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April 29, 1999

10 CFR 50.36a(a)(2)

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Attention: Document Control Desk
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Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Radioactive Effluent Release Report January - December, 1998

Enclosed please find a copy of the Kewaunee Nuclear Power Plant Radioactive Effluent Release Report for January through December, 1998. This report is submitted to meet the requirements of Technical Specification 6.9.b.2.

Sincerely,

Mark L. Marchi
Vice President-Nuclear

DFS/jmf

Enc.

cc - US NRC Senior Resident Inspector
US NRC Region III

///
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KEWAUNEE

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RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

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KEWAUNEE NUCLEAR POWER PLANT

RADIOACTIVE EFFLUENT RELEASE REPORT JAN-DEC 1998



WISCONSIN PUBLIC SERVICE CORPORATION
ALLIANT ENERGY
MADISON GAS & ELECTRIC COMPANY

DOCKET 50-305

KEWAUNEE NUCLEAR POWER PLANT

**ANNUAL RADIOACTIVE
EFFLUENT RELEASE REPORT**

January 1 - December 31, 1998

Wisconsin Public Service Corporation
Green Bay, Wisconsin
April 23, 1999

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Appendix A Meteorological Data

0.0 SUMMARY

During 1998 all solid, liquid, and gaseous radioactive effluents from the Kewaunee Nuclear Plant were well below regulatory limits. For individual effluent streams, the quarterly limit most closely approached was:

| | | | |
|-----------------|---|--|---------------------------|
| <u>GASEOUS:</u> | Ingestion Pathway-Organ | Total Body | |
| | Quarterly Limit (mRems) | 7.5 | |
| | Actual Dose (mRems) | 0.001389 | (1 st Quarter) |
| | % of Specification | 0.01852 | |
| <u>LIQUID:</u> | Ingestion Pathway-Organ | GI-LLI | |
| | Quarterly Limit (mRems) | 5 | |
| | Actual Dose (mRems) | 0.06771 | (4 th Quarter) |
| | % of Limit | 1.35 | |
| <u>SOLID:</u> | No upper limit for solid radioactive waste applies. | | |
| | Cubic Meters Shipped | 3.96 m ³ (140 ft ³) | |

1.0 INTRODUCTION

This report is being submitted in accordance with the requirements of Kewaunee Technical Specifications, Section 6.9.b.2 and the Offsite Dose Calculation Manual, Section 3/4.7. It includes data from all effluent releases made from January 1 - December 31, 1998. The report contains summaries of the gaseous and liquid releases made to the environment including the quantity, characterization, time duration and calculated radiation dose at the site boundary resulting from these releases. The report also includes a summation of solid waste disposal, revisions to the Process Control Program and the Offsite Dose Calculation Manual, and addresses the cumulative meteorological data.

1.1 **Effluent Dose Limits**

Specifications are set to insure that offsite doses are maintained as low as reasonably achievable while still allowing for practical and dependable operation of the Kewaunee Plant.

The Kewaunee Offsite Dose Calculation Manual (ODCM) describes the methodology and parameters used in:

- 1.) The calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints.
- 2.) The calculation of radioactive liquid and gaseous concentrations, dose rates and cumulative quarterly and annual doses. The ODCM methodology is acceptable for use in demonstrating compliance with 10 CFR 20.106; 10 CFR 50, Appendix I; and 40 CFR 190.

2.0 GASEOUS EFFLUENTS

2.1 Lower Limits of Detection (LLD) for Gaseous Effluents

Gaseous radioactive effluents are released in both the continuous mode and the batch mode. The auxiliary building stack is sampled continuously for particulates, halogens and Strontium by an "off-line" sample train. This stack is also grab-sampled daily for gaseous gamma emitters. Batch releases are sampled prior to release for principal gaseous and particulate gamma emitters, halogens and tritium.

The LLD's for gaseous radioanalyses, as listed in Table 4.4 of the Kewaunee ODCM are:

| Analysis | LLD ($\mu\text{Ci/ml}$) |
|----------------------------------|---------------------------|
| Gaseous Gamma Emitters | 1.00 E-04 |
| Iodine 131 | 3.00 E-12 |
| Particulate Gamma Emitters | 1.00 E-11 |
| Particulate Gross Alpha | 1.00 E-11 |
| Strontium 89, 90 | 1.00 E-11 |
| Noble Gases, Gross Beta or Gamma | 1.00 E-06 |

The nominal "a priori" LLD values are shown below.

| Isotope | a priori LLD ($\mu\text{Ci/ml}$) |
|---------|------------------------------------|
|---------|------------------------------------|

a. Gaseous emissions:

| | |
|---------|----------|
| Kr-87 | 1.11E-07 |
| Kr-88 | 1.73E-07 |
| Xe-133 | 1.30E-07 |
| Xe-133m | 2.51E-07 |
| Xe-135 | 3.34E-08 |
| Xe-138 | 8.99E-08 |

b. Particulate emissions:

| | |
|--------|----------|
| Mn-54 | 1.56E-13 |
| Fe-59 | 2.33E-13 |
| Co-58 | 2.56E-13 |
| Co-60 | 3.90E-13 |
| Zn-65 | 1.89E-13 |
| Mo-99 | 1.52E-13 |
| Cs-134 | 2.18E-13 |
| Cs-137 | 4.32E-13 |
| Ce-141 | 1.65E-13 |
| Ce-144 | 1.14E-12 |

c. Other identifiable gamma emitters:

| | |
|---------|----------|
| Ar-41 | 4.36E-08 |
| Kr-85 | 9.85E-06 |
| Kr-85m | 6.11E-08 |
| Kr-89 | 5.45E-07 |
| Xe-127 | 2.74E-08 |
| Xe-131m | 2.05E-06 |
| Xe-135m | 5.39E-08 |
| Xe-137 | 3.20E-07 |
| I-131 | 1.35E-13 |

d. Composite particulate samples:

| | |
|-------------|-----------|
| Sr-89 | 1 E-14 |
| Sr-90 | 1 E-14 |
| Gross Alpha | 1.00 E-14 |

These "a priori" LLDs represent the capabilities of the counting systems in use, not an after the fact "a posteriori" limit for a particular measurement.

2.2 Gaseous Batch Release Statistics

The following is a summation of all gaseous batch releases made during 1998.

| | |
|--|---------|
| Number of batch releases..... | 24 |
| Total time for all batch releases (min)..... | 12441.0 |
| Maximum time for a batch release (min)..... | 1440.0 |
| Average time for a batch release (min)..... | 518.4 |
| Minimum time for a batch release (min)..... | 25.0 |

2.3 Gaseous Effluent Data

The following Table 2.1 presents a quarterly summation of the total activity released and average release rates of four categories of gaseous effluents. Table 2.2 lists the quarterly sums of individual gaseous radionuclides released by continuous and batch modes. Table 2.3 is essentially the same data, but is presented as monthly summations. Table 2.4 presents the dose limits for gaseous effluents, and the calculated doses this year from gaseous effluents.

Table 2.1
Annual Radioactive Effluent Release Report 1998
Gaseous Effluents - Summation of all Releases

| Fission and Activation Gases | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|--------------------------------------|-------------|-------------|-------------|-------------|
| Total Activity Released (Ci) | 4.635E-002 | 0.000E+000 | 0.000E+000 | 4.637E-002 |
| Average Release Rate (μ Ci/sec) | 5.895E-003 | 0.000E+000 | 0.000E+000 | 5.898E-003 |
| Iodines | | | | |
| Total Activity Released (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Average Release Rate (μ Ci/sec) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Particulates | | | | |
| Total Activity Released (Ci) | 3.153E-007 | 0.000E+000 | 0.000E+000 | 2.388E-006 |
| Average Release Rate (μ Ci/sec) | 4.010E-008 | 0.000E+000 | 0.000E+000 | 3.038E-007 |
| Gross Alpha Released (Ci) | 1.507E-006 | 0.000E+000 | 1.912E-007 | 8.053E-008 |
| Tritium | | | | |
| Total Activity Released (Ci) | 6.575E+001 | 1.117E+000 | 4.058E-001 | 5.019E+000 |
| Average Release Rate (μ Ci/sec) | 8.362E+000 | 1.420E-001 | 5.161E-002 | 6.384E-001 |

Table 2.2
Annual Radioactive Effluent Release Report 1998
Gaseous Effluents

| | Nuclides Released (Ci) Continuous Mode | | | |
|----------------------|---|-------------|-------------|-------------|
| | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
| Fission Gases | | | | |
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Iodines | | | | |
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Particulates | | | | |
| Co-58 | 0.000E+000 | 0.000E+000 | 0.000E+000 | 1.451E-006 |
| Co-60 | 0.000E+000 | 0.000E+000 | 0.000E+000 | 2.880E-007 |
| Sr-89 | 3.153E-007 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Cs-137 | 0.000E+000 | 0.000E+000 | 0.000E+000 | 6.490E-007 |
| Total | 3.153E-007 | 0.000E+000 | 0.000E+000 | 2.388E-006 |

Table 2.2(cont.)
Annual Radioactive Effluent Release Report 1998
Gaseous Effluents

Nuclides Released (Ci)
 Batch Mode

Fission Gases

| | | | | |
|---------|------------|------------|------------|------------|
| Ar-41 | 3.650E-002 | 0.000E+000 | 0.000E+000 | 3.526E-002 |
| Xe-133 | 9.799E-003 | 0.000E+000 | 0.000E+000 | 1.112E-002 |
| Xe-133m | 4.893E-005 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total | 4.635E-002 | 0.000E+000 | 0.000E+000 | 4.637E-002 |

Iodines

| | | | | |
|-------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
|-------|------------|------------|------------|------------|

Particulates

| | | | | |
|-------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
|-------|------------|------------|------------|------------|

Table 2.3A
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Total of all Releases

Noble Gasses (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Ar-41 | 0.000E+000 | 3.650E-002 | 0.000E+000 | 3.650E-002 |
| Xe-133 | 0.000E+000 | 9.799E-003 | 0.000E+000 | 9.799E-003 |
| Xe-133m | 0.000E+000 | 4.893E-005 | 0.000E+000 | 4.893E-005 |
| Total | 0.000E+000 | 4.635E-002 | 0.000E+000 | 4.635E-002 |

Particulates (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Sr-89 | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |
| Total | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |

Halogens (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Total of all Releases

| Summary | January | February | March | <u>Total</u> |
|------------------------------------|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 4.635E-002 | 0.000E+000 | 4.635E-002 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma | | | | |

| | | | | |
|--|------------|------------|------------|------------|
| Half-Lives > 8 Days (Ci) | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |
| Total Tritium (Ci) | 2.662E-001 | 6.547E+001 | 9.097E-003 | 6.575E+001 |
| Total Particulate Gross Alpha (Ci) | 1.058E-007 | 1.362E-006 | 3.893E-008 | 1.507E-006 |

**Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Total of all Releases**

Noble Gasses (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Total of all Releases**

| Summary | April | May | June | <u>Total</u> |
|---------|-------|-----|------|--------------|
|---------|-------|-----|------|--------------|

| | | | | |
|---|------------|------------|------------|------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 8.719E-001 | 8.906E-003 | 2.358E-001 | 1.117E+000 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
3rd Quarter Gaseous Release
Total of all Releases**

Noble Gasses (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998**

**3rd Quarter Gaseous Release
Total of all Releases**

| Summary | July | August | September | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives > 8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 0.000E+000 | 0.000E+000 | 4.058E-001 | 4.058E-001 |
| Total Particulate Gross Alpha (Ci) | 1.587E-007 | 3.256E-008 | 0.000E+000 | 1.912E-007 |

**Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Total of all Releases**

Noble Gases (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Ar-41 | 3.526E-002 | 0.000E+000 | 0.000E+000 | 3.526E-002 |
| Xe-133 | 1.002E-002 | 1.096E-003 | 0.000E+000 | 1.112E-002 |
| Total | 4.528E-002 | 1.096E-003 | 0.000E+000 | 4.637E-002 |

Particulates (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Co-58 | 1.041E-006 | 4.107E-007 | 0.000E+000 | 1.451E-006 |
| Co-60 | 0.000E+000 | 0.000E+000 | 2.880E-007 | 2.880E-007 |

| | | | | |
|--------|------------|------------|------------|------------|
| Cs-137 | 0.000E+000 | 0.000E+000 | 6.490E-007 | 6.490E-007 |
| Total | 1.041E-006 | 4.107E-007 | 9.370E-007 | 2.388E-006 |

Halogens (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.3A (cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Total of all Releases

| Summary | October | November | December | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 4.528E-002 | 1.096E-003 | 0.000E+000 | 4.637E-002 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 1.041E-006 | 4.107E-007 | 9.370E-007 | 2.388E-006 |
| Total Tritium (Ci) | 2.133E+000 | 2.236E+000 | 6.508E-001 | 5.019E+000 |
| Total Particulate Gross Alpha (Ci) | 8.053E-008 | 0.000E+000 | 0.000E+000 | 8.053E-008 |

Table 2.3B
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Continuons Mode Only

Noble Gasses (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Sr-89 | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |
| Total | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |

Halogens (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Continuous Mode Only

| Summary | January | February | March | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 3.153E-007 | 0.000E+000 | 3.153E-007 |
| Total Tritium (Ci) | 2.582E-001 | 4.999E+001 | 9.097E-003 | 5.026E+001 |
| Total Particulate Gross Alpha (Ci) | 1.058E-007 | 1.362E-006 | 3.893E-008 | 1.507E-006 |

**Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Continuous Mode Only**

Noble Gasses (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Continuous Mode Only**

| Sammary | April | May | June | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 8.719E-001 | 0.000E+000 | 2.324E-001 | 1.104E+000 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3B (cont.)
Annual Radioactive Effluent Release Report 1998
3rd Quarter Gaseous Release
Continuous Mode Only**

Noble Gasses (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
3rd Quarter Gaseous Release
Continuous Mode Only**

| Summary | July | August | September | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives > 8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 0.000E+000 | 0.000E+000 | 4.058E-001 | 4.058E-001 |
| Total Particulate Gross Alpha (Ci) | 1.587E-007 | 3.256E-008 | 0.000E+000 | 1.912E-007 |

Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Continuous Mode Only

Noble Gasses (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Co-58 | 1.041E-006 | 4.107E-007 | 0.000E+000 | 1.451E-006 |
| Co-60 | 0.000E+000 | 0.000E+000 | 2.880E-007 | 2.880E-007 |
| Cs-137 | 0.000E+000 | 0.000E+000 | 6.490E-007 | 6.490E-007 |
| Total | 1.041E-006 | 4.107E-007 | 9.370E-007 | 2.388E-006 |

