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April 29, 2024

AEP-NRC-2024-28
10 CFR 50.36(a)

Docket Nos.: 50-315
50-316

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

Donald C. Cook Nuclear Plant Unit 1 and 2
2023 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 as the enclosure to this letter, the Annual Radioactive Effluent Release Report. This report covers the period January 1, 2023, through December 31, 2023.

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

OAF/sjh

Enclosure: Donald C. Cook Nuclear Plant Units 1 and 2 - 2023 ANNUAL RADIOACTIVE EFFLUENT
RELEASE REPORT

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ENCLOSURE to AEP-NRC-2024-28

Donald C. Cook Nuclear Plant Units 1 and 2
2023 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT



An **AEP** Company

COOK PLANT



Donald C. Cook Nuclear Plant Units 1 and 2 2023 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 2023. 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, 2023, to December 31, 2023. 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 2023.

| Parameter | Unit 1 | Unit 2 |
|---|-----------|------------|
| Gross Electrical Energy Generation (Megawatt Hour (MWH)) | 8,554,980 | 10,666,130 |
| Unit Service Factor (Percent (%)) | 91.0 | 100.0 |
| Unit Capacity Factor (Maximum Dependable Capacity (MDC)) Net (%) | 90.2 | 99.9 |

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 rapid downpower to 52% power on July 12, 2023 to support repair work on the West Main Feed Pump. The unit returned to NFP on July 15, 2023. The unit performed a normal downpower and was manually tripped on October 14, 2023 entering refueling outage U1C32. The unit attained criticality on November 13, 2023 and returned to NFP on November 18, 2023. The unit performed a planned power reduction to 23% power on December 11, 2023 to support repairs of a steam leak. The unit reached NFP on December 15, 2023. 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 planned power reduction to 91% to support Main Turbine repair work on January 18, 2023. The unit attained NFP on January 19, 2023. 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 2023. 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 2023 there were 62 liquid batch releases performed. The number of liquid batch releases for the 1st, 2nd, 3rd, and 4th quarters in 2023 were 10, 7, 16, 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 2023 there were five batch releases from Gas Decay Tanks (GDT) and 61 Containment Pressure Reliefs (CPR). During the second quarter there were three batch releases from GDTs and 58 CPR. During the third quarter there were five batch releases from GDTs and 57 CPR. During the fourth quarter there were three batch releases from GDTs, one containment purge, one system tank vent, and 71 CPR. The CPR continue to be listed as batch releases as described in Nuclear Regulatory Commission Inspections 50-315/89016 (DRSS); 50-316/89017 (DRSS) for CNP, dated June 13, 1989. Doses continue to be calculated utilizing continuous criteria as allowed by NUREG-0133. There was a total of 16 GDT releases, one containment purge, one system tank vent, and 247 CPR gaseous batch releases made during 2023.

In calculating the dose consequences for continuous and batch gaseous releases during 2023, 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 13 shipments of radioactive waste made during 2023. 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 2023. 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 2023 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 2023 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 | 1.47E-02 | 2.47E-02 | 5.59E-02 | 2.24E-02 |
| Total Body Air | 2.80E-04 | 7.20E-04 | 1.70E-03 | 6.90E-04 |
| Skin | 4.60E-04 | 1.20E-03 | 2.80E-03 | 1.10E-03 |
| Liquid TB | 5.19E-03 | 5.33E-03 | 2.63E-02 | 3.02E-02 |
| Liquid Organ | 5.19E-03 | 5.33E-03 | 2.63E-02 | 3.02E-02 |
| Direct Radiation | 0 | 0 | 0 | 0 |
| Quarterly Dose Total | 2.58E-02 | 3.73E-02 | 1.13E-01 | 8.46E-02 |
| Sum of Quarter Doses | | | | 2.61E-01 |
| C14 (Annual) Dose | | | | 2.39E+00 |
| C14 (Annual) Curies | | | | 2.06E+01 |
| Grand Total Dose (Total Body or any other Organ) mrem | | | | 2.65E+00 |
| Annual Dose Limit (mrem) | | | | 25 |
| Percent of limit | | | | 1.06E+01 |

The following data reflects a comparison with 2009 annual dose data (the last year without calculating C-14 dose), 2023 annual dose data, and 2023 annual dose data with C-14 added. This indicates that 2023 annual dose was 'typical' for a year regarding radioactive effluents. The table is presented as follows:

| | Annual Dose (mrem) | % of limit |
|----------------|--------------------|------------|
| 2009 | 2.60E-01 | 1.04 |
| 2023 | 2.61E-01 | 1.04 |
| 2023 with C-14 | 2.65E+00 | 10.6 |

VI. RADIATION MONITORS INOPERABLE GREATER THAN 30 DAYS

The Radiation Monitor System has undergone an extensive replacement project to upgrade and modernize the equipment to support the expected operational lives of the two CNP units. This work completed in April of 2020. One effluent monitor pathway continues to have issues regarding this project with the background radiation levels due to the detector sensitivities. 12-RRS-1001(a)/ 1001(b) channels of the Waste Disposal liquid effluent monitors were declared inoperable on July 24, 2020, and required software changes in order to address the higher background detected due to the increased sensitivity. The actual room area radiation levels are relatively unchanged, but the new redundant detectors are far more sensitive and capable of detecting much lower radiation levels. The software was redeveloped and delivered to CNP in December, 2021, however this was not successful in restoring the monitors back to operability. On 4/20/2023, 12-RRS-1001 (b) channel was restored to operable following extensive periods of flushing and a passing channel operability test. This restores the monitoring on this pathway and makes 12-RRS-1001 operable. The 1001 (a) channel is having a new detector installation scheduled to restore redundancy. All releases on this pathway have been and remain in compliance with ODCM and any required compensatory actions.

There were no other release pathways with inoperable monitors for greater than 30 days.

VII. NOTEWORTHY CONDITIONS IDENTIFIED IN 2023

A rain event on September 6, 2023 resulted in loss of iodine and particulate sample media on our Unit 2 Vent Stack effluent radiation monitor 2-VRS-2500 and the 2-VSX-2501 backup sample system for that week. Rain water overloaded the moisture traps on the sample lines and resulted in the media becoming wet and unusable for counting. The continuous monitoring and sampling were quickly restored by draining the traps and replacing the sample media. This reduced the runtime on the media and reduced the possible lower limit of detection for the remaining period that week. The air space being sampled is common to Unit 1 which did not suffer any rain water intrusion and subsequent samples did not show any unusual activity. Continuous monitoring of our Auxiliary Building airspace remained active throughout and the ODCM allows for short interruptions to accommodate sampling and activities like draining trap water.

Carbon-14 Supplemental Information for the 2023 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 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 2023 results in a site total of 20.63 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 2.89 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 2023 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 1.99 mrem to the bone and a whole body dose of 0.396 mrem, for a combined total C-14 dose of 2.39 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).

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 for the 2023 report.

2023 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.

2023 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 ensure 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.

2023 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.

2023 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, 2023
7 releases in the 2nd quarter, 2023
16 releases in the 3rd quarter, 2023
29 releases in the 4th quarter, 2023

5.1.2 Total time period for batch releases:

28,909 minutes

5.1.3 Maximum time for a batch release:

899 minutes

5.1.4 Average time period for batch release:

466 minutes

5.1.5 Minimum time period for a batch release:

126 minutes

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

6.84E+5 gpm circulating water

2023 Effluent and Waste Disposal Annual Report

5.2 Gaseous

5.2.1 Number of batch releases:

66 releases in the 1st quarter, 2023
61 releases in the 2nd quarter, 2023
62 releases in the 3rd quarter, 2023
76 releases in the 4th quarter, 2023

5.2.2 Total time period for batch releases:

15,671 minutes

5.2.3 Maximum time for a batch release:

354 minutes

5.2.4 Average time period for batch release:

59.1 minutes

5.2.5 Minimum time period for a batch release:

5 minutes

2023 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 |

2023 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 | 2.08E+01 | 1.37E+01 | 1.46E+01 | 1.70E+01 |
| AR41 | Ci | ----- | ----- | ----- | ----- |
| KR85 | Ci | ----- | ----- | ----- | ----- |
| XE133 | Ci | ----- | ----- | ----- | ----- |
| XE135 | Ci | ----- | ----- | ----- | ----- |
| XE131m | Ci | ----- | ----- | ----- | ----- |
| XE133m | Ci | ----- | ----- | ----- | ----- |
| XE135m | Ci | ----- | ----- | ----- | ----- |
| Total for Period | Ci | 2.08E+01 | 1.37E+01 | 1.46E+01 | 1.70E+01 |

| | | | | | |
|------------------|----|-------|-------|-------|----------|
| 2. IODINES | | | | | |
| I131 | Ci | ----- | ----- | ----- | 3.13E-05 |
| I132 | Ci | ----- | ----- | ----- | ----- |
| I133 | Ci | ----- | ----- | ----- | 2.93E-07 |
| Total for Period | Ci | ----- | ----- | ----- | 3.16E-05 |

