INDIANA MICHIGAN POWER

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

Donald C. Cook Nuclear Plant Units 1 and 2
2019 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 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, 2019, through December 31, 2019.

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

Sincerely,

M.K. Scarpello

Michael K. Scarpello
Regulatory Affairs Director

SJM/mll

Enclosure: Donald C. Cook Nuclear Plant Units 1 and 2 - 2019 Annual Radioactive Effluent Release Report

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ENCLOSURE to AEP-NRC-2020-35

DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2
2019 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 2019. 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, 2019, to December 31, 2019. 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 2019.

Parameter	Unit 1	Unit 2
Gross Electrical Energy Generation (Megawatt Hour (MWH))	7,594,318	9,075,948
Unit Service Factor (Percent (%))	82.3	85.9
Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%)	81.4	86.2

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. The unit performed a normal downpower and was manually tripped on March 6, 2019, entering refueling outage U1C29. The unit attained criticality on May 8, 2019, and returned to NFP on May 20, 2019. The unit exited the reporting period at NFP.

Unit 2 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 rapid downpower and was manually tripped on July 21, 2019, to perform repairs on NESW Strainers. The unit attained criticality on July 24, 2019, and attained NFP on July 26, 2019. The unit performed a normal downpower and was manually tripped on October 2, 2019, entering refueling outage U2C25. The unit attained criticality on November 18, 2019, and attained NFP on November 22, 2019. 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 2019. 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 2019 there were 131 liquid batch releases performed. The number of liquid batch releases for the 1st, 2nd, 3rd, and 4th quarters in 2019 were 35, 35, 26, and 35, 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 2019 there was one batch release from Gas Decay Tanks (GDT), one containment purge, one system tank vent, one header piping vent, and 61 Containment Pressure Reliefs (CPR). During the second quarter there were five batch releases from GDTs and 58 CPR. During the third quarter there were two batch releases from GDTs, and 101 CPR. During the fourth quarter there were no batch releases from GDTs, one system tank vent, one containment purge, 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 eight GDT releases, two containment purge, two system tank vents, one header vent, and 347 CPR gaseous batch releases made during 2019.

In calculating the dose consequences for continuous and batch gaseous releases during 2019, 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 25 shipments of radioactive waste made during 2019. 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 2019. 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.

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 2019 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 2019 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	1.82E-02	2.75E-02	4.30E-02	3.96E-02
Total Body Air	1.90E-04	2.00E-04	7.30E-04	2.10E-04
Skin	3.00E-04	3.20E-04	1.20E-03	3.30E-04
Liquid TB	4.07E-02	1.38E-02	1.87E-02	1.18E-02
Liquid Organ	4.07E-02	1.38E-02	1.87E-02	1.21E-02
Direct Radiation	0	0	0	0
Quarterly Dose Total	1.00E-01	5.56E-02	8.23E-02	6.40E-02
Sum of Quarter Doses				3.02E-01
C14 (Annual) Dose				2.07E+00
Grand Total Dose (Total Body or any other Organ) mrem				2.37E+00
Annual Dose Limit (mrem)				25
Percent of limit				9.49E+00

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2019 annual dose data, and 2019 annual dose data with C-14 added. This indicates that 2019 annual dose was 'typical' for a dual 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
2019	3.02E-01	1.21
2019 with C-14	2.37E+00	9.49

VI. RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS

The Radiation Monitor System (RMS) has undergone an extensive replacement project to upgrade and modernize the equipment to support the expected operational lives of the two Cook Plant units. Steam Generator Blowdown Monitor R-19 (1-DRA-300/1-DRA-353) entered 2019 being out of service, being removed from service as part of the planned Radiation Monitor System (RMS) Replacement Project on October 15, 2018. It was returned to service on September 11, 2019. The appropriate compensatory sampling actions were taken throughout the year as releases on this pathway continued. The monitor was being upgraded and modernized, and this inoperable time period > 30days was planned for/ expected due to having to install all the hardware, wiring backbone, network, and displays. The RMS replacement project did significant work in 2019, with the table below providing the details on when work was started (starting the 30 day clock) and when it was returned to service. All were greater than 30 days and all had appropriate compensatory sampling actions or surveys performed throughout the duration. All effluent releases complied with ODCM requirements. The list includes some area radiation monitors which are not involved with effluent pathways, but are included for completeness. Additionally, work continued into 2020 and those affected monitors are also listed since that work was completed prior to this writing on April 14, 2020 and also concludes the RMS Replacement Project. Specifics for the 2020 work will be included in that year's annual report. There were no other release pathways with inoperable monitors for greater than 30 days.

1-WRA-713	East Essential Service Water Header Effluent	S: 1/15/19	F: 9/11/19
1-WRA-717	West Essential Service Water Header Effluent	S: 1/15/19	F: 9/11/19
12-RRC-330	Spent Fuel Pit Area	S: 12/18/18	F: 9/11/19
1-CRA-415	East Component Cooling Loop	S: 3/14/19	F: 9/11/19
1-CRA-425	West Component Cooling Loop	S: 3/12/19	F: 9/11/19
12-ERA-7000	Nuclear Sampling Room Area	S: 12/3/18	F: 9/19/19
1-ERA- 7300	Aux Building Equipment Room	S: 1/28/19	F: 9/19/19
1-ERS-7400	Control Room, Instrument Room, and Aux building Area	S: 3/12/19	F: 9/19/19
12-ERA-7500	Aux Building Elevation 573' and 587' Area	S: 1/2/19	F: 9/19/19
12-RRS-1000	Waste Disposal Liquid Effluent	S: 7/8/19	F: 11/7/19
1-MRA-1600	SG 1 and 4 PORVs	S: 7/8/19	F: 11/21/19
1-MRA-1700	SG 2 and 3 PORVs	S: 7/8/19	F: 11/21/19
1-VRS-1200	Upper Containment Area	S: 7/8/19	F: 11/21/19
1-ERS-1400	Lower Containment Area	S: 7/8/19	F: 11/21/19
2-DRA-300	SG Blow-down Pre-treatment Effluent	S: 6/11/19	F: 12/4/19
2-DRA-353	SG Blow-down Post-treatment Effluent	S: 6/11/19	F: 12/4/19
2-CRA-415	East Component Cooling Loop	S: 6/11/19	F: 12/4/19
1-VRS-1500	Unit Vent Effluent	S: 8/19/19	F: 1/17/20
1-SRA-1800	Gland Steam Leak off Vent	S: 8/19/19	F: 12/18/19
1- SRA-1900	Steam Jet Air Ejector Vent	S: 9/30/19	F: 12/18/19
12-ERA-7600	Aux Building Elevation 633' and 650' Area	S: 8/19/19	F: 12/18/19
2-WRA-714	East Essential Service Water Header Effluent	S: 6/11/19	F: 1/23/20
2-WRA-718	West Essential Service Water Header Effluent	S: 6/11/19	F: 1/23/20
2-CRA-425	West Component Cooling Loop	S: 6/11/19	F: 1/23/20
1-VRS-1100	Upper Containment Area	S: 12/3/19	F: 4/7/20
1-ERS-1300	Lower Containment Area	S: 12/3/19	F: 4/7/20
2-VRS-2200	Upper Containment Area	S: 11/25/19	F: 2/7/20
2-ERS-2400	Lower Containment Area	S: 11/25/19	F: 2/7/20
2-ERA-8300	Aux Building Equipment Room	S: 10/8/19	F: 2/13/20
2-ERS-8400	Control Room, Instrument Room, and Aux Building Area	S: 12/2/19	F: 2/13/20
2-VRS-2500	Unit Vent Effluent	S: 2/11/20	F: 4/14/20
2-SRA-2800	Gland Steam Leak off Vent	S: 2/20/20	F: 4/14/20
2- SRA-2900	Steam Jet Air Ejector Vent	S: 2/20/20	F: 4/14/20
2-MRA-2700	SG 2 and 3 PORVs	S: 1/23/20	F: 4/14/20
2-VRS-2100	Upper Containment Area	S: 2/20/20	F: 4/14/20
2-MRA-2600	SG 1 and 4 PORVs	S: 1/21/20	F: 4/14/20
2-ERS-2300	Lower Containment Area	S: 2/12/20	F: 4/14/20

