4.82E-01	11.5
2. Average release rate for period	uCi/sec	9.48E-02	2.99E-02	6.65E-02	6.06E-02	
3. Percent of applicable limit*	% Gamma Beta	8.47E-03 5.94E-03	7.15E-03 1.34E-03	1.75E-02 5.88E-02	1.02E-02 2.34E-03	

B. IODINES						
1. Total I-131	Ci	0.00E+00	4.08E-07	0.00E+00	0.00E+00	23.4
2. Average release rate for period	uCi/sec	0.00E+00	5.19E-08	0.00E+00	0.00E+00	
3. Percent of applicable limit*	%	0.00E+00	1.48E-07	0.00E+00	0.00E+00	

C. PARTICULATES						
1. Particulates with half lives > 8 days	Ci	2.18E-09	1.47E-12	0.00E+00	0.00E+00	27.7
2. Average release rate for period	uCi/sec	2.80E-10	1.86E-13	0.00E+00	0.00E+00	
3. Percent of applicable limit*	%	7.98E-10	5.31E-13	0.00E+00	0.00E+00	
4. Gross alpha radioactivity	Ci	<6.50E-07	<8.82E-07	<7.79E-07	<6.43E-07	

D. TRITIUM						
1. Total Release	Ci	3.13E+01	2.42E+01	2.31E+01	2.47E+01	13.2
2. Average release rate for period	uCi/sec	4.02E+00	3.07E+00	2.91E+00	3.10E+00	
3. Percent of applicable limit*	%	2.29E-02	1.75E-02	1.66E-02	1.77E-02	

* Applicable limits are expressed in terms of dose. See Appendices A1.2-1 through A1.2-4

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	4.90E+02	3.93E+02	4.91E+02	9.31E+01
CR51	Ci	-----	-----	-----	-----
MN54	Ci	-----	-----	-----	-----
FE55	Ci	1.95E-05	1.09E-03	-----	-----
CO58	Ci	3.84E-05	7.33E-05	4.76E-05	2.89E-05
CO60	Ci	6.43E-05	3.18E-05	3.74E-05	5.50E-05
NI63	Ci	3.82E-04	6.67E-04	-----	3.19E-04
*KR85	Ci	-----	-----	-----	-----
ZR95	Ci	-----	-----	-----	-----
NB95	Ci	-----	-----	-----	-----
MO99	Ci	-----	5.02E-06	-----	-----
TC99m	Ci	-----	2.10E-06	-----	-----
AG110m	Ci	1.94E-05	1.24E-05	1.38E-06	3.31E-06
SB124	Ci	-----	1.94E-06	-----	-----
SB125	Ci	1.30E-05	1.20E-05	-----	9.66E-06
CS134	Ci	7.57E-07	1.05E-05	-----	-----
CS137	Ci	9.80E-07	2.09E-05	1.20E-06	1.30E-06
*XE135	Ci	-----	-----	-----	-----
I131	Ci	-----	-----	-----	-----
*XE133	Ci	2.19E-05	1.41E-05	6.81E-06	3.25E-06
*XE133m	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
BATCH MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	5.39E-04	1.93E-03	8.76E-05	4.17E-04	15.1

2. Average diluted concentration during period	uCi/ml	1.58E-11	4.15E-11	2.16E-12	4.64E-11	

3. Percent of applicable limit	%	9.61E-05	1.45E-04	4.01E-05	2.80E-04	

B. TRITIUM						

1. Total Release	Ci	4.90E+02	3.93E+02	4.91E+02	9.31E+01	10.1

2. Average diluted concentration during period	uCi/ml	1.43E-05	8.44E-06	1.21E-05	1.04E-05	

3. Percent of applicable limit	%	1.43E+00	8.44E-01	1.21E+00	1.04E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	2.19E-05	1.41E-05	6.81E-06	3.25E-06	18.4

2. Average diluted concentration during period	uCi/ml	6.41E-13	3.03E-13	1.68E-13	3.62E-13	

3. Percent of applicable limit	%	3.21E-07	1.52E-07	8.39E-08	1.81E-07	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE	Ci	<1.17E-04	<1.58E-04	<8.78E-05	<4.10E-05	N/A

E. VOLUME OF WASTE RELEASED	Liters	1.22E+06	1.64E+06	9.14E+05	4.26E+05	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	3.42E+10	4.66E+10	4.06E+10	8.98E+09	3.48

2015 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
CONTINUOUS MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

B. TRITIUM						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE	Ci	0.00E+00	0.00E+00	0.00E+00	<1.35E-04	N/A

E. VOLUME OF WASTE RELEASED	Liters	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48

**2015 Effluent and Waste Disposal Annual Report
Solid Waste and Irradiated Fuel Shipments**

Solid Waste Shipped Offsite for Burial or Disposal			
1) Type of Waste	Unit	Estimated amount	Estimated Total Error, %
a) Spent resins, filters, sludge, evaporator bottoms, etc.	m ³ Curies	2.44E+02 3.73E+02	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m ³ Curies	5.34E+02 1.01E+00	1.00E+00 6.48E+00
c) Irradiated components, control rods, etc.	m ³ Curies		
d) Other (contaminated soil)	m ³ Curies		

2) Estimate of Principle Radionuclide Composition								
a)	H-3	5 %	Co-58	11 %	Sb-125	2 %	Cs-137	3 %
	Mn-54	2 %	Co-60	10 %	Cs-134	2.5 %		
	Fe-55	9 %	Ni-63	55 %	C-14	0.5 %		
b)	Ni-59	1 %	Co-58	3 %	Sb-125	5 %		
	Mn-54	2 %	Co-60	39 %	Zr/Nb-95	1 %		
	Fe-55	35.5 %	Ni-63	12 %	Zn-65	1 %	C-14	0.5 %

3) Solid Waste Disposition		
No. of Shipments	Mode of Transportation	Destination
34	Truck	Oak Ridge, TN
2	Truck	Erwin, TN
1	Truck	Kingston, TN

4) Type of Containers used for Shipment: Containers used are excepted packages, Type A, Sea Land, metal boxes, drums, tankers, and high integrity containers (HICs).

5) Solidification Agent: There were no solidifications performed during this report period.

2015 Effluent and Waste Disposal Annual Report Yearly Release Rates
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GASES		
Fission and Activation Gases	Total Release	1.98E+00 Curies
	Average Release Rate	6.30E-02 $\mu\text{Ci}/\text{sec}$
	% of Applicable Limits*	γ 2.17E-02 % β 3.06E-02 %
Iodines	Total I-131 Release	4.08E-07 Curies
	Average Release Rate	5.19E-08 $\mu\text{Ci}/\text{sec}$
	% of Applicable Limit*	4.57E-01 %
Particulates	Total Release	2.18E-09 Curies
	Average Release Rate	1.40E-10 $\mu\text{Ci}/\text{sec}$
	% of Applicable Limit*	7.98E-10 %
LIQUIDS		
Fission and Activation Products	Total Release	2.97E-03 Curies
	Average Diluted Concentration	2.65E-11 $\mu\text{Ci}/\text{ml}$
	% of Applicable Limits*	Total Body 1.43E+00 % Organ 4.30E-01 %

* Applicable limits are expressed in terms of the annual 10 CFR 50, Appendix I, dose limits.

Site Boundary and Nearest Residence Listing

The following distances were used in the calculation of the maximum individual doses:

<u>Sector</u>	<u>Direction</u>	<u>Boundary (Meters)</u>	<u>Nearest Residence (Meters)</u>
A	N	651	659
B	NNE	617	660
C	NE	789	943
D	ENE	1497	1747
E	E	1274	1716
F	ESE	972	1643
G	SE	629	1640
H	SSE	594	964
J	S	594	997
K	SSW	629	942

Summary of Maximum Individual Doses

First Quarter 2015

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.69E-02	Child	Receptor 1	1.13E+00	1.5E+0
Liquid	Liver	1.69E-02	Child	Receptor 1	3.39E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	4.23E-04	Any Age	651 (N)	8.47E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	5.94E-04	Any Age	972 (ESE)	5.94E-03	1.0E+1
Iodines and Particulates	Total Body	1.62E-02	Child	659 (N)	2.16E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2015

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.19E-02	Child	Receptor 1	7.91E-01	1.5E+0
Liquid	Liver	1.20E-02	Child	Receptor 1	2.39E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	3.58E-04	Any Age	651 (N)	7.15E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.34E-04	Any Age	651 (N)	1.34E-03	1.0E+1
Iodines and Particulates	Total Body	1.95E-02	Child	659 (N)	2.60E-01	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2015

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.27E-02	Child	Receptor 1	8.48E-01	1.5E+0
Liquid	Liver	1.27E-02	Child	Receptor 1	2.55E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	8.73E-04	Any Age	651 (N)	1.75E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	5.88E-03	Any Age	629 (SSW)	5.88E-02	1.0E+1
Iodines and Particulates	Total Body	4.61E-02	Child	659 (N)	6.14E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2015

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.47E-03	Child	Receptor 1	1.65E-01	1.5E+0
Liquid	Liver	2.48E-03	Child	Receptor 1	4.96E-02	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	5.10E-04	Any Age	651 (N)	1.02E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	2.34E-04	Any Age	651 (N)	2.34E-03	1.0E+1
Iodines and Particulates	Total Body	1.57E-02	Child	942 (SSW)	2.10E-01	7.5E+0

2015 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-22D	MW-22M	MW-22S	MW-24D	MW-24M	MW-24S	MW-25D	MW-25M
02/25/2015				<LLD	<LLD	<LLD	<LLD	<LLD
02/26/2015	<LLD	<LLD	<LLD					
03/29/2015							<LLD	<LLD
04/01/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/29/2015							<LLD	<LLD
05/30/2015				<LLD	<LLD	<LLD		
05/31/2015	<LLD	<LLD	<LLD					
06/24/2015				<LLD	<LLD	<LLD		
06/25/2015							<LLD	<LLD
06/26/2015	<LLD	<LLD	<LLD					
07/04/2015				<LLD	<LLD	<LLD		
07/29/2015	<LLD	<LLD	<LLD				<LLD	<LLD
08/28/2015				<LLD	<LLD	<LLD	<LLD	<LLD
09/14/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/21/2015							<LLD	<LLD
10/23/2015				<LLD	<LLD	<LLD		
11/18/2015							<LLD	<LLD
11/20/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
12/14/2015	<LLD	<LLD	<LLD					
12/15/2015				<LLD	<LLD	<LLD	<LLD	<LLD

(Note: Wells MW-22 through MW-27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2015 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-25S	MW-26D	MW-26M	MW-26S	MW-27D	MW-27M	MW-27S	EW-19
02/25/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
02/26/2015								<LLD
03/29/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/01/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/06/2015								<LLD
05/26/2015					<LLD	<LLD	<LLD	
05/29/2015	<LLD	<LLD	<LLD	<LLD				
06/01/2015								<LLD
06/24/2015		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
06/25/2015	<LLD							
07/08/2015								<LLD
07/29/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
08/28/2015	<LLD	<LLD	<LLD	<LLD				
09/14/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
10/21/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
11/18/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
12/15/2015	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	

(Note: Wells MW-22 through MW-27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2015 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	SG-1	SG-2	SG-4	SG-5	OW-2	MW-20	MW-21	EW-18
01/16/2015	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
02/26/2015						<LLD	<LLD	<LLD
04/15/2015						<LLD	<LLD	
04/19/2015	<LLD	<LLD	<LLD	<LLD				
04/24/2015					<LLD			
06/01/2015								<LLD
07/07/2015						<LLD	<LLD	
07/10/2015	<LLD	<LLD	<LLD	<LLD				
09/18/2015	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
10/05/2015	<LLD	<LLD	<LLD	<LLD				
10/06/2015						<LLD	<LLD	
11/24/2015						<LLD		
12/14/2015						<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2015 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-9	W-10	W-11	W-12	W-13	W-14	W-15	OW-1
01/16/2015		<LLD	<LLD	<LLD	<LLD	<LLD		
01/19/2015	<LLD						<LLD	
02/26/2015			<LLD			<LLD		
04/06/2015		<LLD		<LLD	<LLD		<LLD	
04/14/2015			<LLD	<LLD	<LLD	<LLD		
04/15/2015		<LLD					<LLD	
04/19/2015	<LLD							
04/24/2015								<LLD
05/30/2015							<LLD	
05/31/2015						<LLD*		<LLD
06/24/2015							<LLD	
06/26/2015						<LLD		
06/29/2015								<LLD*
07/07/2015		<LLD	<LLD	<LLD				
07/08/2015		<LLD			<LLD	<LLD		
07/09/2015							<LLD	
07/10/2015					<LLD	<LLD		
07/14/2015	<LLD							
07/29/2015								<LLD
09/14/2015			<LLD	<LLD	<LLD	<LLD	<LLD	
09/21/2015								<LLD
10/06/2015		<LLD	<LLD	<LLD				
10/07/2015	<LLD				<LLD	<LLD	<LLD	
10/21/2015								<LLD
11/20/2015								<LLD
12/15/2015								<LLD

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2015 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)

Lower Limit of Detection = LLD

Date	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
01/16/2015							<LLD	
01/19/2015	<LLD	<LLD		<LLD	<LLD	<LLD		
01/20/2015			<LLD					<LLD
04/06/2015								<LLD
04/14/2015							<LLD	
04/15/2015	<LLD							<LLD
04/16/2015		<LLD						
04/19/2015			<LLD					
04/24/2015				<LLD	<LLD	<LLD		
07/08/2015			<LLD					
07/09/2015				<LLD	<LLD	<LLD		
07/10/2015	<LLD						<LLD	<LLD
07/14/2015		<LLD	<LLD					
10/06/2015	<LLD		<LLD					
10/07/2015		<LLD					<LLD	<LLD
10/14/2015				<LLD	<LLD	<LLD		
12/15/2015						<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)

Lower Limit of Detection = LLD

Date	OW-4	MW-28	MW-29					
07/29/2015	<LLD							
09/21/2015	<LLD							
10/21/2015	<LLD							
10/23/2015		<LLD	<LLD					
11/20/2015	<LLD							
12/15/2015	<LLD							

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2015 GPI Sample Data

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2015 indicates no groundwater contamination in excess of the reporting threshold of $2.00\text{E-}5$ uCi/mL for tritium. Gamma spectroscopy was performed on all Radiological Environmental Monitoring Program wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP's 2015 Annual Radiological Environmental Operating Report. There were no positively identified radionuclides from plant effluents detected in any of the GPI well samples.

The LLD value used for tritium counting of the samples varied between $9.42\text{E-}7$ and $9.63\text{E-}7$ uCi/mL, depending on which scintillation counter was used. This is well below the required maximum LLD value of $2.00\text{E-}6$ uCi/mL per the ODCM.

While no valid unsuspected tritium values were found above LLD for 2015, values found above the LLD are not abnormal, unexpected, or inconsistent with past sampling history. The samples observed above LLD historically were expected results from the release of tritiated water into the Absorption Pond, a licensed pathway and part of plant design, or the result of recapture deposition of tritium from licensed radioactive gaseous release points. The 2015 results were expected considering the reduction in tritium released to the Absorption Pond and typical rainfall experienced.

Wells located inside the Protected Area of the plant are subject to recapture deposition of tritium and may show occasional sample results above LLD values following rainfalls and snow melt. The results observed in 2015 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed in 2015.

Two additional wells were installed in 2015, MW-28 and MW-29. These wells are shallow wells placed in close proximity to each Unit's Refueling Water Storage Tanks to improve leak detection capabilities. These wells are also closer to the Containment structures and plant ventilation stacks to better monitor tritium inside the Protected Area.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2015 impacting groundwater. The sample results indicate proper well placement to ensure the protection of the groundwater and early identification of any abnormal conditions involving groundwater. This is validated by the demonstrated ability to monitor percolation from the Absorption Pond and recaptured tritium in precipitation, with flow direction and behavior acting as described in the plant licensing documents.

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	1	3	14	21	3	0	42	
NNE	0	1	9	1	2	0	13	
NE	1	2	3	1	0	0	7	
ENE	0	6	9	2	0	0	17	
E	0	10	12	0	0	0	22	
ESE	0	11	6	2	0	0	19	
SE	0	9	3	6	0	0	18	
SSE	0	14	14	9	1	0	38	
S	1	9	7	14	3	1	35	
SSW	0	2	2	3	0	0	7	
SW	1	6	13	15	1	0	36	
WSW	0	7	20	10	11	1	49	
W	0	16	15	11	2	0	44	
WNW	0	10	12	5	3	0	30	
NW	0	8	17	24	3	1	53	
NNW	1	6	14	15	3	0	39	
Total	5	120	170	139	32	3	469	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	469
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	2	4	6	2	0	14
NNE	0	2	11	4	0	0	17
NE	1	0	10	5	0	0	16
ENE	0	1	1	2	5	0	9
E	0	2	6	0	0	0	8
ESE	0	5	3	2	0	0	10
SE	0	0	1	0	0	0	1
SSE	1	4	6	2	0	0	13
S	1	4	8	1	2	0	16
SSW	0	3	5	5	1	0	14
SW	2	3	13	5	0	0	23
WSW	0	3	1	5	2	0	11
W	0	0	1	6	5	0	12
WNW	0	2	2	3	8	4	19
NW	2	0	2	4	3	2	13
NNW	0	5	5	4	5	2	21
Total	7	36	79	54	33	8	217
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 217
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015. - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	9	8	11	4	34	
NNE	0	2	10	9	3	0	24	
NE	0	3	12	3	0	0	18	
ENE	0	4	9	2	2	1	18	
E	1	5	12	4	1	0	23	
ESE	0	8	9	0	0	0	17	
SE	0	6	3	3	0	0	12	
SSE	1	7	9	5	2	0	24	
S	0	2	12	7	2	0	23	
SSW	1	6	11	5	4	0	27	
SW	0	2	10	11	1	2	26	
WSW	0	1	3	7	8	6	25	
W	0	0	2	13	12	2	29	
WNW	0	1	2	8	18	2	31	
NW	0	2	2	8	13	9	34	
NNW	0	4	11	16	9	11	51	
Total	3	55	126	109	86	37	416	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	416
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class: D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	3	4	9	7	4	0	27
NNE	0	6	7	5	0	0	18
NE	0	7	10	3	0	0	20
ENE	2	10	10	3	0	0	25
E	2	9	12	1	0	0	24
ESE	1	11	7	3	1	0	23
SE	1	13	10	16	4	0	44
SSE	4	3	9	10	5	0	31
S	0	4	26	7	6	1	44
SSW	0	8	41	22	7	0	78
SW	0	5	21	31	9	1	67
WSW	1	4	11	39	9	1	65
W	0	8	10	20	9	1	48
WNW	1	5	8	17	11	2	44
NW	1	2	19	22	15	7	66
NNW	0	6	2	14	8	10	40
Total	16	105	212	220	88	23	664
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							664
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total	
N	0	0	0	1	0	0	1	
NNE	1	4	0	0	0	0	5	
NE	3	6	7	0	0	0	16	
ENE	0	5	3	1	0	0	9	
E	0	2	10	5	0	0	17	
ESE	0	3	5	3	0	0	11	
SE	1	6	7	9	0	0	23	
SSE	1	3	7	4	0	0	15	
S	0	2	16	13	0	0	31	
SSW	0	5	18	11	0	0	34	
SW	0	1	16	4	1	0	22	
WSW	2	1	11	6	3	0	23	
W	1	2	5	7	2	0	17	
WNW	0	3	2	4	3	0	12	
NW	2	2	5	5	0	0	14	
NNW	0	1	2	2	0	0	5	
Total	11	46	114	75	9	0	255	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	255
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	0	1	1	0	0	0	2	
NNE	0	2	1	0	0	0	3	
NE	0	1	0	0	0	0	1	
ENE	0	1	4	0	0	0	5	
E	1	1	3	1	0	0	6	
ESE	0	1	5	2	0	0	8	
SE	1	3	1	0	0	0	5	
SSE	0	2	7	3	0	0	12	
S	0	2	6	5	0	0	13	
SSW	0	2	4	2	0	0	8	
SW	0	1	9	2	0	0	12	
WSW	1	1	2	0	0	0	4	
W	0	3	1	1	0	0	5	
WNW	0	1	1	0	0	0	2	
NW	0	1	0	0	0	0	1	
NNW	0	1	0	0	0	0	1	
Total	3	24	45	16	0	0	88	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	88
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2015 - 03/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	1	0	0	0	0	1	
NNE	0	0	0	0	0	0	0	
NE	0	1	3	0	0	0	4	
ENE	0	2	3	0	0	0	5	
E	0	1	3	2	0	0	6	
ESE	0	0	2	0	0	0	2	
SE	0	1	2	0	0	0	3	
SSE	0	0	2	0	0	0	2	
S	0	0	5	2	0	0	7	
SSW	0	0	6	1	0	0	7	
SW	0	0	3	0	0	0	3	
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	
Total	0	6	29	5	0	0	40	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	40
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