Halogens (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Continuous Mode Only**

| Summary | October | November | December | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 1.041E-006 | 4.107E-007 | 9.370E-007 | 2.388E-006 |
| Total Tritium (Ci) | 0.000E+000 | 2.235E+000 | 6.508E-001 | 2.886E+000 |
| Total Particulate Gross Alpha (Ci) | 8.053E-008 | 0.000E+000 | 0.000E+000 | 8.053E-008 |

Table 2.3C
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Batch Mode Only

Noble Gasses (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Ar-41 | 0.000E+000 | 3.650E-002 | 0.000E+000 | 3.650E-002 |
| Xe-133 | 0.000E+000 | 9.799E-003 | 0.000E+000 | 9.799E-003 |
| Xe-133m | 0.000E+000 | 4.893E-005 | 0.000E+000 | 4.893E-005 |
| Total | 0.000E+000 | 4.635E-002 | 0.000E+000 | 4.635E-002 |

Particulates (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | January | February | March | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
1st Quarter Gaseous Release
Batch Mode Only

| Summary | January | February | March | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 4.635E-002 | 0.000E+000 | 4.635E-002 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 7.965E-003 | 1.548E+001 | 0.000E+000 | 1.549E+001 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Batch Mode Only**

Noble Gasses (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | April | May | June | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
2nd Quarter Gaseous Release
Batch Mode Only**

| Summary | April | May | June | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 0.000E+000 | 8.906E-003 | 3.409E-003 | 1.231E-002 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3C (cont.)
Annual Radioactive Effluent Release Report 1998
3rd Quarter Gaseous Release
Batch Mode Only**

Noble Gasses (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Particulates (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | July | August | September | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
3rd Quarter Gaseous Release
Batch Mode Only**

| Summary | July | August | September | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Batch Mode Only

Noble Gasses (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Ar-41 | 3.526E-002 | 0.000E+000 | 0.000E+000 | 3.526E-002 |
| Xe-133 | 1.002E-002 | 1.096E-003 | 0.000E+000 | 1.112E-002 |
| Total | 4.528E-002 | 1.096E-003 | 0.000E+000 | 4.637E-002 |

Particulates (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Halogens (Curies)

| Isotope | October | November | December | Total |
|---------|------------|------------|------------|------------|
| Total | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

**Table 2.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
4th Quarter Gaseous Release
Batch Mode Only**

| Summary | October | November | December | <u>Total</u> |
|---|------------|------------|------------|--------------|
| Total Noble Gases (Ci) | 4.528E-002 | 1.096E-003 | 0.000E+000 | 4.637E-002 |
| Total Halogens (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Particulate Gross Beta-Gamma Half-Lives>8 Days (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Total Tritium (Ci) | 2.133E+000 | 7.436E-004 | 0.000E+000 | 2.133E+000 |
| Total Particulate Gross Alpha (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |

Table 2.4
Annual Radioactive Effluent Release Report 1998
Dose From Gaseous Effluents

The offsite dose limits from radioactive materials in gaseous effluents are specified in Section 3/4.4 of the Kewaunee ODCM and can be summarized as follows:

| Limit | Whole Body | Skin | Organ |
|-----------|------------|-----------|-----------|
| | Gamma | Beta | |
| Quarterly | 5.0 mRad | 10.0 mRad | 7.5 mRem |
| Annual | 10.0 mRad | 20.0 mRad | 15.0 mRem |

The total release of gaseous effluents during each quarter of 1998 was within limits. The following offsite doses were calculated using equations 2.7, 2.8, and 2.11 from the Kewaunee ODCM. Calculated offsite doses versus quarterly limits are shown below:

| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
|-----------------------------------|------------|------------|------------|------------|
| 1. Gamma-Whole Body | | | | |
| Specification (mRads) | 5.000E+000 | 5.000E+000 | 5.000E+000 | 5.000E+000 |
| Actual Dose (mRads) | 3.913E-005 | 0.000E+000 | 0.000E+000 | 3.787E-005 |
| % of Specification | 7.827E-004 | 0.000E+000 | 0.000E+000 | 7.573E-004 |
| 2. Beta-Skin | | | | |
| Specification (mRads) | 1.000E+001 | 1.000E+001 | 1.000E+001 | 1.000E+001 |
| Actual Dose (mRads) | 1.484E-005 | 0.000E+000 | 0.000E+000 | 1.453E-005 |
| % of Specification | 1.484E-004 | 0.000E+000 | 0.000E+000 | 1.453E-004 |
| 3. Ingestion Pathway-Organ | | | | |
| Specification (mRems) | 7.500E+000 | 7.500E+000 | 7.500E+000 | 7.500E+000 |
| Actual Dose (mRems) | 1.389E-003 | 2.359E-005 | 8.573E-006 | 1.119E-004 |
| % of Specification | 1.852E-002 | 3.145E-004 | 1.143E-004 | 1.492E-003 |

**Table 2.4 (Cont.)
Annual Radioactive Effluent Release Report 1998
Dose From Gaseous Effluents**

In addition, the cumulative annual offsite doses for the period January 1 - December 31, 1998 versus the ODCM annual limits were:

| | Annual |
|----------------------------|------------|
| 1. Gamma-Whole Body | |
| Specification (mRads) | 1.000E+001 |
| Actual Dose (mRads) | 7.700E-005 |
| % of Specification | 7.700E-004 |
| 2. Beta-Skin | |
| Specification (mRads) | 2.000E+001 |
| Actual Dose (mRads) | 2.937E-005 |
| % of Specification | 1.469E-004 |
| 3. Ingestion Pathway-Organ | |
| Specification (mRems) | 1.500E+001 |
| Actual Dose (mRems) | 1.533E-003 |
| % of Specification | 1.022E-002 |

3.0 LIQUID EFFLUENTS

3.1 Lower Limits of Detection (LLD) for Liquid Effluents

Liquid radioactive effluents are released as both batch releases and continuous releases. Each batch is sampled prior to release and analyzed for gamma emitters and tritium. A fraction of each sample is retained for a monthly proportional composite, which is then analyzed for Gross Alpha, Strontium 89, Strontium 90 and Iron 55.

The LLD's for liquid batch release radioanalyses, as listed in Table 4.3 of the Kewaunee Nuclear Power Plant Off-Site Dose Calculation Manual, are:

| <u>Analysis</u> | <u>LLD (μCi/ml)</u> |
|--------------------------|---------------------|
| Principal Gamma Emitters | 1.00 E-06 |
| Iodine 131 | 1.00 E-06 |
| Tritium | 1.00 E-05 |
| Gross Alpha | 5.00 E-07 |
| Strontium 89, 90 | 5.00 E-08 |
| Iron 55 | 1.00 E-06 |

The actual obtained "a priori" LLD values for batch releases are shown below.

| Isotope | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Average a priori LLD (μCi/ml) |
|-------------|-------------|-------------|-------------|-------------|-------------------------------|
| Mn-54 | 6.74E-10 | 9.53E-08 | 9.53E-08 | 9.53E-08 | 7.16E-08 |
| Fe-59 | 2.09E-07 | 1.48E-09 | 1.48E-09 | 1.48E-09 | 5.34E-08 |
| Co-58 | 6.62E-10 | 6.62E-08 | 6.62E-10 | 6.62E-10 | 1.70E-08 |
| Co-60 | 8.80E-08 | 9.74E-10 | 8.80E-10 | 8.80E-08 | 4.45E-08 |
| Zn-65 | 2.36E-07 | 1.67E-07 | 1.67E-07 | 1.67E-09 | 1.43E-07 |
| Mo-99 | 4.78E-09 | 4.78E-09 | 4.78E-07 | 6.75E-07 | 2.91E-07 |
| Cs-134 | 5.30E-08 | 5.86E-08 | 5.30E-10 | 5.30E-10 | 2.82E-08 |
| Cs-137 | 4.90E-07 | 6.56E-10 | 6.56E-10 | 6.56E-08 | 1.39E-07 |
| Ce-141 | 7.30E-08 | 7.73E-08 | 7.30E-08 | 4.21E-08 | 6.64E-08 |
| Ce-144 | 2.43E-07 | 1.72E-09 | 1.72E-07 | 4.62E-07 | 2.20E-07 |
| I-131 | 5.79E-08 | 4.09E-10 | 4.09E-08 | 4.09E-10 | 2.49E-08 |
| H-3 | 3.86E-06 | 4.43E-06 | 4.32E-06 | 3.59E-06 | 4.05E-06 |
| Sr-89 | 1.27E-08 | 1.43E-08 | 1.16E-08 | 1.36E-08 | 1.31E-08 |
| Sr-90 | 1.04E-08 | 6.63E-09 | 7.33E-09 | 6.67E-09 | 7.75E-09 |
| Gross Alpha | 6.60E-09 | 5.33E-09 | 7.13E-09 | 1.12E-08 | 7.57E-09 |
| Fe-55 | 7.17E-07 | 5.50E-07 | 5.47E-07 | 5.40E-07 | 5.88E-07 |

Continuous liquid releases are grab sampled weekly and analyzed for principal gamma emitters. A fraction of each weekly sample is retained for a monthly proportional composite, which is then analyzed for Tritium, Gross Alpha, Strontium 89, Strontium 90 and Iron 55.

The LLD's for liquid continuous release radioanalyses, as listed in Table 4.3 of the Kewaunee Nuclear Power Plant Off-Site Dose Calculation Manual, are:

| Analysis | LLD ($\mu\text{Ci/ml}$) |
|--------------------------|---------------------------|
| Principal Gamma Emitters | 5.00 E-07 |
| Iodine 131 | 1.00 E-06 |
| Tritium | 1.00 E-05 |
| Gross Alpha | 5.00 E-07 |
| Strontium 89, 90 | 5.00 E-08 |
| Iron 55 | 1.00 E-06 |

The actual obtained "a priori" LLD values for continuous releases are shown below.

| Isotope | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Average a priori LLD ($\mu\text{Ci/ml}$) |
|-------------|-------------|-------------|-------------|-------------|--|
| Mn-54 | 4.03E-08 | 1.12E-08 | 1.12E-08 | 1.12E-08 | 1.85E-08 |
| Fe-59 | 2.47E-10 | 6.16E-08 | 2.47E-10 | 6.04E-08 | 3.06E-08 |
| Co-58 | 2.70E-08 | 3.64E-08 | 1.10E-08 | 1.10E-08 | 2.14E-08 |
| Co-60 | 2.07E-08 | 2.30E-08 | 3.28E-08 | 1.62E-08 | 2.32E-08 |
| Zn-65 | 2.78E-08 | 2.78E-10 | 3.07E-08 | 5.56E-08 | 2.86E-08 |
| Mo-99 | 3.91E-07 | 3.84E-07 | 2.89E-07 | 2.12E-07 | 3.19E-07 |
| Cs-134 | 8.84E-11 | 8.84E-11 | 8.84E-11 | 2.38E-08 | 6.02E-09 |
| Cs-137 | 1.09E-08 | 1.09E-10 | 3.55E-08 | 3.44E-08 | 2.02E-08 |
| Ce-141 | 1.91E-08 | 3.10E-08 | 2.80E-08 | 3.05E-08 | 2.72E-08 |
| Ce-144 | 1.66E-07 | 9.06E-08 | 2.26E-07 | 1.64E-07 | 1.62E-07 |
| I-131 | 3.27E-08 | 2.95E-08 | 2.07E-08 | 6.82E-11 | 2.07E-08 |
| H-3 | 3.86E-06 | 4.43E-06 | 4.32E-06 | 3.59E-06 | 4.05E-06 |
| Sr-89 | 1.02E-08 | 1.73E-08 | 9.80E-09 | 1.38E-08 | 1.28E-08 |
| Sr-90 | 8.33E-09 | 8.00E-09 | 6.75E-09 | 7.12E-09 | 7.55E-09 |
| Gross Alpha | 5.33E-09 | 4.33E-09 | 6.43E-09 | 7.57E-09 | 5.92E-09 |
| Fe-55 | 7.08E-07 | 5.57E-07 | 5.52E-07 | 5.47E-07 | 5.91E-07 |

3.2 Liquid Batch Release Statistics

The following is a summation of all liquid batch releases made during 1998.

| <u>Release Type</u> | <u>Number</u> | <u>Gallons Released</u> |
|---------------------|---------------|-------------------------|
| A SGBT Monitor Tk. | 7 | 61000.0 |
| B SGBT Monitor Tk. | 5 | 47219.0 |
| A CVC Monitor | 22 | 143010.0 |
| B CVC Monitor | 20 | 125615.0 |
| Both WCTs | 85 | 156450.0 |

Total time for all batch releases..... 29458.0 Min.

Maximum time for a batch release..... 1170.0 Min.

Minimum time for a batch release..... 36.0 Min.

Average time for a batch release..... 211.9 Min.

3.3 Liquid Effluent Data

The following Table 3.1 presents a quarterly summation of the total activity released and average concentration for all liquid effluents. It also presents the gross alpha activity released, volume of waste released and volume of dilution water used. Tables 3.2 and 3.3 are monthly summations of the same information in Table 3.1. Table 3.2 contains the quantity of the individual isotopes released to the unrestricted area for batch releases. Table 3.3 presents a monthly summation of gross radioactivity, tritium, gross alpha and isotopic activity for the secondary blowdown and leakage releases. It also presents the monthly total volume for these releases and dilution volumes. Table 3.4 presents the doses from liquid effluents for each quarter and the calculated doses this year from liquid effluents.