VII. NOTEWORTHY CONDITIONS IDENTIFIED IN 2019

The RMS Replacement Project initiated physical plant alterations in preparation of upgrading and modernizing the plant's ability to monitor radioactive effluents. The first effluent monitor to be physically removed and replaced was R-19, the steam generator blowdown effluent monitor. This major project will enhance reliability and capabilities while maintaining all regulatory requirements per our License and Technical

Specifications. The Offsite Dose Calculation Manual revisions will be expected to occur in 2020 reflecting the completion of the project.

The usage of compensatory actions and sampling during the time periods for which a pathway's monitor is out of service does create some conservatism in the calculations for dose to ensure compliance with all regulations. This may take the form of using maximum design flow rates when a flow instrument is out of service, for example. Another example would be the inability to utilize fans during containment pressure reliefs, resulting in longer times of release to lower the observed pressure as well as more actual relief activities since pressure drops are limited. These conservative assumptions increase the calculated dose, and can be observed in the reporting this year. The increases are relatively small when compared to Carbon-14 dose, which was not affected. It is anticipated that the 2020 results will return to the expected range for our units and scheduled work activities.

Carbon-14 Supplemental Information for the 2019 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 2019 results in a site total of 17.9 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 2.50 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 pathway. A 'p' factor of 0.33 is determined utilizing the time of batch gaseous releases performed during 2019 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 1.725 mrem to the bone and a whole body dose of 0.343 mrem, for a combined total C-14 dose of 2.07 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 ($\leq$75 mrem for thyroid).

This is planned to be the last year where this detailed C-14 section will be added to the report, since 10 years have now passed with the doses expected to be observed from power plants now incorporating C-14 created dose as the new "normal". These 10 years have demonstrated that the dose as compared to pre-2010 has remained consistent or improved when not accounting for C-14 dose. The C-14 dose is now the major contributor, and will consistently be about 8-10 times higher than the pre-2010 calculations. This dose will only change with online power generation, so it will not alter significantly unless the plant is shutdown for an extended period.

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 documents attached for 2019.

2019 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.

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} μCi/ml total activity.

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.

5 BATCH RELEASES

5.1 Liquid

5.1.1 Number of batch releases:

35 releases in the 1st quarter, 2019
35 releases in the 2nd quarter, 2019
26 releases in the 3rd quarter, 2019
35 releases in the 4th quarter, 2019

5.1.2 Total time period for batch releases:

52,892 minutes

5.1.3 Maximum time for a batch release:

1,698 minutes

5.1.4 Average time period for batch release:

404 minutes

5.1.5 Minimum time period for a batch release:

104 minutes

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

6.45E+5 gpm circulating water

5.2 Gaseous

5.2.1 Number of batch releases:

65 releases in the 1st quarter, 2019
63 releases in the 2nd quarter, 2019
103 releases in the 3rd quarter, 2019
129 releases in the 4th quarter, 2019

5.2.2 Total time period for batch releases:

25,120 minutes

5.2.3 Maximum time for a batch release:

354 minutes

5.2.4 Average time period for batch release:

69.8 minutes

5.2.5 Minimum time period for a batch release:

5 minutes

6 ABNORMAL RELEASES

6.1 Liquid

6.1.1 Number of Releases:

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	0	0	0

6.1.2 Total activity released (Ci):

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	0	0	0

6.2 Gaseous

6.2.1 Number of Releases:

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	0	0	0

6.2.2 Total activity released (Ci):

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	0	0	0

2019 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	2.47E+01	2.20E+01	2.12E+01	3.84E+01
AR41	Ci	--------	--------	--------	--------
KR85	Ci	--------	--------	--------	--------
XE133	Ci	--------	--------	--------	4.74E-02
XE135	Ci	--------	--------	--------	--------
XE131m	Ci	--------	--------	--------	--------
XE133m	Ci	--------	--------	--------	--------
XE135m	Ci	--------	--------	--------	--------
Total for Period	Ci	2.47E+01	2.20E+01	2.12E+01	3.84E+01
2. IODINES					
I131	Ci	--------	--------	--------	5.07E-06
I132	Ci	--------	--------	--------	--------
I133	Ci	--------	--------	--------	--------
Total for Period	Ci	--------	--------	--------	5.07E-06
3. PARTICULATES					
MN54	Ci	--------	--------	--------	--------
CO60	Ci	--------	--------	--------	--------
CS137	Ci	--------	--------	--------	--------
Total for Period	Ci	--------	--------	--------	--------