01/01/2015 - 03/31/2015

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	4	13	37	43	20	4	121
NNE	1	17	38	19	5	0	80
NE	5	20	45	12	0	0	82
ENE	2	29	39	10	7	1	88
E	4	30	58	13	1	0	106
ESE	1	39	37	12	1	0	90
SE	3	38	27	34	4	0	106
SSE	7	33	54	33	8	0	135
S	2	23	80	49	13	2	169
SSW	1	26	87	49	12	0	175
SW	3	18	85	68	12	3	189
WSW	4	17	48	67	33	8	177
W	1	29	34	58	30	3	155
WNW	1	22	27	37	43	8	138
NW	5	15	45	63	34	19	181
NNW	1	23	34	51	25	23	157
Total	45	392	775	618	248	71	2149
Calm Hours not Included above for :					Total Period		0
Variable Direction Hours for:					Total Period		0
Invalid Hours for:					Total Period		11
Valid Hours for this Stability Class for:					Total Period		2149
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	0	15	33	25	1	0	74	
NNE	0	3	1	3	0	0	7	
NE	0	3	2	4	0	0	9	
ENE	0	3	7	1	0	0	11	
E	0	4	6	8	0	0	18	
ESE	0	5	6	8	1	0	20	
SE	0	5	12	4	0	0	21	
SSE	0	6	13	10	2	0	31	
S	0	3	15	9	1	0	28	
SSW	0	4	3	1	0	0	8	
SW	0	3	5	9	1	0	18	
WSW	1	4	30	25	9	1	70	
W	0	19	26	12	4	0	61	
WNW	0	15	17	13	1	0	46	
NW	0	15	15	8	1	0	39	
NNW	0	23	49	26	0	0	98	
Total	1	130	240	166	21	1	559	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	559
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	3	7	7	0	0	17
NNE	0	1	0	0	0	0	1
NE	1	2	1	0	0	0	4
ENE	0	2	1	2	0	0	5
E	0	1	6	4	1	0	12
ESE	0	0	0	3	0	0	3
SE	0	4	5	1	0	0	10
SSE	1	5	7	0	0	0	13
S	0	2	5	5	0	0	12
SSW	0	0	4	3	1	0	8
SW	0	3	7	5	0	0	15
WSW	1	6	4	3	3	1	18
W	0	4	3	2	2	0	11
WNW	0	11	2	0	0	0	13
NW	1	4	3	1	0	0	9
NNW	1	1	3	1	0	0	6
Total	5	49	58	37	7	1	157
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 157
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	4	10	7	0	0	21
NNE	2	3	0	3	0	0	8
NE	0	0	1	0	0	0	1
ENE	0	0	4	5	0	0	9
E	0	2	6	7	2	0	17
ESE	0	0	1	8	3	0	12
SE	0	2	5	1	0	0	8
SSE	1	1	1	0	0	0	3
S	2	2	0	4	1	0	9
SSW	1	7	5	5	2	0	20
SW	1	1	2	3	2	1	10
WSW	0	2	0	1	4	2	9
W	1	4	2	1	3	0	11
WNW	5	5	5	1	1	0	17
NW	1	3	1	3	2	0	10
NNW	0	6	1	2	0	0	9
Total	14	42	44	51	20	3	174
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							174
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	1	12	19	12	0	0	44
NNE	3	4	11	3	1	0	22
NE	3	2	7	16	0	0	28
ENE	3	5	10	4	1	0	23
E	1	8	25	15	3	0	52
ESE	1	10	18	18	4	0	51
SE	0	8	8	12	0	0	28
SSE	2	3	12	9	1	0	27
S	4	5	17	26	4	0	56
SSW	2	5	15	22	5	1	50
SW	2	6	21	37	9	0	75
WSW	1	7	14	26	9	4	61
W	1	3	6	12	6	2	30
WNW	3	3	9	10	4	0	29
NW	2	7	9	8	0	0	26
NNW	1	8	12	4	0	0	25
Total	30	96	213	234	47	7	627
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							627
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	1	11	0	0	0	14
NNE	0	10	9	1	0	0	20
NE	1	5	14	1	0	0	21
ENE	0	4	6	2	0	0	12
E	2	2	12	0	0	0	16
ESE	0	3	3	4	0	0	10
SE	0	5	28	4	0	0	37
SSE	0	2	14	9	0	0	25
S	0	4	13	42	0	0	59
SSW	0	2	13	10	0	0	25
SW	0	4	9	12	0	0	25
WSW	1	3	11	4	0	0	19
W	0	2	3	2	0	0	7
WNW	3	4	4	2	1	0	14
NW	0	5	8	0	2	0	15
NNW	0	1	6	0	0	0	7
Total	9	57	164	93	3	0	326
Calm Hours not Included above for :				Total Period		0	
Valid Hours for this Stability Class for:				Total Period		326	
Total Hours for Period						2184	

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	1	0	2	0	0	0	3	
NNE	0	4	1	0	0	0	5	
NE	1	6	7	0	0	0	14	
ENE	0	8	7	2	0	0	17	
E	0	1	7	4	0	0	12	
ESE	3	3	5	2	0	0	13	
SE	0	4	10	2	0	0	16	
SSE	1	4	4	6	0	0	15	
S	0	1	16	9	0	0	26	
SSW	0	1	8	7	0	0	16	
SW	0	0	9	1	0	0	10	
WSW	1	4	4	0	0	0	9	
W	1	3	0	0	0	0	4	
WNW	0	2	1	0	0	0	3	
NW	0	2	0	0	1	0	3	
NNW	0	6	3	0	0	0	9	
Total	8	49	84	33	1	0	175	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	175
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	0	1	0	0	0	1	
NNE	0	3	1	0	0	0	4	
NE	0	3	9	0	0	0	12	
ENE	0	8	9	1	0	0	18	
E	2	3	7	3	0	0	15	
ESE	0	1	3	1	0	0	5	
SE	0	6	8	2	0	0	16	
SSE	0	3	11	1	0	0	15	
S	2	5	9	8	0	0	24	
SSW	0	1	3	4	0	0	8	
SW	4	3	5	0	0	0	12	
WSW	1	5	3	0	0	0	9	
W	0	0	1	0	0	0	1	
WNW	0	0	0	0	0	0	0	
NW	0	1	1	0	0	0	2	
NNW	0	0	0	0	0	0	0	
Total	9	42	71	20	0	0	142	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	142
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 04/01/2015 - 06/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M

Delta-Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	4	35	83	51	1	0	174	
NNE	5	28	23	10	1	0	67	
NE	6	21	41	21	0	0	89	
ENE	3	30	44	17	1	0	95	
E	5	21	69	41	6	0	142	
ESE	4	22	36	44	8	0	114	
SE	0	34	76	26	0	0	136	
SSE	5	24	62	35	3	0	129	
S	8	22	75	103	6	0	214	
SSW	3	20	51	52	8	1	135	
SW	7	20	58	67	12	1	165	
WSW	6	31	66	59	25	8	195	
W	3	35	41	29	15	2	125	
WNW	11	40	38	26	7	0	122	
NW	4	37	37	20	6	0	104	
NNW	2	45	74	33	0	0	154	
Total	76	465	874	634	99	12	2160	
Calm Hours not Included above for :							Total Period	0
Variable Direction Hours for:							Total Period	0
Invalid Hours for:							Total Period	24
Valid Hours for this Stability Class for:							Total Period	2160
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	5	35	20	7	0	68	
NNE	0	2	4	0	0	0	6	
NE	0	1	4	3	0	0	8	
ENE	0	4	9	0	0	0	13	
E	1	5	8	0	0	0	14	
ESE	1	9	11	0	0	0	21	
SE	0	8	11	3	0	0	22	
SSE	0	9	10	4	0	0	23	
S	0	3	10	14	0	0	27	
SSW	0	4	4	10	0	0	18	
SW	0	3	11	11	1	0	26	
WSW	0	16	35	6	3	0	60	
W	1	23	19	4	2	0	49	
WNW	0	34	20	3	0	0	57	
NW	0	17	16	5	1	0	39	
NNW	0	17	42	12	2	0	73	
Total	4	160	249	95	16	0	524	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	524
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	6	1	1	0	10	
NNE	0	0	0	0	1	0	1	
NE	0	0	1	0	0	0	1	
ENE	0	0	0	0	0	0	0	
E	1	4	2	0	0	0	7	
ESE	0	3	3	0	0	0	6	
SE	3	4	0	0	0	0	7	
SSE	1	6	2	2	0	0	11	
S	1	7	10	5	0	0	23	
SSW	0	5	4	3	0	0	12	
SW	1	3	5	2	0	0	11	
WSW	2	5	9	0	1	0	17	
W	0	4	1	1	1	0	7	
WNW	0	3	1	1	0	0	5	
NW	0	2	4	2	0	0	8	
NNW	1	4	1	0	0	0	6	
Total	10	52	49	17	4	0	132	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	132
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	1	5	5	1	0	12	
NNE	0	0	0	3	0	0	3	
NE	0	1	0	0	0	0	1	
ENE	2	0	0	0	0	0	2	
E	0	0	2	0	0	0	2	
ESE	1	3	1	0	0	0	5	
SE	0	3	2	1	0	0	6	
SSE	2	3	2	0	0	0	7	
S	1	7	5	3	0	0	16	
SSW	0	4	4	0	0	0	8	
SW	1	4	4	2	0	0	11	
WSW	0	5	8	2	2	0	17	
W	2	0	1	1	2	0	6	
WNW	0	4	0	2	0	0	6	
NW	0	1	1	1	0	0	3	
NNW	0	3	1	0	1	0	5	
Total	9	39	36	20	6	0	110	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	110
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	15	27	8	2	0	52	
NNE	0	5	10	11	1	0	27	
NE	0	1	11	2	0	0	14	
ENE	1	4	4	0	0	0	9	
E	0	6	3	1	0	0	10	
ESE	0	2	13	0	0	0	15	
SE	2	12	1	4	0	0	19	
SSE	1	7	18	5	1	0	32	
S	1	5	22	12	0	0	40	
SSW	1	5	24	8	0	0	38	
SW	1	9	23	21	4	0	58	
WSW	1	0	11	9	0	0	21	
W	2	4	1	12	1	0	20	
WNW	0	7	4	8	0	0	19	
NW	1	6	5	9	5	0	26	
NNW	3	13	14	4	2	0	36	
Total	14	101	191	114	16	0	436	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	436
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	4	13	15	5	0	0	37
NNE	0	4	12	2	0	0	18
NE	1	6	16	1	0	0	24
ENE	1	7	11	2	0	0	21
E	0	2	7	0	0	0	9
ESE	0	3	13	0	0	0	16
SE	1	7	11	1	0	0	20
SSE	0	8	31	6	0	0	45
S	1	3	37	21	0	0	62
SSW	0	8	23	8	0	0	39
SW	1	3	14	4	1	0	23
WSW	1	0	12	6	0	0	19
W	0	0	3	3	0	0	6
WNW	3	2	9	11	0	0	25
NW	1	6	10	0	0	0	17
NNW	3	7	12	0	0	0	22
Total	17	79	236	70	1	0	403
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							403
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	5	5	0	0	0	10	
NNE	1	4	7	0	0	0	12	
NE	0	6	5	0	0	0	11	
ENE	1	2	11	0	0	0	14	
E	1	3	12	4	0	0	20	
ESE	0	2	17	0	0	0	19	
SE	2	5	15	4	0	0	26	
SSE	0	9	26	5	0	0	40	
S	1	4	19	21	0	0	45	
SSW	1	3	13	9	0	0	26	
SW	0	2	15	1	0	0	18	
WSW	0	1	4	0	0	0	5	
W	0	0	0	0	0	0	0	
WNW	0	2	1	0	0	0	3	
NW	1	1	1	0	0	0	3	
NNW	0	1	0	0	0	0	1	
Total	8	50	151	44	0	0	253	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	253
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2015 - 09/30/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	4	3	2	0	0	0	9	
NNE	0	0	2	0	0	0	2	
NE	4	5	16	0	0	0	25	
ENE	3	3	14	1	0	0	21	
E	2	8	10	4	0	0	24	
ESE	8	14	22	3	0	0	47	
SE	2	11	18	1	0	0	32	
SSE	0	13	27	13	0	0	53	
S	0	10	21	9	0	0	40	
SSW	1	10	28	3	0	0	42	
SW	3	3	10	2	0	0	18	
WSW	0	4	7	0	0	0	11	
W	1	4	2	0	0	0	7	
WNW	3	1	2	0	0	0	6	
NW	3	2	1	0	0	0	6	
NNW	2	2	1	0	0	0	5	
Total	36	93	183	36	0	0	348	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	348
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

07/01/2015 - 09/30/2015

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	9	44	95	39	11	0	198	
NNE	1	15	35	16	2	0	69	
NE	5	20	53	6	0	0	84	
ENE	8	20	49	3	0	0	80	
E	5	28	44	9	0	0	86	
ESE	10	36	80	3	0	0	129	
SE	10	50	58	14	0	0	132	
SSE	4	55	116	35	1	0	211	
S	5	39	124	85	0	0	253	
SSW	3	39	100	41	0	0	183	
SW	7	27	82	43	6	0	165	
WSW	4	31	86	23	6	0	150	
W	6	35	27	21	6	0	95	
WNW	6	53	37	25	0	0	121	
NW	6	35	38	17	6	0	102	
NNW	9	47	71	16	5	0	148	
Total	98	574	1095	396	43	0	2206	
Calm Hours not Included above for :							Total Period	0
Variable Direction Hours for:							Total Period	0
Invalid Hours for:							Total Period	2
Valid Hours for this Stability Class for:							Total Period	2206
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	4	15	6	2	0	27	
NNE	0	2	2	1	1	0	6	
NE	0	3	2	3	0	0	8	
ENE	0	4	3	11	3	0	21	
E	0	2	5	0	0	0	7	
ESE	0	1	1	2	0	0	4	
SE	1	4	3	1	4	0	13	
SSE	0	4	15	4	3	0	26	
S	0	2	6	7	0	0	15	
SSW	0	1	5	1	6	0	13	
SW	0	3	7	17	0	0	27	
WSW	0	0	17	18	3	3	41	
W	0	7	11	6	7	1	32	
WNW	0	7	8	5	0	0	20	
NW	0	5	8	8	2	0	23	
NNW	0	2	10	3	0	0	15	
Total	1	51	118	93	31	4	298	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	298
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	3	1	0	0	6	
NNE	0	0	0	2	0	0	2	
NE	0	0	1	0	0	0	1	
ENE	0	0	1	1	0	0	2	
E	0	3	1	3	1	0	8	
ESE	0	1	0	1	0	0	2	
SE	0	0	0	1	1	0	2	
SSE	0	3	2	2	1	0	8	
S	1	1	4	4	0	0	10	
SSW	0	3	6	4	0	0	13	
SW	1	3	3	4	0	0	11	
WSW	0	3	3	7	0	2	15	
W	0	1	1	7	3	3	15	
WNW	0	1	2	5	3	1	12	
NW	0	0	1	0	0	0	1	
NNW	1	1	1	1	0	0	4	
Total	3	22	29	43	9	6	112	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	112
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	1	6	1	0	10	
NNE	0	0	3	6	1	0	10	
NE	0	2	10	2	0	0	14	
ENE	0	3	1	5	1	0	10	
E	0	1	1	1	7	0	10	
ESE	0	1	0	4	3	0	8	
SE	0	1	4	2	3	1	11	
SSE	0	3	3	3	0	0	9	
S	0	5	7	2	4	0	18	
SSW	0	3	16	6	3	0	28	
SW	0	0	9	5	0	0	14	
WSW	0	1	3	13	11	8	36	
W	1	0	6	22	10	7	46	
WNW	0	0	4	4	5	2	15	
NW	2	0	1	2	0	0	5	
NNW	0	2	3	1	1	0	7	
Total	3	24	72	84	50	18	251	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	251
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	1	10	11	8	0	0	30
NNE	1	5	11	5	0	0	22
NE	1	5	14	16	0	0	36
ENE	0	10	17	17	4	0	48
E	1	5	10	8	2	0	26
ESE	2	1	8	19	7	0	37
SE	0	1	18	34	12	0	65
SSE	0	7	24	28	15	14	88
S	0	5	33	69	26	3	136
SSW	1	3	18	50	24	3	99
SW	0	2	12	62	10	6	92
WSW	2	2	9	23	22	21	79
W	0	2	7	17	9	17	52
WNW	0	3	6	23	10	10	52
NW	2	3	9	27	19	1	61
NNW	2	4	5	10	6	1	28
Total	13	68	212	416	166	76	951
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 951
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	2	4	2	0	0	8	
NNE	0	7	8	0	0	0	15	
NE	0	0	12	3	0	0	15	
ENE	1	3	6	4	0	0	14	
E	0	1	3	11	0	0	15	
ESE	0	3	9	4	0	0	16	
SE	1	1	2	13	1	0	18	
SSE	0	0	12	24	1	1	38	
S	0	7	31	28	0	0	66	
SSW	0	3	15	30	1	0	49	
SW	0	1	7	10	0	0	18	
WSW	0	1	7	1	0	0	9	
W	0	1	3	0	0	0	4	
WNW	0	0	3	2	0	0	5	
NW	1	3	5	14	1	0	24	
NNW	0	4	1	1	0	0	6	
Total	3	37	128	147	4	1	320	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	320
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	0	0	0	0	1
NNE	0	0	1	0	0	0	1
NE	2	1	3	0	0	0	6
ENE	0	0	9	2	0	0	11
E	0	2	2	2	0	0	6
ESE	0	1	10	1	0	0	12
SE	1	0	3	1	0	0	5
SSE	0	2	5	7	0	0	14
S	0	1	9	18	0	0	28
SSW	0	1	2	9	0	0	12
SW	0	0	4	4	0	0	8
WSW	1	1	1	0	0	0	3
W	1	0	1	0	0	0	2
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	1	0	0	0	0	1
Total	5	11	50	44	0	0	110
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							110
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	0	3	0	0	0	3	
NNE	2	0	0	0	0	0	2	
NE	2	2	2	0	0	0	6	
ENE	2	0	3	0	0	0	5	
E	1	1	8	0	0	0	10	
ESE	2	3	4	2	0	0	11	
SE	1	2	7	3	0	0	13	
SSE	0	1	11	7	0	0	19	
S	1	2	9	7	0	0	19	
SSW	0	2	1	3	0	0	6	
SW	1	3	3	3	0	0	10	
WSW	0	0	0	0	0	0	0	
W	0	2	0	0	0	0	2	
WNW	1	2	0	0	0	0	3	
NW	1	2	2	0	0	0	5	
NNW	0	2	0	0	0	0	2	
Total	14	24	53	25	0	0	116	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	116
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 10/01/2015 - 12/31/2015
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	21	37	23	3	0	85
NNE	3	14	25	14	2	0	58
NE	5	13	44	24	0	0	86
ENE	3	20	40	40	8	0	111
E	2	15	30	25	10	0	82
ESE	4	11	32	33	10	0	90
SE	4	9	37	55	21	1	127
SSE	0	20	72	75	20	15	202
S	2	23	99	135	30	3	292
SSW	1	16	63	103	34	3	220
SW	2	12	45	105	10	6	180
WSW	3	8	40	62	36	34	183
W	2	13	29	52	29	28	153
WNW	1	13	23	39	18	13	107
NW	6	13	26	51	22	1	119
NNW	3	16	20	16	7	1	63
Total	42	237	662	852	260	105	2158
Calm Hours not Included above for :							0
Variable Direction Hours for:							0
Invalid Hours for:							50
Valid Hours for this Stability Class for:							2158
Total Hours for Period							2208

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was revised during this reporting period. A copy of Revision 25 is included as part of this report. The reasons for the changes and the PORC approval are documented on the Review and Approval tracking form. These changes were determined to maintain the level of radioactive effluent control required by 10 CFR 20.1302, 40 CFR 190, 10 CFR 50.36a, and Appendix I to 10 CFR 50 and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

ENCLOSURE 4 to AEP-NRC-2018-35

DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2014 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT, Revision 1

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I. INTRODUCTION

This report discusses the radioactive discharges from Unit 1 and Unit 2 of the Donald C. Cook Nuclear Plant (CNP) during 2014. This is in accordance with the requirements of CNP Technical Specification (TS) 5.6.3.