TABLE 3.1
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Summation of all Releases

| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
|---|------------|------------|------------|------------|
| Fission and Activation Products | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | 1.357E-003 | 2.115E-002 | 2.474E-003 | 2.595E-002 |
| Average Concentration (µCi/ml) | 1.303E-011 | 1.412E-010 | 1.192E-011 | 2.436E-010 |
| Tritium | | | | |
| Total Release (Ci) | 2.275E+002 | 1.175E+001 | 7.923E+001 | 5.891E+001 |
| Average Concentration (µCi/ml) | 2.185E-006 | 7.847E-008 | 3.816E-007 | 5.532E-007 |
| % of Tech. Spec. Limit(3.0E-3 µCi/ml) | 7.284E-002 | 2.616E-003 | 1.272E-002 | 1.844E-002 |
| Dissolved Gases | | | | |
| Total Release (Ci) | 1.732E-005 | 0.000E+000 | 1.493E-005 | 0.000E+000 |
| Average Concentration (µCi/ml) | 1.664E-013 | 0.000E+000 | 7.192E-014 | 0.000E+000 |
| % of Tech. Spec. Limit(2.0E-4 µCi/ml) | 8.319E-008 | 0.000E+000 | 3.596E-008 | 0.000E+000 |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Volume of Waste Released | | | | |
| Batch (liters) | 5.737E+005 | 1.593E+005 | 3.254E+005 | 9.602E+005 |
| Continuous (liters) | 3.102E+007 | 2.921E+007 | 2.877E+007 | 2.710E+007 |
| Total (liters) | 3.159E+007 | 2.937E+007 | 2.909E+007 | 2.806E+007 |
| Volume of Dilution Water | | | | |
| Batch (liters) | 6.020E+009 | 2.966E+009 | 7.220E+009 | 9.177E+009 |
| Continuous (liters) | 9.807E+010 | 1.468E+011 | 2.004E+011 | 9.732E+010 |
| Total (liters) | 1.041E+011 | 1.498E+011 | 2.076E+011 | 1.065E+011 |

TABLE 3.2A
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| | January | February | March | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 7.904E-005 | 9.675E-004 | 2.118E-004 | 1.258E-003 |
| Avg. Conc. (μCi/ml) | | | | |
| | 2.528E-010 | 1.899E-010 | 3.454E-010 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 1.819E+001 | 1.972E+002 | 1.168E+001 | 2.271E+002 |
| Avg. Conc. (μCi/ml) | | | | |
| | 5.818E-005 | 3.872E-005 | 1.905E-005 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 1.732E-005 | 0.000E+000 | 1.732E-005 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 3.400E-012 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 3.952E+004 | 4.619E+005 | 7.228E+004 | 5.737E+005 |
| Volume of Dilution Water | | | | |
| (liters) | 3.127E+008 | 5.094E+009 | 6.132E+008 | 6.020E+009 |

TABLE 3.2A (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| Isotope (Ci) | January | February | March | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 1.819E+001 | 1.972E+002 | 1.168E+001 | 2.271E+002 |
| Fe-55 | 7.904E-005 | 0.000E+000 | 0.000E+000 | 7.904E-005 |
| Co-58 | 0.000E+000 | 1.538E-004 | 2.065E-004 | 3.603E-004 |
| Co-60 | 0.000E+000 | 1.114E-004 | 5.322E-006 | 1.167E-004 |
| Ag-110m | 0.000E+000 | 7.022E-004 | 0.000E+000 | 7.022E-004 |
| Xe-133 | 0.000E+000 | 1.732E-005 | 0.000E+000 | 1.732E-005 |
| Total | 1.819E+001 | 1.972E+002 | 1.168E+001 | 2.271E+002 |

TABLE 3.2B
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| | April | May | June | <u>Total</u> |
|--|------------|------------|------------|--------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 1.583E-002 | 3.238E-006 | 5.193E-003 | 2.102E-002 |
| Avg. Conc. (μCi/ml) | | | | |
| | 1.140E-008 | 3.960E-011 | 3.471E-009 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 6.792E+000 | 2.071E-004 | 4.618E+000 | 1.141E+001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 4.892E-006 | 2.533E-009 | 3.087E-006 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 7.014E+004 | 7.117E+003 | 8.209E+004 | 1.593E+005 |
| Volume of Dilution Water | | | | |
| (liters) | 1.388E+009 | 8.176E+007 | 1.496E+009 | 2.966E+009 |

TABLE 3.2B (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| Isotope (Ci) | April | May | June | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 6.792E+000 | 2.071E-004 | 4.618E+000 | 1.141E+001 |
| Fe-55 | 9.118E-005 | 0.000E+000 | 0.000E+000 | 9.118E-005 |
| Co-58 | 1.362E-002 | 3.238E-006 | 3.323E-003 | 1.694E-002 |
| Co-60 | 3.127E-004 | 0.000E+000 | 3.416E-004 | 6.542E-004 |
| Ag-110m | 1.647E-003 | 0.000E+000 | 9.815E-004 | 2.628E-003 |
| Sb-125 | 1.601E-004 | 0.000E+000 | 5.474E-004 | 7.075E-004 |
| Total | 6.808E+000 | 2.103E-004 | 4.623E+000 | 1.143E+001 |

TABLE 3.2C
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| | July | August | September | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 1.913E-003 | 0.000E+000 | 5.162E-004 | 2.429E-003 |
| Avg. Conc. (μCi/ml) | | | | |
| | 6.741E-010 | 0.000E+000 | 2.848E-010 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 2.771E+001 | 3.476E+001 | 1.648E+001 | 7.896E+001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 9.767E-006 | 1.353E-005 | 9.093E-006 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 1.493E-005 | 1.493E-005 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 8.239E-012 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 1.143E+005 | 1.141E+005 | 9.705E+004 | 3.254E+005 |
| Volume of Dilution Water | | | | |
| (liters) | 2.838E+009 | 2.570E+009 | 1.812E+009 | 7.220E+009 |

TABLE 3.2C (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| Isotope (Ci) | July | August | September | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 2.771E+001 | 3.476E+001 | 1.648E+001 | 7.896E+001 |
| Fe-55 | 0.000E+000 | 0.000E+000 | 8.637E-005 | 8.637E-005 |
| Co-58 | 1.136E-003 | 0.000E+000 | 1.581E-004 | 1.294E-003 |
| Co-60 | 1.261E-004 | 0.000E+000 | 2.661E-005 | 1.528E-004 |
| Ag-110m | 3.099E-004 | 0.000E+000 | 2.749E-005 | 3.374E-004 |
| Sb-125 | 3.404E-004 | 0.000E+000 | 2.176E-004 | 5.580E-004 |
| Xe-133 | 0.000E+000 | 0.000E+000 | 1.493E-005 | 1.493E-005 |
| Total | 2.772E+001 | 3.476E+001 | 1.648E+001 | 7.896E+001 |

TABLE 3.2D
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| | October | November | December | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 7.169E-003 | 1.223E-002 | 6.293E-003 | 2.569E-002 |
| Avg. Conc. (μCi/ml) | | | | |
| | 9.625E-010 | 1.037E-008 | 1.145E-008 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 5.355E+001 | 4.338E+000 | 6.876E-001 | 5.858E+001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 7.190E-006 | 3.680E-006 | 1.251E-006 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 5.664E+005 | 3.392E+005 | 5.464E+004 | 9.602E+005 |
| Volume of Dilution Water | | | | |
| (liters) | 7.448E+009 | 1.179E+009 | 5.496E+008 | 9.177E+009 |

TABLE 3.2D (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Batch Releases

| Isotope (Ci) | October | November | December | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 5.355E+001 | 4.338E+000 | 6.876E-001 | 5.858E+001 |
| Cr-51 | 0.000E+000 | 1.142E-003 | 4.592E-004 | 1.601E-003 |
| Mn-54 | 6.343E-006 | 1.255E-006 | 0.000E+000 | 7.598E-006 |
| Fe-55 | 0.000E+000 | 2.408E-003 | 7.103E-004 | 3.119E-003 |
| Co-58 | 3.959E-003 | 2.420E-003 | 9.436E-004 | 7.323E-003 |
| Co-60 | 1.077E-003 | 1.906E-003 | 3.929E-004 | 3.375E-003 |
| Sr-90 | 0.000E+000 | 0.000E+000 | 4.426E-007 | 4.426E-007 |
| Nb-95 | 5.132E-006 | 2.971E-004 | 9.284E-005 | 3.950E-004 |
| Zr-95 | 7.473E-006 | 1.749E-004 | 9.317E-005 | 2.756E-004 |
| Ag-110m | 1.130E-003 | 1.774E-003 | 6.368E-004 | 3.541E-003 |
| Sn-113 | 0.000E+000 | 4.420E-005 | 0.000E+000 | 4.420E-005 |
| Sb-124 | 1.439E-004 | 1.804E-004 | 3.486E-004 | 6.729E-004 |
| Sb-125 | 8.409E-004 | 1.874E-003 | 2.561E-003 | 5.276E-003 |
| Cs-137 | 0.000E+000 | 7.815E-006 | 5.463E-005 | 6.245E-005 |
| Total | 5.356E+001 | 4.351E+000 | 6.939E-001 | 5.861E+001 |

TABLE 3.3A
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| | January | February | March | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 0.000E+000 | 9.828E-005 | 0.000E+000 | 9.828E-005 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 3.229E-012 | 0.000E+000 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 1.007E-001 | 9.994E-002 | 1.622E-001 | 3.628E-001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 2.979E-009 | 3.284E-009 | 4.793E-009 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 8.332E+006 | 1.002E+007 | 1.267E+007 | 3.102E+007 |
| Volume of Dilution Water | | | | |
| (liters) | 3.380E+010 | 3.043E+010 | 3.384E+010 | 9.807E+010 |

TABLE 3.3A (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| Isotope (Ci) | January | February | March | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 1.007E-001 | 9.994E-002 | 1.622E-001 | 3.628E-001 |
| Co-58 | 0.000E+000 | 6.863E-007 | 0.000E+000 | 6.863E-007 |
| Co-60 | 0.000E+000 | 9.760E-005 | 0.000E+000 | 9.760E-005 |
| Total | 1.007E-001 | 1.000E-001 | 1.622E-001 | 3.629E-001 |

TABLE 3.3B
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| | April | May | June | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 1.172E-004 | 0.000E+000 | 9.433E-006 | 1.266E-004 |
| Avg. Conc. (μCi/ml) | | | | |
| | 3.582E-012 | 0.000E+000 | 1.480E-013 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 8.287E-002 | 9.885E-002 | 1.605E-001 | 3.423E-001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 2.534E-009 | 1.962E-009 | 2.519E-009 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 8.326E+006 | 9.244E+006 | 1.164E+007 | 2.921E+007 |
| Volume of Dilution Water | | | | |
| (liters) | 3.271E+010 | 5.038E+010 | 6.373E+010 | 1.468E+011 |

TABLE 3.3B (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| Isotope (Ci) | April | May | June | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 8.287E-002 | 9.885E-002 | 1.605E-001 | 3.423E-001 |
| Co-60 | 1.172E-004 | 0.000E+000 | 0.000E+000 | 1.172E-004 |
| Sr-90 | 0.000E+000 | 0.000E+000 | 9.433E-006 | 9.433E-006 |
| Total | 8.299E-002 | 9.885E-002 | 1.605E-001 | 3.424E-001 |

TABLE 3.3C
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| | July | August | September | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 2.891E-005 | 0.000E+000 | 1.623E-005 | 4.514E-005 |
| Avg. Conc. (μCi/ml) | | | | |
| | 4.278E-013 | 0.000E+000 | 2.481E-013 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 1.168E-001 | 1.239E-001 | 3.074E-002 | 2.714E-001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 1.727E-009 | 1.837E-009 | 4.700E-010 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 8.158E+006 | 1.128E+007 | 9.332E+006 | 2.877E+007 |
| Volume of Dilution Water | | | | |
| (liters) | 6.759E+010 | 6.741E+010 | 6.541E+010 | 2.004E+011 |

**TABLE 3.3C (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases**

| Isotope (Ci) | July | August | September | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 1.168E-001 | 1.239E-001 | 3.074E-002 | 2.714E-001 |
| Co-60 | 0.000E+000 | 0.000E+000 | 1.623E-005 | 1.623E-005 |
| Sr-90 | 2.891E-005 | 0.000E+000 | 0.000E+000 | 2.891E-005 |
| Total | 1.168E-001 | 1.239E-001 | 3.076E-002 | 2.714E-001 |

TABLE 3.3D
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| | October | November | December | Total |
|--|------------|------------|------------|------------|
| Gross Radioactivity | | | | |
| Total Release Excluding H3 and Dissolved Gases (Ci) | | | | |
| | 5.736E-005 | 4.279E-005 | 1.540E-004 | 2.541E-004 |
| Avg. Conc. (μCi/ml) | | | | |
| | 1.117E-012 | 3.522E-012 | 4.549E-012 | |
| Tritium | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 1.255E-001 | 2.059E-001 | 3.313E-001 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 1.033E-008 | 6.083E-009 | |
| Dissolved Gases | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Gross Alpha Activity | | | | |
| Total Release (Ci) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | 0.000E+000 |
| Avg. Conc. (μCi/ml) | | | | |
| | 0.000E+000 | 0.000E+000 | 0.000E+000 | |
| Volume of Waste Released | | | | |
| (liters) | 5.433E+006 | 6.067E+006 | 1.560E+007 | 2.710E+007 |
| Volume of Dilution Water | | | | |
| (liters) | 5.133E+010 | 1.215E+010 | 3.384E+010 | 9.732E+010 |

TABLE 3.3D (Cont.)
Annual Radioactive Effluent Release Report 1998
Liquid Effluents - Continuous Releases

| Isotope (Ci) | October | November | December | Total |
|--------------|------------|------------|------------|------------|
| H-3 | 0.000E+000 | 1.255E-001 | 2.059E-001 | 3.313E-001 |
| Co-58 | 0.000E+000 | 4.279E-005 | 1.418E-005 | 5.697E-005 |
| Co-60 | 5.736E-005 | 0.000E+000 | 1.398E-004 | 1.971E-004 |
| Total | 5.736E-005 | 1.255E-001 | 2.060E-001 | 3.316E-001 |

Table 3.4
Annual Radioactive Effluent Report 1998
Dose From Liquid Effluents

The dose to a member of the public from total liquid radioactive releases for each quarter was below the ODCM limits of 1.5 mRems to the total body and less than or equal to 5 mRems to any organ. Additionally, the dose to a member of the public from total liquid radioactive releases for the year was below the ODCM limits of 3 mRems to the total body and less than or equal to 10 mRems to any organ.