* DENOTES SUPPLEMENTAL ISOTOPES

2019 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	1.19E-01	4.00E-02	9.80E-02	1.43E-01
AR41	Ci	2.38E-01	1.50E-01	2.62E-01	1.55E-01
KR85	Ci	3.75E-02	9.16E-02	3.99E-02	--------
XE131M	Ci	--------	--------	--------	--------
XE133M	Ci	--------	--------	--------	--------
XE133	Ci	4.68E-02	3.97E-02	1.74E-01	3.89E-02
XE135m	Ci	--------	--------	--------	--------
XE135	Ci	1.37E-03	1.46E-03	3.44E-03	1.50E-03
Total for Period	Ci	4.43E-01	3.23E-01	5.77E-01	3.38E-01
2. IODINES					
I131	Ci	--------	--------	--------	--------
I133	Ci	--------	--------	--------	--------
Total for Period	Ci	--------	--------	--------	--------
3. PARTICULATES					
CS137	Ci	--------	--------	--------	--------
CO60	Ci	--------	--------	--------	--------
Total for Period	Ci	--------	--------	--------	--------

* DENOTES SUPPLEMENTAL ISOTOPES

2019 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	3.24E-01	2.83E-01	4.77E-01	2.25E-01	11.8
2.	Average release rate for period	uCi/sec	4.16E-02	3.60E-02	6.00E-02	2.84E-02	
3.	Percent of applicable limit*	% Gamma	4.53E-03	7.10E-03	1.27E-02	3.43E-03	
		Beta	8.55E-04	1.94E-03	6.85E-03	6.60E-04	
B.	IODINES						
1.	Total I-131	Ci	0.00E+00	0.00E+00	0.00E+00	5.07E-06	17.1
2.	Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	6.38E-07	
3.	Percent of applicable limit*	%	0.00E+00	0.00E+00	0.00E+00	1.82E-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	<1.03E-06	<8.16E-07	<9.05E-07	<8.96E-07	
D.	TRITIUM						
1.	Total Release	Ci	2.48E+01	2.21E+01	2.13E+01	3.86E+01	17.4
2.	Average release rate for period	uCi/sec	3.19E+00	2.81E+00	2.67E+00	4.85E+00	
3.	Percent of applicable limit*	%	1.82E-02	1.60E-02	1.52E-02	2.76E-02	

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

2019 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS
CONTINUOUS MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	2.51E-02	--------	--------	--------
CS137	Ci	--------	--------	--------	--------

BATCH MODE

Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
H3	Ci	1.18E+03	5.04E+02	6.92E+02	3.14E+02
CR51	Ci	--------	--------	--------	--------
MN54	Ci	--------	--------	--------	--------
FE55	Ci	--------	--------	--------	--------
CO58	Ci	6.51E-05	9.32E-05	2.79E-05	1.14E-04
CO60	Ci	5.77E-05	1.38E-05	2.09E-05	4.32E-05
NI63	Ci	--------	--------	--------	--------
*KR85	Ci	--------	--------	--------	--------
ZR95	Ci	--------	--------	--------	--------
NB95	Ci	--------	--------	--------	--------
MO99	Ci	--------	3.27E-05	5.15E-06	--------
TC99m	Ci	2.71E-06	3.08E-05	7.93E-06	2.75E-06
AG110m	Ci	2.45E-06	--------	1.79E-05	5.62E-07
SB124	Ci	--------	1.49E-05	--------	4.67E-05
SB125	Ci	--------	4.34E-05	1.51E-05	1.78E-04
CS134	Ci	--------	--------	--------	4.69E-06
CS137	Ci	3.20E-06	6.06E-07	--------	8.21E-05
I131	Ci	--------	--------	--------	--------
*XE133	Ci	2.35E-04	6.96E-05	4.23E-04	1.01E-04
*XE133m	Ci	--------	--------	7.03E-06	--------
*XE135	Ci	--------	3.21E-06	2.42E-05	--------

* DENOTES SUPPLEMENTAL ISOTOPES

2019 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	1.31E-04	2.70E-04	1.04E-04	4.72E-04	13.0
2.	Average diluted concentration during period	uCi/ml	2.11E-12	5.82E-12	5.63E-12	2.99E-11	
3.	Percent of applicable limit	%	4.19E-05	3.42E-05	6.63E-05	7.60E-04	
B.	TRITIUM						
1.	Total Release	Ci	1.18E+03	5.04E+02	6.92E+02	3.14E+02	10.1
2.	Average diluted concentration during period	uCi/ml	1.89E-05	1.08E-05	3.73E-05	1.99E-05	
3.	Percent of applicable limit	%	1.89E+00	1.08E+00	3.73E+00	1.99E+00	
C.	DISSOLVED AND ENTRAINED GASES						
1.	Total Release	Ci	2.35E-04	7.28E-05	4.48E-04	1.01E-04	12.0
2.	Average diluted concentration during period	uCi/ml	3.77E-12	1.57E-12	2.41E-11	6.39E-12	
3.	Percent of applicable limit	%	1.89E-06	7.83E-07	1.21E-05	3.20E-06	
D.	GROSS ALPHA RADIOACTIVITY TOTAL RELEASE	Ci	<1.97E-04	<1.95E-04	<1.40E-04	<2.01E-04	N/A
E.	VOLUME OF WASTE RELEASED	Liters	2.12E+06	2.10E+06	1.51E+06	2.17E+06	2.00
F.	VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	5.95E+10	4.66E+10	1.86E+10	1.58E+10	3.48

2019 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	2.51E-02	0.00E+00	0.00E+00	0.00E+00	36.5
2.	Average diluted concentration during period	uCi/ml	6.50E-11	0.00E+00	0.00E+00	0.00E+00	
3.	Percent of applicable limit	%	6.50E-06	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	0.00E+00	N/A
E.	VOLUME OF WASTE RELEASED	Liters	1.72E+07	0.00E+00	0.00E+00	0.00E+00	2.00
F.	VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	3.86E+11	0.00E+00	0.00E+00	0.00E+00	3.48

2019 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	9.15E+00 1.13E+01	1.00E+00 3.75E+00
b) Dry compressible waste, contaminated equipment, etc.	m^3 Curies	8.52E+02 1.67E+01	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	34 %	Co-58	7%	Sb-125	1 %	Cs-137	1 %
	Mn-54	2 %	Co-60	18 %	Nb/Zr-95	6 %		
	Fe-55	15 %	Ni-63	10 %	C-14	6 %		
b)	Ni-59	1 %	Co-58	11 %	Sb-125	2 %		
	Mn-54	3 %	Co-60	28 %	Zr/Nb-95	10 %		
	Fe-55	24 %	Ni-63	9 %	Cs-137	2 %	C-14	10 %

3) Solid Waste Disposition		
No. of Shipments	Mode of Transportation	Destination
22	Truck	Oak Ridge, TN
3	Truck	Andrews, TX

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.