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

* DENOTES SUPPLEMENTAL ISOTOPES

2023 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 | 1.34E-01 | 1.74E-01 | 1.80E-01 | 2.64E-01 |
| AR41 | Ci | 2.15E-01 | 2.13E-01 | 2.27E-01 | 2.67E-01 |
| KR85 | Ci | 1.23E-03 | 4.36E-04 | ----- | 4.26E-04 |
| KR85m | Ci | ----- | ----- | ----- | ----- |
| KR87 | Ci | ----- | ----- | ----- | ----- |
| XE131M | Ci | ----- | ----- | ----- | 8.71E-05 |
| XE133 | Ci | 2.47E-03 | 3.49E-03 | 3.24E-03 | 4.35E-01 |
| XE135m | Ci | ----- | ----- | ----- | 4.66E-05 |
| XE135 | Ci | ----- | ----- | ----- | 1.01E-03 |
| Total for Period | Ci | 3.53E-01 | 3.91E-01 | 4.10E-01 | 9.68E-01 |
| 2. IODINES | | | | | |
| I131 | Ci | ----- | ----- | ----- | 5.27E-06 |
| I132 | Ci | ----- | ----- | ----- | ----- |
| I133 | Ci | ----- | ----- | ----- | 2.91E-06 |
| I134 | Ci | ----- | ----- | ----- | ----- |
| I135 | Ci | ----- | ----- | ----- | 4.92E-07 |
| Total for Period | Ci | ----- | ----- | ----- | 8.67E-06 |

* DENOTES SUPPLEMENTAL ISOTOPES

2023 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS-GROUND LEVEL RELEASES

BATCH MODE

| Nuclides Released | Unit | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|-------------------|------|-------------|-------------|-------------|-------------|
| 3. PARTICULATES | | | | | |
| CR51 | Ci | ----- | ----- | ----- | ----- |
| CO58 | Ci | ----- | ----- | ----- | ----- |
| CO60 | Ci | ----- | ----- | ----- | ----- |
| NB95 | Ci | ----- | ----- | ----- | ----- |
| Total for Period | Ci | ----- | ----- | ----- | ----- |

* DENOTES SUPPLEMENTAL ISOTOPES

2023 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 | 2.18E-01 | 2.17E-01 | 2.30E-01 | 7.08E-01 | 19.4 |
| 2. | Average release rate for period | uCi/sec | 2.81E-02 | 2.76E-02 | 2.90E-02 | 8.90E-02 | |
| 3. | Percent of applicable limit* | % Gamma Beta | 4.70E-03 8.35E-04 | 1.32E-02 2.34E-03 | 3.15E-02 5.55E-03 | 1.19E-02 2.66E-03 | |
| B. IODINES | | | | | | | |
| 1. | Total I-131 | Ci | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.66E-05 | 13.4 |
| 2. | Average release rate for period | uCi/sec | 0.00E+00 | 0.00E+00 | 0.00E+00 | 4.60E-06 | |
| 3. | Percent of applicable limit* | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.31E-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 | <7.86E-07 | <7.09E-07 | <8.77E-07 | <1.08E-06 | |
| D. TRITIUM | | | | | | | |
| 1. | Total Release | Ci | 2.09E+01 | 1.39E+01 | 1.48E+01 | 1.71E+01 | 20.0 |
| 2. | Average release rate for period | uCi/sec | 2.69E+00 | 1.77E+00 | 1.86E+00 | 2.16E+00 | |
| 3. | Percent of applicable limit* | % | 1.53E-02 | 1.01E-02 | 1.06E-02 | 1.23E-02 | |

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

2023 EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT

LIQUID EFFLUENTS

CONTINUOUS MODE

| Nuclides Released | Unit | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|-------------------|------|-------------|-------------|-------------|-------------|
| H3 | Ci | ----- | 1.03E-02 | 3.10E-02 | 3.58E-02 |

BATCH MODE

| Nuclides Released | Unit | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|-------------------|------|-------------|-------------|-------------|-------------|
| H3 | Ci | 1.50E+02 | 1.79E+02 | 1.01E+03 | 9.23E+02 |
| CR51 | Ci | ----- | ----- | ----- | 1.62E-04 |
| MN54 | Ci | ----- | ----- | ----- | 2.21E-05 |
| CO57 | Ci | ----- | ----- | ----- | ----- |
| CO58 | Ci | 9.01E-07 | ----- | ----- | 6.44E-04 |
| CO60 | Ci | 1.33E-05 | 2.22E-05 | 1.51E-04 | 6.54E-04 |
| NI63 | Ci | ----- | ----- | ----- | ----- |
| ZN65 | Ci | ----- | ----- | ----- | 7.26E-06 |
| ZR95 | Ci | ----- | ----- | ----- | ----- |
| NB95 | Ci | ----- | ----- | ----- | 3.89E-06 |
| MO99 | Ci | ----- | ----- | ----- | ----- |
| TC99m | Ci | ----- | ----- | ----- | 1.60E-06 |
| AG110m | Ci | ----- | ----- | ----- | 1.63E-05 |
| SB124 | Ci | ----- | ----- | ----- | 9.45E-06 |
| SB125 | Ci | ----- | ----- | 5.98E-06 | 9.63E-05 |
| CS134 | Ci | ----- | ----- | ----- | ----- |
| CS137 | Ci | ----- | ----- | 7.01E-07 | 5.59E-07 |
| I131 | Ci | ----- | ----- | ----- | ----- |
| I133 | Ci | ----- | ----- | ----- | ----- |
| *SN113 | Ci | ----- | ----- | ----- | ----- |
| *XE133 | Ci | 1.66E-06 | ----- | ----- | 3.77E-04 |
| *XE135 | Ci | ----- | ----- | ----- | ----- |
| *XE133m | Ci | ----- | ----- | ----- | ----- |

* DENOTES SUPPLEMENTAL ISOTOPES

2023 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 | 1.42E-05 | 2.22E-05 | 1.58E-04 | 1.62E-03 | 11.6 |
| 2. | Average diluted concentration during period | uCi/ml | 2.36E-12 | 2.77E-12 | 5.32E-12 | 5.18E-11 | |
| 3. | Percent of applicable limit | % | 7.44E-05 | 9.25E-05 | 1.73E-04 | 8.36E-04 | |
| B. | TRITIUM | | | | | | |
| 1. | Total Release | Ci | 1.50E+02 | 1.79E+02 | 1.01E+03 | 9.23E+02 | 10.1 |
| 2. | Average diluted concentration during period | uCi/ml | 2.49E-05 | 2.24E-05 | 3.42E-05 | 2.96E-05 | |
| 3. | Percent of applicable limit | % | 2.49E+00 | 2.24E+00 | 3.42E+00 | 2.96E+00 | |
| C. | DISSOLVED AND ENTRAINED GASES | | | | | | |
| 1. | Total Release | Ci | 1.66E-06 | 0.00E+00 | 0.00E+00 | 3.79E-04 | 11.6 |
| 2. | Average diluted concentration during period | uCi/ml | 2.76E-13 | 0.00E+00 | 0.00E+00 | 1.21E-11 | |
| 3. | Percent of applicable limit | % | 1.38E-07 | 0.00E+00 | 0.00E+00 | 6.07E-06 | |
| D. | GROSS ALPHA RADIOACTIVITY TOTAL RELEASE | Ci | <5.57E-05 | <7.12E-04 | <2.28E-03 | <1.84E-03 | N/A |
| E. | VOLUME OF WASTE RELEASED | Liters | 5.67E+05 | 7.24E+06 | 2.32E+07 | 1.87E+07 | 2.00 |
| F. | VOLUME OF DILUTION WATER USED DURING PERIOD | Liters | 6.02E+09 | 8.02E+09 | 2.96E+10 | 3.11E+10 | 3.48 |