Instantaneous release concentrations are limited by the individual radionuclide concentrations established in 10 CFR 20, Appendix B, for unrestricted areas. During the report period, none of the isotopes released exceed the concentrations specified in Appendix B. The following offsite doses were calculated using equation 1.5 from the Kewaunee ODCM.

| Organ 1st Qtr Dose | Dose Total mRem | Quarterly Limit mRem | Percent of Limit |
|-----------------------|-----------------------|----------------------------|---------------------|
| Total Body | 1.653E-003 | 1.5 | 0.11 |
| Bone | 1.166E-006 | 5.0 | 0.00 |
| Liver | 1.652E-003 | 5.0 | 0.03 |
| Thyroid | 1.650E-003 | 5.0 | 0.03 |
| Kidney | 1.650E-003 | 5.0 | 0.03 |
| Lung | 1.650E-003 | 5.0 | 0.03 |
| GI-LL1 | 1.683E-003 | 5.0 | 0.03 |

| Organ 2nd Qtr Dose | Dose Total mRem | Quarterly Limit mRem | Percent of Limit |
|-----------------------|-----------------------|----------------------------|---------------------|
| Total Body | 1.404E-004 | 1.5 | 0.01 |
| Bone | 1.433E-006 | 5.0 | 0.00 |
| Liver | 1.001E-004 | 5.0 | 0.00 |
| Thyroid | 6.612E-005 | 5.0 | 0.00 |
| Kidney | 6.620E-005 | 5.0 | 0.00 |
| Lung | 6.667E-005 | 5.0 | 0.00 |
| GI-LL1 | 7.495E-004 | 5.0 | 0.01 |

Table 3.4 (Cont.)
Annual Radioactive Effluent Report 1998
Dose From Liquid Effluents

| Organ 3rd Qtr Dose | Dose Total mRem | Quarterly Limit mRem | Percent of Limit |
|-----------------------|-----------------------|----------------------------|---------------------|
| Total Body | 2.907E-004 | 1.5 | 0.02 |
| Bone | 6.695E-007 | 5.0 | 0.00 |
| Liver | 2.889E-004 | 5.0 | 0.01 |
| Thyroid | 2.868E-004 | 5.0 | 0.01 |
| Kidney | 2.868E-004 | 5.0 | 0.01 |
| Lung | 2.871E-004 | 5.0 | 0.01 |
| GI-LLI | 3.230E-004 | 5.0 | 0.01 |

| Organ 4th Qtr Dose | Dose Total mRem | Quarterly Limit mRem | Percent of Limit |
|-----------------------|-----------------------|----------------------------|---------------------|
| Total Body | 2.519E-003 | 1.5 | 0.17 |
| Bone | 2.757E-003 | 5.0 | 0.06 |
| Liver | 3.761E-003 | 5.0 | 0.08 |
| Thyroid | 3.243E-004 | 5.0 | 0.01 |
| Kidney | 1.342E-003 | 5.0 | 0.03 |
| Lung | 8.761E-004 | 5.0 | 0.02 |
| GI-LLI | 6.771E-002 | 5.0 | 1.35 |

| Calculated Dose This Year | | | |
|---------------------------|-----------------------|----------------------------|---------------------|
| Organ | Dose Total mRem | Quarterly Limit mRem | Percent of Limit |
| Total Body | 4.603E-003 | 3.0 | 0.15 |
| Bone | 2.760E-003 | 10.0 | 0.03 |
| Liver | 5.802E-003 | 10.0 | 0.06 |
| Thyroid | 2.327E-003 | 10.0 | 0.02 |
| Kidney | 3.344E-003 | 10.0 | 0.03 |
| Lung | 2.880E-003 | 10.0 | 0.03 |
| GI-LLI | 7.046E-002 | 10.0 | 0.70 |

4.0 UNPLANNED RELEASES

No unplanned releases were made from the Kewaunee Plant during the report period.

The January-June 1991 Semi-Annual Effluent Release Report described an unplanned release which occurred on April 25, 1991. Offsite doses attributed to this release were well below the established ODCM (Technical Specifications at the time) limits.

As corrective action, WPSC stated in that report that valves WG-301 and WG-302 were scheduled to be replaced during 1992. Also, a new vent line was added between valves WG-300 and WG-301 to allow local leak rate testing with the Waste Gas Decay Tanks isolated. The valves were to be replaced with like-for-like replacements. However, after receipt inspection, the replacement valves failed to pass the seat leakage tests. During 1998, WPSC continued to evaluate options associated with these valves and will continue to provide status updates in future Effluent Release Reports until this issue is resolved and corrective actions are complete. A plant design change request, DCR-2349, was issued to address this concern.

5.0 METEOROLOGICAL DATA

Meteorological data for 1998 is retained on file at the Kewaunee Nuclear Power Plant. The data on file includes a continuous strip chart recording and a 15-minute interval listing of wind speed, wind direction and atmospheric stability. This is more conservative than the requirements of ODCM Section 3/4.6.1.b. See Appendix A for missing meteorological data and the joint frequency distribution tables.

6.0 SOLID WASTE DISPOSAL

Table 6.1 is a summation of solid wastes shipped during 1998. Presented are the types of wastes, major nuclide composition, disposition of the wastes and shipping containers used.

The containers utilized at Kewaunee Nuclear Power Plant have the following volumes:

| | |
|--------------------------------|---------------------|
| High Integrity Container (HIC) | 158 ft ³ |
| LSA Box (B-25) | 98 ft ³ |
| Compactor Boxes | 50 ft ³ |
| DOT-17H Drum | 7.5 ft ³ |

A composite sample from a 1998 dewatered resin shipments was analyzed by a contractor for transuranic nuclides. The results showed an average transuranic concentration of 3.30 E-02 nanocuries/gram, well within the disposal site limit of 10 nanocuries/gram.

Table 6.1 contains the radionuclide content (curies) and percent abundance for each type of waste.

Table 6.1
Annual Radioactive Effluent Report 1998
Solid Waste and Irradiated Fuel Shipments

Isotopes denoted by an asterisk (*) in Table 6.1 are correlated values.

A. Solid Waste Shipped Off-Site for Burial or Disposal
 (Not Irradiated Fuel - m³ is actual waste volume not burial volume)

| 1. Type of Waste | Unit | Quantity |
|---|----------------|----------------|
| a. Dewatered resin | m ³ | None |
| Container: HIC | Ci | None |
| b. Dewatered filter media | m ³ | 3.96E+00 |
| Container: HIC | Ci | 2.45E+00 |
| c. DAW (Compactable) | m ³ | None |
| Container: Compactor Box | Ci | None |
| d. DAW (Non-Compactable) | m ³ | None |
| Container: Compactor Box | Ci | None |
| Average Transuranics shipped (all shipments): | | 3.30E-02 nCi/g |
| 2. Estimate of Major Nuclide by Composition | | |
| (By Type of Waste) | <u>%</u> | <u>Ci</u> |
| a. Dewatered resin | None | None |
| b. Dewatered filter media | 100% | 2.45E+00 |
| Cr51 | 0.00E+00 | 0.00E+00 |
| Mn54 | 7.18E-01 | 1.76E-02 |
| Co57 | 4.32E-01 | 1.06E-02 |
| Co58 | 6.28E+01 | 1.54E+00 |
| Co60 | 1.14E+01 | 2.79E-01 |
| Zr95 | 0.00E+00 | 0.00E+00 |
| Nb95 | 0.00E+00 | 0.00E+00 |
| Ag110m | 1.03E+00 | 2.52E-02 |
| Cs134 | 0.00E+00 | 0.00E+00 |
| Cs137 | 0.00E+00 | 0.00E+00 |
| Sb124 | 0.00E+00 | 0.00E+00 |
| Sb125 | 0.00E+00 | 0.00E+00 |
| Sn113 | 0.00E+00 | 0.00E+00 |
| Fe55 | 1.25E+01 | 3.07E-01 |
| Fe59 | 0.00E+00 | 0.00E+00 |

| b.(cont) | % | Ci |
|----------|----------|----------|
| C14 | 5.18E-04 | 1.27E-05 |
| Ni59 | 1.92E+00 | 4.72E-02 |
| Tc99 | 2.17E-02 | 5.32E-04 |
| I129 | 0.00E+00 | 0.00E+00 |
| Nb94 | 0.00E+00 | 0.00E+00 |
| TRU | 1.01E-03 | 2.47E-05 |
| Pu241 | 0.00E+00 | 0.00E+00 |
| Cm242 | 0.00E+00 | 0.00E+00 |
| T | 0.00E+00 | 0.00E+00 |
| Ni63 | 9.18E+00 | 2.25E-01 |
| Sr90 | 0.00E+00 | 0.00E+00 |
| Ra226 | 0.00E+00 | 0.00E+00 |
| Sr89 | 0.00E+00 | 0.00E+00 |
| Zn65 | 0.00E+00 | 0.00E+00 |
| Sr92 | 0.00E+00 | 0.00E+00 |
| Na24 | 0.00E+00 | 0.00E+00 |
| Xe135 | 0.00E+00 | 0.00E+00 |
| Xe133 | 0.00E+00 | 0.00E+00 |
| Ni56 | 0.00E+00 | 0.00E+00 |
| Br82 | 0.00E+00 | 0.00E+00 |
| MoTc99m | 0.00E+00 | 0.00E+00 |
| I133 | 0.00E+00 | 0.00E+00 |
| Zr97 | 0.00E+00 | 0.00E+00 |
| I135 | 0.00E+00 | 0.00E+00 |
| W187 | 0.00E+00 | 0.00E+00 |
| Nb97 | 0.00E+00 | 0.00E+00 |
| Cs138 | 0.00E+00 | 0.00E+00 |
| I131 | 0.00E+00 | 0.00E+00 |
| Sn117m | 0.00E+00 | 0.00E+00 |

c. DAW (Compactable) None None

d. DAW (Non-Compactable) None None

3. Solid Waste Disposition

| a. | Date of Shipment | Mode of Transportation | Destination |
|----|------------------|------------------------|--------------|
| | 11/18/98 | CNSI 14-190 Cask | Barnwell, SC |

B. Irradiated Fuel Shipments

No irradiated fuel shipments were made from the Kewaunce Nuclear Power Plant during 1998.

7.0 PROGRAM REVISIONS

In accordance with Technical Specifications 6.18.b.3 and 6.19.a, the revisions to the Process Control Program, Offsite Dose Calculation Manual and radioactive waste treatment systems are listed below.

7.1 **Offsite Dose Calculation Manual**

The Offsite Dose Calculation Manual (ODCM) has not been revised during this report period.

7.2 **Major Changes to the Radioactive Liquid, Gaseous and Solid Waste Treatment Systems**

Major changes to the radioactive liquid, gaseous or solid waste systems are submitted in the annual Updated Final Safety Analysis Report consistent with Technical Specification 6.19.

8.0 REPORTABLE OCCURRENCES

8.1 Underreporting Tritium in Continuous Liquid Effluents

One reportable occurrence was identified during this reporting period. Underreporting of Tritium radioactivity was identified in continuous liquid effluents. Underreporting has occurred since the 1991 conversion to the current effluent and dose tracking software, RETSCode, was put in service. A Kewaunee Assessment Process (KAP) evaluation, KAP-1879, was submitted to identify and track the correction of the condition. A copy of KAP-1879 is on file in the plant quality assurance (QA) vault. The following tables are included to show the corrected values for Total Curies released during the affected period of 1991 through 1997 and the changes in liquid effluent dose for the same period.

The underreporting of Tritium had little effect on the actual dose to the public due to radiological liquid effluents.

1991

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1991 | Second Quarter 1991 | Third Quarter 1991 | Fourth Quarter 1991 | Annual Total 1991 |
|-------------------|--------------------|---------------------|--------------------|---------------------|-------------------|
| As First Reported | 1.648E+02 | 2.836E+01 | 6.799E+01 | 1.743E+02 | 4.355E+02 |
| As Corrected | 1.649E+02 | 2.846E+01 | 6.839E+01 | 1.745E+02 | 4.363E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 6.696E-03 | 6.700E-03 | 3.0 | 0.22 | 0.22 |
| Bone | 4.459E-03 | 4.459E-03 | 10.0 | 0.04 | 0.04 |
| Liver | 7.876E-03 | 7.879E-03 | 10.0 | 0.08 | 0.08 |
| Thyroid | 2.503E-03 | 2.506E-03 | 10.0 | 0.03 | 0.03 |
| Kidney | 3.960E-03 | 3.963E-03 | 10.0 | 0.04 | 0.04 |
| Lung | 3.294E-03 | 3.298E-03 | 10.0 | 0.03 | 0.03 |
| GI-LLI | 1.430E-01 | 1.430E-01 | 10.0 | 1.43 | 1.43 |

1992

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1992 | Second Quarter 1992 | Third Quarter 1992 | Fourth Quarter 1992 | Annual Total 1992 |
|-------------------|--------------------|---------------------|--------------------|---------------------|-------------------|
| As First Reported | 1.107E+02 | 1.866E+01 | 1.091E+02 | 5.129E+01 | 2.898E+02 |
| As Corrected | 1.109E+02 | 1.873E+01 | 1.092E+02 | 5.146E+01 | 2.903E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 2.169E-03 | 2.172E-03 | 3.0 | 0.07 | 0.07 |
| Bone | 5.437E-04 | 5.437E-04 | 10.0 | 0.01 | 0.01 |
| Liver | 2.268E-03 | 2.271E-03 | 10.0 | 0.02 | 0.02 |
| Thyroid | 1.831E-03 | 1.834E-03 | 10.0 | 0.02 | 0.02 |
| Kidney | 1.855E-03 | 1.858E-03 | 10.0 | 0.02 | 0.02 |
| Lung | 1.983E-03 | 1.986E-03 | 10.0 | 0.02 | 0.02 |
| GI-LLI | 7.720E-02 | 7.720E-02 | 10.0 | 0.77 | 0.77 |

1993

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1993 | Second Quarter 1993 | Third Quarter 1993 | Fourth Quarter 1993 | Annual Total 1993 |
|-------------------|-----------------------|------------------------|-----------------------|------------------------|----------------------|
| As First Reported | 6.092E+01 | 3.871E+01 | 4.625E+01 | 9.026E+01 | 2.361E+02 |
| As Corrected | 6.098E+01 | 4.577E+01 | 4.713E+01 | 9.068E+01 | 2.446E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 2.909E-03 | 2.960E-03 | 3.0 | 0.10 | 0.10 |
| Bone | 4.677E-03 | 4.677E-03 | 10.0 | 0.05 | 0.05 |
| Liver | 2.377E-03 | 2.428E-03 | 10.0 | 0.02 | 0.02 |
| Thyroid | 4.158E-03 | 4.208E-03 | 10.0 | 0.04 | 0.04 |
| Kidney | 1.766E-03 | 1.816E-03 | 10.0 | 0.02 | 0.02 |
| Lung | 1.890E-03 | 1.941E-03 | 10.0 | 0.02 | 0.02 |
| GI-LLI | 5.877E-02 | 5.882E-02 | 10.0 | 0.59 | 0.59 |

1994

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1994 | Second Quarter 1994 | Third Quarter 1994 | Fourth Quarter 1994 | Annual Total 1994 |
|-------------------|-----------------------|------------------------|-----------------------|------------------------|----------------------|
| As First Reported | 5.584E+01 | 2.035E+01 | 2.974E+01 | 5.808E+01 | 1.640E+02 |
| As Corrected | 5.605E+01 | 2.068E+01 | 3.123E+01 | 6.001E+01 | 1.680E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 1.541E-03 | 1.561E-03 | 3.0 | 0.05 | 0.05 |
| Bone | 2.127E-03 | 2.127E-03 | 10.0 | 0.02 | 0.02 |
| Liver | 1.476E-03 | 1.496E-03 | 10.0 | 0.01 | 0.01 |
| Thyroid | 1.427E-03 | 1.447E-03 | 10.0 | 0.01 | 0.01 |
| Kidney | 9.770E-04 | 9.968E-04 | 10.0 | 0.01 | 0.01 |
| Lung | 1.199E-03 | 1.219E-03 | 10.0 | 0.01 | 0.01 |
| GI-LLI | 2.926E-02 | 2.928E-02 | 10.0 | 0.29 | 0.29 |