2019 Effluent and Waste Disposal Annual Report Yearly Release Rates

GASES		
Fission and Activation Gases	Total Release	1.31E+00 Curies
	Average Release Rate	4.02E-02 µCi/sec
	% of Applicable Limits*	γ 2.50E-02 % β 9.40E-03 %
Iodines	Total I-131 Release	0.00 Curies
	Average Release Rate	0.00 µCi/sec
	% of Applicable Limit*	0.00 %
Particulates	Total Release	0.00 Curies
	Average Release Rate	0.00 µCi/sec
	% of Applicable Limit*	0.00 %
LIQUIDS		
Fission and Activation Products	Total Release	9.80E-04 Curies
	Average Diluted Concentration	2.00E-12 µCi/ml
	% of Applicable Limits*	Total Body 1.42E+00 % Organ 4.28E-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:

Sector	Direction	Boundary (Meters)	Nearest Residence (Meters)
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 2019

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	4.07E-02	Child	Receptor 1	1.36E+00	1.5E+0
Liquid	Liver	4.07E-02	Child	Receptor 1	4.07E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	4.53E-04	Any Age	629 (SE)	4.53E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.71E-04	Any Age	629 (SE)	8.55E-04	1.0E+1
Iodines and Particulates	Total Body	1.82E-02	Child	659 (N)	1.21E-01	7.5E+0

Summary of Maximum Individual Doses

Second Quarter 2019

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.38E-02	Child	Receptor 1	4.59E-01	1.5E+0
Liquid	Liver	1.38E-02	Child	Receptor 1	1.38E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	7.10E-04	Any Age	594 (S)	7.10E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	3.88E-04	Any Age	629 (SSW)	1.94E-03	1.0E+1
Iodines and Particulates	Total Body	2.75E-02	Child	659 (N)	1.84E-01	7.5E+0

Summary of Maximum Individual Doses

Third Quarter 2019

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.87E-02	Child	Receptor 1	6.20E-01	1.5E+0
Liquid	GI-LLI	1.87E-02	Child	Receptor 1	1.87E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	1.27E-03	Any Age	651 (N)	1.27E-02	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.37E-03	Any Age	594 (S)	6.85E-03	1.0E+1
Iodines and Particulates	Total Body	4.30E-02	Child	659 (N)	2.87E-01	7.5E+0

Summary of Maximum Individual Doses

Fourth Quarter 2019

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (mrem)	AGE GROUP	LOCATION DIST DIR (M) (Toward)	% OF APPLICABLE LIMIT	LIMIT (mrem) QTR
Liquid	Total Body	1.18E-02	Child	Receptor 1	3.94E-01	1.5E+0
Liquid	GI_LLI	1.21E-02	Child	Receptor 1	1.21E-01	5.0E+0
Noble Gas	Air Dose (Gamma-mrad)	3.43E-04	Any Age	651 (N)	3.43E-03	5.0E+0
Noble Gas	Air dose (Beta-mrad)	1.32E-04	Any Age	651 (N)	6.60E-04	1.0E+1
Iodines and Particulates	Total Body	3.96E-02	Child	660 (NNE)	2.64E-01	7.5E+0

2019 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
02/28/2019							<LLD	<LLD
03/18/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
04/26/2019							<LLD	<LLD
05/17/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD		
08/28/2019	<LLD	<LLD	<LLD	<LLD	<LLD *	<LLD	<LLD	<LLD
11/19/2019	<LLD	<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.)

2019 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	
02/28/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/26/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
08/28/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
11/19/2019	<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.)

2019 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
01/08/2019	<LLD	<LLD	<LLD					<LLD
01/09/2019							<LLD	
01/15/2019				<LLD	<LLD	<LLD		
04/03/2019	<LLD	<LLD	<LLD					<LLD
04/08/2019				<LLD	<LLD	<LLD	<LLD	
06/12/2019				<LLD				
07/16/2019		<LLD	<LLD				<LLD	
07/17/2019								<LLD
07/25/2019				<LLD	<LLD	<LLD		
10/08/2019							<LLD	
10/09/2019		<LLD	<LLD					
11/04/2019	<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.)

2019 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	95-11A		
01/15/2019		<LLD						
02/28/2019	<LLD	<LLD	<LLD	1.20e-6	<LLD			
03/27/2019				1.34e-6 *	<LLD			
03/31/2019	2.66e-6	<LLD	<LLD					
04/06/2019	<LLD *							
04/08/2019		<LLD						
04/27/2019			<LLD	1.05e-6	<LLD			
05/16/2019	<LLD		<LLD	1.08e-6	<LLD			
06/28/2019			<LLD	1.08e-6	<LLD *			
07/25/2019		<LLD *						
08/23/2019	<LLD	<LLD		<LLD	<LLD			
09/17/2019	<LLD	<LLD	<LLD	1.02e-6	<LLD			
11/01/2019	<LLD		<LLD	1.25e-6	<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.)

2019 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
01/07/2019					<LLD			
01/09/2019						<LLD	<LLD	
01/15/2019	<LLD	<LLD	<LLD	<LLD				
04/01/2019					<LLD			
04/04/2019						<LLD	<LLD	
04/08/2019	<LLD	<LLD	<LLD	<LLD				
07/09/2019					<LLD			
07/16/2019						<LLD	<LLD	
07/17/2019	<LLD	<LLD	<LLD	<LLD				
10/07/2019					<LLD			
10/08/2019						<LLD		
10/09/2019	<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.)

2019 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	
01/08/2019	<LLD							
01/09/2019		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
04/03/2019	<LLD							
04/04/2019		<LLD	<LLD	<LLD				
04/08/2019					<LLD	<LLD	<LLD	
07/16/2019	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
10/08/2019					<LLD	<LLD		
10/09/2019	<LLD	<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.)

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2019 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 2019 Annual Radiological Environmental Operating Report. There were no positively identified gamma radionuclides from plant effluents detected in any of the GPI well samples, and one well with trace levels of tritium just above detection limits.

The LLD value used for tritium counting of the samples varied between 9.45E-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 2019, 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 2019 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 2019 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed. Wells OW-1 and MW-28 lie close to the vent stacks in the predominant wind directions, 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 2019 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.