2023 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 | 1.04E-02 | 3.10E-02 | 3.58E-02 | 53.0 |
| 2. | Average diluted concentration during period | uCi/ml | 0.00E+00 | 1.52E-11 | 3.84E-11 | 5.17E-11 | |
| 3. | Percent of applicable limit | % | 0.00E+00 | 1.52E-06 | 3.84E-06 | 5.17E-06 | |
| 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 | <6.81E-04 | <2.38E-03 | <1.81E-03 | N/A |
| E. | VOLUME OF WASTE RELEASED | Liters | 0.00E+00 | 6.93E+06 | 2.43E+07 | 1.84E+07 | 2.00 |
| F. | VOLUME OF DILUTION WATER USED DURING PERIOD | Liters | 0.00E+00 | 6.85E+11 | 8.07E+11 | 6.93E+11 | 3.48 |

2023 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 | 1.18E+01 9.71E+01 | 1.00E+00 3.75E+00 |
| b) Dry compressible waste, contaminated equipment, etc. | m ³ Curies | 3.44E+02 4.64E-01 | 1.00E+00 6.48E+00 |
| c) Irradiated components, control rods, etc. | m ³ Curies | | |
| d) Other (oil, soil, etc) | m ³ Curies | | |

2) Estimate of Principle Radionuclide Composition

| | | | | | | | | |
|----|-------|-----|-------|-----|----------|-----|--------|-----|
| a) | H-3 | 9 % | Co-58 | 1 % | Sb-125 | 1 % | Cs-137 | 1 % |
| | Mn-54 | 1% | Co-60 | 13% | Cs-134 | 1 % | C-14 | 1 % |
| | Fe-55 | 18% | Ni-63 | 54% | | | | |
| b) | H-3 | 1 % | Co-58 | 3 % | Cs-137 | 2 % | C-14 | 2 % |
| | Cr-51 | 2 % | Co-60 | 17% | Fe-55 | 55% | Sb-125 | 1 % |
| | Mn-54 | 2 % | Ni-63 | 13% | Zr/Nb-95 | 2 % | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

3) Solid Waste Disposition

| No. of Shipments | Mode of Transportation | Destination |
|------------------|------------------------|-----------------------------|
| 7 | Truck | UniTech Services Group, Inc |
| 6 | Truck | Energy Solutions, LLC |
| | | |

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.

2023 Effluent and Waste Disposal Annual Report Yearly Release Rates

| GASES | | |
|---------------------------------|-------------------------------|---|
| Fission and Activation Gases | Total Release | 1.37E+00 Curies |
| | Average Release Rate | 4.35E-02 μ Ci/sec |
| | % of Applicable Limits* | γ 3.06E-02 % β 5.69E-03 % |
| Iodines | Total I-131 Release | 3.66E-05 Curies |
| | Average Release Rate | 1.16E-06 μ Ci/sec |
| | % of Applicable Limit* | 3.92E-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 | 1.81E-03 Curies |
| | Average Diluted Concentration | 2.43E-11 μ Ci/ml |
| | % of Applicable Limits* | Total Body 1.12E+00 % Organ 3.35E-01 % |

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

2023 Effluent and Waste Disposal Annual Report

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 | 1577 |
| 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 2023

| EFFLUENT | APPLICABLE ORGAN | ESTIMATED DOSE (mrem) | AGE GROUP | LOCATION DIST DIR (M) (Toward) | % OF APPLICABLE LIMIT | LIMIT (mrem) QTR |
|--------------------------|-----------------------|-----------------------|-----------|--------------------------------|-----------------------|------------------|
| Liquid | Total Body | 5.19E-03 | Child | Receptor 1 | 1.73E-01 | 1.5E+0 |
| Liquid | GI-LLI | 5.19E-03 | Child | Receptor 1 | 5.20E-02 | 5.0E+0 |
| Noble Gas | Air Dose (Gamma-mrad) | 4.70E-04 | Any Age | 651 (N) | 4.70E-03 | 5.0E+0 |
| Noble Gas | Air dose (Beta-mrad) | 1.67E-04 | Any Age | 651 (N) | 8.35E-04 | 1.0E+1 |
| Iodines and Particulates | Total Body | 1.47E-02 | Child | 659 (N) | 9.75E-02 | 7.5E+0 |

Summary of Maximum Individual Doses

Second Quarter 2023

| EFFLUENT | APPLICABLE ORGAN | ESTIMATED DOSE (mrem) | AGE GROUP | LOCATION DIST DIR (M) (Toward) | % OF APPLICABLE LIMIT | LIMIT (mrem) QTR |
|--------------------------|-------------------------|------------------------------|------------------|---------------------------------------|------------------------------|-------------------------|
| Liquid | Total Body | 5.33E-03 | Child | Receptor 1 | 1.78E-01 | 1.5E+0 |
| Liquid | GI-LLI | 5.33E-03 | Child | Receptor 1 | 5.35E-02 | 5.0E+0 |
| Noble Gas | Air Dose (Gamma-mrad) | 1.32E-03 | Any Age | 651 (N) | 1.32E-02 | 5.0E+0 |
| Noble Gas | Air dose (Beta-mrad) | 4.68E-04 | Any Age | 651 (N) | 2.34E-03 | 1.0E+1 |
| Iodines and Particulates | Total Body | 2.47E-02 | Child | 659 (N) | 1.65E-01 | 7.5E+0 |

Summary of Maximum Individual Doses

Third Quarter 2023

| EFFLUENT | APPLICABLE ORGAN | ESTIMATED DOSE (mrem) | AGE GROUP | LOCATION DIST DIR (M) (Toward) | % OF APPLICABLE LIMIT | LIMIT (mrem) QTR |
|--------------------------|-----------------------|-----------------------|-----------|--------------------------------|-----------------------|------------------|
| Liquid | Total Body | 2.63E-02 | Child | Receptor 1 | 8.75E-01 | 1.5E+0 |
| Liquid | Liver | 2.63E-02 | Child | Receptor 1 | 2.63E-01 | 5.0E+0 |
| Noble Gas | Air Dose (Gamma-mrad) | 3.14E-03 | Any Age | 651 (N) | 3.15E-02 | 5.0E+0 |
| Noble Gas | Air dose (Beta-mrad) | 1.11E-03 | Any Age | 651 (N) | 5.55E-03 | 1.0E+1 |
| Iodines and Particulates | Total Body | 5.59E-02 | Child | 659 (N) | 3.73E-01 | 7.5E+0 |

Summary of Maximum Individual Doses

Fourth Quarter 2023

| EFFLUENT | APPLICABLE ORGAN | ESTIMATED DOSE (mrem) | AGE GROUP | LOCATION DIST DIR (M) (Toward) | % OF APPLICABLE LIMIT | LIMIT (mrem) QTR |
|--------------------------|-----------------------|-----------------------|-----------|--------------------------------|-----------------------|------------------|
| Liquid | Total Body | 3.02E-02 | Child | Receptor 1 | 1.01E+00 | 1.5E+0 |
| Liquid | GI-LLI | 3.02E-02 | Child | Receptor 1 | 3.02E-01 | 5.0E+0 |
| Noble Gas | Air Dose (Gamma-mrad) | 1.18E-03 | Any Age | 651 (N) | 1.19E-02 | 5.0E+0 |
| Noble Gas | Air dose (Beta-mrad) | 5.32E-04 | Any Age | 651 (N) | 2.66E-03 | 1.0E+1 |
| Iodines and Particulates | Thyroid | 2.24E-02 | Child | 659 (N) | 1.50E-01 | 7.5E+0 |

2023 NEI GROUNDWATER PROTECTION INITIATIVE SAMPLE DATA

Analysis of the Sample Data

The Groundwater Protection Initiative (GPI) Sample Data for 2023 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 (REMP) wells quarterly. Those results are not actual GPI results so are not included in the ARERR, but are part of CNP's 2023 Annual Radiological Environmental Operating Report. There were no positively identified gamma radionuclides from plant effluents detected in any of the GPI well samples, and no wells with levels of tritium above detection limits.

The Lower Limit of Detection (LLD) value used for tritium counting of the samples was $9.45\text{E-}7$ or $9.83\text{E-}7$, depending on lab equipment used. This is well below the required maximum LLD value of $2.00\text{E-}6$ uCi/mL per the ODCM.

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 2023 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 2023 continue to reflect normal expectations and behaviors as they relate to recaptured tritium for the weather conditions observed. It was a drier year resulting in less recaptured tritium, as shown by the lack of positive tritium sample results.