1995

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1995 | Second Quarter 1995 | Third Quarter 1995 | Fourth Quarter 1995 | Annual Total 1995 |
|-------------------|--------------------|---------------------|--------------------|---------------------|-------------------|
| As First Reported | 9.489E+01 | 2.747E+01 | 7.344E+01 | 3.985E+01 | 2.357E+02 |
| As Corrected | 9.567E+01 | 2.772E+01 | 7.434E+01 | 4.127E+01 | 2.390E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 7.033E-03 | 7.167E-03 | 3.0 | 0.23 | 0.24 |
| Bone | 6.364E-03 | 6.796E-03 | 10.0 | 0.06 | 0.07 |
| Liver | 9.988E-03 | 1.001E-02 | 10.0 | 0.10 | 0.10 |
| Thyroid | 1.416E-03 | 2.013E-03 | 10.0 | 0.01 | 0.02 |
| Kidney | 4.237E-03 | 4.261E-03 | 10.0 | 0.04 | 0.04 |
| Lung | 2.472E-03 | 2.490E-03 | 10.0 | 0.02 | 0.02 |
| GI-LLI | 5.758E-02 | 5.770E-02 | 10.0 | 0.58 | 0.58 |

1996

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1996 | Second Quarter 1996 | Third Quarter 1996 | Fourth Quarter 1996 | Annual Total 1996 |
|-------------------|--------------------|---------------------|--------------------|---------------------|-------------------|
| As First Reported | 6.823E+01 | 1.711E+02 | 6.789E+01 | 6.096E+00 | 3.133E+02 |
| As Corrected | 6.968E+01 | 1.718E+02 | 6.821E+01 | 6.096E+00 | 3.158E+02 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|-------------------------------------|--------------------------------|---------------------|------------------------------------|-------------------------------|
| Total Body | 6.071E-03 | 6.471E-03 | 3.0 | 0.20 | 0.22 |
| Bone | 5.305E-03 | 6.883E-03 | 10.0 | 0.05 | 0.07 |
| Liver | 8.539E-03 | 8.554E-03 | 10.0 | 0.09 | 0.09 |
| Thyroid | 1.721E-03 | 1.864E-03 | 10.0 | 0.02 | 0.02 |
| Kidney | 3.813E-03 | 3.827E-03 | 10.0 | 0.04 | 0.04 |
| Lung | 2.726E-03 | 2.739E-03 | 10.0 | 0.03 | 0.03 |
| GI-LLI | 1.492E-02 | 1.499E-02 | 10.0 | 0.15 | 0.15 |

1997

Total Release, Curies, as reported in Table 3.1.

| | First Quarter 1997 | Second Quarter 1997 | Third Quarter 1997 | Fourth Quarter 1997 | Annual Total 1997 |
|-------------------|--------------------------|---------------------------|--------------------------|---------------------------|-------------------------|
| As First Reported | 2.072E+00 | 4.837E+00 | 5.681E+00 | 4.147E+01 | 5.406E+01 |
| As Corrected | 2.072E+00 | 4.854E+00 | 6.142E+00 | 4.201E+01 | 5.508E+01 |

Dose from Liquid Effluents, mRem, as reported in Table 3.4.

| Organs | Total Dose as First Reported (mRem) | Total Dose as Corrected (mRem) | Annual Limit (mRem) | Percent of Limit as First Reported | Percent of Limit as Corrected |
|------------|---|--------------------------------------|---------------------------|--|-------------------------------------|
| Total Body | 6.531E-3 | 6.608E-3 | 3.0 | 0.22 | 0.22 |
| Bone | 6.333E-3 | 6.333E-3 | 10.0 | 0.06 | 0.06 |
| Liver | 9.497E-3 | 9.539E-3 | 10.0 | 0.09 | 0.10 |
| Thyroid | 1.257E-3 | 1.263E-3 | 10.0 | 0.01 | 0.01 |
| Kidney | 3.861E-3 | 3.867E-3 | 10.0 | 0.04 | 0.04 |
| Lung | 2.398E-3 | 2.403E-3 | 10.0 | 0.02 | 0.02 |
| GI-LL1 | 3.675E-3 | 4.299E-3 | 10.0 | 0.04 | 0.04 |

8.2 No other Reportable Occurrences

Appendix A

Kewaunee Nuclear Power Plant

1998 Meteorological Data

Missing Meteorological Data

First Quarter: 140.50 Hours
Second Quarter: 10.25 Hours
Third Quarter: 473.50 Hours
Fourth Quarter: 335.50 Hours

Note: The joint frequency distribution tables on the following pages represent 89.0% of the year - 1998. The balance of the data was unavailable due to inconsistencies with data transfer to the plant process computer, not due to the unavailability of the meteorological instruments. Most of the 11% of the missing data not addressed in these tables are available on the continuous strip chart recordings.

First Quarter 1998

Stability Class A

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|------|-------|
| N | 0 | 0 | 3 | 24.75 | 7 | 0 | 0 | 34.75 |
| NNE | 0 | 0 | 1.5 | 8.25 | 17.5 | 15.5 | 1.75 | 44.5 |
| NE | 0 | 0 | 3.25 | 9.25 | 6.5 | 5 | 0.25 | 24.25 |
| ENE | 0 | 0.25 | 2 | 3 | 7.75 | 1.25 | 0 | 14.25 |
| E | 0 | 1 | 3.25 | 9 | 18 | 1.25 | 0 | 32.5 |
| ESE | 0 | 1.25 | 5.25 | 7.5 | 4.5 | 4 | 1.25 | 23.75 |
| SE | 0 | 0.5 | 7 | 9.5 | 4 | 2.25 | 0.25 | 23.5 |
| SSE | 0 | 0.5 | 4.25 | 2.5 | 1.25 | 0 | 0 | 8.5 |
| S | 0 | 0 | 0.75 | 1.5 | 0.5 | 0 | 0 | 2.75 |
| SSW | 0 | 1 | 4.5 | 5.5 | 1.75 | 0 | 0 | 12.75 |
| SW | 0 | 0.5 | 4 | 0.25 | 1.5 | 1.75 | 0.25 | 8.25 |
| WSW | 0 | 0.75 | 0.25 | 3.75 | 3.25 | 1.25 | 0 | 9.25 |
| W | 0 | 0.25 | 2.25 | 9.5 | 6.75 | 3.5 | 0.25 | 22.5 |
| WNW | 0 | 0 | 1.5 | 12.5 | 8.5 | 0 | 0 | 22.5 |
| NW | 0 | 0.5 | 2.25 | 10.5 | 7.25 | 0 | 0 | 20.5 |
| NNW | 0 | 0.25 | 2.25 | 17.75 | 7.5 | 0.25 | 0 | 28 |
| TOTAL | 0 | 6.75 | 47.25 | 135 | 103.5 | 36 | 4 | 332.5 |

First Quarter 1998

Stability Class B

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|------|-------|
| N | 0 | 1.25 | 5.25 | 8.5 | 1.5 | 0 | 1 | 17.5 |
| NNE | 0 | 0.5 | 1.75 | 9 | 7.5 | 5.25 | 0.5 | 24.5 |
| NE | 0.25 | 0 | 0 | 3.25 | 5.25 | 2.75 | 0.25 | 11.75 |
| ENE | 0.25 | 0.75 | 0.5 | 2.75 | 3 | 0.25 | 0 | 7.5 |
| E | 0 | 0.25 | 2.75 | 5 | 5 | 1.25 | 0 | 14.25 |
| ESE | 0 | 1 | 1.5 | 7.75 | 6.25 | 0.5 | 0 | 17 |
| SE | 0 | 1.5 | 1.25 | 3.75 | 1.5 | 0 | 0 | 8 |
| SSE | 0 | 0.25 | 1.75 | 0.25 | 1 | 0 | 0 | 3.25 |
| S | 0 | 0.25 | 0.75 | 1.25 | 0 | 0 | 0 | 2.25 |
| SSW | 0 | 0 | 1.5 | 4.25 | 0.75 | 0 | 0 | 6.5 |
| SW | 0.25 | 0.5 | 1 | 2 | 3.5 | 0 | 0 | 7.25 |
| WSW | 0 | 0.25 | 0 | 1 | 0.75 | 0 | 0 | 2 |
| W | 0 | 0.25 | 0.5 | 3.75 | 1 | 0.25 | 0 | 5.75 |
| WNW | 0 | 0.75 | 1.25 | 6.25 | 0.75 | 0 | 0 | 9 |
| NW | 0 | 0.5 | 4.75 | 2.25 | 1 | 0 | 0 | 8.5 |
| NNW | 0 | 1.25 | 4.75 | 9.75 | 2.75 | 1.25 | 0.75 | 20.5 |
| TOTAL | 0.75 | 9.25 | 29.25 | 70.75 | 41.5 | 11.5 | 2.5 | 165.5 |

First Quarter 1998

Stability Class C

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|------|-------|-------|-------|------|--------|
| N | 0.25 | 0.75 | 6.5 | 9.5 | 1 | 0.25 | 1.75 | 20 |
| NNE | 0 | 0.5 | 2.75 | 7.25 | 10.25 | 8 | 6.25 | 35 |
| NE | 0 | 0.25 | 4.5 | 3.75 | 4.5 | 4 | 0.5 | 17.5 |
| ENE | 0 | 0 | 0.5 | 3.75 | 2.75 | 1.75 | 0 | 8.75 |
| E | 0 | 1 | 1.5 | 3.5 | 5 | 0.5 | 0 | 11.5 |
| ESE | 0 | 1.5 | 4.5 | 7.5 | 3.75 | 0 | 0 | 17.25 |
| SE | 0 | 0.75 | 1.5 | 2.75 | 0 | 0 | 0 | 5 |
| SSE | 0 | 0.25 | 1.75 | 1.25 | 0.75 | 0 | 0 | 4 |
| S | 0 | 0.25 | 2.25 | 1.25 | 0.25 | 1 | 0 | 5 |
| SSW | 0 | 0.25 | 2.25 | 3.5 | 0.5 | 0 | 0 | 6.5 |
| SW | 0 | 0.75 | 2 | 0.5 | 0.5 | 0.5 | 0.5 | 4.75 |
| WSW | 0.25 | 0.75 | 1.75 | 1 | 0.75 | 0 | 0 | 4.5 |
| W | 0.25 | 0.75 | 2 | 2.25 | 1.5 | 0 | 0 | 6.75 |
| WNW | 0.25 | 0.5 | 3.25 | 2.25 | 3 | 0 | 0 | 9.25 |
| NW | 0.25 | 1 | 1.25 | 4.5 | 0.75 | 0 | 0 | 7.75 |
| NNW | 0 | 2 | 2.25 | 7.25 | 2 | 0.25 | 1.5 | 15.25 |
| TOTAL | 1.25 | 11.25 | 40.5 | 61.75 | 37.25 | 16.25 | 10.5 | 178.75 |

First Quarter 1998

Stability Class D

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|--------|--------|--------|-------|-------|-------|
| N | 0 | 5 | 34 | 38 | 7.25 | 3 | 5.25 | 92.5 |
| NNE | 0 | 1.5 | 7.25 | 13.25 | 32.5 | 23 | 10.75 | 88.25 |
| NE | 0 | 1.75 | 8.25 | 6 | 22.25 | 8.5 | 0.25 | 47 |
| ENE | 0 | 0.75 | 4 | 2.75 | 6.5 | 5.5 | 0 | 19.5 |
| E | 0.25 | 2.5 | 3.25 | 2.25 | 0.5 | 0 | 0 | 8.75 |
| ESE | 0 | 0.75 | 5.5 | 0.75 | 2 | 0.25 | 1 | 10.25 |
| SE | 0 | 0.25 | 3.75 | 9.5 | 0.5 | 0 | 0 | 14 |
| SSE | 0 | 2.75 | 4.25 | 3.75 | 2.75 | 1.5 | 1.5 | 16.5 |
| S | 0 | 1.75 | 8.25 | 10.25 | 8.75 | 1 | 0 | 30 |
| SSW | 0 | 4 | 19 | 21 | 2.75 | 0 | 0 | 46.75 |
| SW | 0 | 4 | 13 | 8 | 6.5 | 0.75 | 0.25 | 32.5 |
| WSW | 0 | 4.75 | 6 | 6.75 | 5 | 1.5 | 0 | 24 |
| W | 0 | 3.75 | 8.25 | 7.5 | 9.5 | 5.75 | 0.5 | 35.25 |
| WNW | 0 | 3 | 10.75 | 8.75 | 18.5 | 0.75 | 0 | 41.75 |
| NW | 0 | 3.25 | 12.5 | 17 | 3.75 | 0.25 | 0 | 36.75 |
| NNW | 0 | 5 | 29.25 | 35.25 | 9.75 | 8.5 | 1.5 | 89.25 |
| TOTAL | 0.25 | 44.75 | 177.25 | 190.75 | 138.75 | 60.25 | 21 | 633 |

First Quarter 1998

Stability Class E

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|--------|--------|-------|-------|------|--------|
| N | 0.25 | 1 | 7.25 | 18.25 | 2.75 | 0 | 0 | 29.5 |
| NNE | 0 | 0.75 | 2 | 7.75 | 6.25 | 0.75 | 1 | 18.5 |
| NE | 0 | 1 | 2.25 | 1.5 | 3 | 0 | 0 | 7.75 |
| ENE | 0 | 1 | 1.75 | 2.25 | 10.25 | 0.25 | 0 | 15.5 |
| E | 0 | 0.5 | 1.5 | 1.25 | 3 | 1.25 | 0 | 7.5 |
| ESE | 0 | 1.25 | 1 | 0.25 | 3 | 2.5 | 1.5 | 9.5 |
| SE | 0 | 1.25 | 1.5 | 4 | 4.75 | 1 | 0.5 | 13 |
| SSE | 0.5 | 2.5 | 3.75 | 7.25 | 4.75 | 0 | 0 | 18.75 |
| S | 0.75 | 3 | 10 | 8.75 | 2.75 | 0 | 0 | 25.25 |
| SSW | 0 | 3 | 21 | 18 | 2.5 | 0 | 0 | 44.5 |
| SW | 0.25 | 5.75 | 7.75 | 8.5 | 5.25 | 0.25 | 0.75 | 28.5 |
| WSW | 0.5 | 3.25 | 6.5 | 4.5 | 4 | 0.25 | 0 | 19 |
| W | 0 | 4 | 3.5 | 9 | 7.25 | 0.75 | 0 | 24.5 |
| WNW | 0 | 1.75 | 12.75 | 8 | 5.25 | 0 | 0 | 27.75 |
| NW | 0.25 | 1.75 | 8 | 8.25 | 3.25 | 0.5 | 0 | 22 |
| NNW | 0 | 0.75 | 11.25 | 9.25 | 1.5 | 0 | 0 | 22.75 |
| TOTAL | 2.5 | 32.5 | 101.75 | 116.75 | 69.5 | 7.5 | 3.75 | 334.25 |