The table below summarizes the pertinent statistics concerning the Plant's operation during the period from January 1, 2014, to December 31, 2014. The data in this table and the descriptive information on plant operation are based upon the respective unit's Monthly Operating Reports, Performance Indicators and Control Room Logs for 2014.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	8,574,834	9,631,872
Unit Service Factor (Percent (%))	91.0	97.1
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	92.0	99.0

Unit 1 entered the reporting period in Mode 1 at Nominal Full Power (NFP). Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit performed a normal downpower and was manually tripped on September 24, 2014, entering the refueling outage U1C26. The unit attained criticality on October 23, 2014 and attained NFP on October 27, 2014. On November 1, 2014, a manual trip of the reactor was performed due to degraded cooling water intake conditions caused by severe weather. The unit attained criticality on November 3, 2014 and attained NFP on November 7, 2014. The unit exited the reporting period at NFP.

Unit 2 entered the reporting period in Mode 1 at NFP. Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit commenced a normal planned downpower to 25% on July 11, 2014 to support online maintenance work. The unit returned to NFP on July 15, 2014. On November 1, 2014, a manual trip of the reactor was performed due to degraded cooling water intake conditions caused by severe weather. The unit attained criticality on November 10, 2014 and attained NFP on November 13, 2014. The unit exited the reporting period at NFP.

II. RADIOACTIVE RELEASES AND RADIOLOGICAL IMPACT ON MAN

Since a number of release points are common to both units, the release data from both units are combined to form this two-unit, Annual Radioactive Effluent Release Report. Appendix A1.1 through A2.4 of this report present the information in accordance with Section 5.6.3 of Appendix A to the Facility Operating Licenses, as specified in the Technical Specifications, Regulatory Guide 1.21, and 10 CFR Part 50, Appendix I.

The "MIDAS System" is a computer code that calculates doses due to radionuclides that were released from the CNP.

All liquid and gaseous releases were well within Offsite Dose Calculation Manual (ODCM) limits and federal limits.

There were no abnormal liquid releases and no abnormal gaseous releases in 2014.

The Independent Spent Fuel Storage Installation (ISFSI) impacts are included with Unit 1 and Unit 2 statistics. The ISFSI cask system does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the ISFSI.

Liquid Releases

During 2014 there were 71 liquid batch releases performed. The number of liquid batch releases for the four quarters in 2014 was 10, 10, 22, and 29, respectively.

Estimated doses (in mrem) to maximally exposed individuals via the liquid release pathways are given in Appendix A1.2 of this report.

Gaseous Releases

During the first quarter of 2014 there were two batch releases from Gas Decay Tanks (GDT) and 90 Containment Pressure Reliefs (CPR). During the second quarter there were 109 CPR. During the third quarter there were five batch releases from GDTs, one containment purge, and 108 CPR. During the fourth quarter there were two batch releases from GDTs and 104 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89017 (DRSS); 50-316/89016 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There were a total of nine GDT releases, one containment purge, and 411 CPR gaseous batch releases made during 2014.

In calculating the dose consequences for continuous and batch gaseous releases during 2014, the meteorological data measured at the time of the release were used.

The estimated doses (in mrem) to maximally exposed individuals via the gaseous release pathways are given in Appendix A1.2 of this report. For individuals that are within the site boundary, the occupancy time is sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary.

Solid Waste Disposition

There were 31 shipments of radioactive waste made during 2014. These included shipments made from the site to various radioactive waste processors for ultimate disposal.

III. METEOROLOGICAL

Appendices A2.1, A2.2, A2.3, and A2.4 of this report contain the cumulative joint frequency distribution tables of wind speed and wind direction, corresponding to the various atmospheric stability classes for the first, second, third and fourth quarters of 2014. Hourly meteorological data is available for review and/or inspection upon request.

IV. OFFSITE DOSE CALCULATION MANUAL (ODCM) CHANGES

The ODCM, PMP-6010-OSD-001, was not revised during the report period.

V. TOTAL DOSE

Section 3.2.5 of the ODCM requires that the dose or dose commitment to a real individual from all uranium fuel cycle sources in Berrien County be limited to no more than 25 mrem to the total body or any organ (except the thyroid, which is limited to no more than 75 mrem) over a period of 12 consecutive months to show conformance with the requirements of 40 CFR Part 190. The maximum cumulative dose to an individual from liquid and gaseous effluents during 2014 was well within the ODCM limits. Measurements using thermoluminescent dosimeters (TLD) at 12 onsite stations indicate that the dose due to direct radiation is consistent with preoperational and current control (background) levels. This is fully evaluated in CNP's 2014 Annual Radiological Environmental Operating Report. Additional TLD dosimetry installed by Radiation Protection department programs monitor dose received by individuals on site as visitors.

The annual dose to the maximum individual will be estimated by first, summing the quarterly total body air dose, the quarterly skin air dose, the quarterly critical organ dose from iodines and particulates (I&P), the quarterly total body dose from liquid effluents, the quarterly critical organ dose from liquid effluents, and the Radiological Environmental Monitoring Program onsite direct radiation TLD data. These quarterly values are summed with the annual Carbon-14 dose and compared to the annual total body limit for conservative reasons. The table that follows here represents the above written description:

Dose (mrem)	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
I & P	1.02E-02	1.37E-02	3.27E-02	1.28E-02
Total Body Air	3.10E-04	5.30E-04	1.70E-03	1.70E-04
Skin	5.10E-04	8.60E-04	3.30E-03	2.80E-04
Liquid TB	2.80E-03	1.26E-02	3.58E-02	2.62E-02
Liquid Organ	2.80E-03	1.26E-02	3.58E-02	2.62E-02
C14 (Annual)				2.38E+00
Direct Radiation	0	0	0	0
Total	1.66E-02	4.03E-02	1.09E-01	2.45E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.61E+00
Annual Dose Limit (mrem)				25
Percent of limit				1.04E+01

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2014 annual dose data, and 2014 annual dose data with C-14 added. This indicates that 2014 was a 'normal' single unit outage year with respect to radioactive effluents and allows for easier comparison. The table is presented as follows:

	Annual Dose (mrem)	% of limit
2009	2.60E-01	1.04
2014	2.32E-01	0.93
2014 with C-14	2.61E+00	10.4

VI. RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS

There were no release pathways unmonitored for greater than 30 days.

VII. NOTEWORTHY CONDITIONS IDENTIFIED IN 2014

There were no new noteworthy conditions identified in 2014. The past year did however validate the successful repairs of the CNP 60-Meter Meteorological Tower as previously discussed in the 2012 and 2013 Annual Radiological Effluent Release Reports.

During the Fourth Quarter of 2012, an intermittent fault was identified on the CNP 60-Meter Meteorological Tower that resulted in a large number of invalid data hours collected. A Condition Report (2012-2305) was initiated and repair work performed. The issue appeared to be a connection to the Delta Temperature instrumentation. Repairs yielded better data collection results in December 2012, however the intermittent fault returned and the system yielded additional invalid data hours during the First and Second Quarters of 2013. Additional repair work was performed when conditions allowed for safe work on the tower, and this resulted in the problem being positively identified as cabling fault grounding out the 10 Meter Delta Temperature instrumentation on the Main 60-Meter Tower. The repairs on the cable and instrumentation were successful at eliminating the intermittent fault and data collection has returned to near 100% valid hours. This issue is now considered corrected and closed.

Carbon-14 Supplemental Information for the 2014 Annual Radioactive Effluent Release Report.

C-14 has a 5730 year half-life and is a naturally occurring radionuclide produced by cosmic ray interactions in the atmosphere. C-14 is a relatively low energy beta emitter. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally, from weapons testing, or coal burning power plants. The inventory of C-14 in Earth's biosphere is about 300 million Curies, of which most is in the oceans.

Since the U.S. Nuclear Regulatory Commission (NRC) published Regulatory Guide (RG) 1.21, Revision 1, in 1974, the analytical methods for determining C-14 have improved.

Coincidentally, the radioactive effluents from commercial nuclear power plants over the same period have decreased to the point that C-14 is likely to be a principal radionuclide in gaseous effluents. Based on these reasons and a desire to adjust policy to align with international standards, the nuclear industry was required to report, starting in 2010, the quantity and dose impact of C-14 here in the United States. The dose will be reported both with and without C-14 so a comparison to 2009 can be made, keeping in mind the differing standards.

The quantity of C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. RG 1.21, Revision 2). A recent study recommends a source term scaling factor of approximately 9.0 to 9.8 Curies/GWe-yr for a Westinghouse Pressurized Water Reactor (Ref. EPRI 1021106 "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents" December 23, 2010). A scaling factor of 9.4 Curies/GWe-yr was assumed for this report. Using this source term scaling factor and actual electrical generation (in MWH) produced during 2014 results in a site total of 19.54 Curies produced.

C-14 releases from PWRs occur primarily as a mix of organic carbon (methane) and inorganic carbon (carbon dioxide). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as gas. Any time the primary coolant is exposed to an oxidizing environment (during shutdown or refueling), a slow transformation from an organic to an inorganic species occurs. Various studies documenting measured C-14 releases from PWRs suggest an average 80% organic fraction with the remainder being carbon dioxide. This equates to 3.91 Curies released as carbon dioxide which is available for the food pathway through photosynthesis to vegetation.

Dose is calculated utilizing the methodology prescribed in RG 1.109, Appendix C with the vegetation dose being the most predominant. A 'p' factor of 0.33 is determined utilizing the 185 hours of batch gaseous releases performed during 2014 and the assumption that 70% of the C-14 released is from gaseous batch releases. A further reduction to the vegetation and leafy vegetable dose is warranted due to the limited growing season in Michigan, which was conservatively limited to nine months.

The final results indicated a calculated organ dose from C-14 to a child at the site boundary of 1.88 mrem to the bone and a whole body dose of 0.499 mrem, for a combined total C-14 dose of 2.38 mrem. This is less than the dose limit of 15 mrem/unit to any organ prescribed in 10 CFR 50, Appendix I, and the 40 CFR Part 190 limit of 25 mrem for total body and for any organ (≤ 75 mrem for thyroid).

VIII. CONCLUSION

Based on the information presented in this report, it is concluded that CNP Units 1 and 2 performed their intended design function with no demonstrable adverse effect on the health and safety of the general public.

Note: This entire document is Revision 1 submitted as "Errata" attached to the 2017 Annual Radioactive Effluent Release Report per Corrective Action 2017-4835. This new revision completely replaces the previously submitted report. This errata was necessitated due to problems identified with equipment utilized for counting tritium samples dating back to 2013. The alterations changed the overall public dose calculated from 2.59 millirems (10.4% of the 40 CFR190 allowable dose limits) to 2.61 millirems (10.4% of the 40CFR190 allowable dose limits). There were no adverse impacts to public health or safety by this minor change to dose.

2014 Effluent and Waste Disposal Annual Report

SUPPLEMENTAL INFORMATION

Facility: Donald C. Cook Nuclear Plant
Licensee: Indiana Michigan Power Company

1 REGULATORY LIMITS

1.1 Noble Gases

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be limited to the following:

1.1.1 During any calendar quarter, to ≤ 5 mrad/unit for gamma radiation and ≤ 10 mrad/unit for beta radiation.

1.1.2 During any calendar year, to ≤ 10 mrad/unit for gamma radiation and ≤ 20 mrad/unit for beta radiation.

1.2 Iodines - Particulates

The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to unrestricted areas shall be limited to the following:

1.2.1 During any calendar quarter to ≤ 7.5 mrem/unit to any organ.

1.2.2 During any calendar year to ≤ 15 mrem/unit to any organ.

1.3 Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited:

1.3.1 During any calendar quarter to ≤ 1.5 mrem/unit to the total body and to ≤ 5 mrem/unit to any organ.

1.3.2 During any calendar year to ≤ 3 mrem/unit to the total body and to ≤ 10 mrem/unit to any organ.

2014 Effluent and Waste Disposal Annual Report

1.4 Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2 MAXIMUM PERMISSIBLE CONCENTRATIONS

2.1 Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site shall be limited to the following:

2.1.1 For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.

2.1.2 For all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days: ≤ 1500 mrem/yr to any organ.

The above limits are provided to insure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits in 10 CFR Part 20, Appendix B, Table 2, Column 1.

2.2 Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

2014 Effluent and Waste Disposal Annual Report

3 AVERAGE ENERGY

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public. Release rates are calculated using an isotopic mix from actual samples rather than average energy.

4 MEASUREMENTS and APPROXIMATIONS of TOTAL RADIOACTIVITY

4.1 Fission and Activation Gases

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters.

4.2 Iodines

Sampled on iodine adsorbing media, and analyzed on an 8192 channel analyzer and HpGe detector.

4.3 Particulates

Sampled on a glass filter and analyzed on an 8192 channel analyzer and HpGe detector. Sr-89 and Sr-90 analyses are performed by offsite vendor.

4.4 Liquid Effluents

Sampled and analyzed on an 8192 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters. Fe-55, Sr-89 and Sr-90 analyses are performed by an offsite vendor. Ni-63 is also currently being analyzed by the offsite vendor in response to evaluation of the 10 CFR 61 sample results.

2014 Effluent and Waste Disposal Annual Report

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

10 releases in the 1st quarter, 2014
10 releases in the 2nd quarter, 2014
22 releases in the 3rd quarter, 2014
29 releases in the 4th quarter, 2014

5.1.2 Total time period for batch releases:

53,606 minutes

5.1.3 Maximum time for a batch release:

1,655 minutes

5.1.4 Average time period for batch release:

755 minutes

5.1.5 Minimum time period for a batch release:

164 minutes

5.1.6 Average stream flow during periods of release of effluent into a flowing stream:

7.13E+5 gpm circulating water

2014 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

92 releases in the 1st quarter, 2014
109 releases in the 2nd quarter, 2014
114 releases in the 3rd quarter, 2014
106 releases in the 4th quarter, 2014

5.2.2 Total time period for batch releases:

11,090 minutes

5.2.3 Maximum time for a batch release:

355 minutes

5.2.4 Average time period for batch release:

26 minutes

5.2.5 Minimum time period for a batch release:

5 minutes

2014 Effluent and Waste Disposal Annual Report

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.1.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2 Gaseous

6.2.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.57E+01	1.85E+01	1.75E+01	2.33E+01
XE135m	Ci	-----	-----	-----	-----
KR85	Ci	-----	-----	-----	-----
XE131m	Ci	-----	-----	-----	-----
XE133m	Ci	-----	-----	-----	-----
XE133	Ci	-----	-----	-----	1.90E-05
XE135	Ci	-----	-----	-----	-----
Total for Period	Ci	2.57E+01	1.85E+01	1.75E+01	2.33E+01
2. IODINES					
I131	Ci	3.91E-10	-----	-----	7.32E-06
I132	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	3.91E-10	-----	-----	7.32E-06
3. PARTICULATES					
MN54	Ci	-----	-----	-----	-----
CO60	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.37E-02	2.95E-02	5.45E-02	3.20E-02
AR41	Ci	3.58E-01	3.60E-01	4.53E-01	1.55E-01
KR85	Ci	3.18E-01	-----	9.81E-01	2.45E-01
XE131M	Ci	-----	-----	-----	-----
XE133M	Ci	-----	-----	-----	-----
XE133	Ci	5.87E-02	7.53E-02	1.17E-01	1.46E-03
XE135	Ci	-----	-----	8.11E-07	2.56E-05
Total for Period	Ci	7.58E-01	4.65E-01	1.61E+00	4.33E-01
2. IODINES					
I131	Ci	-----	-----	-----	-----
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----
3. PARTICULATES					
* BR80	Ci	-----	-----	-----	-----
* BR82	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. FISSION AND ACTIVATION GASES						
1. Total Release	Ci	7.35E-01	4.35E-01	1.55E+00	4.01E-01	11.5
2. Average release rate for period	uCi/sec	9.45E-02	5.54E-02	1.95E-01	5.05E-02	
3. Percent of applicable limit*	% Gamma Beta	1.03E-02 6.12E-03	1.80E-02 3.35E-03	6.02E-02 3.90E-02	5.54E-03 3.19E-03	
B. IODINES						
1. Total I-131	Ci	3.91E-10	0.00E+00	0.00E+00	7.32E-06	18.9
2. Average release rate for period	uCi/sec	5.03E-11	0.00E+00	0.00E+00	9.21E-07	
3. Percent of applicable limit*	%	1.43E-10	0.00E+00	0.00E+00	2.62E-06	
C. PARTICULATES						
1. Particulates with half lives > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit*	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
4. Gross alpha radioactivity	Ci	<7.06E-07	<6.46E-07	<7.67E-07	<8.46E-07	
D. TRITIUM						
1. Total Release	Ci	2.57E+01	1.85E+01	1.75E+01	2.33E+01	13.7
2. Average release rate for period	uCi/sec	3.31E+00	2.36E+00	2.20E+00	2.93E+00	
3. Percent of applicable limit*	%	1.89E-02	1.34E-02	1.26E-02	1.67E-02	

* Applicable limits are expressed in terms of dose. See Appendices A1.2-1 through A1.2-4

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	7.26E-02	2.02E-02	1.25E-02	8.13E-02
CS137	Ci	-----	-----	-----	-----

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	1.03E+02	4.85E+02	1.38E+03	7.80E+02
CR51	Ci	-----	-----	-----	-----
MN54	Ci	-----	-----	1.46E-06	-----
FE55	Ci	-----	-----	-----	-----
CO58	Ci	4.52E-05	3.29E-05	3.98E-05	1.53E-04
CO60	Ci	4.41E-05	5.70E-05	1.66E-04	7.87E-05
NI63	Ci	-----	-----	-----	-----
*KR85	Ci	-----	-----	-----	-----
ZR95	Ci	-----	-----	-----	-----
NB95	Ci	-----	-----	-----	-----
MO99	Ci	-----	-----	-----	-----
TC99m	Ci	-----	-----	-----	7.01E-07
AG110m	Ci	8.81E-06	1.43E-05	1.58E-04	4.23E-05
*XE131m	Ci	-----	-----	-----	-----
SB125	Ci	2.20E-06	-----	2.79E-05	5.08E-06
CS134	Ci	-----	-----	-----	-----
CS137	Ci	7.93E-07	8.51E-07	2.25E-06	-----
*XE135	Ci	-----	-----	-----	-----
I131	Ci	-----	-----	-----	-----
*XE133	Ci	-----	-----	1.76E-04	4.65E-05
*XE133m	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
BATCH MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	1.01E-04	1.05E-04	3.96E-04	2.80E-04	12.4