The sample data indicates that no radioactive spills or unidentified leaks have occurred in 2023 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

2023 GPI Sample Data

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

| Sample Date | W-1 | W-2 | W-3 | W-4 | W-5 | W-6 | W-7 | W-8 | W-9 | W-10 |
|-------------|------|------|------|------|------|------|------|------|------|------|
| 01/12/2023 | | | | <LLD | <LLD | <LLD | | | | |
| 01/13/2023 | <LLD | <LLD | <LLD | | | | <LLD | <LLD | <LLD | <LLD |
| 04/14/2023 | <LLD | <LLD | <LLD | | | | <LLD | <LLD | <LLD | <LLD |
| 04/18/2023 | | | | <LLD | <LLD | <LLD | | | | |
| 07/21/2023 | <LLD | <LLD | <LLD | | | | <LLD | <LLD | <LLD | <LLD |
| 08/01/2023 | | | | <LLD | <LLD | <LLD | | | | |
| 10/20/2023 | <LLD | <LLD | <LLD | | | | | <LLD | <LLD | |
| 10/23/2023 | | | | | | | | | | <LLD |
| 10/24/2023 | | | | | | | <LLD | | | |
| 10/27/2023 | | | | <LLD | <LLD | <LLD | | | | |

| Sample Date | W-11 | W-12 | W-13 | W-14 | W-15 | EW-18 | W-20 | W-21 | OW-1 | OW-2 |
|-------------|------|------|------|------|------|-------|------|------|------|------|
| 01/13/2023 | <LLD | <LLD | <LLD | <LLD | <LLD | | <LLD | <LLD | | |
| 03/02/2023 | | | | | | <LLD* | | | | |
| 03/07/2023 | | | | | | | | | <LLD | <LLD |
| 04/14/2023 | <LLD | <LLD | <LLD | <LLD | <LLD | | <LLD | <LLD | | |
| 05/24/2023 | | | | | | | | | <LLD | <LLD |
| 07/21/2023 | <LLD | <LLD | <LLD | <LLD | <LLD | | <LLD | <LLD | | |
| 08/30/2023 | | | | | | <LLD* | | | | |
| 09/27/2023 | | | | | | | | | <LLD | <LLD |
| 10/18/2023 | | | | | | <LLD | | | <LLD | <LLD |
| 10/19/2023 | | | | | | <LLD | | | | |
| 10/20/2023 | | | | | <LLD | | | | | |
| 10/23/2023 | <LLD | <LLD | | | | | <LLD | <LLD | | |
| 10/24/2023 | | | <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).

2023 GPI Sample Data

| Sample Date | MW-22S | MW-22M | MW-22D | MW-24S | MW-24M | MW-24D | MW-25S | MW-25M | MW-25D |
|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 03/02/23 | <LLD | <LLD | <LLD | <LLD* | <LLD | <LLD | | | |
| 03/07/23 | | | | | | | <LLD | <LLD | <LLD |
| 04/30/23 | | | | | | | <LLD | <LLD | <LLD |
| 05/22/23 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | | | |
| 08/29/23 | <LLD | <LLD | <LLD | | | | | | |
| 08/30/23 | | | | <LLD | <LLD | <LLD | | | |
| 09/27/23 | | | | | | | <LLD | <LLD | <LLD |
| 10/18/23 | | | | | | | <LLD | <LLD | <LLD |
| 10/19/23 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | | | |
| | | | | | | | | | |

| Sample Date | MW-26S | MW-26M | MW-26D | MW-27S | MW-27-M | MW-27D | SG-1 | SG-2 | SG-4 | SG-5 |
|-------------|--------|--------|--------|--------|---------|--------|------|------|------|------|
| 01/13/23 | | | | | | | <LLD | <LLD | <LLD | <LLD |
| 03/07/23 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | | | | |
| 04/18/23 | | | | | | | <LLD | <LLD | <LLD | <LLD |
| 04/30/23 | <LLD | <LLD | <LLD | <LLD* | <LLD | <LLD | | | | |
| 07/21/23 | | | | | | | <LLD | <LLD | <LLD | <LLD |
| 09/27/23 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | | | | |
| 10/18/23 | <LLD | <LLD | <LLD | <LLD | <LLD | <LLD | | | | |
| 10/24/23 | | | | | | | <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).

2023 GPI Sample Data

| Sample Date | OW-4 | MW-28 | MW-29 | ISF-8 |
|-------------|------|-------|-------|-------|
| 01/16/23 | | <LLD | <LLD | |
| 02/20/23 | | <LLD | <LLD | |
| 03/07/23 | | <LLD* | <LLD* | |
| 04/30/23 | | <LLD | <LLD | |
| 05/24/23 | <LLD | <LLD | <LLD | |
| 06/28/23 | | <LLD | <LLD | |
| 07/26/23 | | <LLD | <LLD | |
| 08/31/23 | | <LLD | <LLD | |
| 09/27/23 | | <LLD | <LLD | |
| 10/12/23 | | | | <LLD* |
| 10/18/23 | | <LLD | <LLD | |
| 10/19/23 | | | | <LLD* |
| 11/20/23 | <LLD | <LLD | <LLD | |
| 12/07/23 | | <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).

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = Total Period
01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 21 | 4 | 0 | 0 | 0 | 25 |
| NNE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| E | 0 | 4 | 1 | 0 | 0 | 0 | 5 |
| ESE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| SSE | 0 | 4 | 1 | 0 | 0 | 0 | 5 |
| S | 0 | 0 | 6 | 1 | 0 | 0 | 7 |
| SSW | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| SW | 0 | 4 | 8 | 0 | 0 | 0 | 12 |
| WSW | 0 | 6 | 6 | 0 | 0 | 0 | 12 |
| W | 0 | 7 | 0 | 0 | 0 | 0 | 7 |
| WNW | 2 | 5 | 0 | 0 | 0 | 0 | 7 |
| NW | 3 | 13 | 0 | 0 | 0 | 0 | 16 |
| NNW | 5 | 18 | 2 | 0 | 0 | 0 | 25 |
| Total | 10 | 91 | 30 | 2 | 0 | 0 | 133 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 133 |
| Total Hours for the Period: | | | 2160 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 1 | 4 | 1 | 0 | 0 | 0 | 6 |
| NNE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 7 | 0 | 0 | 0 | 0 | 7 |
| E | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ESE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 5 | 1 | 0 | 0 | 0 | 6 |
| SSE | 0 | 4 | 4 | 0 | 0 | 0 | 8 |
| S | 0 | 1 | 8 | 0 | 0 | 0 | 9 |
| SSW | 0 | 1 | 3 | 0 | 0 | 0 | 4 |
| SW | 0 | 8 | 6 | 0 | 0 | 0 | 14 |
| WSW | 2 | 6 | 0 | 0 | 0 | 0 | 8 |
| W | 0 | 2 | 6 | 0 | 0 | 0 | 8 |
| WNW | 0 | 4 | 2 | 0 | 0 | 0 | 6 |
| NW | 1 | 6 | 0 | 0 | 0 | 0 | 7 |
| NNW | 2 | 9 | 0 | 0 | 0 | 0 | 11 |
| Total | 7 | 60 | 31 | 0 | 0 | 0 | 98 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 98 |
| Total Hours for the Period: | | | 2160 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = 01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 7 | 1 | 0 | 0 | 0 | 9 |
| NNE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| E | 1 | 4 | 1 | 0 | 0 | 0 | 6 |
| ESE | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| SSE | 0 | 5 | 2 | 0 | 0 | 0 | 7 |
| S | 0 | 0 | 4 | 2 | 0 | 0 | 6 |
| SSW | 0 | 2 | 3 | 0 | 0 | 0 | 5 |
| SW | 0 | 8 | 4 | 0 | 0 | 0 | 12 |
| WSW | 1 | 12 | 2 | 0 | 0 | 0 | 15 |
| W | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| WNW | 1 | 2 | 1 | 0 | 0 | 0 | 4 |
| NW | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| NNW | 4 | 7 | 1 | 0 | 0 | 0 | 12 |
| Total | 9 | 61 | 22 | 2 | 0 | 0 | 94 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 94 |
| Total Hours for the Period: | | | 2160 |

