

Callaway Energy Center 2013 Annual Radioactive Effluent Release Report

Facility Operating License NPF-30

Docket Number 50-483



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1. Introduction

This Annual Radioactive Effluent Release Report (ARERR) is submitted by Union Electric Co., dba Ameren Missouri, in accordance with the requirements of 10 CFR 50.36a and Callaway Energy Center Technical Specification 5.6.3. This report is for the period January 1, 2013 to December 31, 2013.

The doses to the Member of the Public from all liquid and gaseous effluents discharged during the reporting period were small fractions of the Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA) regulatory limits and the Radiological Effluent Control limits in the Offsite Dose Calculation Manual (ODCM).

Abstract

The Annual Radioactive Effluent Release Report covers the operation of the Callaway Energy Center during the year 2013. The report includes a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The report also includes an annual summary of hourly meteorological data collected during the year and an assessment of radiation dose to the Member of the Public from liquid and gaseous effluents.

To maximize consistency, aid in the review by Members of the Public, and to allow easier industry- wide comparison of the data, this report is presented in the format recommended by Regulatory Guide 1.21, revision 2, *insofar as is practicable*. Callaway is committed to revision 1 of Regulatory Guide 1.21, and some of the information is not readily available in the format recommended by revision 2.

2. Gaseous Effluents

The quantity of radioactive material released in gaseous effluents during the reporting period is summarized in Table A-1. The quarterly and annual sums of all radionuclides discharged in gaseous effluents are reported in Tables A-1A and A-1B. All gaseous effluent releases are considered to be ground level.

The quantity of ^{14}C released in gaseous effluents was calculated as described in EPRI Technical Report 1021106^a and the Callaway Energy Center Offsite Dose Calculation Manual (ODCM).

3. Liquid Effluents

The quantity of radioactive material released in liquid effluents during the reporting period is summarized in Table A-2. The quarterly and annual sums of all radionuclides discharged in liquid effluents are reported in Table A-2A. All liquid effluents were discharged in batch mode; there were no continuous liquid discharges for the reporting period. Dilution by the Missouri River, in the form of the near- field dilution factor, is utilized in the ODCM dose calculation methodology.

4. Solid Waste Storage and Shipments

The volume and activity of solid waste shipped for disposal is provided in Table A-3. Table A-3 is presented in the format of rev. 1 to Regulatory Guide 1.21 because the data is not readily available in the format recommended by rev. 2 to Regulatory Guide 1.21.

5. Dose Assessments

The annual evaluation of dose to the Member of the Public is calculated in accordance with the methodology and parameters in the ODCM and is reported in Tables A-4 and A-5.

^a *Estimation of Carbon- 14 in Nuclear Power Plant Gaseous Effluents*, Technical Report 1011106, Electric Power Research Institute, December, 2010.

5.1 Table A-4, Dose Assessments, 10 CFR 50, Appendix I

The dose assessments reported in Table A-4 were calculated using the methodology and parameters in the ODCM and demonstrate compliance with 10 CFR 50, Appendix I. The gamma air dose and beta air dose were calculated at the nearest Site Boundary location with the highest value of χ/Q^b , as described in the ODCM. The maximum organ dose from gaseous effluents was calculated for the ingestion, inhalation, and ground plane pathways at the location of the nearest resident with the highest value of D/Q^c , as described in the ODCM. The organ dose does not include the dose from ^{14}C , which is listed separately.

5.2 Table A-5, EPA 40 CFR 190 Individual in the Unrestricted Area

The dose assessments reported in Table A-5 are the doses to the Member of the Public from activities within the Site Boundary plus the doses at the location of the Nearest Residence. A large portion of the residual land of the Callaway Site is managed by the State of Missouri Conservation Department as the Reform Wildlife Management Area. Pursuant to the guidance provided in Regulatory Guide 1.21, rev.2, the dose reported in Table A-5 is the sum of the dose from gaseous effluents (at the Nearest Resident location and within the Site Boundary), plus the dose contribution due to activities within the Site Boundary and the organ dose from inhalation of ^{14}C (at the Nearest Resident location and within the Site Boundary). The dose assessments in Table A-5 demonstrate compliance with 10 CFR 20.1301(e) and 40 CFR 190.

6. Supplemental Information

6.1 Abnormal Releases or Abnormal Discharges

There were no abnormal releases or abnormal discharges during the reporting period.

6.2 Non- routine Planned Discharges

The March 2013 monthly gross alpha liquid composite sample was accidentally contaminated with Liquid Scintillation Counting cocktail waste. Attempts were made to analyze the March monthly composite for gross alpha, however the transmission loss was too high and the March monthly composite could not be used for the gross alpha analysis required by ODCM Table 16.11-1. The only remaining option was to analyze quarterly composite sample. The quarterly composite represents an average of the gross alpha concentration for the 1st quarter, 2013 whereas the monthly composite represents only the month of March, 2013; therefore the monthly and the quarterly composites are not equivalent samples; however, analysis of the quarterly composite was the only remaining option for recovery. The result of the analysis of the

^b A numerical value corresponding to the atmospheric transport and diffusion of gases released in gaseous effluents. X is the average atmospheric concentration and Q is the effluent emission over the time interval.