2. Average diluted concentration during period	uCi/ml	1.44E-11	4.79E-12	6.24E-12	5.35E-12	

3. Percent of applicable limit	%	2.74E-04	1.09E-04	1.37E-04	7.86E-05	

B. TRITIUM						

1. Total Release	Ci	1.03E+02	4.85E+02	1.38E+03	7.80E+02	10.1

2. Average diluted concentration during period	uCi/ml	1.47E-05	2.21E-05	2.18E-05	1.49E-05	

3. Percent of applicable limit	%	1.47E+00	2.21E+00	2.18E+00	1.49E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	-----	-----	1.76E-04	4.65E-05	13.0

2. Average diluted concentration during period	uCi/ml	-----	-----	2.77E-12	8.88E-13	

3. Percent of applicable limit	%	-----	-----	1.39E-06	4.44E-07	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

1. Total Release	Ci	<5.85E-05	<5.85E-05	<1.29E-04	<1.70E-04	N/A

E. VOLUME OF WASTE RELEASED						

1. Total Release	Liters	6.09E+05	6.09E+05	1.34E+06	1.77E+06	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

1. Total Release	Liters	7.04E+09	2.19E+10	6.34E+10	5.23E+10	3.48

2014 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
CONTINUOUS MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

B. TRITIUM						

1. Total Release	Ci	7.26E-02	2.02E-02	1.25E-02	8.13E-07	22.2

2. Average diluted concentration during period	uCi/ml	1.08E-10	3.77E-11	1.57E-11	4.93E-12	

3. Percent of applicable limit	%	1.08E-03	3.77E-04	1.57E-04	4.93E-05	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	<5.08E-05	N/A

E. VOLUME OF WASTE RELEASED						

1. Total Release	Liters	2.29E+06	4.81E+06	3.08E+06	0.00E+00	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

1. Total Release	Liters	7.07E+11	5.36E+11	7.95E+11	1.65E+08	3.48

2014 Effluent and Waste Disposal Annual Report Solid Waste and Irradiated Fuel Shipments

Solid Waste Shipped Offsite for Burial or Disposal

1) Type of Waste	Unit	Estimated amount	Estimated Total Error, %
a) Spent resins, filters, sludge, evaporator bottoms, etc.	m ³ Curies	3.98E+01 2.82E+02	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m ³ Curies	7.39E+02 2.09E+00	1.00E+00 6.48E+00
c) Irradiated components, control rods, etc.	m ³ Curies		
d) Other (contaminated soil)	m ³ Curies		

2) Estimate of Principle Radionuclide Composition

a)	H-3	9 %	Co-58	1 %	Sb-125	1 %	Cs-137	5 %
	Mn-54	1 %	Co-60	12 %	Cs-134	3 %		
	Fe-55	9.5 %	Ni-63	58 %	Ni-59	0.5 %		
b)	Ni-59	1 %	Co-58	3 %	Sb-125	5 %		
	Mn-54	2.5 %	Co-60	39 %	Zr/Nb-95	1 %		
	Fe-55	35 %	Ni-63	12 %	Zn-65	1 %	C-14	0.5 %

3) Solid Waste Disposition

No. of Shipments	Mode of Transportation	Destination
8	Truck	Memphis, TN
18	Truck	Oak Ridge, TN
2	Truck	Erwin, TN
3	Truck	Kingston, TN

4) Type of Containers used for Shipment: Containers used are excepted packages, Type A, Sea Land, metal boxes, drums, tankers, and high integrity containers (HICs).

5) Solidification Agent: There were no solidifications performed during this report period.

2014 Effluent and Waste Disposal Annual Report Yearly Release Rates
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GASES		
Fission and Activation Gases	Total Release	3.12E+00 Curies
	Average Release Rate	9.89E-02 μ Ci/sec
	% of Applicable Limits*	γ 4.70E-02 % β 2.11E-02 %
Iodines	Total I-131 Release	7.32E-06 Curies
	Average Release Rate	2.30E-07 μ Ci/sec
	% of Applicable Limit*	4.57E-01 %
Particulates	Total Release	0.00 Curies
	Average Release Rate	0.00 μ Ci/sec
	% of Applicable Limit*	0.00 %
LIQUIDS		
Fission and Activation Products	Total Release	8.82E-04 Curies
	Average Diluted Concentration	8.10E-12 μ Ci/ml
	% of Applicable Limits*	Total Body 2.20E+00 % Organ 6.59E-01 %

* Applicable limits are expressed in terms of the annual 10 CFR 50, Appendix I, dose limits.

Site Boundary and Nearest Residence Listing

The following distances were used in the calculation of the maximum individual doses:

<u>Sector</u>	<u>Direction</u>	<u>Boundary (Meters)</u>	<u>Nearest Residence (Meters)</u>
A	N	651	659
B	NNE	617	660
C	NE	789	943
D	ENE	1497	1747
E	E	1274	1716
F	ESE	972	1643
G	SE	629	1640
H	SSE	594	964
J	S	594	997
K	SSW	629	942

Summary of Maximum Individual Doses

First Quarter 2014

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.80E-03	Child	Receptor 1	1.86E-01	1.5E+0
Liquid	Liver	2.80E-03	Child	Receptor 1	5.60E-02	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	5.14E-04	Any Age	651 (N)	1.03E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	6.12E-04	Any Age	789 (NE)	6.12E-03	1.0E+1
Iodines and Particulates	Total Body	1.02E-02	Child	659 (N)	1.36E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2014

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.26E-02	Child	Receptor 1	8.39E-01	1.5E+0
Liquid	Liver	1.26E-02	Child	Receptor 1	2.52E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	8.99E-04	Any Age	651 (N)	1.80E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	3.35E-04	Any Age	651 (N)	3.35E-03	1.0E+1
Iodines and Particulates	Total Body	1.37E-02	Child	659 (N)	1.83E-01	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2014

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	3.58E-02	Child	Receptor 1	2.39E+00	1.5E+0
Liquid	Liver	3.58E-02	Child	Receptor 1	7.16E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	3.01E-03	Any Age	651 (N)	6.02E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	3.90E-03	Any Age	617 (NNE)	3.90E-02	1.0E+1
Iodines and Particulates	Total Body	3.27E-02	Child	659 (N)	4.36E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2014

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.62E-02	Child	Receptor 1	1.75E+00	1.5E+0
Liquid	GI-LLI	2.62E-02	Child	Receptor 1	5.24E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	2.77E-04	Any Age	651 (N)	5.54E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	3.19E-04	Any Age	594 (SSE)	3.19E-03	1.0E+1
Iodines and Particulates	Thyroid	1.28E-02	Child	659 (N)	1.71E-01	7.5E+0

2014 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-22D	MW-22M	MW-22S	MW-24D	MW-24M	MW-24S	MW-25D	MW-25M
02/17/2014				<LLD	<LLD	<LLD		
02/24/2014							<LLD	<LLD
03/07/2014							<LLD	<LLD
03/08/2014				<LLD	<LLD	<LLD		
03/10/2014	2.21E-6	1.89E-6	2.26E-6					
04/23/2014				<LLD	<LLD	<LLD	<LLD	<LLD
04/28/2014	<LLD	<LLD	<LLD					
05/20/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/02/2014	<LLD	<LLD	<LLD					
06/13/2014				<LLD	<LLD	<LLD	<LLD	<LLD
07/22/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
07/29/2014							<LLD	<LLD
08/11/2014							<LLD	<LLD
08/14/2014				<LLD	<LLD	<LLD		
09/15/2014							<LLD	<LLD
09/17/2014				<LLD	<LLD	<LLD		
09/28/2014	<LLD	<LLD	<LLD					
10/28/2014							<LLD	<LLD
10/29/2014				<LLD	<LLD	<LLD		
11/20/2014				<LLD	<LLD	<LLD	<LLD	<LLD
12/12/2014				<LLD	<LLD	<LLD	<LLD	<LLD

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2014 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-25S	MW-26D	MW-26M	MW-26S	MW-27D	MW-27M	MW-27S	EW-19
01/13/2014								<LLD
02/24/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
03/07/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/22/2014								<LLD
04/23/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
05/20/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
06/13/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
07/22/2014								<LLD
07/29/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
08/01/2014								<LLD
08/11/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
09/15/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
10/28/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
11/20/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
12/12/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	

(Note: Wells MW-22 through MW- 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2014 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	SG-1	SG-2	SG-4	SG-5	OW-2	MW-20	MW-21	EW-18
02/17/2014						<LLD	<LLD	
02/24/2014	<LLD	<LLD	<LLD	<LLD				
03/10/2014	<LLD	<LLD	<LLD	<LLD		1.11E-6	9.74E-7	
04/28/2014						<LLD	<LLD	
04/30/2014	<LLD	<LLD	<LLD	<LLD				
05/23/2014	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	<LLD
06/13/2014	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
07/21/2014						<LLD	<LLD	
07/22/2014	<LLD	<LLD	<LLD	<LLD				
08/14/2014	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
09/28/2014						<LLD	<LLD	
10/05/2014								<LLD
10/17/2014						<LLD	<LLD	
10/20/2014		<LLD		<LLD				
10/23/2014					<LLD			
10/30/2014	<LLD		<LLD					
11/21/2014						<LLD	<LLD	

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2014 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-9	W-10	W-11	W-12	W-13	W-14	W-15	OW-1
01/13/2014		<LLD					<LLD	
01/14/2014					<LLD	<LLD		
01/30/2014							<LLD	
02/17/2014		<LLD	<LLD	<LLD	<LLD	<LLD		
02/19/2014	<LLD							
03/10/2014		1.49E-6	1.65E-6					
03/11/2014					<LLD	<LLD	<LLD	1.78E-6
03/31/2014				<LLD				
04/22/2014		<LLD			<LLD		<LLD	
04/28/2014		<LLD	<LLD	<LLD	<LLD	<LLD		
04/29/2014							<LLD	<LLD
04/30/2014	<LLD							
05/20/2014			<LLD	<LLD				
05/23/2014					<LLD	<LLD	<LLD	
05/30/2014								<LLD
06/02/2014			<LLD	<LLD	<LLD	<LLD		
06/16/2014							<LLD	<LLD
07/21/2014	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
08/14/2014			<LLD	<LLD	<LLD	<LLD	<LLD	
09/28/2014			<LLD	<LLD				
09/29/2014					<LLD	<LLD	<LLD	
09/30/2014								<LLD
10/17/2014		<LLD	<LLD	<LLD	<LLD	<LLD		
10/20/2014	<LLD						<LLD	
10/29/2014								<LLD
11/21/2014			<LLD	<LLD	<LLD			

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2014 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
01/13/2014			<LLD					
01/30/2014				<LLD	<LLD	<LLD		
02/03/2014	<LLD		<LLD					
02/04/2014								<LLD
02/17/2014							<LLD	
02/19/2014		<LLD						
04/22/2014	<LLD							<LLD
04/28/2014							<LLD	<LLD
04/29/2014				<LLD	<LLD	<LLD		
04/30/2014	<LLD	<LLD	<LLD					
07/21/2014	<LLD						<LLD	
07/22/2014		<LLD	<LLD					<LLD
07/23/2014				<LLD	<LLD	<LLD		
10/17/2014	<LLD						<LLD	
10/18/2014								<LLD
10/20/2014		<LLD	<LLD					
10/21/2014				<LLD	<LLD	<LLD	<LLD	

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2014 GPI Sample Data

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2014 indicates no groundwater contamination in excess of the reporting threshold of $2.00\text{E-}5$ uCi/mL for tritium. Gamma spectroscopy was performed on all Radiological Environmental Monitoring Program wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP's 2014 Annual Radiological Environmental Operating Report. There were no positively identified radionuclides from plant effluents detected in any of the GPI well samples.

The LLD value used for tritium counting of the samples varied between $9.42\text{E-}7$ and $9.63\text{E-}7$ uCi/mL, depending on which scintillation counter was used. This is well below the required maximum LLD value of $2.00\text{E-}6$ uCi/mL per the ODCM.

A set of samples obtained in March 2014 were found to have detectable tritium above the LLD, but these results appeared suspect as they were unusually distributed across the site, having had no prior indications of any previous groundwater tritium present in recent sampling. An investigation was initiated and documented via AR#2014-7010, to identify a cause. Subsequent samples did not indicate detectable tritium present. It was determined that the sample results were not accurate, due to a combination of factors. The samples were counted in the Plant's Hot Lab where high airborne concentrations of tritium are possible from reactor coolant samples, causing potential contamination of the samples. This lab is not the normal location used for environmental samples due to this potential. Additionally, the background in the Hot Lab was found to have changed significantly during this period, creating an environment for false positives to occur in samples with low LLDs. Corrective actions were completed to minimize the likelihood of this occurring again, including training via a Crew Event Notice to ensure personnel were aware of the condition and know how to avoid a repeat situation.

While no valid unsuspected tritium values were found above LLD for 2014, values found above the LLD are not abnormal, unexpected, or inconsistent with past sampling history. The samples observed above LLD historically were expected results from the release of tritiated water into the Absorption Pond, a licensed pathway and part of plant design, or the result of recapture deposition of tritium from licensed radioactive gaseous release points. The 2014 results were expected considering the reduction in tritium released to the Absorption Pond and a below average rainfall experienced.

Wells located inside the Protected Area of the plant are subject to recapture deposition of tritium and may show occasional sample results above LLD values following rainfalls and snow melt. The results observed in 2014 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed in 2014.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2014 impacting groundwater. The sample results indicate proper well placement to ensure the protection of the groundwater and early identification of any abnormal conditions involving groundwater. This is validated by the demonstrated ability to monitor percolation from the Absorption Pond and recaptured tritium in precipitation, with flow direction and behavior acting as described in the plant licensing documents.

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	5	20	17	10	0	52
NNE	0	3	4	4	0	0	11
NE	0	5	3	6	1	0	15
ENE	0	6	6	6	0	0	18
E	0	0	4	0	0	0	4
ESE	0	1	9	9	0	0	19
SE	3	2	16	13	1	0	35
SSE	0	10	28	17	11	0	66
S	0	4	6	17	3	0	30
SSW	0	3	4	3	2	2	14
SW	0	1	7	31	10	7	56
WSW	0	11	11	24	4	3	53
W	0	7	23	18	14	1	63
WNW	0	14	14	19	2	0	49
NW	0	5	12	15	6	3	41
NNW	0	3	18	11	6	1	39
Total	3	80	185	210	70	17	565
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 565
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	4	6	8	2	0	20	
NNE	1	2	11	6	1	0	21	
NE	0	7	5	0	0	0	12	
ENE	0	6	7	2	0	0	15	
E	0	2	1	0	0	0	3	
ESE	0	2	3	0	2	0	7	
SE	0	2	2	4	0	0	8	
SSE	0	2	4	1	4	0	11	
S	0	0	2	4	3	0	9	
SSW	0	1	3	3	3	1	11	
SW	0	0	5	9	6	1	21	
WSW	1	2	2	1	2	2	10	
W	0	0	2	3	4	4	13	
WNW	0	1	1	8	2	1	13	
NW	0	1	5	2	1	0	9	
NNW	0	2	8	2	1	0	13	
Total	2	34	67	53	31	9	196	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	196
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	2	8	6	0	1	18
NNE	0	2	4	6	0	0	12
NE	1	4	6	14	0	0	25
ENE	0	3	6	6	0	0	15
E	1	2	1	0	0	0	4
ESE	0	0	3	2	3	0	8
SE	1	4	8	2	1	0	16
SSE	0	3	10	5	5	0	23
S	0	2	16	3	6	1	28
SSW	0	0	10	3	2	0	15
SW	0	3	5	11	6	2	27
WSW	0	1	5	6	6	5	23
W	0	1	7	13	7	5	33
WNW	0	1	6	13	22	2	44
NW	1	1	6	5	5	2	20
NNW	0	2	7	5	0	0	14
Total	5	31	108	100	63	18	325
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							325
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	2	5	5	1	1	0	14	
NNE	1	4	8	5	2	0	20	
NE	2	4	16	13	1	0	36	
ENE	1	6	14	4	0	0	25	
E	1	3	10	2	1	0	17	
ESE	0	1	6	7	0	0	14	
SE	0	5	17	10	4	0	36	
SSE	0	6	8	11	14	4	43	
S	2	13	17	24	36	5	97	
SSW	1	9	18	16	10	1	55	
SW	0	3	9	26	26	11	75	
WSW	1	1	6	19	17	4	48	
W	0	1	12	33	20	4	70	
WNW	0	2	9	41	23	16	91	
NW	2	3	8	16	4	4	37	
NNW	2	2	11	2	0	0	17	
Total	15	68	174	230	159	49	695	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	695
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	3	3	1	0	8
NNE	0	3	2	1	0	0	6
NE	0	1	3	1	0	0	5
ENE	1	6	6	0	0	0	13
E	0	0	1	2	0	0	3
ESE	0	1	8	3	2	0	14
SE	0	3	16	8	0	0	27
SSE	0	4	10	7	2	0	23
S	1	1	9	12	3	1	27
SSW	0	1	11	7	3	0	22
SW	0	3	4	8	4	1	20
WSW	0	3	6	12	2	0	23
W	0	5	2	5	4	0	16
WNW	0	1	0	1	1	1	4
NW	0	2	1	2	0	2	7
NNW	0	0	2	1	0	0	3
Total	2	35	84	73	22	5	221
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							221
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	0	0	1	0	1
NNE	0	1	0	0	0	0	1
NE	0	3	1	0	0	0	4
ENE	1	0	3	0	0	0	4
E	0	1	1	0	0	0	2
ESE	0	3	3	0	0	0	6
SE	0	1	6	1	0	0	8
SSE	1	3	10	12	1	0	27
S	0	3	8	3	1	0	15
SSW	0	1	4	0	0	0	5
SW	2	0	7	0	0	0	9
WSW	0	0	1	0	0	0	1
W	1	1	0	0	0	0	2
WNW	0	0	0	0	0	1	1
NW	1	0	0	0	0	1	2
NNW	0	1	0	0	0	0	1
Total	6	18	44	16	3	2	89

Calm Hours not Included above for :	Total Period	0
Valid Hours for this Stability Class for:	Total Period	89
Total Hours for Period		2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2014 - 03/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	0	0	0	0	0
NNE	1	0	0	0	0	0	1
NE	1	0	0	0	0	0	1
ENE	0	2	0	0	0	0	2
E	0	4	0	0	0	0	4
ESE	0	1	2	1	0	0	4
SE	0	5	3	1	0	0	9
SSE	0	2	7	1	0	0	10
S	0	5	7	0	0	0	12
SSW	0	6	4	0	0	0	10
SW	0	3	1	0	0	0	4
WSW	1	2	0	0	0	0	3
W	1	1	0	0	0	0	2
WNW	1	2	0	0	0	0	3
NW	0	0	1	0	0	0	1
NNW	0	0	0	0	0	0	0
Total	5	33	25	3	0	0	66
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							66
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

01/01/2014 - 03/31/2014

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	3	17	42	35	15	1	113
NNE	3	15	29	22	3	0	72
NE	4	24	34	34	2	0	98
ENE	3	29	42	18	0	0	92
E	2	12	18	4	1	0	37
ESE	0	9	34	22	7	0	72
SE	4	22	68	39	6	0	139
SSE	1	30	77	54	37	4	203
S	3	28	65	63	52	7	218
SSW	1	21	54	32	20	4	132
SW	2	13	38	85	52	22	212
WSW	3	20	31	62	31	14	161
W	2	16	46	72	49	14	199
WNW	1	21	30	82	50	21	205
NW	4	12	33	40	16	12	117
NNW	2	10	46	21	7	1	87
Total	38	299	687	685	348	100	2157