Site: AFP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = 01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 30 | 92 | 20 | 0 | 0 | 0 | 142 |
| NNE | 18 | 22 | 0 | 0 | 0 | 0 | 40 |
| NE | 15 | 7 | 0 | 0 | 0 | 0 | 22 |
| ENE | 12 | 37 | 6 | 0 | 0 | 0 | 55 |
| E | 39 | 61 | 22 | 0 | 0 | 0 | 122 |
| ESE | 24 | 11 | 6 | 0 | 0 | 0 | 41 |
| SE | 22 | 33 | 13 | 0 | 0 | 0 | 68 |
| SSE | 17 | 37 | 21 | 0 | 0 | 0 | 75 |
| S | 17 | 41 | 40 | 6 | 0 | 0 | 104 |
| SSW | 11 | 46 | 34 | 5 | 0 | 0 | 96 |
| SW | 11 | 50 | 24 | 2 | 0 | 0 | 87 |
| WSW | 8 | 47 | 22 | 0 | 0 | 0 | 77 |
| W | 8 | 54 | 15 | 0 | 0 | 0 | 77 |
| WNW | 12 | 37 | 23 | 0 | 0 | 0 | 72 |
| NW | 16 | 38 | 6 | 0 | 0 | 0 | 60 |
| NNW | 24 | 59 | 6 | 0 | 0 | 0 | 89 |
| Total | 284 | 672 | 258 | 13 | 0 | 0 | 1227 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 1227 |
| Total Hours for the Period: | | | 2160 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 15 | 2 | 0 | 0 | 0 | 0 | 17 |
| NNE | 10 | 3 | 0 | 0 | 0 | 0 | 13 |
| NE | 6 | 2 | 0 | 0 | 0 | 0 | 8 |
| ENE | 18 | 10 | 0 | 0 | 0 | 0 | 28 |
| E | 14 | 20 | 0 | 0 | 0 | 0 | 34 |
| ESE | 12 | 10 | 1 | 0 | 0 | 0 | 23 |
| SE | 12 | 15 | 9 | 0 | 0 | 0 | 36 |
| SSE | 15 | 26 | 11 | 0 | 0 | 0 | 52 |
| S | 15 | 50 | 12 | 3 | 0 | 0 | 80 |
| SSW | 11 | 26 | 22 | 0 | 0 | 0 | 59 |
| SW | 13 | 35 | 8 | 0 | 0 | 0 | 56 |
| WSW | 4 | 16 | 3 | 0 | 0 | 0 | 23 |
| W | 6 | 9 | 0 | 0 | 0 | 0 | 15 |
| WNW | 6 | 8 | 0 | 0 | 0 | 0 | 14 |
| NW | 10 | 11 | 0 | 0 | 0 | 0 | 21 |
| NNW | 10 | 11 | 0 | 0 | 0 | 0 | 21 |
| Total | 177 | 254 | 66 | 3 | 0 | 0 | 500 |

Calm Hours not Included above for:

Number of Valid Hours for this Table:

Total Hours for the Period:

Total Period

Total Period

All Hours

All Hours

7

500

2160

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
01/01/2023 - 03/31/2023
Elevation: Speed: SPI0M Direction: DIR10M 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 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| ENE | 8 | 1 | 0 | 0 | 0 | 0 | 9 |
| E | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| ESE | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| SE | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| SSE | 8 | 2 | 0 | 0 | 0 | 0 | 10 |
| S | 12 | 8 | 0 | 0 | 0 | 0 | 20 |
| SSW | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| SW | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| WSW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| W | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| WNW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 58 | 14 | 0 | 0 | 0 | 0 | 72 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 72 |
| Total Hours for the Period: | | | 2160 |

Site: ALP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = Total Period
01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SE | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| SSE | 9 | 1 | 0 | 0 | 0 | 0 | 10 |
| S | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| SSW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| SW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 25 | 1 | 0 | 0 | 0 | 0 | 26 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 26 |
| Total Hours for the Period: | | | 2160 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
01/01/2023 - 03/31/2023
Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M

Stability Class: ALL Delta Temperature:

| Wind Direction | Wind Speed (mph) | | | | | | Total |
|----------------|------------------|------|------|-------|-------|------|-------|
| | 1-4 | 4-8 | 8-13 | 13-19 | 19-25 | > 25 | |
| N | 47 | 126 | 26 | 0 | 0 | 0 | 199 |
| NNE | 29 | 28 | 0 | 0 | 0 | 0 | 57 |
| NE | 24 | 10 | 0 | 0 | 0 | 0 | 34 |
| ENE | 38 | 60 | 7 | 0 | 0 | 0 | 105 |
| E | 58 | 92 | 24 | 0 | 0 | 0 | 174 |
| ESE | 43 | 26 | 7 | 0 | 0 | 0 | 76 |
| SE | 44 | 61 | 23 | 0 | 0 | 0 | 128 |
| SSE | 49 | 79 | 39 | 0 | 0 | 0 | 167 |
| S | 52 | 100 | 70 | 12 | 0 | 0 | 234 |
| SSW | 27 | 75 | 63 | 6 | 0 | 0 | 171 |
| SW | 26 | 106 | 50 | 2 | 0 | 0 | 184 |
| WSW | 18 | 87 | 33 | 0 | 0 | 0 | 138 |
| W | 18 | 72 | 24 | 0 | 0 | 0 | 114 |
| WNW | 22 | 56 | 26 | 0 | 0 | 0 | 104 |
| NW | 30 | 71 | 6 | 0 | 0 | 0 | 107 |
| NNW | 45 | 104 | 9 | 0 | 0 | 0 | 158 |
| Total | 570 | 1153 | 407 | 20 | 0 | 0 | 2150 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 7 |
| Variable Direction Hours for: | Total Period | All Hours | 0 |
| Invalid Hours for: | Total Period | All Hours | 3 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 2150 |
| Total Hours for the Period: | | | 2160 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 22 | 74 | 1 | 0 | 0 | 0 | 97 |
| NNE | 7 | 5 | 0 | 0 | 0 | 0 | 12 |
| NE | 2 | 7 | 0 | 0 | 0 | 0 | 9 |
| ENE | 1 | 5 | 0 | 0 | 0 | 0 | 6 |
| E | 2 | 6 | 0 | 0 | 0 | 0 | 8 |
| ESE | 1 | 6 | 1 | 0 | 0 | 0 | 8 |
| SE | 0 | 13 | 4 | 0 | 0 | 0 | 17 |
| SSE | 0 | 13 | 9 | 0 | 0 | 0 | 22 |
| S | 1 | 5 | 8 | 0 | 0 | 0 | 14 |
| SSW | 3 | 4 | 1 | 0 | 0 | 0 | 8 |
| SW | 1 | 20 | 9 | 0 | 0 | 0 | 30 |
| WSW | 6 | 20 | 4 | 0 | 0 | 0 | 30 |
| W | 5 | 20 | 1 | 0 | 0 | 0 | 26 |
| WNW | 6 | 11 | 0 | 0 | 0 | 0 | 17 |
| NW | 10 | 31 | 0 | 0 | 0 | 0 | 41 |
| NNW | 23 | 79 | 0 | 0 | 0 | 0 | 102 |
| Total | 90 | 319 | 38 | 0 | 0 | 0 | 447 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 447 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = 04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 2 | 8 | 0 | 0 | 0 | 0 | 10 |
| NNE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NE | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| ENE | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| E | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| ESE | 3 | 1 | 0 | 0 | 0 | 0 | 4 |
| SE | 1 | 3 | 1 | 0 | 0 | 0 | 5 |
| SSE | 2 | 7 | 4 | 0 | 0 | 0 | 13 |
| S | 1 | 5 | 3 | 0 | 0 | 0 | 9 |
| SSW | 0 | 5 | 1 | 0 | 0 | 0 | 6 |
| SW | 1 | 7 | 2 | 0 | 0 | 0 | 10 |
| WSW | 2 | 6 | 0 | 0 | 0 | 0 | 8 |
| W | 3 | 4 | 0 | 0 | 0 | 0 | 7 |
| WNW | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| NW | 2 | 3 | 0 | 0 | 0 | 0 | 5 |
| NNW | 7 | 9 | 0 | 0 | 0 | 0 | 16 |
| Total | 33 | 63 | 11 | 0 | 0 | 0 | 107 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 107 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 4 | 5 | 0 | 0 | 0 | 0 | 9 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| ENE | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| E | 4 | 2 | 0 | 0 | 0 | 0 | 6 |
| ESE | 3 | 2 | 0 | 0 | 0 | 0 | 5 |
| SE | 4 | 1 | 1 | 0 | 0 | 0 | 6 |
| SSE | 4 | 5 | 1 | 0 | 0 | 0 | 10 |
| S | 0 | 6 | 1 | 1 | 0 | 0 | 8 |
| SSW | 2 | 2 | 1 | 0 | 0 | 0 | 5 |
| SW | 0 | 11 | 3 | 0 | 0 | 0 | 14 |
| WSW | 1 | 5 | 0 | 0 | 0 | 0 | 6 |
| W | 1 | 2 | 4 | 0 | 0 | 0 | 7 |
| WNW | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| NW | 2 | 4 | 1 | 0 | 0 | 0 | 7 |
| NNW | 10 | 4 | 1 | 0 | 0 | 0 | 15 |
| Total | 37 | 55 | 14 | 1 | 0 | 0 | 107 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 107 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 37 | 23 | 2 | 0 | 0 | 0 | 62 |
| NNE | 13 | 1 | 0 | 0 | 0 | 0 | 14 |
| NE | 15 | 10 | 0 | 0 | 0 | 0 | 25 |
| ENE | 4 | 11 | 2 | 0 | 0 | 0 | 17 |
| E | 9 | 19 | 2 | 0 | 0 | 0 | 30 |
| ESE | 12 | 7 | 1 | 0 | 0 | 0 | 20 |
| SE | 12 | 10 | 4 | 0 | 0 | 0 | 26 |
| SSE | 9 | 13 | 2 | 0 | 0 | 0 | 24 |
| S | 9 | 11 | 5 | 0 | 0 | 0 | 25 |
| SSW | 8 | 19 | 7 | 2 | 0 | 0 | 36 |
| SW | 13 | 29 | 13 | 1 | 0 | 0 | 56 |
| WSW | 9 | 20 | 9 | 0 | 0 | 0 | 38 |
| W | 6 | 17 | 3 | 0 | 0 | 0 | 26 |
| WNW | 5 | 16 | 4 | 0 | 0 | 0 | 25 |
| NW | 14 | 16 | 3 | 0 | 0 | 0 | 33 |
| NNW | 25 | 28 | 8 | 0 | 0 | 0 | 61 |
| Total | 200 | 250 | 65 | 3 | 0 | 0 | 518 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 518 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 35 | 8 | 0 | 0 | 0 | 0 | 43 |
| NNE | 30 | 8 | 0 | 0 | 0 | 0 | 38 |
| NE | 18 | 6 | 0 | 0 | 0 | 0 | 24 |
| ENE | 20 | 2 | 0 | 0 | 0 | 0 | 22 |
| E | 17 | 8 | 0 | 0 | 0 | 0 | 25 |
| ESE | 17 | 3 | 0 | 0 | 0 | 0 | 20 |
| SE | 22 | 23 | 1 | 0 | 0 | 0 | 46 |
| SSE | 11 | 27 | 2 | 0 | 0 | 0 | 40 |
| S | 13 | 13 | 4 | 2 | 1 | 0 | 33 |
| SSW | 8 | 20 | 4 | 0 | 0 | 0 | 32 |
| SW | 7 | 16 | 8 | 0 | 0 | 0 | 31 |
| WSW | 8 | 6 | 0 | 0 | 0 | 0 | 14 |
| W | 7 | 2 | 0 | 0 | 0 | 0 | 9 |
| WNW | 11 | 3 | 0 | 0 | 0 | 0 | 14 |
| NW | 16 | 1 | 0 | 0 | 0 | 0 | 17 |
| NNW | 22 | 8 | 3 | 0 | 0 | 0 | 33 |
| Total | 262 | 154 | 22 | 2 | 1 | 0 | 441 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 441 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| NNE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| NE | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| ENE | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| E | 15 | 0 | 0 | 0 | 0 | 0 | 15 |
| ESE | 21 | 0 | 0 | 0 | 0 | 0 | 21 |
| SE | 28 | 4 | 0 | 0 | 0 | 0 | 32 |
| SSE | 16 | 4 | 0 | 0 | 0 | 0 | 20 |
| S | 11 | 9 | 1 | 0 | 0 | 0 | 21 |
| SSW | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| SW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| WSW | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| W | 3 | 1 | 0 | 0 | 0 | 0 | 4 |
| WNW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| NW | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| NNW | 10 | 0 | 0 | 0 | 0 | 0 | 10 |
| Total | 149 | 18 | 1 | 0 | 0 | 0 | 168 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 168 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
 04/01/2023 - 06/30/2023
 Elevation: Speed: SP10M Direction: DIR10M 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 | 0 | 0 | 0 | 0 | 0 | 2 |
| NNE | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| NE | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| ENE | 15 | 0 | 0 | 0 | 0 | 0 | 15 |
| E | 69 | 1 | 0 | 0 | 0 | 0 | 70 |
| ESE | 71 | 0 | 0 | 0 | 0 | 0 | 71 |
| SE | 50 | 0 | 0 | 0 | 0 | 0 | 50 |
| SSE | 23 | 0 | 0 | 0 | 0 | 0 | 23 |
| S | 28 | 0 | 0 | 0 | 0 | 0 | 28 |
| SSW | 21 | 0 | 0 | 0 | 0 | 0 | 21 |
| SW | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| WSW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| W | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 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 | 302 | 1 | 0 | 0 | 0 | 0 | 303 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 303 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
04/01/2023 - 06/30/2023
Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M