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

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	0	2	4	3	6	0	15
NNE	0	0	1	0	0	0	1
NE	0	0	0	1	0	0	1
ENE	0	2	3	1	0	0	6
E	0	2	0	0	0	0	2
ESE	0	1	0	0	0	0	1
SE	0	0	1	0	0	0	1
SSE	0	0	3	0	0	0	3
S	0	0	1	3	0	0	4
SSW	0	0	0	2	0	0	2
SW	0	0	0	2	0	0	2
WSW	0	0	4	7	0	0	11
W	0	3	4	4	0	0	11
WNW	0	7	5	9	0	0	21
NW	0	2	6	3	0	0	11
NNW	0	8	13	4	1	0	26
Total	0	27	45	39	7	0	118

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 118

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

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	5	0	2	0	9
NNE	0	0	0	0	0	0	0
NE	0	0	1	1	0	0	2
ENE	0	0	0	1	0	0	1
E	0	3	3	0	0	0	6
ESE	0	2	1	1	2	0	6
SE	0	1	3	0	0	0	4
SSE	0	0	1	0	0	0	1
S	0	1	1	1	0	0	3
SSW	0	0	1	0	0	0	1
SW	0	1	2	3	0	0	6
WSW	0	0	1	2	0	0	3
W	1	1	1	4	1	0	8
WNW	0	2	3	3	1	0	9
NW	0	2	1	1	0	0	4
NNW	0	2	7	0	0	0	9
Total	1	17	31	17	6	0	72

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 72

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	0	2	3	2	2	0	9
NNE	0	2	6	0	0	0	8
NE	0	2	1	0	0	0	3
ENE	2	2	0	1	0	0	5
E	0	4	10	0	0	0	14
ESE	0	0	1	0	0	1	2
SE	0	2	2	1	0	0	5
SSE	0	2	2	0	0	0	4
S	0	0	2	0	0	0	2
SSW	0	1	1	2	0	0	4
SW	0	1	7	5	0	0	13
WSW	0	4	5	5	0	0	14
W	0	2	1	10	5	0	18
WNW	0	2	1	5	2	0	10
NW	0	1	0	1	0	0	2
NNW	0	3	2	4	0	0	9
Total	2	30	44	36	9	1	122

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 122

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019
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	2	34	32	22	7	4	101
NNE	1	13	15	6	1	0	36
NE	2	16	12	16	2	0	48
ENE	2	14	28	16	2	0	62
E	1	19	36	29	3	0	88
ESE	6	24	43	40	10	6	129
SE	9	18	19	25	20	1	92
SSE	2	8	19	11	7	2	49
S	2	7	29	26	1	0	65
SSW	2	7	16	15	2	0	42
SW	3	7	20	21	18	1	70
WSW	1	20	12	30	51	25	139
W	4	23	7	31	41	34	140
WNW	2	4	17	54	32	6	115
NW	3	9	26	34	19	2	93
NNW	2	19	34	27	10	0	92
Total	44	242	365	403	226	81	1361

Calm Hours not Included above for : **Total Period** 0
Valid Hours for this Stability Class for: **Total Period** 1361
Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

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	1	4	7	1	0	0	13
NNE	0	7	7	2	0	0	16
NE	0	9	11	4	0	0	24
ENE	1	7	11	1	0	0	20
E	0	3	5	2	0	0	10
ESE	0	1	7	5	0	0	13
SE	3	2	2	9	1	0	17
SSE	2	4	13	14	7	0	40
S	0	1	14	45	3	0	63
SSW	2	4	12	15	0	0	33
SW	1	1	5	11	2	1	21
WSW	1	1	6	7	1	3	19
W	0	2	4	12	3	0	21
WNW	0	0	0	6	2	0	8
NW	2	1	0	2	0	0	5
NNW	0	3	0	1	0	0	4
Total	13	50	104	137	19	4	327

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 327

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

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	5	1	0	0	0	6
NNE	0	4	2	0	0	0	6
NE	0	2	5	0	0	0	7
ENE	0	1	9	0	0	0	10
E	0	1	3	2	0	0	6
ESE	0	0	9	2	0	0	11
SE	1	1	7	0	0	0	9
SSE	0	1	1	1	0	0	3
S	0	1	5	4	0	0	10
SSW	0	0	3	3	0	0	6
SW	0	0	3	1	0	0	4
WSW	0	2	0	0	0	0	2
W	0	2	3	0	0	0	5
WNW	0	3	4	0	0	0	7
NW	0	4	1	0	0	0	5
NNW	0	1	0	0	0	0	1
Total	1	28	56	13	0	0	98

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 98

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2019 - 3/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	0	0	0	0	0	0	0
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	0	1	0	0	0	1
E	0	0	2	2	0	0	4
ESE	0	4	0	0	0	0	4
SE	0	2	2	0	0	0	4
SSE	0	0	3	3	0	0	6
S	0	1	2	5	0	0	8
SSW	0	2	3	0	0	0	5
SW	0	1	1	0	0	0	2
WSW	0	3	0	0	0	0	3
W	1	4	1	0	0	0	6
WNW	1	6	2	0	0	0	9
NW	1	0	2	0	0	0	3
NNW	0	0	0	0	0	0	0
Total	3	25	19	10	0	0	57

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 57

Total Hours for Period 2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 1/1/2019 - 3/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	3	49	52	28	17	4	153
NNE	1	27	31	8	1	0	68
NE	2	30	30	22	2	0	86
ENE	5	26	52	20	2	0	105
E	1	32	59	35	3	0	130
ESE	6	32	61	48	12	7	166
SE	13	26	36	35	21	1	132
SSE	4	15	42	29	14	2	106
S	2	11	54	84	4	0	155
SSW	4	14	36	37	2	0	93
SW	4	11	38	43	20	2	118
WSW	2	30	28	51	52	28	191
W	6	37	21	61	50	34	209
WNW	3	24	32	77	37	6	179
NW	6	19	36	41	19	2	123
NNW	2	36	56	36	11	0	141
Total	64	419	664	655	267	86	2155

Calm Hours not Included above for :	**Total Period**	0
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	5
Valid Hours for this Stability Class for:	**Total Period**	2155
Total Hours for Period		2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019
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	4	10	34	15	3	0	66
NNE	1	4	5	2	0	0	12
NE	2	2	3	2	1	0	10
ENE	2	6	5	3	0	0	16
E	0	6	1	0	0	0	7
ESE	1	7	2	1	3	4	18
SE	1	3	7	4	0	0	15
SSE	0	0	8	10	1	0	19
S	0	0	1	4	2	0	7
SSW	0	0	1	1	0	0	2
SW	1	0	4	1	2	0	8
WSW	1	4	7	3	3	0	18
W	2	8	15	3	0	0	28
WNW	1	13	19	0	0	0	33
NW	3	15	22	8	4	0	52
NNW	1	19	43	14	3	2	82
Total	20	97	177	71	22	6	393