Calm Hours not Included above for :	Total Period	0
Variable Direction Hours for:	Total Period	0
Invalid Hours for:	Total Period	3
Valid Hours for this Stability Class for:	Total Period	2157
Total Hours for Period		2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	16	31	17	3	0	67	
NNE	2	6	4	0	0	0	12	
NE	1	4	1	0	0	0	6	
ENE	1	2	6	2	0	0	11	
E	1	5	14	9	1	5	35	
ESE	0	2	10	14	10	2	38	
SE	2	3	16	6	4	1	32	
SSE	1	12	36	24	3	0	76	
S	1	3	27	13	2	0	46	
SSW	0	2	5	7	2	0	16	
SW	2	4	29	20	2	0	57	
WSW	0	13	44	22	9	1	89	
W	0	24	22	9	4	0	59	
WNW	5	30	13	9	1	0	58	
NW	2	25	17	16	1	0	61	
NNW	2	33	66	26	15	0	142	
Total	20	184	341	194	57	9	805	
Calm Hours not Included above for :							Total Period	6
Valid Hours for this Stability Class for:							Total Period	805
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	3	6	1	2	0	14
NNE	0	2	2	1	0	0	5
NE	2	1	0	0	0	0	3
ENE	1	1	1	0	0	0	3
E	0	0	3	0	0	1	4
ESE	0	1	1	1	0	1	4
SE	0	1	1	1	1	0	4
SSE	0	0	2	1	1	0	4
S	0	1	0	1	1	0	3
SSW	0	0	2	2	1	0	5
SW	0	2	3	7	1	0	13
WSW	0	3	0	0	3	0	6
W	1	3	1	1	0	0	6
WNW	1	2	2	0	0	0	5
NW	0	3	0	0	0	0	3
NNW	0	3	0	0	2	1	6
Total	7	26	24	16	12	3	88

Calm Hours not Included above for :	Total Period	6
Valid Hours for this Stability Class for:	Total Period	88
Total Hours for Period		2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	3	5	5	2	0	17
NNE	1	4	1	0	0	0	6
NE	0	1	2	0	0	0	3
ENE	0	1	3	1	0	0	5
E	0	1	2	0	2	1	6
ESE	0	0	1	0	2	0	3
SE	0	1	1	0	0	0	2
SSE	0	0	3	3	0	0	6
S	0	3	4	5	4	0	16
SSW	0	1	2	0	1	1	5
SW	2	0	5	1	0	1	9
WSW	0	0	0	2	3	1	6
W	1	2	0	0	0	0	3
WNW	2	3	0	1	0	0	6
NW	0	3	0	0	0	0	3
NNW	0	3	1	0	0	0	4
Total	8	26	30	18	14	4	100
Calm Hours not Included above for :							6
Valid Hours for this Stability Class for:							100
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	6	8	18	11	8	0	51
NNE	4	9	8	6	0	0	27
NE	2	5	5	0	0	0	12
ENE	0	2	5	1	0	0	8
E	2	4	11	13	16	9	55
ESE	1	3	4	9	16	1	34
SE	1	2	9	17	6	0	35
SSE	2	1	3	14	1	0	21
S	0	4	23	33	10	0	70
SSW	0	4	8	25	8	0	45
SW	0	6	3	9	3	0	21
WSW	1	5	4	10	1	2	23
W	5	0	7	3	5	0	20
WNW	0	2	3	1	3	0	9
NW	2	4	7	3	3	0	19
NNW	5	4	6	4	3	0	22
Total	31	63	124	159	83	12	472
Calm Hours not Included above for :							Total Period 6
Valid Hours for this Stability Class for:							Total Period 472
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	1	4	7	2	1	0	15	
NNE	0	7	7	1	0	0	15	
NE	1	6	17	2	0	0	26	
ENE	0	8	7	5	0	0	20	
E	0	2	14	2	1	0	19	
ESE	2	4	18	6	0	0	30	
SE	1	7	30	15	0	0	53	
SSE	1	6	21	17	3	0	48	
S	1	5	18	12	5	0	41	
SSW	1	2	7	6	1	1	18	
SW	2	4	5	10	1	0	22	
WSW	0	2	3	4	0	0	9	
W	0	0	2	5	0	0	7	
WNW	0	2	9	5	4	0	20	
NW	0	4	4	3	0	0	11	
NNW	0	4	1	1	0	0	6	
Total	10	67	170	96	16	1	360	
Calm Hours not Included above for :							Total Period	6
Valid Hours for this Stability Class for:							Total Period	360
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	1	5	5	0	0	0	11
NNE	0	4	1	0	0	0	5
NE	1	3	10	1	0	0	15
ENE	1	6	5	5	0	0	17
E	1	1	7	1	0	0	10
ESE	1	3	16	2	0	0	22
SE	0	5	9	4	0	0	18
SSE	0	3	10	13	0	0	26
S	1	2	9	18	0	0	30
SSW	0	3	7	4	0	0	14
SW	0	0	0	0	0	0	0
WSW	0	2	1	0	0	0	3
W	0	2	2	1	0	0	5
WNW	0	2	2	0	0	0	4
NW	1	1	2	0	0	0	4
NNW	0	1	3	2	0	0	6
Total	7	43	89	51	0	0	190
Calm Hours not Included above for :							6
Valid Hours for this Stability Class for:							190
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2014 - 06/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	4	4	0	0	0	8	
NNE	0	2	1	0	0	0	3	
NE	1	5	1	0	0	0	7	
ENE	0	6	14	4	0	0	24	
E	1	2	9	1	0	0	13	
ESE	0	6	17	1	0	0	24	
SE	2	5	15	1	0	0	23	
SSE	0	3	3	3	0	0	9	
S	0	1	4	1	0	0	6	
SSW	0	0	10	2	0	0	12	
SW	0	1	2	1	0	0	4	
WSW	0	1	2	1	0	0	4	
W	1	1	0	0	0	0	2	
WNW	1	1	0	0	0	0	2	
NW	1	3	0	0	0	0	4	
NNW	0	3	0	0	0	0	3	
Total	7	44	82	15	0	0	148	
Calm Hours not Included above for :							Total Period	6
Valid Hours for this Stability Class for:							Total Period	148
Total Hours for Period								2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

04/01/2014 - 06/30/2014

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	12	43	76	36	16	0	183
NNE	7	34	24	8	0	0	73
NE	8	25	36	3	0	0	72
ENE	3	26	41	18	0	0	88
E	5	15	60	26	20	16	142
ESE	4	19	67	33	28	4	155
SE	6	24	81	44	11	1	167
SSE	4	25	78	75	8	0	190
S	3	19	85	83	22	0	212
SSW	1	12	41	46	13	2	115
SW	6	17	47	48	7	1	126
WSW	1	26	54	39	16	4	140
W	8	32	34	19	9	0	102
WNW	9	42	29	16	8	0	104
NW	6	43	30	22	4	0	105
NNW	7	51	77	33	20	1	189
Total	90	453	860	549	182	29	2163

Calm Hours not Included above for :	Total Period	6
Variable Direction Hours for:	Total Period	0
Invalid Hours for:	Total Period	15
Valid Hours for this Stability Class for:	Total Period	2163
Total Hours for Period		2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	4	6	27	22	1	0	60
NNE	1	0	2	0	0	0	3
NE	1	6	5	0	0	0	12
ENE	2	5	9	0	0	0	16
E	0	8	10	0	0	0	18
ESE	1	7	10	0	0	0	18
SE	2	10	2	0	0	0	14
SSE	3	3	14	7	0	0	27
S	1	6	11	5	0	0	23
SSW	0	3	6	0	0	0	9
SW	0	3	7	6	0	0	16
WSW	1	23	29	6	1	1	61
W	4	22	27	6	0	0	59
WNW	2	29	18	0	0	0	49
NW	3	15	22	2	1	0	43
NNW	9	24	37	12	1	1	84
Total	34	170	236	66	4	2	512
Calm Hours not Included above for :							Total Period 26
Valid Hours for this Stability Class for:							Total Period 512
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	1	3	3	1	0	9
NNE	0	0	0	0	0	0	0
NE	0	1	1	0	0	0	2
ENE	2	1	0	0	0	0	3
E	0	0	0	0	0	0	0
ESE	0	4	1	0	0	0	5
SE	1	1	1	1	0	0	4
SSE	1	4	6	2	0	0	13
S	0	5	4	3	0	0	12
SSW	0	4	6	2	1	0	13
SW	1	3	3	7	0	0	14
WSW	3	7	4	1	0	0	15
W	2	3	2	1	0	0	8
WNW	0	3	0	0	0	0	3
NW	0	2	2	1	0	0	5
NNW	1	2	2	3	0	0	8
Total	12	41	35	24	2	0	114

Calm Hours not Included above for :	Total Period	26
Valid Hours for this Stability Class for:	Total Period	114
Total Hours for Period		2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	0	2	4	1	0	7	
NNE	0	1	0	1	0	0	2	
NE	0	1	0	0	0	0	1	
ENE	0	1	1	0	0	0	2	
E	0	1	2	0	0	0	3	
ESE	0	2	0	0	0	0	2	
SE	2	1	0	0	0	0	3	
SSE	0	3	1	2	0	0	6	
S	0	6	3	1	0	0	10	
SSW	0	4	5	1	0	0	10	
SW	1	1	5	2	0	0	9	
WSW	2	3	3	3	0	0	11	
W	1	1	0	0	0	0	2	
WNW	2	3	0	0	1	0	6	
NW	1	3	0	0	0	1	5	
NNW	1	3	3	4	0	0	11	
Total	10	34	25	18	2	1	90	
Calm Hours not Included above for :							Total Period	26
Valid Hours for this Stability Class for:							Total Period	90
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	14	15	26	6	0	62
NNE	0	2	5	4	1	0	12
NE	0	6	6	0	0	0	12
ENE	0	4	7	0	0	0	11
E	0	5	5	0	0	0	10
ESE	1	0	6	0	0	0	7
SE	0	7	12	0	0	0	19
SSE	0	1	10	5	1	0	17
S	3	6	12	8	0	0	29
SSW	2	8	13	14	2	0	39
SW	0	10	17	21	2	0	50
WSW	1	7	10	7	3	1	29
W	0	6	3	0	0	0	9
WNW	1	6	1	2	5	1	16
NW	3	0	1	2	7	0	13
NNW	2	10	7	20	10	1	50
Total	14	92	130	109	37	3	385
Calm Hours not Included above for :							26
Valid Hours for this Stability Class for:							385
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	3	11	11	1	0	0	26	
NNE	3	6	8	0	0	0	17	
NE	0	7	16	0	0	0	23	
ENE	0	5	8	0	0	0	13	
E	0	5	5	0	0	0	10	
ESE	0	4	14	3	0	0	21	
SE	0	6	24	2	0	0	32	
SSE	1	6	13	9	0	0	29	
S	3	11	32	14	0	0	60	
SSW	1	7	24	9	0	0	41	
SW	1	3	13	8	0	0	25	
WSW	0	2	5	6	0	0	13	
W	1	4	3	0	0	0	8	
WNW	1	7	3	0	0	0	11	
NW	2	5	5	1	1	0	14	
NNW	0	3	5	1	0	0	9	
Total	16	92	189	54	1	0	352	
Calm Hours not Included above for :							Total Period	26
Valid Hours for this Stability Class for:							Total Period	352
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	2	4	1	1	0	0	8	
NNE	1	6	4	1	0	0	12	
NE	1	5	12	0	0	0	18	
ENE	0	4	14	0	0	0	18	
E	1	4	9	1	0	0	15	
ESE	0	4	17	5	0	0	26	
SE	2	1	15	1	1	0	20	
SSE	0	6	18	0	0	0	24	
S	0	3	23	3	0	0	29	
SSW	0	4	8	1	0	0	13	
SW	0	4	6	1	0	0	11	
WSW	1	1	2	0	0	0	4	
W	1	1	3	0	0	0	5	
WNW	0	1	0	0	0	0	1	
NW	0	1	0	0	0	0	1	
NNW	1	0	1	0	0	0	2	
Total	10	49	133	14	1	0	207	
Calm Hours not Included above for :							Total Period	26
Valid Hours for this Stability Class for:							Total Period	207
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2014 - 09/30/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	5	1	0	0	0	6	
NNE	3	4	3	0	0	0	10	
NE	7	7	8	0	0	0	22	
ENE	1	15	10	1	0	0	27	
E	2	9	13	4	0	0	28	
ESE	2	4	16	6	0	0	28	
SE	6	9	19	2	0	0	36	
SSE	3	8	25	2	0	0	38	
S	1	6	18	14	0	0	39	
SSW	2	6	17	11	0	0	36	
SW	3	7	17	0	0	0	27	
WSW	0	9	7	0	0	0	16	
W	2	7	0	0	0	0	9	
WNW	1	9	0	0	0	0	10	
NW	3	3	1	0	0	0	7	
NNW	2	7	0	0	0	0	9	
Total	38	115	155	40	0	0	348	
Calm Hours not Included above for :							Total Period	26
Valid Hours for this Stability Class for:							Total Period	348
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

07/01/2014 - 09/30/2014

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	11	41	60	57	9	0	178
NNE	8	19	22	6	1	0	56
NE	9	33	48	0	0	0	90
ENE	5	35	49	1	0	0	90
E	3	32	44	5	0	0	84
ESE	4	25	64	14	0	0	107
SE	13	35	73	6	1	0	128
SSE	8	31	87	27	1	0	154
S	8	43	103	48	0	0	202
SSW	5	36	79	38	3	0	161
SW	6	31	68	45	2	0	152
WSW	8	52	60	23	4	2	149
W	11	44	38	7	0	0	100
WNW	7	58	22	2	6	1	96
NW	12	29	31	6	9	1	88
NNW	16	49	55	40	11	2	173
Total	134	593	903	325	47	6	2008

Calm Hours not Included above for :

Total Period 26

Variable Direction Hours for:

Total Period 0

Invalid Hours for:

Total Period 174

Valid Hours for this Stability Class for:

Total Period 2008

Total Hours for Period

2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	15	3	0	0	19
NNE	0	0	3	1	0	0	4
NE	0	2	5	1	0	0	8
ENE	0	3	3	0	0	0	6
E	0	2	1	0	0	0	3
ESE	0	4	6	0	0	0	10
SE	0	1	11	8	0	0	20
SSE	0	2	8	8	2	1	21
S	0	2	8	7	0	0	17
SSW	0	0	2	2	0	0	4
SW	0	2	6	5	0	0	13
WSW	0	5	9	7	4	0	25
W	0	4	11	15	8	0	38
WNW	0	3	16	12	4	0	35
NW	0	1	10	5	1	0	17
NNW	0	1	13	3	0	0	17
Total	0	33	127	77	19	1	257
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							257
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	1	2	6	0	0	9	
NNE	1	0	2	4	0	0	7	
NE	1	2	0	0	0	0	3	
ENE	0	1	1	0	0	0	2	
E	0	4	2	0	0	0	6	
ESE	0	3	1	1	0	0	5	
SE	2	1	0	1	0	0	4	
SSE	2	4	4	6	1	0	17	
S	0	0	9	5	0	0	14	
SSW	0	0	10	6	1	0	17	
SW	0	1	8	3	0	0	12	
WSW	0	2	13	3	2	1	21	
W	0	3	7	12	7	4	33	
WNW	1	1	4	10	3	0	19	
NW	0	0	3	1	0	1	5	
NNW	0	1	1	3	1	0	6	
Total	7	24	67	61	15	6	180	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	180
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	5	3	0	1	9
NNE	0	0	2	4	0	0	6
NE	0	3	0	0	0	0	3
ENE	0	1	1	0	0	0	2
E	0	7	1	0	0	0	8
ESE	0	5	5	2	0	0	12
SE	0	2	8	3	0	0	13
SSE	1	6	8	6	1	0	22
S	0	3	22	5	1	0	31
SSW	1	5	17	6	0	0	29
SW	0	4	10	3	1	2	20
WSW	1	3	14	6	15	10	49
W	1	1	4	11	23	17	57
WNW	0	1	8	33	8	3	53
NW	0	1	6	13	8	0	28
NNW	1	2	4	6	5	0	18
Total	5	44	115	101	62	33	360
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							360
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	4	26	24	3	3	60
NNE	0	1	17	5	1	5	29
NE	0	12	10	8	5	0	35
ENE	1	3	4	0	0	0	8
E	0	6	7	0	0	0	13
ESE	0	8	8	11	0	0	27
SE	1	6	29	26	1	0	63
SSE	0	11	20	46	6	0	83
S	1	17	53	55	3	0	129
SSW	0	13	54	72	14	0	153
SW	1	1	18	19	5	2	46
WSW	1	6	12	31	9	1	60
W	0	1	20	48	43	10	122
WNW	0	8	19	42	31	4	104
NW	0	2	20	28	17	2	69
NNW	1	2	9	17	18	11	58
Total	6	101	326	432	156	38	1059
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							1059
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	1	1	0	0	0	4
NNE	1	8	3	0	0	0	12
NE	0	7	5	0	0	0	12
ENE	2	2	5	0	0	0	9
E	0	1	8	1	0	0	10
ESE	1	1	1	3	0	0	6
SE	0	2	9	15	1	0	27
SSE	0	2	5	9	1	1	18
S	1	2	25	11	0	0	39
SSW	1	1	13	3	0	0	18
SW	0	2	0	1	0	0	3
WSW	0	0	1	3	0	0	4
W	0	0	2	2	0	0	4
WNW	0	2	0	3	1	0	6
NW	0	2	5	6	2	0	15
NNW	0	0	13	2	1	0	16
Total	8	33	96	59	6	1	203
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							203
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	0	0	0	0	0
NNE	0	1	3	0	0	0	4
NE	0	2	2	0	0	0	4
ENE	0	0	4	0	0	0	4
E	0	1	4	1	0	0	6
ESE	1	1	3	0	0	0	5
SE	0	1	6	1	0	0	8
SSE	0	1	2	5	0	0	8
S	0	1	3	1	0	0	5
SSW	0	1	2	1	0	0	4
SW	0	1	0	1	0	0	2
WSW	1	1	0	0	0	0	2
W	1	2	0	0	0	0	3
WNW	0	0	0	0	0	0	0
NW	0	1	1	0	0	0	2
NNW	0	0	0	0	0	0	0
Total	3	14	30	10	0	0	57
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							57
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2014 - 12/31/2014
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	1	4	0	0	0	5
ENE	2	1	11	0	0	0	14
E	1	3	7	1	0	0	12
ESE	0	4	7	0	0	0	11
SE	0	1	5	2	0	0	8
SSE	0	2	2	1	0	0	5
S	0	1	4	1	0	0	6
SSW	1	0	1	2	0	0	4
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	1	0	0	0	0	1
Total	4	14	41	7	0	0	66

Calm Hours not Included above for :	Total Period	0
Valid Hours for this Stability Class for:	Total Period	66
Total Hours for Period		2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

10/01/2014 - 12/31/2014

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	2	7	49	36	3	4	101
NNE	2	10	30	14	1	5	62
NE	1	29	26	9	5	0	70
ENE	5	11	29	0	0	0	45
E	1	24	30	3	0	0	58
ESE	2	26	31	17	0	0	76
SE	3	14	68	56	2	0	143
SSE	3	28	49	81	11	2	174
S	2	26	124	85	4	0	241
SSW	3	20	99	92	15	0	229
SW	1	11	42	32	6	4	96
WSW	3	17	49	50	30	12	161
W	2	11	44	88	81	31	257
WNW	1	15	47	100	47	7	217
NW	0	7	45	53	28	3	136
NNW	2	7	40	31	25	11	116
Total	33	263	802	747	258	79	2182

Calm Hours not Included above for :	Total Period	0
Variable Direction Hours for:	Total Period	0
Invalid Hours for:	Total Period	26
Valid Hours for this Stability Class for:	Total Period	2182
Total Hours for Period		2208

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was not revised during this reporting period.

ENCLOSURE 5 to AEP-NRC-2018-35

DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2013 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT, Revision 1

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I. INTRODUCTION

This report discusses the radioactive discharges from Unit 1 and Unit 2 of the Donald C. Cook Nuclear Plant (CNP) during 2013. This is in accordance with the requirements of CNP Technical Specification (TS) 5.6.3.