Stability Class: ALL Delta Temperature

Wind Speed (mph)

| Wind Direction | 1-4 | 4-8 | 8-13 | 13-19 | 19-25 | > 25 | Total |
|----------------|------|-----|------|-------|-------|------|-------|
| N | 106 | 118 | 3 | 0 | 0 | 0 | 227 |
| NNE | 60 | 14 | 0 | 0 | 0 | 0 | 74 |
| NE | 54 | 23 | 0 | 0 | 0 | 0 | 77 |
| ENE | 51 | 22 | 2 | 0 | 0 | 0 | 75 |
| E | 117 | 37 | 2 | 0 | 0 | 0 | 156 |
| ESE | 128 | 19 | 2 | 0 | 0 | 0 | 149 |
| SE | 117 | 54 | 11 | 0 | 0 | 0 | 182 |
| SSE | 65 | 69 | 18 | 0 | 0 | 0 | 152 |
| S | 63 | 49 | 22 | 3 | 1 | 0 | 138 |
| SSW | 49 | 50 | 14 | 2 | 0 | 0 | 115 |
| SW | 27 | 83 | 35 | 1 | 0 | 0 | 146 |
| WSW | 36 | 57 | 13 | 0 | 0 | 0 | 106 |
| W | 27 | 46 | 8 | 0 | 0 | 0 | 81 |
| WNW | 26 | 36 | 5 | 0 | 0 | 0 | 67 |
| NW | 50 | 55 | 4 | 0 | 0 | 0 | 109 |
| NNW | 97 | 128 | 12 | 0 | 0 | 0 | 237 |
| Total | 1073 | 860 | 151 | 6 | 1 | 0 | 2091 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 80 |
| Variable Direction Hours for: | Total Period | All Hours | 0 |
| Invalid Hours for: | Total Period | All Hours | 13 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 2091 |
| Total Hours for the Period: | | | 2184 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 31 | 38 | 0 | 0 | 0 | 0 | 69 |
| NNE | 2 | 4 | 0 | 0 | 0 | 0 | 6 |
| NE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| ENE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| E | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| ESE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 0 | 6 | 0 | 0 | 0 | 0 | 6 |
| S | 1 | 3 | 1 | 0 | 0 | 0 | 5 |
| SSW | 0 | 12 | 2 | 0 | 0 | 0 | 14 |
| SW | 2 | 20 | 0 | 0 | 0 | 0 | 22 |
| WSW | 1 | 6 | 0 | 0 | 0 | 0 | 7 |
| W | 6 | 5 | 0 | 0 | 0 | 0 | 11 |
| WNW | 8 | 7 | 0 | 0 | 0 | 0 | 15 |
| NW | 11 | 9 | 0 | 0 | 0 | 0 | 20 |
| NNW | 22 | 28 | 0 | 0 | 0 | 0 | 50 |
| Total | 93 | 140 | 3 | 0 | 0 | 0 | 236 |

Calm Hours not Included above for:
Number of Valid Hours for this Table:
Total Hours for the Period:

Total Period
Total Period

All Hours
All Hours

162
236
2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 7 | 9 | 0 | 0 | 0 | 0 | 16 |
| NNE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| NE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| ENE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| E | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| ESE | 2 | 4 | 0 | 0 | 0 | 0 | 6 |
| SE | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| SSE | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| S | 1 | 4 | 1 | 0 | 0 | 0 | 6 |
| SSW | 1 | 18 | 3 | 0 | 0 | 0 | 22 |
| SW | 4 | 17 | 0 | 0 | 0 | 0 | 21 |
| WSW | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| W | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| WNW | 6 | 1 | 0 | 0 | 0 | 0 | 7 |
| NW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| NNW | 9 | 4 | 0 | 0 | 0 | 0 | 13 |
| Total | 48 | 65 | 4 | 0 | 0 | 0 | 117 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 162 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 117 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 6 | 5 | 0 | 0 | 0 | 0 | 11 |
| NNE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| NE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| ENE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| E | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| ESE | 4 | 4 | 0 | 0 | 0 | 0 | 8 |
| SE | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| SSE | 3 | 4 | 0 | 0 | 0 | 0 | 7 |
| S | 2 | 10 | 0 | 0 | 0 | 0 | 12 |
| SSW | 3 | 18 | 0 | 0 | 0 | 0 | 21 |
| SW | 3 | 18 | 0 | 0 | 0 | 0 | 21 |
| WSW | 9 | 1 | 0 | 0 | 0 | 0 | 10 |
| W | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| WNW | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| NW | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| NNW | 6 | 1 | 0 | 0 | 0 | 0 | 7 |
| Total | 52 | 69 | 0 | 0 | 0 | 0 | 121 |
| Calm Hours not Included above for: | | | | | | | 162 |
| Number of Valid Hours for this Table: | | | | | | | 121 |
| Total Hours for the Period: | | | | | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 44 | 24 | 1 | 0 | 0 | 0 | 69 |
| NNE | 14 | 0 | 0 | 0 | 0 | 0 | 14 |
| NE | 9 | 0 | 0 | 0 | 0 | 0 | 9 |
| ENE | 6 | 1 | 0 | 0 | 0 | 0 | 7 |
| E | 9 | 2 | 0 | 0 | 0 | 0 | 11 |
| ESE | 26 | 10 | 0 | 0 | 0 | 0 | 36 |
| SE | 30 | 8 | 0 | 0 | 0 | 0 | 38 |
| SSE | 20 | 2 | 0 | 0 | 0 | 0 | 22 |
| S | 36 | 46 | 1 | 0 | 0 | 0 | 83 |
| SSW | 11 | 38 | 2 | 0 | 0 | 0 | 51 |
| SW | 18 | 29 | 1 | 0 | 0 | 0 | 48 |
| WSW | 8 | 4 | 0 | 0 | 0 | 0 | 12 |
| W | 13 | 4 | 0 | 0 | 0 | 0 | 17 |
| WNW | 16 | 0 | 0 | 0 | 0 | 0 | 16 |
| NW | 19 | 0 | 0 | 0 | 0 | 0 | 19 |
| NNW | 44 | 9 | 0 | 0 | 0 | 0 | 53 |
| Total | 323 | 177 | 5 | 0 | 0 | 0 | 505 |

Calm Hours not Included above for:
Number of Valid Hours for this Table:
Total Hours for the Period:

Total Period
Total Period

All Hours
All Hours

162
505
2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 54 | 10 | 1 | 1 | 0 | 0 | 66 |
| NNE | 7 | 2 | 0 | 0 | 0 | 0 | 9 |
| NE | 11 | 4 | 0 | 0 | 0 | 0 | 15 |
| ENE | 11 | 2 | 0 | 0 | 0 | 0 | 13 |
| E | 16 | 2 | 0 | 0 | 0 | 0 | 18 |
| ESE | 44 | 1 | 0 | 0 | 0 | 0 | 45 |
| SE | 35 | 3 | 0 | 0 | 0 | 0 | 38 |
| SSE | 28 | 4 | 0 | 0 | 0 | 0 | 32 |
| S | 47 | 34 | 2 | 0 | 0 | 0 | 83 |
| SSW | 27 | 23 | 3 | 0 | 0 | 0 | 53 |
| SW | 15 | 6 | 2 | 0 | 0 | 0 | 23 |
| WSW | 6 | 2 | 0 | 0 | 0 | 0 | 8 |
| W | 12 | 1 | 0 | 0 | 0 | 0 | 13 |
| WNW | 7 | 1 | 0 | 0 | 0 | 0 | 8 |
| NW | 10 | 1 | 0 | 0 | 0 | 0 | 11 |
| NNW | 18 | 2 | 0 | 0 | 0 | 0 | 20 |
| Total | 348 | 98 | 8 | 1 | 0 | 0 | 455 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 162 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 455 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: **Speed:** SP10M **Direction:** DIR10M **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 | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| NNE | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| NE | 9 | 0 | 0 | 0 | 0 | 0 | 9 |
| ENE | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| E | 23 | 0 | 0 | 0 | 0 | 0 | 23 |
| ESE | 42 | 0 | 0 | 0 | 0 | 0 | 42 |
| SE | 37 | 0 | 0 | 0 | 0 | 0 | 37 |
| SSE | 31 | 0 | 0 | 0 | 0 | 0 | 31 |
| S | 34 | 6 | 0 | 0 | 0 | 0 | 40 |
| SSW | 11 | 1 | 0 | 0 | 0 | 0 | 12 |
| SW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| WSW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| W | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | 216 | 7 | 0 | 0 | 0 | 0 | 223 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 162 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 223 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| ENE | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| E | 44 | 0 | 0 | 0 | 0 | 0 | 44 |
| ESE | 75 | 0 | 0 | 0 | 0 | 0 | 75 |
| SE | 45 | 0 | 0 | 0 | 0 | 0 | 45 |
| SSE | 47 | 0 | 0 | 0 | 0 | 0 | 47 |
| S | 70 | 0 | 0 | 0 | 0 | 0 | 70 |
| SSW | 35 | 0 | 0 | 0 | 0 | 0 | 35 |
| SW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| WSW | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| W | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| WNW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 336 | 0 | 0 | 0 | 0 | 0 | 336 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 162 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 336 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
07/01/2023 - 09/30/2023
Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M

Stability Class: ALL Delta Temperature

| Wind Direction | Wind Speed (mph) | | | | | | Total |
|----------------|------------------|-----|------|-------|-------|------|-------|
| | 1-4 | 4-8 | 8-13 | 13-19 | 19-25 | > 25 | |
| N | 148 | 86 | 2 | 1 | 0 | 0 | 237 |
| NNE | 35 | 6 | 0 | 0 | 0 | 0 | 41 |
| NE | 42 | 4 | 0 | 0 | 0 | 0 | 46 |
| ENE | 36 | 3 | 0 | 0 | 0 | 0 | 39 |
| E | 97 | 8 | 0 | 0 | 0 | 0 | 105 |
| ESE | 194 | 19 | 0 | 0 | 0 | 0 | 213 |
| SE | 149 | 17 | 0 | 0 | 0 | 0 | 166 |
| SSE | 131 | 18 | 0 | 0 | 0 | 0 | 149 |
| S | 191 | 103 | 5 | 0 | 0 | 0 | 299 |
| SSW | 88 | 110 | 10 | 0 | 0 | 0 | 208 |
| SW | 48 | 90 | 3 | 0 | 0 | 0 | 141 |
| WSW | 29 | 14 | 0 | 0 | 0 | 0 | 43 |
| W | 40 | 13 | 0 | 0 | 0 | 0 | 53 |
| WNW | 40 | 11 | 0 | 0 | 0 | 0 | 51 |
| NW | 47 | 10 | 0 | 0 | 0 | 0 | 57 |
| NNW | 101 | 44 | 0 | 0 | 0 | 0 | 145 |
| Total | 1416 | 556 | 20 | 1 | 0 | 0 | 1993 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 162 |
| Variable Direction Hours for: | Total Period | All Hours | 0 |
| Invalid Hours for: | Total Period | All Hours | 53 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 1993 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = Total Period
10/01/2023 00:00 - 12/31/2023 23:00
Elevation: Speed: SP10M Direction: DIR10M 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 | 5 | 11 | 0 | 0 | 0 | 0 | 16 |
| NNE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 8 | 0 | 0 | 0 | 0 | 8 |
| WSW | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| W | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| WNW | 1 | 6 | 0 | 0 | 0 | 0 | 7 |
| NW | 0 | 11 | 0 | 0 | 0 | 0 | 11 |
| NNW | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| Total | 6 | 47 | 1 | 0 | 0 | 0 | 54 |
| Calm Hours not Included above for: | Total Period | | All Hours | | 24 | | |
| Number of Valid Hours for this Table: | Total Period | | All Hours | | 54 | | |
| Total Hours for the Period: | | | | | 2208 | | |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = Total Period
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 1 | 0 | 0 | 0 | 5 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 0 | 5 | 1 | 0 | 0 | 0 | 6 |
| S | 0 | 6 | 3 | 0 | 0 | 0 | 9 |
| SSW | 0 | 2 | 3 | 0 | 0 | 0 | 5 |
| SW | 0 | 13 | 3 | 0 | 0 | 0 | 16 |
| WSW | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| W | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| WNW | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| NW | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| NNW | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| Total | 1 | 47 | 11 | 0 | 0 | 0 | 59 |
| Calm Hours not Included above for: | Total Period | | All Hours | | 24 | | |
| Number of Valid Hours for this Table: | Total Period | | All Hours | | 59 | | |
| Total Hours for the Period: | | | | | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 2 | 7 | 0 | 0 | 0 | 0 | 9 |
| NNE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| ENE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| E | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| ESE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| S | 0 | 7 | 7 | 0 | 0 | 0 | 14 |
| SSW | 0 | 7 | 6 | 0 | 0 | 0 | 13 |
| SW | 0 | 7 | 3 | 0 | 0 | 0 | 10 |
| WSW | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| W | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| WNW | 1 | 4 | 0 | 0 | 0 | 0 | 5 |
| NW | 4 | 1 | 0 | 0 | 0 | 0 | 5 |
| NNW | 1 | 4 | 0 | 0 | 0 | 0 | 5 |
| Total | 16 | 47 | 16 | 0 | 0 | 0 | 79 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 24 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 79 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 22 | 39 | 2 | 0 | 0 | 0 | 63 |
| NNE | 32 | 6 | 0 | 0 | 0 | 0 | 38 |
| NE | 21 | 2 | 0 | 0 | 0 | 0 | 23 |
| ENE | 24 | 6 | 0 | 0 | 0 | 0 | 30 |
| E | 25 | 22 | 1 | 0 | 0 | 0 | 48 |
| ESE | 27 | 36 | 3 | 0 | 0 | 0 | 66 |
| SE | 21 | 31 | 4 | 0 | 0 | 0 | 56 |
| SSE | 29 | 36 | 1 | 0 | 0 | 0 | 66 |
| S | 21 | 83 | 41 | 3 | 0 | 0 | 148 |
| SSW | 15 | 62 | 30 | 0 | 0 | 0 | 107 |
| SW | 14 | 51 | 3 | 1 | 0 | 0 | 69 |
| WSW | 4 | 27 | 10 | 0 | 0 | 0 | 41 |
| W | 6 | 48 | 10 | 0 | 0 | 0 | 64 |
| WNW | 10 | 36 | 2 | 0 | 0 | 0 | 48 |
| NW | 5 | 37 | 2 | 0 | 0 | 0 | 44 |
| NNW | 17 | 38 | 14 | 0 | 0 | 0 | 69 |
| Total | 293 | 560 | 123 | 4 | 0 | 0 | 980 |