Calm Hours not Included above for : **Total Period** 1
Valid Hours for this Stability Class for: **Total Period** 393
Total Hours for Period 2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019
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	7	6	8	3	0	24
NNE	0	1	2	1	0	0	4
NE	1	4	0	0	0	0	5
ENE	0	1	2	0	0	0	3
E	0	1	1	0	0	0	2
ESE	0	1	1	0	2	1	5
SE	0	1	1	3	0	0	5
SSE	0	1	1	2	1	0	5
S	0	0	0	2	0	0	2
SSW	0	0	1	3	1	0	5
SW	1	0	3	5	0	0	9
WSW	0	4	5	4	0	0	13
W	1	6	4	2	0	0	13
WNW	0	7	3	2	0	0	12
NW	0	5	3	0	0	0	8
NNW	1	5	6	3	1	1	17
Total	4	44	39	35	8	2	132

Calm Hours not Included above for :	**Total Period**	1
Valid Hours for this Stability Class for:	**Total Period**	132
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019
Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	3	11	5	1	0	20
NNE	0	1	0	1	0	0	2
NE	0	1	2	0	0	0	3
ENE	2	3	2	2	0	0	9
E	0	6	5	3	0	0	14
ESE	0	3	5	1	0	1	10
SE	0	1	3	2	0	0	6
SSE	0	1	1	2	0	0	4
S	0	1	1	4	1	0	7
SSW	0	1	2	2	0	0	5
SW	0	0	3	3	0	0	6
WSW	0	5	8	3	1	1	18
W	0	5	2	1	0	0	8
WNW	0	4	1	0	1	0	6
NW	1	4	1	2	0	0	8
NNW	0	13	4	0	0	1	18
Total	3	52	51	31	4	3	144

Calm Hours not Included above for :	**Total Period**	1
Valid Hours for this Stability Class for:	**Total Period**	144
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019
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	4	29	18	15	5	1	72
NNE	2	10	10	5	3	0	30
NE	2	9	13	3	0	0	27
ENE	4	8	7	11	0	0	30
E	2	2	19	23	11	3	60
ESE	2	10	14	29	26	2	83
SE	7	6	17	9	5	0	44
SSE	1	7	5	8	1	0	22
S	2	4	7	10	0	0	23
SSW	1	5	24	16	4	0	50
SW	2	4	16	31	3	0	56
WSW	1	19	10	14	5	0	49
W	2	9	8	7	4	0	30
WNW	4	6	3	6	0	0	19
NW	4	16	8	6	0	0	34
NNW	1	17	12	9	6	2	47
Total	41	161	191	202	73	8	676

Calm Hours not Included above for :	**Total Period**	1
Valid Hours for this Stability Class for:	**Total Period**	676
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019

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	1	13	20	3	0	0	37
NNE	1	12	6	10	1	0	30
NE	1	4	10	2	0	0	17
ENE	0	2	10	2	0	0	14
E	1	1	16	8	0	0	26
ESE	0	7	10	10	1	0	28
SE	2	4	10	5	1	0	22
SSE	0	3	11	17	1	0	32
S	0	0	27	18	3	0	48
SSW	0	2	22	17	0	0	41
SW	0	4	10	20	3	0	37
WSW	0	0	15	24	3	0	42
W	1	5	9	13	8	0	36
WNW	1	5	4	2	1	0	13
NW	3	4	1	2	1	0	11
NNW	2	12	5	3	3	0	25
Total	13	78	186	156	26	0	459

Calm Hours not Included above for :	**Total Period**	1
Valid Hours for this Stability Class for:	**Total Period**	459
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019
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	2	6	3	0	0	0	11
NNE	1	9	1	0	0	0	11
NE	0	5	4	0	0	0	9
ENE	0	3	12	0	0	0	15
E	0	3	14	2	0	0	19
ESE	2	2	4	3	0	0	11
SE	0	3	9	1	0	0	13
SSE	1	5	9	5	0	0	20
S	0	1	10	6	0	0	17
SSW	0	2	7	4	0	0	13
SW	1	0	8	2	0	0	11
WSW	1	1	5	0	0	0	7
W	0	4	4	0	0	0	8
WNW	1	4	1	0	0	0	6
NW	0	1	0	0	0	0	1
NNW	0	1	0	0	0	0	1
Total	9	50	91	23	0	0	173

Calm Hours not Included above for :	**Total Period**	1
Valid Hours for this Stability Class for:	**Total Period**	173
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 4/1/2019 - 6/30/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	2	1	2	0	0	0	5
NNE	5	6	1	0	0	0	12
NE	1	7	7	0	0	0	15
ENE	2	5	12	1	0	0	20
E	2	4	10	1	0	0	17
ESE	1	9	7	1	0	0	18
SE	3	6	10	0	0	0	19
SSE	2	4	7	7	0	0	20
S	1	2	9	2	0	0	14
SSW	0	2	3	2	0	0	7
SW	1	2	11	2	0	0	16
WSW	0	4	6	0	0	0	10
W	1	6	1	0	0	0	8
WNW	0	3	0	0	0	0	3
NW	0	2	1	0	0	0	3
NNW	1	3	1	0	0	0	5
Total	22	66	88	16	0	0	192

Calm Hours not Included above for : **Total Period** 1

Valid Hours for this Stability Class for: **Total Period** 192

Total Hours for Period 2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 4/1/2019 - 6/30/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	13	69	94	46	12	1	235
NNE	10	43	25	19	4	0	101
NE	7	32	39	7	1	0	86
ENE	10	28	50	19	0	0	107
E	5	23	66	37	11	3	145
ESE	6	39	43	45	32	8	173
SE	13	24	57	24	6	0	124
SSE	4	21	42	51	4	0	122
S	3	8	55	46	6	0	118
SSW	1	12	60	45	5	0	123
SW	6	10	55	64	8	0	143
WSW	3	37	56	48	12	1	157
W	7	43	43	26	12	0	131
WNW	7	42	31	10	2	0	92
NW	11	47	36	18	5	0	117
NNW	6	70	71	29	13	6	195
Total	112	548	823	534	133	19	2169

Calm Hours not Included above for :	**Total Period**	1
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	14
Valid Hours for this Stability Class for:	**Total Period**	2169
Total Hours for Period		2184