First Quarter 1998

Stability Class F

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|------|-------|-------|-----|--------|
| N | 0.25 | 2.25 | 7.25 | 4.5 | 0 | 0 | 0 | 14.25 |
| NNE | 0 | 1.25 | 1.75 | 1.25 | 0 | 0 | 0 | 4.25 |
| NE | 0 | 0.75 | 0.25 | 2.5 | 2 | 0 | 0 | 5.5 |
| ENE | 0 | 0.75 | 0 | 1.25 | 0.5 | 0.25 | 0 | 2.75 |
| E | 0 | 0.25 | 1 | 1.75 | 0.75 | 0.75 | 0 | 4.5 |
| ESE | 0 | 1.5 | 2 | 1.5 | 2.5 | 0.75 | 0 | 8.25 |
| SE | 0 | 1.25 | 1.25 | 0 | 0.25 | 0 | 0 | 2.75 |
| SSE | 0 | 1.5 | 3.5 | 4.5 | 0.5 | 0 | 0 | 10 |
| S | 0 | 1.75 | 4.75 | 5 | 0 | 0 | 0 | 11.5 |
| SSW | 0 | 1.75 | 6.5 | 8.5 | 0 | 0 | 0 | 16.75 |
| SW | 0 | 2.75 | 2.75 | 4.5 | 3 | 0 | 0 | 13 |
| WSW | 0.25 | 0.75 | 9.5 | 4.25 | 1.25 | 0.25 | 0 | 16.25 |
| W | 0 | 1.5 | 5.75 | 5 | 1.5 | 0 | 0 | 13.75 |
| WNW | 0 | 0.5 | 14.75 | 8.5 | 2.25 | 0 | 0 | 26 |
| NW | 0 | 1.25 | 6.75 | 4.5 | 0 | 0 | 0 | 12.5 |
| NNW | 0 | 1.25 | 9.5 | 7 | 0.5 | 0 | 0 | 18.25 |
| TOTAL | 0.5 | 21 | 77.25 | 64.5 | 15 | 2 | 0 | 180.25 |

First Quarter 1998

Stability Class G

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|-------|-------|-------|-------|------|--------|
| N | 0.25 | 2 | 7 | 2.25 | 0 | 0 | 0 | 11.5 |
| NNE | 0 | 2 | 1 | 0.25 | 0 | 0 | 0 | 3.25 |
| NE | 0 | 0 | 0.25 | 0.25 | 0 | 0 | 0 | 0.5 |
| ENE | 0 | 0 | 0.25 | 0.75 | 0 | 0 | 0 | 1 |
| E | 0 | 0 | 0 | 0 | 0.25 | 0 | 0 | 0.25 |
| ESE | 0 | 0.5 | 0.5 | 0.25 | 1.75 | 1 | 0.25 | 4.25 |
| SE | 0 | 0.75 | 1 | 0.5 | 0 | 0 | 0 | 2.25 |
| SSE | 0 | 1.5 | 3.25 | 5 | 0.25 | 0 | 0 | 10 |
| S | 0 | 1.25 | 12 | 16.25 | 0.5 | 0 | 0 | 30 |
| SSW | 0 | 1.5 | 6.5 | 4 | 0 | 0 | 0 | 12 |
| SW | 0 | 2.25 | 3 | 2.25 | 0.25 | 0 | 0 | 7.75 |
| WSW | 0 | 1 | 5.5 | 0.25 | 0.25 | 0 | 0 | 7 |
| W | 0 | 3.5 | 14.75 | 10 | 0.25 | 0 | 0 | 28.5 |
| WNW | 0 | 2 | 26 | 11.5 | 0.25 | 0 | 0 | 39.75 |
| NW | 0 | 0.5 | 12.5 | 1.25 | 0 | 0 | 0 | 14.25 |
| NNW | 0.25 | 3 | 17 | 2.75 | 0 | 0 | 0 | 23 |
| TOTAL | 0.5 | 21.75 | 110.5 | 57.5 | 3.75 | 1 | 0.25 | 195.25 |

Second Quarter 1998

Stability Class A

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|--------|--------|-------|-------|-------|-------|
| N | 0 | 0 | 1.5 | 5 | 3.25 | 2.5 | 0.75 | 13 |
| NNE | 0 | 0 | 6 | 32 | 23.25 | 3 | 10.25 | 74.5 |
| NE | 0 | 0.25 | 20.75 | 32.75 | 11.5 | 4.75 | 0 | 70 |
| ENE | 0 | 0.25 | 14.5 | 9.25 | 1 | 1 | 0 | 26 |
| E | 0 | 1.5 | 11.5 | 2 | 0 | 0 | 0 | 15 |
| ESE | 0 | 2.5 | 9.5 | 0.25 | 0 | 0 | 0 | 12.25 |
| SE | 0 | 1.5 | 5 | 0.5 | 0 | 0 | 0 | 7 |
| SSE | 0 | 1 | 7 | 1.75 | 1.25 | 0 | 0 | 11 |
| S | 0 | 0.5 | 2.5 | 2 | 6.5 | 0.75 | 0.25 | 12.5 |
| SSW | 0 | 0 | 2.25 | 3.5 | 1.75 | 0 | 0 | 7.5 |
| SW | 0 | 0.5 | 1.25 | 3.75 | 3.25 | 0.75 | 0 | 9.5 |
| WSW | 0 | 0 | 1.75 | 4.5 | 10 | 9.5 | 3.25 | 29 |
| W | 0 | 0 | 2 | 9.5 | 4.75 | 1.25 | 0 | 17.5 |
| WNW | 0 | 0 | 5.75 | 15 | 9 | 0 | 0 | 29.75 |
| NW | 0 | 0 | 9.25 | 18.25 | 6.75 | 0.5 | 0 | 34.75 |
| NNW | 0 | 0 | 5.25 | 8.75 | 3.5 | 0.75 | 0.5 | 18.75 |
| TOTAL | 0 | 8 | 105.75 | 148.75 | 85.75 | 24.75 | 15 | 388 |

Second Quarter 1998

Stability Class B

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|------|-------|
| N | 0 | 0.75 | 1 | 0.25 | 0.5 | 0.5 | 0 | 3 |
| NNE | 0 | 0.25 | 1.25 | 7 | 11.5 | 5 | 4.75 | 29.75 |
| NE | 0 | 0 | 1.5 | 7.75 | 1 | 0.5 | 0 | 10.75 |
| ENE | 0 | 0 | 2.25 | 5 | 0.5 | 0 | 0 | 7.75 |
| E | 0 | 0 | 0.5 | 1.25 | 0 | 0 | 0 | 1.75 |
| ESE | 0 | 0.5 | 1.25 | 0.5 | 0 | 0 | 0 | 2.25 |
| SE | 0 | 0 | 1.75 | 0 | 0 | 0 | 0 | 1.75 |
| SSE | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| S | 0 | 0 | 0.25 | 0.5 | 0 | 0 | 0 | 0.75 |
| SSW | 0 | 0 | 0 | 1 | 0.25 | 0 | 0 | 1.25 |
| SW | 0 | 0 | 1 | 0.25 | 0 | 0 | 0 | 1.25 |
| WSW | 0 | 0.25 | 0 | 1.75 | 2.25 | 0.25 | 0 | 4.5 |
| W | 0 | 0 | 1.25 | 1 | 2 | 0 | 0 | 4.25 |
| WNW | 0 | 0 | 1 | 3.25 | 1.25 | 0 | 0 | 5.5 |
| NW | 0 | 0 | 0.5 | 1.25 | 0.25 | 0 | 0 | 2 |
| NNW | 0 | 0.25 | 0.25 | 1.5 | 0.25 | 0.25 | 0 | 2.5 |
| TOTAL | 0 | 2 | 14.75 | 32.25 | 20.75 | 6.5 | 4.75 | 81 |

Second Quarter 1998

Stability Class C

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|-----|-------|
| N | 0.25 | 0 | 0.75 | 1.25 | 0.25 | 0 | 0 | 2.5 |
| NNE | 0 | 0 | 1.25 | 6.75 | 11 | 7.25 | 3.5 | 29.75 |
| NE | 0 | 0 | 2.5 | 9.5 | 2.5 | 0 | 0 | 14.5 |
| ENE | 0 | 0 | 3.75 | 2 | 0 | 0 | 0 | 5.75 |
| E | 0 | 1 | 3.25 | 0 | 0 | 0 | 0 | 4.25 |
| ESE | 0 | 1 | 2.25 | 0 | 0 | 0 | 0 | 3.25 |
| SE | 0 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| SSE | 0 | 0 | 1.75 | 0 | 0.5 | 0 | 0 | 2.25 |
| S | 0 | 0 | 0 | 0.25 | 0.5 | 0.25 | 0 | 1 |
| SSW | 0 | 0 | 1.75 | 1 | 0.25 | 0 | 0 | 3 |
| SW | 0 | 0 | 0.5 | 1 | 0.5 | 0 | 0 | 2 |
| WSW | 0 | 0.25 | 0.5 | 1.25 | 1.75 | 0 | 0 | 3.75 |
| W | 0 | 0 | 0.5 | 0.75 | 0.5 | 0 | 0 | 1.75 |
| WNW | 0 | 0 | 0.5 | 1 | 1.75 | 0 | 0 | 3.25 |
| NW | 0 | 0 | 0 | 0.25 | 1.25 | 0 | 0 | 1.5 |
| NNW | 0 | 0 | 1 | 0.75 | 1.5 | 0 | 0 | 3.25 |
| TOTAL | 0.25 | 2.25 | 22.75 | 25.75 | 22.25 | 7.5 | 3.5 | 84.25 |

Second Quarter 1998

Stability Class D

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|--------|-------|-------|-------|------|-------|
| N | 0.25 | 1.5 | 7 | 5.25 | 0.5 | 0.5 | 0.25 | 15.25 |
| NNE | 0 | 0.75 | 9.5 | 42.25 | 42 | 15.75 | 5.75 | 116 |
| NE | 0 | 1 | 22.5 | 30 | 5 | 0.25 | 0 | 58.75 |
| ENE | 0 | 1.5 | 14 | 16.75 | 1.75 | 0.5 | 0 | 34.5 |
| E | 0 | 2.25 | 9.5 | 1 | 0 | 0 | 0 | 12.75 |
| ESE | 0 | 2.25 | 6.5 | 0 | 0 | 0 | 0 | 8.75 |
| SE | 0 | 1.25 | 5 | 1 | 0 | 0 | 0 | 7.25 |
| SSE | 0 | 1 | 12 | 4 | 0.75 | 0.5 | 0 | 18.25 |
| S | 0 | 1.25 | 9.75 | 6.25 | 5 | 0.75 | 0.25 | 23.25 |
| SSW | 0 | 1.75 | 5.5 | 4 | 0.5 | 0 | 0 | 11.75 |
| SW | 0 | 1.75 | 1.75 | 1.5 | 0.5 | 0 | 0 | 5.5 |
| WSW | 0 | 0 | 2.25 | 5 | 2.75 | 0.5 | 0 | 10.5 |
| W | 0 | 1.25 | 0.25 | 0.5 | 5.5 | 3.5 | 0 | 11 |
| WNW | 0 | 0.5 | 4.5 | 3.75 | 2.25 | 0 | 0 | 11 |
| NW | 0 | 1 | 3.25 | 3 | 1.75 | 0 | 0 | 9 |
| NNW | 0 | 1 | 4 | 2.75 | 1.25 | 1 | 0 | 10 |
| TOTAL | 0.25 | 20 | 117.25 | 127 | 69.5 | 23.25 | 6.25 | 363.5 |

Second Quarter 1998

Stability Class E

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|-------|------|-------|--------|-------|-------|------|-------|
| N | 13.75 | 2.25 | 6.25 | 4.75 | 2 | 0 | 0 | 29 |
| NNE | 0 | 1 | 12.5 | 30.5 | 24.5 | 9.25 | 0.5 | 78.25 |
| NE | 0 | 2.5 | 22.25 | 6 | 3 | 0 | 0 | 33.75 |
| ENE | 0 | 1 | 13 | 3 | 1.75 | 0 | 0 | 18.75 |
| E | 0 | 1.75 | 6.25 | 2.5 | 2.25 | 0.5 | 0 | 13.25 |
| ESE | 0 | 4 | 8.75 | 1.25 | 0 | 0 | 0 | 14 |
| SE | 0 | 2.75 | 6.75 | 0.75 | 0.25 | 0.25 | 0.25 | 11 |
| SSE | 0 | 1.5 | 10.25 | 8.25 | 2 | 1.25 | 0 | 23.25 |
| S | 0 | 0.75 | 11.5 | 13.75 | 4.25 | 4.5 | 1 | 35.75 |
| SSW | 0 | 1.25 | 13.5 | 16 | 1.25 | 0 | 0 | 32 |
| SW | 0 | 1.25 | 3.5 | 1 | 3.5 | 0.25 | 0 | 9.5 |
| WSW | 0 | 1.5 | 3.5 | 5.75 | 3.5 | 1.25 | 0.75 | 16.25 |
| W | 0.25 | 0.75 | 3 | 7.25 | 2 | 1 | 0 | 14.25 |
| WNW | 0 | 2.5 | 4.25 | 7.25 | 0.25 | 0 | 0 | 14.25 |
| NW | 0 | 2.25 | 5.5 | 3.25 | 0.5 | 0 | 0.25 | 11.75 |
| NNW | 0 | 0.5 | 4.75 | 3 | 0 | 0.25 | 0 | 8.5 |
| TOTAL | 14 | 27.5 | 135.5 | 114.25 | 51 | 18.5 | 2.75 | 363.5 |

Second Quarter 1998

Stability Class F

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|--------|-------|-------|-------|------|-------|
| N | 0 | 2.75 | 14.75 | 5 | 0 | 0 | 0 | 22.5 |
| NNE | 0 | 2.25 | 11.5 | 7 | 10 | 1.25 | 0 | 32 |
| NE | 0.25 | 4.25 | 14.5 | 2.75 | 1 | 0 | 0 | 22.75 |
| ENE | 0 | 1.25 | 6 | 2.5 | 0.75 | 0 | 0 | 10.5 |
| E | 0 | 2 | 5.25 | 3.25 | 1.75 | 0 | 0 | 12.25 |
| ESE | 0 | 3.25 | 4 | 0.75 | 0.75 | 0.5 | 0 | 9.25 |
| SE | 0 | 2.75 | 7 | 1 | 0.25 | 0 | 0.25 | 11.25 |
| SSE | 0 | 1.5 | 9.25 | 5.25 | 2 | 1 | 2.25 | 21.25 |
| S | 0 | 4 | 12.5 | 12.25 | 3.25 | 0.5 | 0 | 32.5 |
| SSW | 0 | 3.25 | 11 | 6.75 | 3 | 0 | 0.25 | 24.25 |
| SW | 0 | 2.25 | 7.75 | 2.5 | 0.75 | 0 | 0 | 13.25 |
| WSW | 0 | 3.25 | 4.25 | 5.5 | 0 | 0 | 0 | 13 |
| W | 0 | 2.25 | 6.5 | 10 | 0 | 0 | 0 | 18.75 |
| WNW | 0 | 2.25 | 7.5 | 7.25 | 0.75 | 0 | 0 | 17.75 |
| NW | 0.25 | 1 | 5.25 | 1.75 | 0 | 0 | 0 | 8.25 |
| NNW | 0 | 2 | 4.25 | 3.75 | 0 | 0 | 0 | 10 |
| TOTAL | 0.5 | 40.25 | 131.25 | 77.25 | 24.25 | 3.25 | 2.75 | 279.5 |