The table below summarizes the pertinent statistics concerning the Plant's operation during the period from January 1, 2013, to December 31, 2013. The data in this table and the descriptive information on plant operation are based upon the respective unit's Monthly Operating Reports, Performance Indicators and Control Room Logs for 2013.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	8,111,515	8,696,904
Unit Service Factor (Percent (%))	85.3	88.0
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	87.0	89.4

Unit 1 entered the reporting period in Mode 1 at Nominal Full Power (NFP). Small power adjustments were made to facilitate main turbine valve testing throughout the year. The unit performed a normal downpower and was manually tripped on March 27, 2013, entering the refueling outage U1C25. The unit attained criticality on May 18, 2013 and attained NFP on May 24, 2013. On December 13, 2013, a planned downpower to 24% power was performed to support containment glowplug replacement work. The unit returned to NFP on December 16, 2013. The unit exited the reporting period at NFP.

Unit 2 entered the reporting period in Mode 1 at NFP. Small power adjustments were made to facilitate main turbine valve testing throughout the year. Unit 2 performed manual reactor trip and entered a forced outage on July 28, 2013 due to a Condensate Heater Bypass Control valve setpoint issue. The unit returned to NFP on August 1, 2013. The unit performed a normal downpower and was manually tripped on October 2, 2013, entering the refueling outage U2C21. The unit attained criticality on November 11, 2013, and attained NFP on November 18, 2013. The unit exited the reporting period at NFP.

II. RADIOACTIVE RELEASES AND RADIOLOGICAL IMPACT ON MAN

Since a number of release points are common to both units, the release data from both units are combined to form this two-unit, Annual Radioactive Effluent Release Report. Appendix A1.1 through A2.4 of this report present the information in accordance with Section 5.6.3 of Appendix A to the Facility Operating Licenses, as specified in the Technical Specifications, Regulatory Guide 1.21, and 10 CFR Part 50, Appendix I.

The "MIDAS System" is a computer code that calculates doses due to radionuclides that were released from the CNP.

All liquid and gaseous releases were well within Offsite Dose Calculation Manual (ODCM) limits and federal limits.

There were no abnormal liquid releases and no abnormal gaseous releases in 2013.

The Independent Spent Fuel Storage Installation (ISFSI) impacts are included with Unit 1 and Unit 2 statistics. The ISFSI cask system does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the ISFSI.

Liquid Releases

During 2013 there were 90 liquid batch releases performed. The number of liquid batch releases for the four quarters in 2013 was 18, 24, 25, and 23, respectively.

Estimated doses (in mrem) to maximally exposed individuals via the liquid release pathways are given in Appendix A1.2 of this report.

Gaseous Releases

During the first quarter of 2013 there were two batch releases from Gas Decay Tanks (GDT), one containment purge, and 102 Containment Pressure Reliefs (CPR). During the second quarter there was one batch release from GDTs and 108 CPR. During the third quarter there were four batch releases from GDTs and 119 CPR. During the fourth quarter there was one batch release from GDTs, two containment purges, and 62 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89017 (DRSS); 50-316/89016 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There were a total of eight GDT releases, three containment purges, and 391 CPR gaseous batch releases made during 2013.

In calculating the dose consequences for continuous and batch gaseous releases during 2013, the meteorological data measured at the time of the release were used.

The estimated doses (in mrem) to maximally exposed individuals via the gaseous release pathways are given in Appendix A1.2 of this report. For individuals that are within the site boundary, the occupancy time is sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary.

Solid Waste Disposition

There were 23 shipments of radioactive waste made during 2013. These included shipments made from the site to various radioactive waste processors for ultimate disposal.

III. METEOROLOGICAL

Appendices A2.1, A2.2, A2.3, and A2.4 of this report contain the cumulative joint frequency distribution tables of wind speed and wind direction, corresponding to the various atmospheric stability classes for the first, second, third and fourth quarters of 2013. Hourly meteorological data is available for review and/or inspection upon request.

IV. OFFSITE DOSE CALCULATION MANUAL (ODCM) CHANGES

The ODCM, PMP-6010-OSD-001, was not revised during the report period.

V. TOTAL DOSE

Section 3.2.5 of the ODCM requires that the dose or dose commitment to a real individual from all uranium fuel cycle sources in Berrien County be limited to no more than 25 mrem to the total body or any organ (except the thyroid, which is limited to no more than 75 mrem) over a period of 12 consecutive months to show conformance with the requirements of 40 CFR Part 190. The maximum cumulative dose to an individual from liquid and gaseous effluents during 2013 was well within the ODCM limits. Measurements using thermoluminescent dosimeters (TLD) at 12 onsite stations indicate that the dose due to direct radiation is consistent with preoperational and current control (background) levels. This is fully evaluated in CNP's 2013 Annual Radiological Environmental Operating Report.

The annual dose to the maximum individual will be estimated by first, summing the quarterly total body air dose, the quarterly skin air dose, the quarterly critical organ dose from iodines and particulates (I&P), the quarterly total body dose from liquid effluents, the quarterly critical organ dose from liquid effluents, and the Radiological Environmental Monitoring Program onsite direct radiation TLD data. These quarterly values are summed with the annual Carbon-14 dose and compared to the annual total body limit for conservative reasons. The table that follows here represents the above written description:

Dose (mrem)	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
I & P	8.56E-03	1.50E-02	4.53E-02	7.51E-02
Total Body Air	2.10E-04	2.90E-04	9.80E-04	3.10E-04
Skin	3.40E-04	4.70E-04	1.60E-03	9.20E-04
Liquid TB	2.99E-02	9.39E-03	2.72E-03	8.12E-03
Liquid Organ	2.99E-02	9.42E-03	2.72E-03	8.30E-03
C14 (Annual)				2.20E+00
Direct Radiation	0	0	0	0
Total	6.89E-02	3.46E-02	1.02E-01	2.29E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.50E+00
Annual Dose Limit (mrem)				25
Percent of limit				9.99E+00

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2013 annual dose data, and 2013 annual dose data with C-14 added. This indicates that 2013 was a 'normal' dual unit outage year with respect to radioactive effluents and allows for easier comparison. The table is presented as follows:

	Annual Dose (mrem)	% of limit
2009	2.60E-01	1.04
2013	2.99E-01	1.19
2013 with C-14	2.5	9.99

VI. **RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS**

There were no release pathways unmonitored for greater than 30 days.

VII. **NOTEWORTHY CONDITIONS IDENTIFIED IN 2013**

During the Fourth Quarter of 2012, an intermittent fault was identified on the CNP 60-Meter Meteorological Tower that resulted in a large number of invalid data hours collected. A Condition Report (2012-2305) was initiated and repair work performed. The issue appeared to be a connection to the Delta Temperature instrumentation. Repairs yielded better data collection results in December 2012, however the intermittent fault returned and the system yielded additional invalid data hours during the First and Second Quarters of 2013. Additional repair work was performed when conditions allowed for safe work on the tower, and this resulted in the problem being positively identified as cabling fault grounding out the 10 Meter Delta Temperature instrumentation on the Main 60 Meter Tower. The repairs on the cable and instrumentation were successful at eliminating the intermittent fault and data collection has returned to near 100% valid hours.

The meteorological data gathered from the 60 meter tower during valid hours along with data substituted in for invalid hours from a secondary 10 Meter Temperature instrumentation located onsite by our meteorological third party vendor indicate normal weather patterns consistent with historical norms. The updated data was utilized in the dose calculations performed in the MIDAS software to ensure accurate dose assessments. The Joint Frequency Tables attached are taken using the primary instrumentation only as there is no method available in the software to illustrate the data substitution utilized by the vendor.

This methodology of data substitution has always been used for any invalid hours, since the usage of MIDAS software at CNP, to ensure the most accurate dose calculations and reporting. The large number of invalid data hours is unusual though, so it is important to clarify that this did not impact the ability to calculate public dose negatively as a process of data substitution by our vendor already was in place to address any invalid hours.

Carbon-14 Supplemental Information for the 2013 Annual Radioactive Effluent Release Report.

C-14 has a 5730 year half-life and is a naturally occurring radionuclide produced by cosmic ray interactions in the atmosphere. C-14 is a relatively low energy beta emitter. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the

atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally, from weapons testing, or coal burning power plants. The inventory of C-14 in Earth's biosphere is about 300 million Curies, of which most is in the oceans.

Since the U.S. Nuclear Regulatory Commission (NRC) published Regulatory Guide (RG) 1.21, Revision 1, in 1974, the analytical methods for determining C-14 have improved. Coincidentally, the radioactive effluents from commercial nuclear power plants over the same period have decreased to the point that C-14 is likely to be a principal radionuclide in gaseous effluents. Based on these reasons and a desire to adjust policy to align with international standards, the nuclear industry was required to report, starting in 2010, the quantity and dose impact of C-14 here in the United States. The dose will be reported both with and without C-14 so a comparison to 2009 can be made, keeping in mind the differing standards.

The quantity of C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. RG 1.21, Revision 2). A recent study recommends a source term scaling factor of approximately 9.0 to 9.8 Curies/GWe-yr for a Westinghouse Pressurized Water Reactor (Ref. EPRI 1021106 "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents" December 23, 2010). A scaling factor of 9.4 Curies/GWe-yr was assumed for this report. Using this source term scaling factor and actual electrical generation (in MWH) produced during 2013 results in a site total of 18.03 Curies produced.

C-14 releases from PWRs occur primarily as a mix of organic carbon (methane) and inorganic (carbon dioxide). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as gas. Any time the primary coolant is exposed to an oxidizing environment (during shutdown or refueling), a slow transformation from an organic to an inorganic species occurs. Various studies documenting measured C-14 releases from PWRs suggest an average 80% organic fraction with the remainder being carbon dioxide. This equates to 3.61 Curies released as carbon dioxide which is available for the food pathway through photosynthesis to vegetation.

Dose is calculated utilizing the methodology prescribed in RG 1.109, Appendix C with the vegetation dose being the most predominant. A 'p' factor of 0.33 is determined utilizing the 209 hours of batch gaseous releases performed during 2013 and the assumption that 70% of the C-14 released is from gaseous batch releases. A further reduction to the vegetation and leafy vegetable dose is warranted due to the limited growing season in Michigan, which was conservatively limited to nine months.

The final results indicated a calculated organ dose from C-14 to a child at the site boundary of 1.74 mrem to the bone and a whole body dose of 0.461 mrem, for a combined total C-14 dose of 2.20 mrem. This is less than the dose limit of 15 mrem/unit to any organ prescribed in 10 CFR 50, Appendix I, and the 40 CFR Part 190 limit of 25 mrem for total body and for any organ (≤ 75 mrem for thyroid).

VIII. CONCLUSION

Based on the information presented in this report, it is concluded that CNP Units 1 and 2 performed their intended design function with no demonstrable adverse effect on the health and safety of the general public.

Note: This entire document is Revision 1 submitted as "Errata" attached to the 2017 Annual Radioactive Effluent Release Report per Corrective Action 2017-4835. This new revision completely replaces the previously submitted report. This errata was necessitated due to problems identified with equipment utilized for counting tritium samples dating back to 2013. The alterations changed the overall public dose calculated from 2.48 millirems (9.93% of the 40 CFR190 allowable dose limits) to 2.50 millirems (9.99% of the 40CFR190 allowable dose limits). There were no adverse impacts to public health or safety by this minor change to dose.

2013 Effluent and Waste Disposal Annual Report

SUPPLEMENTAL INFORMATION

Facility: Donald C. Cook Nuclear Plant
Licensee: Indiana Michigan Power Company

1 REGULATORY LIMITS

1.1 Noble Gases

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be limited to the following:

1.1.1 During any calendar quarter, to ≤ 5 mrad/unit for gamma radiation and ≤ 10 mrad/unit for beta radiation.

1.1.2 During any calendar year, to ≤ 10 mrad/unit for gamma radiation and ≤ 20 mrad/unit for beta radiation.

1.2 Iodines - Particulates

The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to unrestricted areas shall be limited to the following:

1.2.1 During any calendar quarter to ≤ 7.5 mrem/unit to any organ.

1.2.2 During any calendar year to ≤ 15 mrem/unit to any organ.

1.3 Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited:

1.3.1 During any calendar quarter to ≤ 1.5 mrem/unit to the total body and to ≤ 5 mrem/unit to any organ.

1.3.2 During any calendar year to ≤ 3 mrem/unit to the total body and to ≤ 10 mrem/unit to any organ.

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1.4 Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2 MAXIMUM PERMISSIBLE CONCENTRATIONS

2.1 Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site shall be limited to the following:

2.1.1 For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.

2.1.2 For all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days: ≤ 1500 mrem/yr to any organ.

The above limits are provided to insure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits in 10 CFR Part 20, Appendix B, Table 2, Column 1.

2.2 Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

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3 AVERAGE ENERGY

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public. Release rates are calculated using an isotopic mix from actual samples rather than average energy.

4 MEASUREMENTS and APPROXIMATIONS of TOTAL RADIOACTIVITY

4.1 Fission and Activation Gases

Sampled and analyzed on a 4096 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counters.

4.2 Iodines

Sampled on iodine adsorbing media and analyzed on a 4096 channel analyzer and HpGe detector.

4.3 Particulates

Sampled on a glass filter and analyzed on a 4096 channel analyzer and HpGe detector. Sr-89 and Sr-90 analyses are performed by offsite vendor.

4.4 Liquid Effluents

Sampled and analyzed on a 4096 channel analyzer and HpGe detector. Tritium analysis is performed using liquid scintillation counter. Fe-55, Sr-89 and Sr-90 analyses performed by offsite vendor. Ni-63 is also currently being analyzed by the offsite vendor in response to evaluation of the 10 CFR 61 sample results.

2013 Effluent and Waste Disposal Annual Report

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

18 releases in the 1st quarter, 2013

24 releases in the 2nd quarter, 2013

25 releases in the 3rd quarter, 2013

23 releases in the 4th quarter, 2013

5.1.2 Total time period for batch releases:

56,988 minutes

5.1.3 Maximum time for a batch release:

2,466 minutes

5.1.4 Average time period for batch release:

633 minutes

5.1.5 Minimum time period for a batch release:

95 minutes

5.1.6 Average stream flow during periods of release of effluent into a flowing stream:

6.93E+5 gpm circulating water

2013 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

105 releases in the 1st quarter, 2013
109 releases in the 2nd quarter, 2013
123 releases in the 3rd quarter, 2013
65 releases in the 4th quarter, 2013

5.2.2 Total time period for batch releases:

12,517 minutes

5.2.3 Maximum time for a batch release:

358 minutes

5.2.4 Average time period for batch release:

31 minutes

5.2.5 Minimum time period for a batch release:

7 minutes

2013 Effluent and Waste Disposal Annual Report

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.1.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2 Gaseous

6.2.1 Number of Releases:

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

6.2.2 Total activity released (Ci):

<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
0	0	0	0

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
 GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	2.96E+01	2.76E+01	3.03E+01	3.75E+01
XE135m	Ci	-----	-----	-----	1.60E-03
KR85	Ci	-----	-----	-----	5.68E-03
XE131m	Ci	-----	-----	-----	2.43E-03
XE133m	Ci	-----	-----	-----	3.86E-03
XE133	Ci	-----	8.00E-03	-----	1.77E-01
XE135	Ci	-----	-----	-----	1.95E-02
Total for Period	Ci	2.96E+01	2.76E+01	3.03E+01	3.77E+01
2. IODINES					
I131	Ci	-----	1.72E-05	1.29E-06	1.91E-03
I132	Ci	-----	1.84E-10	-----	-----
I133	Ci	-----	-----	-----	2.47E-06
Total for Period	Ci	-----	1.72E-05	1.29E-06	1.91E-03
3. PARTICULATES					
MN54	Ci	-----	-----	-----	-----
CO60	Ci	-----	-----	-----	-----
CS137	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. FISSION GASES					
H3	Ci	8.33E-02	1.85E-02	1.99E-02	4.48E-02
AR41	Ci	5.51E-01	2.04E-01	3.25E-01	2.60E-01
KR85	Ci	8.10E-01	5.00E-02	4.04E-01	5.69E-01
XE131M	Ci	-----	3.95E-04	1.73E-03	3.40E-03
XE133M	Ci	-----	-----	3.09E-04	-----
XE133	Ci	8.27E-02	1.56E-01	2.98E-01	2.37E-01
XE135	Ci	-----	-----	7.01E-05	4.28E-03
Total for Period	Ci	7.98E-01	4.29E-01	1.05E+00	1.12E+00
2. IODINES					
I131	Ci	-----	-----	-----	5.90E-08
I133	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	5.90E-08
3. PARTICULATES					
* BR80	Ci	-----	-----	-----	-----
* BR82	Ci	-----	-----	-----	-----
Total for Period	Ci	-----	-----	-----	-----

* DENOTES SUPPLEMENTAL ISOTOPES

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION GASES						

1. Total Release	Ci	7.14E-01	4.18E-01	1.03E+00	1.28E+00	11.6

2. Average release rate for period	uCi/sec	9.19E-02	5.32E-02	1.30E-01	1.61E-01	

3. Percent of applicable limit*	% Gamma Beta	8.38E-03 1.53E-03	9.83E-03 2.07E-03	3.40E-02 7.78E-03	1.19E-02 2.20E-02	

B. IODINES						

1. Total I-131	Ci	0.00E+00	1.72E-05	1.29E-06	1.91E-03	11.6

2. Average release rate for period	uCi/sec	0.00E+00	2.19E-06	1.62E-07	2.40E-04	

3. Percent of applicable limit*	%	0.00E+00	6.25E-06	4.63E-07	6.84E-04	

C. PARTICULATES						

1. Particulates with half lives > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit*	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

4. Gross alpha radioactivity	Ci	<1.32E-06	<1.34E-06	<1.35E-06	<1.35E-06	

D. TRITIUM						

1. Total Release	Ci	2.96E+01	2.76E+01	3.03E+01	3.76E+01	13.0

2. Average release rate for period	uCi/sec	3.81E+00	3.51E+00	3.81E+00	4.72E+00	

3. Percent of applicable limit*	%	2.17E-02	2.00E-02	2.17E-02	2.69E-02	

* Applicable limits are expressed in terms of dose. See Appendices A1.2-1 through A1.2-4

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	1.17E-02	1.38E-02	1.89E-02	2.53E-02
CS137	Ci	-----	-----	-----	-----

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	9.19E+02	3.32E+02	1.05E+03	2.47E+02
CR51	Ci	-----	1.36E-05	-----	-----
MN54	Ci	-----	3.26E-06	-----	1.42E-06
FE55	Ci	-----	-----	-----	-----
CO58	Ci	1.31E-05	3.35E-04	8.22E-05	2.77E-04
CO60	Ci	8.35E-05	9.90E-05	1.05E-04	9.69E-05
NI63	Ci	-----	-----	-----	-----
*KR85	Ci	-----	-----	1.97E-04	-----
ZR95	Ci	-----	-----	-----	-----
NB95	Ci	-----	1.87E-06	-----	2.37E-06
MO99	Ci	-----	-----	-----	-----
TC99m	Ci	-----	-----	-----	6.61E-07
AG110m	Ci	2.26E-04	9.72E-05	1.83E-05	4.44E-05
*XE131m	Ci	-----	-----	1.86E-04	5.40E-05
SB125	Ci	-----	-----	-----	7.98E-06
CS134	Ci	-----	-----	-----	2.53E-05
CS137	Ci	-----	1.02E-05	9.63E-07	2.82E-05
*XE135	Ci	-----	-----	2.90E-05	-----
I131	Ci	-----	-----	-----	1.21E-04
*XE133	Ci	3.18E-04	4.63E-05	8.24E-03	3.33E-03
*XE133m	Ci	-----	-----	6.19E-05	2.37E-05

* DENOTES SUPPLEMENTAL ISOTOPES

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
BATCH MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	3.23E-04	5.60E-04	2.06E-04	6.05E-04	12.4