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019

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	0	6	42	33	0	0	81
NNE	0	1	2	0	0	0	3
NE	0	3	0	1	0	0	4
ENE	1	1	3	0	0	0	5
E	0	4	7	3	0	0	14
ESE	0	6	7	4	0	0	17
SE	0	8	8	0	0	0	16
SSE	0	2	7	0	1	0	10
S	0	1	1	2	0	0	4
SSW	0	0	3	0	0	0	3
SW	0	1	5	9	0	0	15
WSW	0	4	32	3	0	0	39
W	0	14	12	0	0	0	26
WNW	0	19	14	5	0	0	38
NW	0	21	13	2	0	0	36
NNW	0	19	46	12	0	0	77
Total	1	110	202	74	1	0	388

Calm Hours not Included above for :	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	388
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019

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	4	2	0	0	9
NNE	0	0	1	1	0	0	2
NE	1	1	0	0	0	0	2
ENE	1	0	2	0	0	0	3
E	1	6	2	0	0	0	9
ESE	0	2	1	0	0	0	3
SE	0	2	2	0	0	0	4
SSE	0	1	3	0	0	0	4
S	1	1	3	0	0	0	5
SSW	0	0	3	1	0	0	4
SW	0	4	4	7	0	0	15
WSW	1	3	17	2	0	0	23
W	0	5	7	1	0	0	13
WNW	0	6	3	0	0	0	9
NW	0	3	2	0	0	0	5
NNW	1	2	2	0	0	0	5
Total	6	39	56	14	0	0	115

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 115

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	1	3	2	1	0	0	7
NNE	0	1	1	0	0	0	2
NE	0	1	0	0	0	0	1
ENE	0	1	1	0	0	0	2
E	0	3	3	0	0	0	6
ESE	0	0	0	0	0	0	0
SE	0	3	3	2	0	0	8
SSE	0	3	1	0	0	0	4
S	1	1	4	4	1	0	11
SSW	1	0	5	0	0	0	6
SW	3	2	9	2	0	0	16
WSW	0	10	5	1	0	0	16
W	1	3	4	0	0	0	8
WNW	0	5	0	0	0	0	5
NW	0	4	1	0	0	0	5
NNW	0	4	1	1	0	0	6
Total	7	44	40	11	1	0	103

Calm Hours not Included above for :	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	103
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019
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	14	23	12	0	0	50
NNE	0	4	6	1	0	0	11
NE	0	5	2	0	0	0	7
ENE	0	6	7	0	0	0	13
E	0	5	9	5	0	0	19
ESE	3	5	20	9	0	0	37
SE	1	5	15	9	0	0	30
SSE	1	5	5	8	1	0	20
S	4	9	17	7	0	0	37
SSW	0	5	26	8	2	0	41
SW	4	9	23	39	4	0	79
WSW	1	8	17	6	2	0	34
W	2	5	9	6	0	0	22
WNW	3	7	7	2	1	0	20
NW	3	8	7	6	0	0	24
NNW	0	12	5	6	3	0	26
Total	23	112	198	124	13	0	470

Calm Hours not Included above for :	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	470
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019
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	1	10	13	6	0	0	30
NNE	2	10	22	1	0	0	35
NE	2	15	11	1	0	0	29
ENE	0	11	11	1	0	0	23
E	0	7	23	0	0	0	30
ESE	2	2	16	5	0	0	25
SE	2	4	9	5	0	0	20
SSE	2	3	10	12	0	0	27
S	0	6	29	18	4	1	58
SSW	1	7	47	19	0	0	74
SW	0	14	27	16	3	0	60
WSW	1	3	13	7	1	0	25
W	1	1	12	18	0	0	32
WNW	1	2	13	5	2	0	23
NW	3	6	7	18	0	0	34
NNW	2	7	1	2	0	0	12
Total	20	108	264	134	10	1	537

Calm Hours not Included above for :	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	537
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019

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	1	8	12	0	0	0	21
NNE	0	9	11	2	0	0	22
NE	0	10	12	0	0	0	22
ENE	0	8	9	0	0	0	17
E	1	1	9	0	0	0	11
ESE	1	4	12	0	0	0	17
SE	3	2	18	2	0	0	25
SSE	1	3	8	4	0	0	16
S	0	7	20	6	0	0	33
SSW	1	2	20	4	0	0	27
SW	0	7	12	0	0	0	19
WSW	2	1	4	0	0	0	7
W	0	0	1	0	0	0	1
WNW	0	2	0	0	0	0	2
NW	4	5	1	0	0	0	10
NNW	0	5	4	0	0	0	9
Total	14	74	153	18	0	0	259

Calm Hours not Included above for : **Total Period** 0

Valid Hours for this Stability Class for: **Total Period** 259

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 7/1/2019 - 9/30/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	0	7	4	0	0	0	11
NNE	3	2	11	0	0	0	16
NE	3	4	7	0	0	0	14
ENE	0	5	19	2	0	0	26
E	3	9	34	1	0	0	47
ESE	2	7	26	0	0	0	35
SE	2	8	14	0	0	0	24
SSE	0	8	21	5	0	0	34
S	1	9	20	2	0	0	32
SSW	0	4	12	0	0	0	16
SW	2	10	13	0	0	0	25
WSW	1	12	2	0	0	0	15
W	1	11	5	0	0	0	17
WNW	2	7	2	0	0	0	11
NW	1	5	0	0	0	0	6
NNW	0	1	1	0	0	0	2
Total	21	109	191	10	0	0	331

Calm Hours not Included above for :	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	331
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 7/1/2019 - 9/30/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	4	51	100	54	0	0	209
NNE	5	27	54	5	0	0	91
NE	6	39	32	2	0	0	79
ENE	2	32	52	3	0	0	89
E	5	35	87	9	0	0	136
ESE	8	26	82	18	0	0	134
SE	8	32	69	18	0	0	127
SSE	4	25	55	29	2	0	115
S	7	34	94	39	5	1	180
SSW	3	18	116	32	2	0	171
SW	9	47	93	73	7	0	229
WSW	6	41	90	19	3	0	159
W	5	39	50	25	0	0	119
WNW	6	48	39	12	3	0	108
NW	11	52	31	26	0	0	120
NNW	3	50	60	21	3	0	137
Total	92	596	1104	385	25	1	2203

Calm Hours not Included above for :	**Total Period**	0
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	5
Valid Hours for this Stability Class for:	**Total Period**	2203
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019
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	0	0	5	4	0	0	9
NNE	0	0	0	0	0	0	0
NE	0	0	2	0	0	0	2
ENE	0	0	0	0	0	0	0
E	0	0	1	0	0	0	1
ESE	0	0	3	0	0	0	3
SE	0	2	9	1	0	0	12
SSE	0	0	2	0	0	0	2
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	3	0	0	3
WSW	0	0	3	0	1	0	4
W	0	0	3	6	0	0	9
WNW	0	1	5	1	0	0	7
NW	0	1	5	2	0	0	8
NNW	0	2	1	1	0	0	4
Total	0	6	39	18	1	0	64