Calm Hours not Included above for:
Number of Valid Hours for this Table:
Total Hours for the Period:

Total Period
Total Period

All Hours
All Hours

24
980
2208

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 18 | 29 | 0 | 0 | 0 | 0 | 47 |
| NNE | 10 | 2 | 0 | 0 | 0 | 0 | 12 |
| NE | 13 | 0 | 0 | 0 | 0 | 0 | 13 |
| ENE | 11 | 1 | 0 | 0 | 0 | 0 | 12 |
| E | 21 | 4 | 0 | 0 | 0 | 0 | 25 |
| ESE | 25 | 11 | 0 | 0 | 0 | 0 | 36 |
| SE | 23 | 25 | 0 | 0 | 0 | 0 | 48 |
| SSE | 42 | 29 | 0 | 0 | 0 | 0 | 71 |
| S | 31 | 117 | 12 | 0 | 0 | 0 | 160 |
| SSW | 10 | 43 | 7 | 0 | 0 | 0 | 60 |
| SW | 6 | 21 | 3 | 0 | 0 | 0 | 30 |
| WSW | 6 | 16 | 0 | 0 | 0 | 0 | 22 |
| W | 8 | 16 | 1 | 0 | 0 | 0 | 25 |
| WNW | 7 | 19 | 0 | 0 | 0 | 0 | 26 |
| NW | 12 | 15 | 0 | 0 | 0 | 0 | 27 |
| NNW | 18 | 27 | 1 | 0 | 0 | 0 | 46 |
| Total | 261 | 375 | 24 | 0 | 0 | 0 | 660 |
| Calm Hours not Included above for: | Total Period | | All Hours | | | | 24 |
| Number of Valid Hours for this Table: | Total Period | | All Hours | | | | 660 |
| Total Hours for the Period: | | | | | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M 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 | 0 | 0 | 0 | 0 | 0 | 2 |
| NNE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| NE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| ENE | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| E | 15 | 0 | 0 | 0 | 0 | 0 | 15 |
| ESE | 21 | 0 | 0 | 0 | 0 | 0 | 21 |
| SE | 25 | 1 | 0 | 0 | 0 | 0 | 26 |
| SSE | 32 | 4 | 0 | 0 | 0 | 0 | 36 |
| S | 16 | 9 | 0 | 0 | 0 | 0 | 25 |
| SSW | 3 | 2 | 0 | 0 | 0 | 0 | 5 |
| SW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 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 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 132 | 16 | 0 | 0 | 0 | 0 | 148 |
| Calm Hours not Included above for: | Total Period | | | | | | 24 |
| Number of Valid Hours for this Table: | Total Period | | | | | | 148 |
| Total Hours for the Period: | | | | | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = **Total Period**
 10/01/2023 - 12/31/2023
 Elevation: Speed: SP10M Direction: DIR10M 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 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| ENE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| E | 12 | 0 | 0 | 0 | 0 | 0 | 12 |
| ESE | 28 | 0 | 0 | 0 | 0 | 0 | 28 |
| SE | 24 | 0 | 0 | 0 | 0 | 0 | 24 |
| SSE | 37 | 0 | 0 | 0 | 0 | 0 | 37 |
| S | 20 | 0 | 0 | 0 | 0 | 0 | 20 |
| SSW | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| SW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| WSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 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 | 131 | 0 | 0 | 0 | 0 | 0 | 131 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 24 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 131 |
| Total Hours for the Period: | | | 2208 |

Site: AEP Cook

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record TM **Total Period**
10/01/2023 - 12/31/2023
Elevation: Speed: SP10M Direction: DIR10M Lapse: DT60M

Stability Class: ALL Delta Temperature

Wind Speed (mph)

| Wind Direction | 1-4 | 4-8 | 8-13 | 13-19 | 19-25 | > 25 | Total |
|----------------|-----|------|------|-------|-------|------|-------|
| N | 49 | 90 | 3 | 0 | 0 | 0 | 142 |
| NNE | 47 | 9 | 0 | 0 | 0 | 0 | 56 |
| NE | 38 | 3 | 0 | 0 | 0 | 0 | 41 |
| ENE | 49 | 8 | 0 | 0 | 0 | 0 | 57 |
| E | 74 | 29 | 1 | 0 | 0 | 0 | 104 |
| ESE | 101 | 48 | 3 | 0 | 0 | 0 | 152 |
| SE | 93 | 57 | 4 | 0 | 0 | 0 | 154 |
| SSE | 141 | 76 | 2 | 0 | 0 | 0 | 219 |
| S | 88 | 226 | 63 | 3 | 0 | 0 | 380 |
| SSW | 31 | 116 | 46 | 0 | 0 | 0 | 193 |
| SW | 22 | 100 | 12 | 1 | 0 | 0 | 135 |
| WSW | 11 | 49 | 11 | 0 | 0 | 0 | 71 |
| W | 16 | 71 | 11 | 0 | 0 | 0 | 98 |
| WNW | 19 | 67 | 2 | 0 | 0 | 0 | 88 |
| NW | 24 | 69 | 2 | 0 | 0 | 0 | 95 |
| NNW | 37 | 74 | 15 | 0 | 0 | 0 | 126 |
| Total | 840 | 1092 | 175 | 4 | 0 | 0 | 2111 |

| | | | |
|---------------------------------------|--------------|-----------|------|
| Calm Hours not Included above for: | Total Period | All Hours | 24 |
| Variable Direction Hours for: | Total Period | All Hours | 0 |
| Invalid Hours for: | Total Period | All Hours | 73 |
| Number of Valid Hours for this Table: | Total Period | All Hours | 2111 |
| Total Hours for the Period: | | | 2208 |

OFF-SITE DOSE CALCULATION MANUAL CHANGES

The Off-Site Dose Calculation Manual, PMP-6010-OSD-001, was not revised during this 2023 reporting period.