Second Quarter 1998

Stability Class G

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|--------|-------|-------|-------|-------|-----|--------|
| N | 0.25 | 5 | 28.75 | 3 | 0 | 0 | 0 | 37 |
| NNE | 0.25 | 3.5 | 6 | 4.5 | 1.75 | 0 | 0 | 16 |
| NE | 0.75 | 3.25 | 8.75 | 3 | 0.75 | 0 | 0 | 16.5 |
| ENE | 0 | 1.75 | 7.25 | 1.5 | 0.75 | 0.25 | 0 | 11.5 |
| E | 0.5 | 4.25 | 12 | 2.25 | 4 | 0 | 0 | 23 |
| ESE | 0 | 7.25 | 8.25 | 0.5 | 0.5 | 0 | 0 | 16.5 |
| SE | 1 | 6.25 | 13 | 1 | 0 | 0 | 0 | 21.25 |
| SSE | 0 | 9.5 | 35 | 20 | 5.5 | 3.75 | 3 | 76.75 |
| S | 0.25 | 11.25 | 47.5 | 47 | 4.5 | 1.75 | 0.5 | 112.75 |
| SSW | 0.5 | 16.5 | 31.25 | 2.5 | 0 | 0 | 0 | 50.75 |
| SW | 1.25 | 18.25 | 25.75 | 8.5 | 0.5 | 0 | 0 | 54.25 |
| WSW | 0 | 12.75 | 21 | 17.75 | 0 | 0 | 0 | 51.5 |
| W | 0.25 | 7 | 20.75 | 32.5 | 0.25 | 0 | 0 | 60.75 |
| WNW | 0.5 | 5.75 | 11.5 | 16.25 | 0 | 0 | 0 | 34 |
| NW | 0.25 | 4.5 | 6.5 | 1.75 | 0.25 | 0 | 0 | 13.25 |
| NNW | 0 | 3.5 | 13.25 | 1.5 | 0 | 0 | 0 | 18.25 |
| TOTAL | 5.75 | 120.25 | 296.5 | 163.5 | 18.75 | 5.75 | 3.5 | 614 |

Third Quarter 1998

Stability Class A

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|--------|-------|-------|-----|--------|
| N | 0 | 0.75 | 5.25 | 18.25 | 15.5 | 1.5 | 0 | 41.25 |
| NNE | 0 | 0.5 | 8 | 15.75 | 1.5 | 0.5 | 0 | 26.25 |
| NE | 0 | 0.5 | 11 | 8.25 | 0 | 0 | 0 | 19.75 |
| ENE | 0 | 1.25 | 12.25 | 1.75 | 0.5 | 0 | 0 | 15.75 |
| E | 0 | 2.25 | 11.5 | 1 | 0.25 | 0 | 0 | 15 |
| ESE | 0 | 2 | 17.5 | 2.25 | 0.25 | 0 | 0 | 22 |
| SE | 0 | 0.25 | 10 | 12 | 7.75 | 0.25 | 0 | 30.25 |
| SSE | 0 | 0.25 | 5.75 | 12.5 | 5.5 | 0.25 | 0 | 24.25 |
| S | 0 | 0.75 | 5.5 | 5.25 | 0 | 0 | 0 | 11.5 |
| SSW | 0 | 1.75 | 4.5 | 7.75 | 1.25 | 0 | 0 | 15.25 |
| SW | 0 | 0.75 | 7 | 18.75 | 7 | 0 | 0 | 33.5 |
| WSW | 0 | 1 | 5.5 | 19 | 5.75 | 0.25 | 0 | 31.5 |
| W | 0 | 0.5 | 9 | 19 | 5 | 0 | 0 | 33.5 |
| WNW | 0 | 0.5 | 6.75 | 16 | 2 | 0 | 0 | 25.25 |
| NW | 0 | 0.5 | 6.5 | 10.75 | 1 | 0 | 0 | 18.75 |
| NNW | 0 | 1 | 8 | 9.5 | 2 | 0 | 0 | 20.5 |
| TOTAL | 0 | 14.5 | 134 | 177.75 | 55.25 | 2.75 | 0 | 384.25 |

Third Quarter 1998

Stability Class B

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|-----|-------|
| N | 0 | 0 | 1.5 | 2.5 | 1.25 | 1 | 0 | 6.25 |
| NNE | 0 | 0 | 1.5 | 3.5 | 1 | 0 | 0 | 6 |
| NE | 0 | 0 | 0.75 | 0.75 | 0.25 | 0 | 0 | 1.75 |
| ENE | 0 | 0 | 1 | 0.25 | 0 | 0 | 0 | 1.25 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 0 | 0.25 | 0.25 | 0 | 0 | 0 | 0.5 |
| SE | 0 | 0.25 | 1.75 | 1.25 | 0 | 0 | 0 | 3.25 |
| SSE | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| S | 0 | 0 | 1.25 | 1.5 | 0 | 0 | 0 | 2.75 |
| SSW | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| SW | 0 | 0 | 0.5 | 1.75 | 0.5 | 0 | 0 | 2.75 |
| WSW | 0 | 0.25 | 0.25 | 2 | 0 | 0 | 0 | 2.5 |
| W | 0 | 0 | 0.25 | 1 | 0 | 0 | 0 | 1.25 |
| WNW | 0 | 0 | 0.75 | 2.25 | 0 | 0 | 0 | 3 |
| NW | 0 | 0 | 1.25 | 1 | 0.25 | 0 | 0 | 2.5 |
| NNW | 0 | 0 | 1.25 | 0.75 | 0.25 | 0 | 0 | 2.25 |
| TOTAL | 0 | 0.5 | 13.25 | 20.75 | 3.5 | 1 | 0 | 39 |

Third Quarter 1998

Stability Class C

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|-----|-------|
| N | 0 | 0 | 0.25 | 6.75 | 0.5 | 0 | 0 | 7.5 |
| NNE | 0 | 0 | 1.75 | 5.75 | 0.25 | 0 | 0 | 7.75 |
| NE | 0 | 0 | 4 | 4.75 | 0.75 | 0 | 0 | 9.5 |
| ENE | 0 | 0 | 5.5 | 0.75 | 0.25 | 0 | 0 | 6.5 |
| E | 0 | 0 | 3.5 | 0 | 0 | 0 | 0 | 3.5 |
| ESE | 0 | 0 | 2.5 | 1 | 0 | 0 | 0 | 3.5 |
| SE | 0 | 0.5 | 3.75 | 2.25 | 0.25 | 0 | 0 | 6.75 |
| SSE | 0 | 1 | 2 | 2.5 | 0.25 | 0 | 0 | 5.75 |
| S | 0 | 0 | 0.75 | 1.25 | 0 | 0 | 0 | 2 |
| SSW | 0 | 0 | 0.75 | 1.25 | 0.75 | 0 | 0 | 2.75 |
| SW | 0 | 0 | 1.75 | 2 | 0.5 | 0 | 0 | 4.25 |
| WSW | 0 | 0 | 0.75 | 2 | 1.5 | 0 | 0 | 4.25 |
| W | 0 | 0 | 0.5 | 2.75 | 1.5 | 0.25 | 0 | 5 |
| WNW | 0 | 0 | 0.75 | 1 | 0.5 | 0.25 | 0 | 2.5 |
| NW | 0 | 0.25 | 0 | 1.75 | 0.5 | 0 | 0 | 2.5 |
| NNW | 0 | 0.25 | 0.25 | 1 | 0.25 | 0 | 0 | 1.75 |
| TOTAL | 0 | 2 | 28.75 | 36.75 | 7.75 | 0.5 | 0 | 75.75 |

Third Quarter 1998

Stability Class D

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|-------|-------|-------|-------|-----|--------|
| N | 0 | 0.25 | 3 | 13.75 | 4.5 | 0 | 0 | 21.5 |
| NNE | 0 | 0 | 7.75 | 12.25 | 1.25 | 0 | 0 | 21.25 |
| NE | 0 | 0.25 | 6.5 | 12 | 0.75 | 0 | 0 | 19.5 |
| ENE | 0 | 1.5 | 7.25 | 4 | 1 | 0 | 0 | 13.75 |
| E | 0 | 2 | 11.25 | 0.25 | 0 | 0 | 0 | 13.5 |
| ESE | 0 | 3 | 8.5 | 1.5 | 0 | 0 | 0 | 13 |
| SE | 0 | 2.25 | 6.5 | 5.25 | 1.5 | 0 | 0 | 15.5 |
| SSE | 0 | 1.25 | 4.25 | 8.75 | 1.25 | 0 | 0 | 15.5 |
| S | 0 | 0.25 | 8.25 | 3.75 | 0 | 0 | 0 | 12.25 |
| SSW | 0 | 0.5 | 4.5 | 2.25 | 0 | 0 | 0 | 7.25 |
| SW | 0 | 1.25 | 6.75 | 4.25 | 0.75 | 0 | 0 | 13 |
| WSW | 0 | 0.5 | 2.75 | 3.75 | 0.75 | 0 | 0 | 7.75 |
| W | 0 | 0.25 | 2 | 4.5 | 0.25 | 0 | 0 | 7 |
| WNW | 0 | 0.75 | 2.25 | 4.25 | 0.75 | 0 | 0 | 8 |
| NW | 0 | 1.5 | 1.75 | 1.5 | 0 | 0 | 0 | 4.75 |
| NNW | 0 | 0.25 | 9 | 6 | 0 | 0 | 0 | 15.25 |
| TOTAL | 0 | 15.75 | 92.25 | 88 | 12.75 | 0 | 0 | 208.75 |

Third Quarter 1998

Stability Class E

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|-------|-------|-------|-------|------|--------|
| N | 1.5 | 2.5 | 4 | 3.25 | 1.75 | 0 | 0 | 13 |
| NNE | 0 | 3 | 5 | 6.5 | 0.5 | 0 | 0 | 15 |
| NE | 0 | 5.25 | 7.5 | 8 | 0 | 0 | 0 | 20.75 |
| ENE | 0 | 4 | 6.25 | 10.25 | 0.75 | 0 | 0 | 21.25 |
| E | 0 | 3.75 | 6 | 4.25 | 0.5 | 0 | 0 | 14.5 |
| ESE | 0 | 1.25 | 4.25 | 2.5 | 0 | 0 | 0 | 8 |
| SE | 0 | 1.75 | 7.5 | 11 | 2.75 | 0 | 0 | 23 |
| SSE | 0 | 2.25 | 14.25 | 13 | 1.5 | 0 | 0 | 31 |
| S | 0 | 2.25 | 51.75 | 11 | 0 | 0 | 0 | 65 |
| SSW | 0 | 3 | 17.25 | 9 | 0.75 | 0 | 0 | 30 |
| SW | 0 | 1.5 | 8.25 | 12 | 3.75 | 0 | 0 | 25.5 |
| WSW | 0 | 1 | 5 | 7 | 2.25 | 0 | 0 | 15.25 |
| W | 0 | 0 | 4 | 5.25 | 0.25 | 0 | 0 | 9.5 |
| WNW | 0 | 0.5 | 2.25 | 6 | 0 | 0 | 0 | 8.75 |
| NW | 0 | 2 | 3.5 | 1.25 | 0 | 0 | 0 | 6.75 |
| NNW | 0 | 1.75 | 6.75 | 3.25 | 0 | 0 | 0.25 | 12 |
| TOTAL | 1.5 | 35.75 | 153.5 | 113.5 | 14.75 | 0 | 0.25 | 319.25 |

Third Quarter 1998

Stability Class F

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|-------|-------|-------|-------|-----|-------|
| N | 0.25 | 1 | 5.75 | 1.75 | 0 | 0 | 0 | 8.75 |
| NNE | 0 | 1.5 | 7 | 1.25 | 0 | 0 | 0 | 9.75 |
| NE | 0 | 1.25 | 4.75 | 3.5 | 0 | 0 | 0 | 9.5 |
| ENE | 0.25 | 0.25 | 1.75 | 1 | 0 | 0 | 0 | 3.25 |
| E | 0 | 1.75 | 2.25 | 0 | 0 | 0 | 0 | 4 |
| ESE | 0 | 0.25 | 1.25 | 0.25 | 0 | 0 | 0 | 1.75 |
| SE | 0 | 1.25 | 3.75 | 7.25 | 2.75 | 0 | 0 | 15 |
| SSE | 0 | 4.5 | 9.75 | 7.25 | 1 | 0 | 0 | 22.5 |
| S | 0 | 2.75 | 21.5 | 3.5 | 0.5 | 0 | 0 | 28.25 |
| SSW | 0 | 2.25 | 20 | 3.5 | 0.25 | 0 | 0 | 26 |
| SW | 0 | 2.5 | 4.75 | 2.75 | 0.75 | 0 | 0 | 10.75 |
| WSW | 0 | 1.5 | 7 | 5 | 0.25 | 0 | 0 | 13.75 |
| W | 0.25 | 1.25 | 4 | 9 | 0 | 0 | 0 | 14.5 |
| WNW | 0.25 | 1.75 | 4.5 | 2.75 | 0 | 0 | 0 | 9.25 |
| NW | 0 | 2.75 | 3.25 | 1 | 0 | 0 | 0 | 7 |
| NNW | 0.5 | 1.25 | 10.75 | 3.5 | 0 | 0 | 0 | 16 |
| TOTAL | 1.5 | 27.75 | 112 | 53.25 | 5.5 | 0 | 0 | 200 |