Calm Hours not Included above for : **Total Period** 2
Valid Hours for this Stability Class for: **Total Period** 64
Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019

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	1	0	1	0	0	2
NNE	0	0	0	1	0	0	1
NE	0	0	2	1	0	0	3
ENE	0	0	1	0	0	0	1
E	0	0	1	0	0	0	1
ESE	0	0	4	0	0	0	4
SE	0	3	1	0	0	0	4
SSE	0	0	9	4	0	0	13
S	0	0	2	0	0	0	2
SSW	0	0	1	2	1	0	4
SW	0	0	2	5	0	0	7
WSW	0	0	3	3	2	0	8
W	0	2	4	3	0	0	9
WNW	0	1	1	0	1	0	3
NW	0	2	1	2	0	0	5
NNW	0	3	3	5	0	0	11
Total	0	12	35	27	4	0	78

Calm Hours not Included above for : **Total Period** 2

Valid Hours for this Stability Class for: **Total Period** 78

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	0	1	2	2	0	0	5
NNE	0	1	0	0	0	0	1
NE	0	2	7	0	0	0	9
ENE	0	1	0	0	0	0	1
E	0	1	0	0	0	0	1
ESE	0	2	2	0	0	0	4
SE	0	1	4	0	0	0	5
SSE	0	2	5	3	0	0	10
S	0	1	8	2	2	0	13
SSW	0	0	4	2	0	0	6
SW	0	1	7	6	0	0	14
WSW	0	3	9	2	1	0	15
W	0	3	6	2	0	1	12
WNW	0	6	4	2	1	0	13
NW	0	0	2	7	0	0	9
NNW	0	2	2	2	0	0	6
Total	0	27	62	30	4	1	124

Calm Hours not Included above for :	**Total Period**	2
Valid Hours for this Stability Class for:	**Total Period**	124
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019

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	13	16	19	6	1	56
NNE	1	6	18	1	0	0	26
NE	2	13	21	2	0	0	38
ENE	4	15	10	2	0	0	31
E	2	12	8	7	3	0	32
ESE	3	11	18	21	8	2	63
SE	4	10	18	11	3	0	46
SSE	0	7	16	20	8	0	51
S	1	16	34	44	12	1	108
SSW	0	12	49	30	5	0	96
SW	5	15	24	25	18	6	93
WSW	0	13	10	22	22	17	84
W	1	13	30	57	35	8	144
WNW	2	5	22	44	34	11	118
NW	0	9	19	35	32	11	106
NNW	0	17	22	26	12	5	82
Total	26	187	335	366	198	62	1174

Calm Hours not Included above for : **Total Period** 2

Valid Hours for this Stability Class for: **Total Period** 1174

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019
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	9	4	1	0	0	14
NNE	1	3	2	0	0	0	6
NE	0	2	5	0	0	0	7
ENE	1	1	5	0	0	0	7
E	2	7	15	0	0	0	24
ESE	2	9	21	5	0	0	37
SE	1	9	22	15	3	0	50
SSE	1	2	19	25	2	0	49
S	0	3	36	28	7	0	74
SSW	0	7	41	33	3	0	84
SW	0	3	12	18	3	0	36
WSW	0	1	5	13	0	0	19
W	0	2	15	14	0	0	31
WNW	0	3	14	14	0	0	31
NW	1	3	3	7	4	5	23
NNW	0	2	4	4	2	0	12
Total	9	66	223	177	24	5	504

Calm Hours not Included above for :	**Total Period**	2
Valid Hours for this Stability Class for:	**Total Period**	504
Total Hours for Period		2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019

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	4	0	0	0	0	4
NE	0	2	0	0	0	0	2
ENE	2	8	5	0	0	0	15
E	0	2	3	0	0	0	5
ESE	0	4	6	2	0	0	12
SE	0	3	17	4	0	0	24
SSE	1	4	8	6	0	0	19
S	0	3	6	8	0	0	17
SSW	0	6	10	7	0	0	23
SW	0	2	9	1	0	0	12
WSW	0	5	0	1	0	0	6
W	0	0	1	0	0	0	1
WNW	2	2	1	0	0	0	5
NW	1	1	0	0	0	0	2
NNW	0	0	1	0	0	0	1
Total	6	47	67	29	0	0	149

Calm Hours not Included above for : **Total Period** 2

Valid Hours for this Stability Class for: **Total Period** 149

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 10/1/2019 - 12/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	1	1	0	0	0	2
ENE	1	0	1	0	0	0	2
E	2	1	2	0	0	0	5
ESE	1	6	12	1	0	0	20
SE	0	6	26	6	0	0	38
SSE	0	2	6	0	0	0	8
S	0	1	9	4	0	0	14
SSW	0	2	7	1	0	0	10
SW	1	0	2	0	0	0	3
WSW	0	1	0	0	0	0	1
W	0	1	0	0	0	0	1
WNW	0	2	1	0	0	0	3
NW	0	4	0	0	0	0	4
NNW	2	0	0	0	0	0	2
Total	7	27	67	12	0	0	113

Calm Hours not Included above for : **Total Period** 2

Valid Hours for this Stability Class for: **Total Period** 113

Total Hours for Period 2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 10/1/2019 - 12/31/2019

Elevation: **Speed:** SPD60M **Direction:** DIR60M **Lapse:** DT60M

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	1	25	27	27	6	1	87
NNE	2	14	20	2	0	0	38
NE	2	20	38	3	0	0	63
ENE	8	25	22	2	0	0	57
E	6	23	30	7	3	0	69
ESE	6	32	66	29	8	2	143
SE	5	34	97	37	6	0	179
SSE	2	17	65	58	10	0	152
S	1	24	95	86	21	1	228
SSW	0	27	112	75	9	0	223
SW	6	21	56	58	21	6	168
WSW	0	23	30	41	26	17	137
W	1	21	59	82	35	9	207
WNW	4	20	48	61	36	11	180
NW	2	20	30	53	36	16	157
NNW	2	26	33	38	14	5	118
Total	48	372	828	659	231	68	2206

Calm Hours not Included above for :	**Total Period**	2
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	0
Valid Hours for this Stability Class for:	**Total Period**	2206
Total Hours for Period		2208