2. Average diluted concentration during period	uCi/ml	8.55E-12	2.07E-11	3.29E-12	2.50E-11	

3. Percent of applicable limit	%	1.75E-04	2.82E-04	6.88E-05	9.57E-04	

B. TRITIUM						

1. Total Release	Ci	9.19E+02	3.32E+02	1.05E+03	2.47E+02	10.1

2. Average diluted concentration during period	uCi/ml	2.44E-05	1.23E-05	1.68E-05	1.02E-05	

3. Percent of applicable limit	%	2.44E+00	1.23E+00	1.68E+00	1.02E+00	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	3.18E-04	4.63E-05	8.27E-03	3.33E-03	11.6

2. Average diluted concentration during period	uCi/ml	8.44E-12	1.71E-12	1.32E-10	1.38E-10	

3. Percent of applicable limit	%	4.22E-06	8.57E-07	6.60E-05	6.89E-05	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

	Ci	<1.05E-04	<1.40E-04	<1.46E-04	<1.35E-04	N/A

E. VOLUME OF WASTE RELEASED						

	Liters	1.36E+07	1.23E+07	1.51E+07	2.49E+07	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

	Liters	7.08E+11	1.51E+11	8.97E+11	6.47E+11	3.48

2013 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES
CONTINUOUS MODE

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %

A. FISSION AND ACTIVATION PRODUCTS						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

B. TRITIUM						

1. Total Release	Ci	1.17E-02	1.38E-02	1.89E-02	2.53E-02	22.6

2. Average diluted concentration during period	uCi/ml	1.74E-11	1.11E-10	2.27E-11	4.06E-11	

3. Percent of applicable limit	%	1.74E-04	1.11E-03	2.27E-04	4.06E-04	

C. DISSOLVED AND ENTRAINED GASES						

1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A

2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

3. Percent of applicable limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. GROSS ALPHA RADIOACTIVITY TOTAL RELEASE						

	Ci	0.00E+00	<8.94E-08	0.00E+00	<8.94E-08	N/A

E. VOLUME OF WASTE RELEASED						

	Liters	7.73E+06	1.09E+07	1.36E+07	2.36E+07	2.00

F. VOLUME OF DILUTION WATER USED DURING PERIOD						

	Liters	6.71E+11	1.24E+11	8.34E+11	6.23E+11	3.48

2013 Effluent and Waste Disposal Annual Report Solid Waste and Irradiated Fuel Shipments

Solid Waste Shipped Offsite for Burial or Disposal

1) Type of Waste	Unit	Estimated amount	Estimated Total Error, %
a) Spent resins, filters, sludge, evaporator bottoms, etc.	m ³ Curies	1.68E+01 2.80E+01	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m ³ Curies	5.78E+02 2.81E+00	1.00E+00 6.48E+00
c) Irradiated components, control rods, etc.	m ³ Curies		
d) Other (contaminated soil)	m ³ Curies		

2) Estimate of Principle Radionuclide Composition

a)	H-3	49 %	Co-58	9 %	Sb-125	2 %	Cs-137	1 %
	Mn-54	0.5 %	Co-60	13 %	Cs-134	0.5 %		
	Fe-55	12 %	Ni-63	12 %	Ni-59	1 %		
b)	Ni-59	0.5 %	Co-58	1 %	Sb-125	1 %		
	Mn-54	0.5 %	Co-60	46 %	Zr/Nb-95	1 %		
	Fe-55	36 %	Ni-63	13 %	Cs-137	0.5 %	C-14	0.5 %
d)								

3) Solid Waste Disposition

No. of Shipments	Mode of Transportation	Destination
16	Truck	Memphis, TN
3	Truck	Oak Ridge, TN
4	Truck	Erwin, TN

4) Type of Containers used for Shipment: Containers used are excepted packages, Type A, Sea Land, metal boxes, drums, tankers, and high integrity containers (HICs).

5) Solidification Agent: There were no solidifications performed during this report period.

2013 Effluent and Waste Disposal Annual Report Yearly Release Rates

GASES		
Fission and Activation Gases	Total Release	3.44E+00 Curies
	Average Release Rate	1.09E-01 μ Ci/sec
	% of Applicable Limits*	γ 1.60E-02 % β 8.35E-03 %
Iodines	Total I-131 Release	1.93E-03 Curies
	Average Release Rate	6.06E-05 μ Ci/sec
	% of Applicable Limit*	6.91E-04 %
Particulates	Total Release	0.00 Curies
	Average Release Rate	0.00 μ Ci/sec
	% of Applicable Limit*	0.00 %
LIQUIDS		
Fission and Activation Products	Total Release	1.69E-03 Curies
	Average Diluted Concentration	1.44E-11 μ Ci/ml
	% of Applicable Limits*	Total Body 1.11E+00 % Organ 3.34E-01 %

* Applicable limits are expressed in terms of the annual 10 CFR 50, Appendix I, dose limits.

Site Boundary and Nearest Residence Listing

The following distances were used in the calculation of the maximum individual doses:

<u>Sector</u>	<u>Direction</u>	<u>Boundary (Meters)</u>	<u>Nearest Residence (Meters)</u>
A	N	651	659
B	NNE	617	660
C	NE	789	943
D	ENE	1497	1747
E	E	1274	1716
F	ESE	972	1643
G	SE	629	1640
H	SSE	594	964
J	S	594	997
K	SSW	629	942

Summary of Maximum Individual Doses

First Quarter 2013

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.99E-02	Child	Receptor 1	1.99E+00	1.5E+0
Liquid	GI-tract	2.99E-02	Child	Receptor 1	5.98E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	4.19E-04	Any Age	629 (SE)	8.38E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.53E-04	Any Age	629 (SE)	1.53E-03	1.0E+1
Iodines and Particulates	Total Body	8.56E-03	Child	659 (N)	1.14E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2013

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	9.39E-03	Child	Receptor 1	6.26E-01	1.5E+0
Liquid	Liver	9.42E-03	Child	Receptor 1	1.88E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	4.92E-04	Any Age	651 (N)	9.83E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	2.07E-04	Any Age	651 (N)	2.07E-03	1.0E+1
Iodines and Particulates	Thyroid	1.50E-02	Child	659 (N)	2.00E-01	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2013

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	2.72E-02	Child	Receptor 1	1.82E+00	1.5E+0
Liquid	Liver	2.72E-02	Child	Receptor 1	5.45E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	1.70E-03	Any Age	651 (N)	3.40E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	7.78E-04	Any Age	651 (N)	7.78E-03	1.0E+1
Iodines and Particulates	Total Body	4.53E-02	Child	659 (N)	6.04E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2013

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	8.12E-03	Child	Receptor 1	5.42E-01	1.5E+0
Liquid	Liver	8.30E-03	Child	Receptor 1	1.66E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	5.94E-04	Any Age	594 (SSE)	1.19E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	2.20E-03	Any Age	629 (SSW)	2.20E-02	1.0E+1
Iodines and Particulates	Thyroid	7.51E-02	Child	659 (N)	1.00E+00	7.5E+0

2013 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	MW-22D	MW-22M	MW-22S	MW-24D	MW-24M	MW-24S	MW-25D	MW-25M
01/04/2013				<LLD	<LLD	<LLD		
01/28/2013							<LLD	<LLD
02/15/2013	<LLD	<LLD	<LLD					
02/25/2013				<LLD	<LLD	<LLD	<LLD	<LLD
03/21/2013	<LLD	<LLD	<LLD					
03/28/2013							<LLD	<LLD
03/30/2013				<LLD	<LLD	<LLD		
04/27/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/07/2013	<LLD	<LLD	<LLD					
05/31/2013				<LLD	<LLD	<LLD	<LLD	<LLD
07/09/2013	<LLD	<LLD	<LLD					
10/14/2013	<LLD							
10/15/2013		<LLD	<LLD					
10/24/2013				<LLD	<LLD	<LLD	<LLD	<LLD
11/22/2013							<LLD	<LLD
12/02/2013				<LLD	<LLD	<LLD		
12/03/2013	<LLD	<LLD	<LLD					
12/06/2013							<LLD	<LLD

Date	MW-25S	MW-26D	MW-26M	MW-26S	MW-27D	MW-27M	MW-27S	EW-19
01/07/2013								<LLD
01/28/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
02/25/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
03/28/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/02/2013								<LLD
04/27/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
05/31/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
07/22/2013								<LLD
10/14/2013								<LLD
10/24/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
11/22/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
12/02/2013								<LLD
12/06/2013	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	

(Note: Wells MW-22 through MW 27 are multi-port wells installed in the Fall of 2009, with three sample points placed at different depths. S= Shallow M= Middle D= Deep.)

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2013 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	SG-1	SG-2	SG-4	SG-5	OW-4	MW-20	MW-21	95-11A
01/18/2013					<LLD			
01/25/2013	<LLD	<LLD	<LLD	<LLD				
01/28/2013						<LLD	<LLD	
02/15/2013	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
02/28/2013					<LLD			
03/21/2013	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
03/31/2013					<LLD			
04/28/2013	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
04/30/2013					<LLD			
05/07/2013						<LLD		
05/08/2013	<LLD	<LLD	<LLD	<LLD			<LLD	
07/10/2013	<LLD	<LLD	<LLD	<LLD		<LLD	<LLD	
10/14/2013						<LLD	<LLD	
11/04/2013	<LLD	<LLD	<LLD	<LLD		<LLD		
11/05/2013							<LLD	
12/02/2013	<LLD	<LLD	<LLD	<LLD				
12/03/2013						<LLD	<LLD	
12/17/2013								<LLD

(Note: A “*” symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2013 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-9	W-10	W-11	W-12	W-13	W-14	W-15	OW-1
01/07/2013							<LLD	
01/08/2013					<LLD	<LLD		
01/18/2013								<LLD
01/28/2013		<LLD	<LLD	<LLD	<LLD	<LLD		
01/29/2013	<LLD						<LLD	
02/15/2013				<LLD	<LLD	<LLD		
02/28/2013							<LLD	<LLD
03/21/2013			<LLD	<LLD	<LLD	<LLD		
03/30/2013							<LLD	
03/31/2013								<LLD
04/27/2013					<LLD	<LLD		
04/28/2013		<LLD	<LLD	<LLD			<LLD	
04/30/2013								<LLD
05/07/2013					<LLD	<LLD		
05/08/2013		<LLD	<LLD	<LLD				
05/09/2013	<LLD						<LLD	
07/09/2013			<LLD	<LLD	<LLD	<LLD		
07/22/2013		<LLD					<LLD	
07/23/2013	<LLD							
10/14/2013		<LLD		<LLD	<LLD	<LLD	<LLD	
10/15/2013			<LLD					
11/04/2013		<LLD	<LLD	<LLD		<LLD		
11/05/2013	<LLD				<LLD		<LLD	
12/02/2013			<LLD	<LLD			<LLD	
12/03/2013					<LLD	<LLD		
12/17/2013								<LLD

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2013 GPI Sample Data

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
01/08/2013			<LLD					
01/25/2013			<LLD					
01/28/2013	<LLD						<LLD	
01/29/2013		<LLD						
01/30/2013				<LLD	<LLD	<LLD		<LLD
05/07/2013	<LLD						<LLD	
05/08/2013			<LLD					<LLD
05/09/2013		<LLD						
05/10/2013				<LLD	<LLD	<LLD		
07/23/2013								<LLD
07/24/2013	<LLD							
07/25/2013		<LLD					<LLD	
07/26/2013			<LLD	<LLD	<LLD	<LLD		
10/14/2013			<LLD					
11/04/2013	<LLD		<LLD				<LLD	
11/05/2013		<LLD						
11/07/2013								<LLD
11/08/2013				<LLD	<LLD	<LLD		

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

Samples analyzed for tritium. Values noted are in microcuries per milliliter (uCi/mL)
Lower Limit of Detection = LLD

Date	EW-18	OW-2						
05/10/2013		<LLD						
12/02/2013	<LLD							

(Note: A "*" symbol following a sample result denotes a gamma count was performed. Any gamma results above LLD will be additionally flagged and documented in the analysis section.)

2013 GPI Sample Data

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2013 indicates no groundwater contamination in excess of the reporting threshold of $2.00E-5$ uCi/mL for tritium. Gamma spectroscopy was performed on all Radiological Environmental Monitoring Program wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP's 2013 Annual Radiological Environmental Operating Report. There were no positively identified radionuclides from plant effluents detected in any of the GPI well samples.

The LLD value used for tritium counting of the samples varied between $9.42E-7$ and $9.63E-7$ uCi/mL, depending on which scintillation counter was used. This is well below the required maximum LLD value of $2.00E-6$ uCi/mL per the ODCM.

While no tritium values were found above LLD for 2013, values found above the LLD are not abnormal, unexpected, or inconsistent with past sampling history. The samples observed above LLD historically were expected results from the release of tritiated water into the Absorption Pond, a licensed pathway and part of plant design, or the result of recapture deposition of tritium from licensed radioactive gaseous release points. The 2013 results were expected considering the reduction in tritium released to the Absorption Pond and a reduction in rainfall experienced.

Wells located inside the Protected Area of the plant are subject to recapture deposition of tritium and may show occasional sample results above LLD values following rainfalls and snow melt. The results observed in 2013 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed in 2013. All gamma samples taken in support of the GPI were less than detectable.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2013 impacting groundwater. The sample results indicate proper well placement to ensure the protection of the groundwater and early identification of any abnormal conditions involving groundwater. This is validated by the demonstrated ability to monitor percolation from the Absorption Pond and recaptured tritium in precipitation, with flow direction and behavior acting as described in the plant licensing documents.

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	1	2	0	0	3
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	1	0	0	0	0	1
SE	0	1	0	0	0	0	1
SSE	0	1	1	0	0	0	2
S	0	0	1	3	0	0	4
SSW	0	0	0	0	0	0	0
SW	0	0	0	4	4	0	8
WSW	0	0	2	0	0	0	2
W	0	0	2	4	0	3	9
WNW	0	0	0	2	0	0	2
NW	0	0	0	9	0	0	9
NNW	0	0	0	1	0	0	1
Total	0	3	7	25	4	3	42
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							42
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	0	0	1	0	0	0	1
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	1	5	0	0	0	6
ESE	0	3	1	0	0	0	4
SE	0	1	0	0	0	0	1
SSE	0	1	0	0	0	0	1
S	0	0	1	1	0	0	2
SSW	0	0	0	0	0	0	0
SW	0	0	1	6	0	0	7
WSW	0	0	0	1	0	0	1
W	0	0	1	3	0	1	5
WNW	0	1	1	8	2	0	12
NW	0	0	1	1	0	0	2
NNW	0	0	0	2	1	0	3
Total	0	7	12	22	3	1	45
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							45
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C **Delta Temperature** **Slightly Unstable**

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	0	0	0	2	0	0	2
NNE	0	1	3	0	0	0	4
NE	0	2	0	0	0	0	2
ENE	0	1	1	1	0	0	3
E	0	1	3	0	0	0	4
ESE	0	4	0	1	0	0	5
SE	0	0	1	0	0	0	1
SSE	1	1	3	0	0	0	5
S	0	1	1	4	0	1	7
SSW	0	0	0	1	0	0	1
SW	0	0	0	2	3	0	5
WSW	0	1	1	3	3	0	8
W	0	0	2	7	3	3	15
WNW	0	0	2	2	8	0	12
NW	0	2	3	4	1	0	10
NNW	0	3	1	0	0	0	4
Total	1	17	21	27	18	4	88
Calm Hours not Included above for :							1
Valid Hours for this Stability Class for:							88
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	0	9	20	0	0	30
NNE	0	4	8	1	0	0	13
NE	0	5	7	0	0	0	12
ENE	2	12	2	1	0	1	18
E	0	7	5	5	3	0	20
ESE	1	3	11	6	4	0	25
SE	0	8	12	9	0	0	29
SSE	1	8	10	2	2	0	23
S	0	1	16	6	2	2	27
SSW	2	1	19	14	2	1	39
SW	1	2	12	29	5	0	49
WSW	0	0	13	21	18	6	58
W	1	1	13	39	36	13	103
WNW	1	2	19	48	52	11	133
NW	0	1	9	45	21	6	82
NNW	1	1	11	16	4	0	33
Total	11	56	176	262	149	40	694
Calm Hours not Included above for :							Total Period 1
Valid Hours for this Stability Class for:							Total Period 694
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	8	7	3	0	0	19
NNE	2	2	1	0	0	0	5
NE	0	5	4	1	0	0	10
ENE	0	2	9	8	1	2	22
E	0	4	2	0	1	1	8
ESE	0	2	3	2	0	0	7
SE	0	4	9	4	3	0	20
SSE	0	1	10	5	4	1	21
S	1	1	12	13	7	0	34
SSW	0	1	7	5	7	0	20
SW	0	3	6	4	9	1	23
WSW	0	0	3	0	0	1	4
W	1	2	6	0	3	1	13
WNW	0	1	9	9	1	0	20
NW	0	3	4	4	1	0	12
NNW	0	2	2	2	0	0	6
Total	5	41	94	60	37	7	244
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class F **Delta Temperature** **Moderately Stable**

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	2	0	1	0	0	3
NNE	0	2	0	0	0	0	2
NE	0	1	0	0	0	0	1
ENE	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	1	1	0	0	3
SE	1	1	1	1	0	0	4
SSE	0	1	1	1	0	0	3
S	0	2	1	1	0	0	4
SSW	0	0	1	2	0	0	3
SW	0	0	1	0	1	0	2
WSW	0	1	0	0	1	0	2
W	0	1	0	0	0	1	2
WNW	0	1	1	0	0	0	2
NW	0	0	1	0	0	0	1
NNW	0	1	0	0	0	0	1
Total	1	15	8	7	2	1	34
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 01/01/2013 - 03/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>	
N	0	1	0	0	0	0	1	
NNE	0	1	0	0	0	0	1	
NE	1	0	0	0	0	0	1	
ENE	1	3	0	0	0	0	4	
E	1	2	0	0	0	0	3	
ESE	0	0	0	0	0	0	0	
SE	0	1	6	0	0	0	7	
SSE	0	2	6	0	0	0	8	
S	1	1	1	0	0	0	3	
SSW	0	1	0	0	0	0	1	
SW	0	0	0	0	0	0	0	
WSW	0	0	1	0	0	0	1	
W	0	1	1	0	0	0	2	
WNW	0	0	0	0	0	0	0	
NW	0	0	3	0	0	0	3	
NNW	0	0	0	0	0	0	0	
Total	4	13	18	0	0	0	35	
Calm Hours not Included above for :							Total Period	1
Valid Hours for this Stability Class for:							Total Period	35
Total Hours for Period								2160

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

01/01/2013 - 03/31/2013

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind.Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>> 25</u>	<u>Total</u>
N	2	11	18	28	0	0	59
NNE	2	10	12	1	0	0	25
NE	1	13	11	1	0	0	26
ENE	3	19	12	10	1	3	48
E	1	15	15	5	4	1	41
ESE	1	14	16	10	4	0	45
SE	1	16	29	14	3	0	63
SSE	2	15	31	8	6	1	63
S	2	6	33	28	9	3	81
SSW	2	3	27	22	9	1	64
SW	1	5	20	45	22	1	94
WSW	0	2	20	25	22	7	76
W	2	5	25	53	42	22	149
WNW	1	5	32	69	63	11	181
NW	0	6	21	63	23	6	119
NNW	1	7	14	21	5	0	48
Total	22	152	336	403	213	56	1182

Calm Hours not Included above for :

Total Period 1

Variable Direction Hours for:

Total Period 0

Invalid Hours for:

Total Period 977

Valid Hours for this Stability Class for:

Total Period 1182

Total Hours for Period

2160

Hours are not adjusted to Daylight Savings Time

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	14	21	7	0	45
NNE	0	1	1	0	0	0	2
NE	1	6	5	0	0	0	12
ENE	3	4	5	1	0	0	13
E	0	4	7	3	0	0	14
ESE	1	3	6	3	0	0	13
SE	2	5	7	2	0	0	16
SSE	0	6	11	1	0	0	18
S	1	1	10	24	1	0	37
SSW	0	0	2	0	0	0	2
SW	0	5	13	8	1	0	27
WSW	0	6	16	3	0	0	25
W	2	13	12	0	0	0	27
WNW	0	14	7	1	0	0	22
NW	0	14	19	7	2	0	42
NNW	0	19	54	12	1	0	86
Total	10	104	189	86	12	0	401
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 401
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	4	0	0	0	5
NNE	0	0	1	0	0	0	1
NE	0	0	2	0	0	0	2
ENE	0	0	0	0	0	0	0
E	0	1	1	0	0	0	2
ESE	0	0	4	1	0	0	5
SE	0	1	1	1	0	0	3
SSE	0	1	2	1	0	0	4
S	1	1	2	8	0	0	12
SSW	0	1	4	2	0	0	7
SW	0	1	6	1	0	0	8
WSW	0	1	0	2	0	0	3
W	0	2	1	0	0	0	3
WNW	1	1	0	0	0	0	2
NW	0	1	0	0	0	0	1
NNW	0	1	4	3	2	0	10
Total	2	13	32	19	2	0	68
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	2	5	0	2	0	10
NNE	0	2	1	0	0	0	3
NE	0	1	1	0	0	0	2
ENE	1	3	3	0	0	0	7
E	0	1	3	0	0	0	4
ESE	0	0	2	0	0	0	2
SE	1	2	3	0	0	0	6
SSE	0	0	0	0	0	0	0
S	0	1	2	7	2	0	12
SSW	0	1	4	3	0	0	8
SW	0	1	1	2	0	0	4
WSW	0	1	2	0	0	0	3
W	0	4	0	1	0	0	5
WNW	0	1	0	1	0	0	2
NW	0	3	3	0	1	0	7
NNW	0	4	3	2	0	0	9
Total	3	27	33	16	5	0	84
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 84
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>>25</u>	<u>Total</u>
N	1	5	10	8	2	0	26
NNE	0	1	4	1	0	0	6
NE	0	1	4	2	0	0	7
ENE	2	0	2	3	2	0	9
E	0	1	5	1	7	2	16
ESE	0	1	6	3	0	0	10
SE	0	1	10	0	0	0	11
SSE	1	3	6	9	0	0	19
S	2	1	14	22	3	0	42
SSW	0	3	7	5	0	0	15
SW	2	3	7	10	2	4	28
WSW	0	6	4	5	1	1	17
W	2	6	5	2	2	0	17
WNW	1	3	2	0	2	0	8
NW	3	4	1	7	6	0	21
NNW	0	5	8	4	1	2	20
Total	14	44	95	82	28	9	272
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	0	4	15	1	1	0	21
NNE	0	3	15	0	0	0	18
NE	1	4	10	0	0	0	15
ENE	0	3	11	1	0	0	15
E	0	6	11	5	5	1	28
ESE	0	5	13	12	1	0	31
SE	1	1	6	2	0	0	10
SSE	1	1	16	19	2	0	39
S	0	1	15	14	2	0	32
SSW	1	2	12	4	1	0	20
SW	0	5	7	3	5	0	20
WSW	0	2	6	2	1	0	11
W	0	3	4	1	1	0	9
WNW	1	1	0	0	0	0	2
NW	1	5	6	4	1	0	17
NNW	1	5	6	2	0	0	14
Total	7	51	153	70	20	1	302
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							302
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>>25</u>	<u>Total</u>
N	0	3	1	1	0	0	5
NNE	0	4	4	0	0	0	8
NE	0	2	10	1	0	0	13
ENE	0	7	9	2	0	0	18
E	0	2	11	3	0	0	16
ESE	1	3	12	1	0	0	17
SE	1	2	6	0	0	0	9
SSE	1	1	6	5	1	0	14
S	0	1	3	4	0	0	8
SSW	0	3	1	0	0	0	4
SW	2	1	1	0	0	0	4
WSW	0	1	3	0	0	0	4
W	0	0	3	0	0	0	3
WNW	1	2	0	0	0	0	3
NW	0	1	1	0	0	0	2
NNW	1	3	0	0	0	0	4
Total	7	36	71	17	1	0	132
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							132
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 04/01/2013 - 06/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥ 25</u>	<u>Total</u>
N	1	1	2	1	0	0	5
NNE	1	6	6	1	0	0	14
NE	1	6	1	0	0	0	8
ENE	2	3	10	2	0	0	17
E	0	8	10	5	0	0	23
ESE	3	3	8	1	0	0	15
SE	2	3	7	1	0	0	13
SSE	1	6	7	2	0	0	16
S	5	3	4	0	0	0	12
SSW	1	1	4	1	0	0	7
SW	2	4	4	0	0	0	10
WSW	0	4	1	0	0	0	5
W	0	0	1	0	0	0	1
WNW	4	1	1	0	0	0	6
NW	0	4	1	0	0	0	5
NNW	2	1	0	0	0	0	3
Total	25	54	67	14	0	0	160
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							160
Total Hours for Period							2184

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

04/01/2013 - 06/30/2013

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	3	19	51	32	12	0	117
NNE	1	17	32	2	0	0	52
NE	3	20	33	3	0	0	59
ENE	8	20	40	9	2	0	79
E	0	23	48	17	12	3	103
ESE	5	15	51	21	1	0	93
SE	7	15	40	6	0	0	68
SSE	4	18	48	37	3	0	110
S	9	9	50	79	8	0	155
SSW	2	11	34	15	1	0	63
SW	6	20	39	24	8	4	101
WSW	0	21	32	12	2	1	68
W	4	28	26	4	3	0	65
WNW	8	23	10	2	2	0	45
NW	4	32	31	18	10	0	95
NNW	4	38	75	23	4	2	146
Total	68	329	640	304	68	10	1419

Calm Hours not Included above for :

Total Period

0

Variable Direction Hours for:

Total Period

0

Invalid Hours for:

Total Period

765

Valid Hours for this Stability Class for:

Total Period

1419

Total Hours for Period

2184

Hours are not adjusted for Daylight Savings Time

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	1	2	19	19	3	0	44
NNE	0	3	1	2	1	0	7
NE	2	10	10	4	0	0	26
ENE	2	7	9	0	0	0	18
E	2	5	7	0	0	0	14
ESE	0	14	9	0	0	0	23
SE	0	21	15	0	0	0	36
SSE	0	6	24	3	0	0	33
S	0	12	12	6	0	0	30
SSW	0	2	2	0	0	0	4
SW	0	15	37	19	1	0	72
WSW	0	18	27	8	1	0	54
W	1	26	17	7	0	0	51
WNW	3	35	18	0	0	0	56
NW	1	13	7	6	0	0	27
NNW	0	14	96	38	4	0	152
Total	12	203	310	112	10	0	647
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period.							0 647 2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	1	3	1	1	0	6
NNE	0	0	2	0	0	0	2
NE	0	0	2	1	0	0	3
ENE	0	0	1	0	0	0	1
E	0	2	0	0	0	0	2
ESE	1	2	1	0	0	0	4
SE	0	0	2	0	0	0	2
SSE	0	2	3	0	0	0	5
S	0	2	7	2	0	0	11
SSW	0	2	0	0	0	0	2
SW	0	3	6	1	0	0	10
WSW	1	3	1	1	0	0	6
W	2	1	0	0	0	0	3
WNW	1	1	3	1	0	0	6
NW	0	0	1	1	0	0	2
NNW	0	3	2	1	0	0	6
Total	5	22	34	9	1	0	71
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							71
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>>25</u>	<u>Total</u>
N	0	3	8	3	0	0	14
NNE	1	0	0	0	0	0	1
NE	0	2	1	0	0	0	3
ENE	0	1	1	0	0	0	2
E	0	1	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	1	1	1	1	0	0	4
SSE	0	4	2	0	0	0	6
S	0	0	5	0	0	0	5
SSW	0	7	1	0	0	0	8
SW	1	2	4	3	0	0	10
WSW	0	2	1	0	0	0	3
W	1	0	1	0	1	0	3
WNW	0	3	0	1	0	0	4
NW	0	2	1	1	0	0	4
NNW	0	1	4	0	0	0	5
Total	4	29	30	9	1	0	73
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							73
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>>25</u>	<u>Total</u>	
N	1	16	17	8	5	0	47	
NNE	1	3	11	4	0	0	19	
NE	1	6	17	3	0	0	27	
ENE	0	4	10	0	0	0	14	
E	0	3	4	1	0	0	8	
ESE	1	2	7	1	0	0	11	
SE	0	4	9	0	0	0	13	
SSE	0	6	10	5	2	0	23	
S	1	8	17	6	0	0	32	
SSW	3	1	17	6	0	0	27	
SW	2	8	7	39	4	0	60	
WSW	0	5	7	5	1	0	18	
W	1	2	6	12	2	0	23	
WNW	2	0	4	12	1	0	19	
NW	1	1	6	9	0	0	17	
NNW	1	9	7	1	0	0	18	
Total	15	78	156	112	15	0	376	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	376
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>≥ 25</u>	<u>Total</u>
N	1	9	18	3	0	0	31
NNE	0	10	13	2	0	0	25
NE	2	2	20	6	0	0	30
ENE	1	8	9	1	0	0	19
E	2	2	4	0	0	0	8
ESE	1	1	17	0	0	0	19
SE	1	4	20	3	0	0	28
SSE	3	6	10	5	0	0	24
S	1	12	34	9	1	0	57
SSW	0	2	14	8	0	0	24
SW	0	2	12	21	1	0	36
WSW	1	2	14	0	0	0	17
W	1	5	3	0	0	0	9
WNW	2	2	4	1	0	0	9
NW	3	1	1	1	0	0	6
NNW	3	6	5	1	1	0	16
Total	22	74	198	61	3	0	358
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							358
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record =

07/01/2013 - 09/30/2013

Elevation: Speed: SPD60M

Direction: DIR60M Lapse: DT60M

Stability Class F

Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥25</u>	<u>Total</u>
N	0	3	6	2	0	0	11
NNE	0	8	9	0	0	0	17
NE	0	10	14	4	0	0	28
ENE	0	6	13	0	0	0	19
E	0	3	10	1	0	0	14
ESE	2	4	14	2	0	0	22
SE	0	3	9	3	0	0	15
SSE	1	5	11	4	0	0	21
S	1	4	18	5	0	0	28
SSW	1	2	7	1	0	0	11
SW	1	3	5	0	0	0	9
WSW	0	2	5	0	0	0	7
W	0	0	1	0	0	0	1
WNW	1	3	0	0	0	0	4
NW	2	0	0	0	0	0	2
NNW	1	2	1	0	0	0	4
Total	10	58	123	22	0	0	213
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							213
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 07/01/2013 - 09/30/2013
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G **Delta Temperature** **Extremely Stable**

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>> 25</u>	<u>Total</u>
N	1	4	1	0	0	0	6
NNE	0	8	5	1	0	0	14
NE	0	10	18	1	0	0	29
ENE	0	12	16	0	0	0	28
E	0	6	25	7	0	0	38
ESE	1	7	27	4	0	0	39
SE	3	7	20	10	0	0	40
SSE	3	10	24	11	0	0	48
S	1	7	10	6	0	0	24
SSW	4	3	12	2	0	0	21
SW	2	3	10	2	0	0	17
WSW	1	2	0	0	0	0	3
W	4	2	0	0	0	0	6
WNW	2	3	0	0	0	0	5
NW	1	3	0	0	0	0	4
NNW	0	6	4	0	0	0	10
Total	23	93	172	44	0	0	332
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							332
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 07/01/2013 - 09/30/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥25</u>	<u>Total</u>
N	4	38	72	36	9	0	159
NNE	2	32	41	9	1	0	85
NE	5	40	82	19	0	0	146
ENE	3	38	59	1	0	0	101
E	4	22	50	9	0	0	85
ESE	6	30	75	7	0	0	118
SE	5	40	76	17	0	0	138
SSE	7	39	84	28	2	0	160
S	4	45	103	34	1	0	187
SSW	8	19	53	17	0	0	97
SW	6	36	81	85	6	0	214
WSW	3	34	55	14	2	0	108
W	10	36	28	19	3	0	96
WNW	11	47	29	15	1	0	103
NW	8	20	16	18	0	0	62
NNW	5	41	119	41	5	0	211
Total	91	557	1023	369	30	0	2070
Calm Hours not Included above for :							Total Period 0
Variable Direction Hours for:							Total Period 0
Invalid Hours for:							Total Period 138
Valid Hours for this Stability Class for:							Total Period 2070
Total Hours for Period							2208

Hours are not adjusted for Daylight Savings Time

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class A **Delta Temperature** **Extremely Unstable**

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥25</u>	<u>Total</u>
N	0	1	0	2	2	0	5
NNE	0	0	2	0	0	0	2
NE	0	1	6	0	0	0	7
ENE	0	7	3	3	0	0	13
E	0	4	7	8	0	0	19
ESE	0	0	5	0	0	0	5
SE	0	9	21	9	0	0	39
SSE	1	11	18	10	2	0	42
S	0	7	16	18	2	1	44
SSW	0	1	3	6	0	0	10
SW	0	5	9	14	6	0	34
WSW	1	4	12	20	10	1	48
W	0	1	16	19	9	1	46
WNW	0	3	5	14	1	0	23
NW	0	2	6	13	4	0	25
NNW	0	6	9	3	5	0	23
Total	2	62	138	139	41	3	385
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							385
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	3	1	0	0	0	4
NNE	0	2	0	0	0	0	2
NE	0	3	5	2	0	0	10
ENE	0	0	0	0	0	0	0
E	0	0	1	8	0	0	9
ESE	0	0	3	3	0	0	6
SE	0	4	6	7	0	0	17
SSE	0	4	5	5	1	0	15
S	0	4	9	11	3	1	28
SSW	0	2	13	6	3	1	25
SW	0	5	5	2	0	0	12
WSW	0	0	3	9	9	2	23
W	0	1	6	11	8	1	27
WNW	0	1	1	7	3	0	12
NW	0	0	5	6	7	1	19
NNW	0	1	1	6	9	0	17
Total	0	30	64	83	43	6	226
Calm Hours not Included above for :							Total Period
Valid Hours for this Stability Class for:							Total Period
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>	
N	0	1	1	0	0	0	2	
NNE	0	1	2	1	0	0	4	
NE	0	3	6	0	0	0	9	
ENE	0	3	2	1	0	0	6	
E	0	0	5	3	0	0	8	
ESE	0	1	2	4	0	0	7	
SE	0	6	5	4	0	0	15	
SSE	0	3	5	7	3	1	19	
S	0	2	17	6	2	0	27	
SSW	0	1	16	9	0	0	26	
SW	0	0	5	4	2	0	11	
WSW	0	1	3	21	7	1	33	
W	1	1	4	27	12	1	46	
WNW	0	0	8	15	2	1	26	
NW	0	0	14	18	5	1	38	
NNW	1	1	4	4	10	2	22	
Total	2	24	99	124	43	7	299	
Calm Hours not Included above for :							Total Period	0
Valid Hours for this Stability Class for:							Total Period	299
Total Hours for Period								2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class D Delta Temperature Neutral

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	1	4	3	0	0	0	8
NNE	1	3	5	0	0	0	9
NE	0	1	11	3	0	0	15
ENE	0	6	4	3	0	0	13
E	1	1	6	2	0	0	10
ESE	1	1	6	6	0	0	14
SE	2	3	28	12	0	0	45
SSE	0	3	24	33	8	1	69
S	0	10	45	33	12	2	102
SSW	0	4	29	54	8	0	95
SW	1	2	14	34	13	1	65
WSW	0	1	12	49	15	6	83
W	0	3	8	43	20	15	89
WNW	0	5	13	65	19	6	108
NW	2	2	16	40	26	1	87
NNW	0	3	10	15	10	0	38
Total	9	52	234	392	131	32	850
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							850
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1 - 4</u>	<u>4 - 8</u>	<u>8 - 13</u>	<u>13 - 19</u>	<u>19 - 25</u>	<u>> 25</u>	<u>Total</u>
N	0	2	0	1	0	0	3
NNE	0	5	2	1	0	0	8
NE	0	1	5	0	0	0	6
ENE	0	0	4	1	0	0	5
E	0	5	3	5	0	0	13
ESE	2	2	13	3	0	0	20
SE	0	8	23	6	0	0	37
SSE	0	1	13	8	0	0	22
S	0	0	26	20	2	0	48
SSW	0	2	24	29	0	0	55
SW	1	1	6	4	2	0	14
WSW	0	1	4	2	1	0	8
W	0	2	6	6	0	0	14
WNW	0	1	3	4	0	0	8
NW	0	0	4	5	0	0	9
NNW	1	2	3	1	0	0	7
Total	4	33	139	96	5	0	277
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							277
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
 Elevation: Speed: SPD60M Direction: DIR60M Lapse: DT60M
 Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>> 25</u>	<u>Total</u>
N	0	0	2	0	0	0	2
NNE	0	1	1	0	0	0	2
NE	0	0	1	0	0	0	1
ENE	0	1	2	0	0	0	3
E	1	0	3	0	0	0	4
ESE	0	1	7	0	0	0	8
SE	0	0	13	14	0	0	27
SSE	0	1	8	6	0	0	15
S	0	0	3	4	0	0	7
SSW	0	0	6	2	0	0	8
SW	0	0	2	2	0	0	4
WSW	0	1	0	0	0	0	1
W	0	1	0	0	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	0	2	0	0	0	2
NNW	0	0	2	0	0	0	2
Total	1	6	52	28	0	0	87
Calm Hours not Included above for :							Total Period 0
Valid Hours for this Stability Class for:							Total Period 87
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/01/2013 - 12/31/2013
Elevation: Speed: SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class G **Delta Temperature** **Extremely Stable**

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥ 25</u>	<u>Total</u>
N	0	0	1	0	0	0	1
NNE	0	0	3	0	0	0	3
NE	0	2	3	0	0	0	5
ENE	0	0	5	2	0	0	7
E	0	1	2	2	0	0	5
ESE	1	3	6	0	0	0	10
SE	0	1	13	10	0	0	24
SSE	0	0	5	6	0	0	11
S	0	1	0	0	0	0	1
SSW	1	1	1	0	0	0	3
SW	0	2	4	0	0	0	6
WSW	0	0	5	0	0	0	5
W	0	1	1	0	0	0	2
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	1	0	0	0	0	1
Total	2	13	49	20	0	0	84
Calm Hours not Included above for :							0
Valid Hours for this Stability Class for:							84
Total Hours for Period							2208

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record =

10/01/2013 - 12/31/2013

Elevation: Speed: SPD60M

Direction: DIR60M

Lapse: DT60M

Delta Temperature

Wind Speed (mph)

<u>Wind Direction</u>	<u>1-4</u>	<u>4-8</u>	<u>8-13</u>	<u>13-19</u>	<u>19-25</u>	<u>≥ 25</u>	<u>Total</u>	
N	1	11	8	3	2	0	25	
NNE	1	12	15	2	0	0	30	
NE	0	11	37	5	0	0	53	
ENE	0	17	20	10	0	0	47	
E	2	11	27	28	0	0	68	
ESE	4	8	42	16	0	0	70	
SE	2	31	109	62	0	0	204	
SSE	1	23	78	75	14	2	193	
S	0	24	116	92	21	4	257	
SSW	1	11	92	106	11	1	222	
SW	2	15	45	60	23	1	146	
WSW	1	8	39	101	42	10	201	
W	1	10	41	106	49	18	225	
WNW	0	10	30	105	25	7	177	
NW	2	4	47	82	42	3	180	
NNW	2	14	29	29	34	2	110	
Total	20	220	775	882	263	48	2208	
Calm Hours not Included above for :							Total Period	0
Variable Direction Hours for:							Total Period	0
Invalid Hours for:							Total Period	0
Valid Hours for this Stability Class for:							Total Period	2208
Total Hours for Period								2208

Hours are not adjusted for Daylight Savings Time

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was not revised during this reporting period.