Third Quarter 1998

Stability Class G

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|-----|-------|
| N | 0 | 3.5 | 18 | 1 | 0 | 0 | 0 | 22.5 |
| NNE | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| NE | 0 | 1.25 | 1 | 0 | 0 | 0 | 0 | 2.25 |
| ENE | 0 | 1 | 1.25 | 0 | 0 | 0 | 0 | 2.25 |
| E | 0 | 0.25 | 0.5 | 0 | 0 | 0 | 0 | 0.75 |
| ESE | 0 | 0.5 | 0.75 | 0.25 | 0 | 0 | 0 | 1.5 |
| SE | 0 | 0.5 | 8 | 8 | 3 | 0 | 0 | 19.5 |
| SSE | 0 | 3.25 | 12.25 | 12.75 | 2 | 0 | 0 | 30.25 |
| S | 0 | 6.25 | 14 | 6.75 | 0 | 0 | 0 | 27 |
| SSW | 0.25 | 7 | 32.75 | 2.25 | 0 | 0 | 0 | 42.25 |
| SW | 0.25 | 9.75 | 53 | 9.75 | 0 | 0 | 0 | 72.75 |
| WSW | 0 | 7.5 | 45.75 | 19.25 | 0.25 | 0 | 0 | 72.75 |
| W | 0.25 | 7.75 | 33.5 | 15.75 | 0 | 0 | 0 | 57.25 |
| WNW | 0 | 7.5 | 19 | 26 | 0 | 0 | 0 | 52.5 |
| NW | 0.25 | 10 | 37.75 | 2.5 | 0 | 0 | 0 | 50.5 |
| NNW | 0.75 | 8 | 41.5 | 0.25 | 0 | 0 | 0 | 50.5 |
| TOTAL | 1.75 | 75 | 321 | 104.5 | 5.25 | 0 | 0 | 507.5 |

Fourth Quarter 1998

Stability Class A

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|------|--------|-------|-------|------|-------|
| N | 0 | 1.25 | 12.5 | 9 | 3.5 | 0 | 0 | 26.25 |
| NNE | 0 | 0.5 | 3 | 8 | 7.75 | 0.75 | 0 | 20 |
| NE | 0 | 0.5 | 2.5 | 2.75 | 4.5 | 1 | 0 | 11.25 |
| ENE | 0 | 0.25 | 2 | 2 | 5.25 | 0.25 | 0 | 9.75 |
| E | 0 | 1.25 | 1.75 | 7.5 | 4 | 0 | 0 | 14.5 |
| ESE | 0 | 3 | 2.75 | 3.25 | 4.75 | 4.75 | 3.75 | 22.25 |
| SE | 0 | 1 | 3.25 | 5.25 | 2 | 3.75 | 1.75 | 17 |
| SSE | 0 | 0.5 | 3.5 | 2.5 | 7.5 | 0.75 | 4.25 | 19 |
| S | 0 | 0.5 | 4.25 | 5 | 2 | 1 | 0 | 12.75 |
| SSW | 0 | 1 | 4.5 | 12.75 | 2.75 | 0 | 0.75 | 21.75 |
| SW | 0 | 0 | 4.5 | 7.25 | 12.75 | 0 | 0.25 | 24.75 |
| WSW | 0 | 1 | 6.5 | 16.75 | 15 | 3 | 0 | 42.25 |
| W | 0 | 1 | 7.5 | 16.25 | 25.5 | 6.25 | 0.25 | 56.75 |
| WNW | 0 | 0.5 | 4.25 | 33.75 | 22.5 | 3.5 | 1.25 | 65.75 |
| NW | 0 | 0.25 | 6.25 | 19.5 | 4.25 | 0.25 | 0 | 30.5 |
| NNW | 0 | 0.5 | 14.5 | 21.25 | 10 | 2.5 | 0.25 | 49 |
| TOTAL | 0 | 13 | 83.5 | 172.75 | 134 | 27.75 | 12.5 | 443.5 |

Fourth Quarter 1998

Stability Class B

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|------|-------|-------|-------|------|-------|
| N | 0 | 0 | 0.25 | 2.75 | 0.75 | 0 | 0 | 3.75 |
| NNE | 0 | 0 | 0.75 | 4 | 3.5 | 0.25 | 0 | 8.5 |
| NE | 0 | 0 | 0.25 | 0.5 | 2.5 | 1.25 | 0 | 4.5 |
| ENE | 0 | 0 | 0.25 | 0 | 1.75 | 0 | 0 | 2 |
| E | 0 | 0.5 | 0.25 | 0.25 | 2 | 0 | 0 | 3 |
| ESE | 0 | 0.25 | 0 | 2.75 | 1 | 0.25 | 3.25 | 7.5 |
| SE | 0 | 0.25 | 0.5 | 4.75 | 2.5 | 1 | 2.5 | 11.5 |
| SSE | 0 | 0.25 | 0.5 | 2 | 3.75 | 1 | 0.75 | 8.25 |
| S | 0 | 0 | 0.5 | 0.75 | 1.5 | 0.75 | 1.25 | 4.75 |
| SSW | 0 | 0 | 1.25 | 2.5 | 1 | 0 | 0 | 4.75 |
| SW | 0 | 0 | 0 | 0.25 | 1.5 | 0 | 0 | 1.75 |
| WSW | 0 | 0 | 0 | 0.5 | 0.5 | 1 | 0 | 2 |
| W | 0 | 0 | 0 | 1.75 | 1 | 0.75 | 0 | 3.5 |
| WNW | 0 | 0 | 0.75 | 2.75 | 1.75 | 0 | 0 | 5.25 |
| NW | 0 | 0.25 | 1 | 2.5 | 0 | 0 | 0 | 3.75 |
| NNW | 0 | 0.25 | 1 | 0.75 | 0.75 | 0.5 | 0 | 3.25 |
| TOTAL | 0 | 1.75 | 7.25 | 28.75 | 25.75 | 6.75 | 7.75 | 78 |

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Stability Class C

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|------|------|-------|-------|------|-------|
| N | 0 | 0.5 | 1.5 | 6 | 3.25 | 0 | 0 | 11.25 |
| NNE | 0 | 0 | 0.25 | 4 | 5.75 | 0.5 | 0 | 10.5 |
| NE | 0 | 0 | 0.5 | 3.5 | 3.5 | 0 | 0 | 7.5 |
| ENE | 0 | 0 | 0 | 3.25 | 3 | 0.5 | 0 | 6.75 |
| E | 0 | 0.25 | 0.75 | 0.5 | 0.75 | 0 | 0 | 2.25 |
| ESE | 0.25 | 0.25 | 0.5 | 0.25 | 1 | 0 | 0.75 | 3 |
| SE | 0.25 | 0 | 0 | 4 | 2.25 | 0.5 | 0.25 | 7.25 |
| SSE | 0 | 0 | 0 | 1.75 | 2.5 | 0 | 0 | 4.25 |
| S | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| SSW | 0 | 0 | 2 | 2.25 | 0.5 | 0.25 | 0.75 | 5.75 |
| SW | 0 | 0 | 0.75 | 1 | 0.25 | 0 | 0.5 | 2.5 |
| WSW | 0 | 0 | 0 | 3.75 | 3.75 | 0.5 | 0 | 8 |
| W | 0 | 0.25 | 0.5 | 6.25 | 2 | 1.25 | 0 | 10.25 |
| WNW | 0 | 0 | 1.75 | 4.25 | 3.25 | 1.5 | 0 | 10.75 |
| NW | 0 | 1 | 1.75 | 2 | 0.75 | 0 | 0 | 5.5 |
| NNW | 0 | 0.5 | 1.25 | 1.75 | 0 | 0 | 0 | 3.5 |
| TOTAL | 0.5 | 2.75 | 12.5 | 46.5 | 32.5 | 5 | 2.25 | 102 |

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Stability Class D

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|------|-------|
| N | 0.25 | 0 | 6.75 | 13.75 | 4.5 | 2.75 | 0 | 28 |
| NNE | 0 | 0.25 | 4.75 | 11.25 | 4.75 | 1.25 | 0 | 22.25 |
| NE | 0 | 0.25 | 1.25 | 0.75 | 0.25 | 0 | 0 | 2.5 |
| ENE | 0 | 0 | 0.75 | 1.75 | 2.5 | 0 | 0 | 5 |
| E | 0 | 1.25 | 1 | 1.5 | 0.75 | 0 | 0 | 4.5 |
| ESE | 0 | 0.25 | 0.5 | 1 | 1.25 | 3 | 1 | 7 |
| SE | 0 | 0.25 | 0.75 | 3.5 | 2.75 | 0.5 | 2.5 | 10.25 |
| SSE | 0 | 0 | 3 | 3.5 | 2 | 2.25 | 0.25 | 11 |
| S | 0 | 0 | 3.5 | 13.25 | 6.25 | 0.75 | 0.5 | 24.25 |
| SSW | 0 | 0 | 11.5 | 16 | 6.5 | 1.25 | 0.5 | 35.75 |
| SW | 0 | 0.25 | 4 | 3.5 | 1.75 | 0 | 0.25 | 9.75 |
| WSW | 0 | 0.75 | 4.25 | 5.25 | 8.5 | 1.5 | 0 | 20.25 |
| W | 0 | 0.75 | 3.5 | 20.75 | 10.5 | 4.75 | 0.25 | 40.5 |
| WNW | 0 | 0.5 | 6.75 | 32.25 | 21.5 | 4 | 0 | 65 |
| NW | 0 | 0.75 | 10.25 | 12.25 | 3.5 | 0.5 | 0 | 27.25 |
| NNW | 0 | 0.75 | 9 | 24.75 | 10 | 0.25 | 0 | 44.75 |
| TOTAL | 0.25 | 6 | 71.5 | 165 | 87.25 | 22.75 | 5.25 | 358 |

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Stability Class E

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|--------|--------|-------|-------|------|--------|
| N | 1.75 | 1.75 | 4.5 | 1.25 | 0 | 0 | 0 | 9.25 |
| NNE | 0.25 | 1.5 | 3 | 2.5 | 0 | 0 | 0 | 7.25 |
| NE | 0.5 | 1 | 3.25 | 0.5 | 0 | 0 | 0 | 5.25 |
| ENE | 0.25 | 1.5 | 0.75 | 0.5 | 0 | 0 | 0 | 3 |
| E | 0 | 0.5 | 1.75 | 0.25 | 0 | 0 | 0 | 2.5 |
| ESE | 0.25 | 2 | 1.25 | 2.5 | 0 | 0 | 0 | 6 |
| SE | 0.25 | 0.25 | 4.5 | 5.75 | 1.5 | 0.75 | 0.75 | 13.75 |
| SSE | 0 | 0.5 | 9.25 | 4.5 | 6.25 | 1 | 2 | 23.5 |
| S | 0 | 0 | 12.5 | 22 | 5 | 0.75 | 0.5 | 40.75 |
| SSW | 0 | 0.5 | 13.25 | 25.25 | 1.5 | 0 | 0 | 40.5 |
| SW | 0 | 1 | 4.5 | 6 | 4.5 | 3.75 | 0 | 19.75 |
| WSW | 0 | 0.5 | 4.25 | 19.5 | 11.5 | 8.25 | 0.5 | 44.5 |
| W | 0 | 1.25 | 12.25 | 17.5 | 17.25 | 1.75 | 0 | 50 |
| WNW | 0 | 1.75 | 23.5 | 24.5 | 4 | 0 | 0 | 53.75 |
| NW | 0.25 | 3.75 | 17.75 | 12.25 | 0 | 0 | 0 | 34 |
| NNW | 0 | 1.75 | 12.5 | 5.5 | 2.75 | 0 | 0 | 22.5 |
| TOTAL | 3.5 | 19.5 | 128.75 | 150.25 | 54.25 | 16.25 | 3.75 | 376.25 |

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Stability Class F

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|------|-------|-------|-------|-------|-----|--------|
| N | 0 | 0.75 | 5.25 | 0 | 0 | 0 | 0 | 6 |
| NNE | 0 | 1 | 5.5 | 0 | 0 | 0 | 0 | 6.5 |
| NE | 0 | 1 | 5.75 | 0 | 0 | 0 | 0 | 6.75 |
| ENE | 0 | 0 | 0.25 | 0 | 0 | 0 | 0 | 0.25 |
| E | 0 | 1 | 0.75 | 0 | 0 | 0 | 0 | 1.75 |
| ESE | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| SE | 0 | 0 | 1.75 | 0.25 | 1.25 | 0 | 0 | 3.25 |
| SSE | 0 | 0.5 | 3 | 2.5 | 0.25 | 0 | 0 | 6.25 |
| S | 0.25 | 1 | 4.25 | 3 | 0.25 | 0 | 0 | 8.75 |
| SSW | 0 | 1.5 | 11.75 | 6 | 0 | 0 | 0 | 19.25 |
| SW | 0.25 | 0.75 | 4.25 | 12.75 | 4.25 | 0.5 | 0 | 22.75 |
| WSW | 0.25 | 0.5 | 5.5 | 20 | 4.5 | 0 | 0 | 30.75 |
| W | 0 | 1.25 | 8 | 16.75 | 23 | 0 | 0 | 49 |
| WNW | 0 | 0.75 | 12.25 | 5.5 | 1.25 | 0 | 0 | 19.75 |
| NW | 0 | 0.75 | 5.75 | 5.25 | 0 | 0 | 0 | 11.75 |
| NNW | 0 | 0.25 | 4.5 | 1.75 | 0 | 0 | 0 | 6.5 |
| TOTAL | 0.75 | 11 | 81.5 | 73.75 | 34.75 | 0.5 | 0 | 202.25 |

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Stability Class G

| Wind Direction | CALM | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | >24 | TOTAL |
|----------------|------|-------|-------|------|-------|-------|-----|-------|
| N | 0.25 | 5.75 | 7.25 | 0 | 0 | 0 | 0 | 13.25 |
| NNE | 0.25 | 3.75 | 3.75 | 0.5 | 0 | 0 | 0 | 8.25 |
| NE | 0.25 | 2.5 | 2.75 | 0.5 | 0 | 0 | 0 | 6 |
| ENE | 0.25 | 1.75 | 2 | 0 | 0 | 0 | 0 | 4 |
| E | 0 | 1.25 | 0.75 | 3 | 0.25 | 0 | 0 | 5.25 |
| ESE | 0 | 0.75 | 2.25 | 1.75 | 0 | 0 | 0 | 4.75 |
| SE | 0 | 0.75 | 3 | 1.25 | 0.25 | 0 | 0 | 5.25 |
| SSE | 0 | 2.75 | 3.25 | 2.25 | 0 | 0 | 0 | 8.25 |
| S | 0.25 | 3.25 | 5.25 | 1 | 0.25 | 0 | 0 | 10 |
| SSW | 0.5 | 6.75 | 12.75 | 1.25 | 0 | 0 | 0 | 21.25 |
| SW | 0.25 | 8.75 | 20 | 4.5 | 0 | 0 | 0 | 33.5 |
| WSW | 0 | 4.75 | 28 | 13.5 | 0 | 0 | 0 | 46.25 |
| W | 0 | 4.75 | 21.25 | 25 | 1.75 | 0 | 0 | 52.75 |
| WNW | 0.75 | 2.75 | 36 | 12.5 | 0 | 0 | 0 | 52 |
| NW | 0.75 | 3 | 16.75 | 1.75 | 0 | 0 | 0 | 22.25 |
| NNW | 0.25 | 3 | 14.5 | 1.75 | 0 | 0 | 0 | 19.5 |
| TOTAL | 3.75 | 56.25 | 179.5 | 70.5 | 2.5 | 0 | 0 | 312.5 |