^c A numerical value corresponding to the deposition rate of particulate and iodine nuclides released in gaseous effluents. D is the average atmospheric deposition and Q is the effluent emission over the time interval.

quarterly liquid composite sample (5.24E-08 $\mu\text{Ci/ml}$) is consistent with historical results. The Effluents Management System (EMS) software was updated with the results of the gross alpha analysis. This is documented in the Callaway corrective action program as CAR 201301930.

On April 18, 2013, a fire at the Unit Auxillary Transformer caused a loss of power to the electrical bus PA02 while on back feed. The loss of electrical power to the Auxiliary Building outlets and lighting resulted in loss of power to equipment used to sample the Unit Vent for ^3H . At the time of the loss of power, the refueling canal was flooded. ODCM Table 16.11-4, note 4 requires ^3H grab samples to be taken and analyzed at least once per 24 hours when the refueling canal is flooded. Due to the loss of power, the ^3H sample was taken approximately 10 hours 24 minutes late. This is documented in the Callaway corrective action program as CAR 201302923.

6.3 Radioactive Waste Treatment System Changes

There were no major changes to the liquid or gaseous radwaste treatment system during the reporting period.

6.4 Annual Land Use Census Changes

There were no changes identified in the locations for dose calculation. Changes in sample locations identified in the Land Use Census are described in the Annual Radiological Environmental Operating Report.

6.5 Effluent Monitoring System Inoperability

On 01/10/13 and on 1/11/13, while performing damper maintenance, the Unit vent flow rate dropped to <6750 standard cubic feet per minute (scfm) which is below the process flow rate necessary to maintain isokinetic sampling. The affected period is approximately 1.22 hours on 1/10/2013 and 1.25 hours on 1/11/2013 which is short compared to the sampling period, which is one week. The sample filters were changed between the two low flow periods, therefore each period is considered a discrete event. The loss of isokinetic flow, while resulting in inaccurate sampling for the 1.22 hours and 1.25 hours has little effect due to the relative length of the sampling period. The installed isokinetic nozzles are incapable of isokinetic sampling at unit vent flow rates <6750 scfm even with auxiliary sampling equipment, therefore, Action 43 of FSAR/ODCM Table 16.11-5 was not met during these two periods. This is documented in the Callaway corrective action program as CAR 201300253 and CAR 201300289.

6.6 Offsite Dose Calculation Manual Changes

There were no changes to the Offsite Dose Calculation Manual during the reporting period.

6.7 Process Control Program Changes

Revision 13 to APA-ZZ-01011, Process Control Program was issued on 12/19/13. This revision added clarification that radioactive material shipped offsite to a processor does not have to meet solidification or dewatering criteria prior to shipment to the vendor. There were no substantive changes to APA-ZZ-01011, "Process Control Program" during the reporting period.

6.8 Corrections to Previous Reports

There are no corrections to previous reports.

6.9 Other Information Related to Radioactive Effluents

Meteorological Joint Frequency Tables for the monitoring period are attached as Appendix B.

Appendix A

Tables of Quantities Released in Liquid and Gaseous Radioactive Effluents and in Solid Radioactive Waste Shipments

Tables of Doses from the Discharge of Liquid and Gaseous Radioactive Effluents

Table A-1: Gaseous Effluents- Summation of All Releases							
Summation of All Releases	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Est. Uncert. (%) ^d
Fission & Activation Gases	Ci	1.02E+00	1.34E+00	2.30E-01	5.05E-02	2.65E+00	20
<i>Average Release Rate</i>	μCi/s	1.32E-01	1.71E-01	2.90E-02	6.36E-03	3.39E-01	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
¹³¹ Iodine	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	23
<i>Average Release Rate</i>	μCi/s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
Particulates	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	30
<i>Average Release Rate</i>	μCi/s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
Gross Alpha	Ci	2.07E-07	1.43E-07	1.04E-07	1.02E-07	5.56E-07	
³ H	Ci	3.77E+00	1.57E+01	1.07E+01	7.82E+00	3.80E+01	14
<i>Average Release Rate</i>	μCi/s	4.84E-01	2.00E+00	1.34E+00	9.84E-01	1.20E+00	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
¹⁴ C ^e	Ci	2.60	2.60	2.60	2.60	10.4	

^d Safety Analysis calculation 87-063-00, January 6, 1988

^e ¹⁴C activity is estimated based on EPRI report TR-1021106, *Estimation of ¹⁴C in Nuclear Power Plant Effluents*, December, 2010.

Table A-1A: Gaseous Effluents- Ground Level Release- Batch Mode						
Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁴¹ Ar	Ci	5.40E-02	3.48E-01	2.29E-02	5.05E-02	4.75E-01
⁸⁵ Kr	Ci	1.52E-01	0.00E+00	00.0E+00	00.0E+00	1.52E-01
^{85m} Kr	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
⁸⁷ Kr	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
^{131m} Xe	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
¹³³ Xe	Ci	8.10E-04	1.53E-02	00.0E+00	00.0E+00	1.61E-02
^{133m} Xe	Ci	00.0E+00	00.0E+00	1.27E-04	00.0E+00	1.27E-04
¹³⁵ Xe	Ci	1.88E-05	2.73E-03	00.0E+00	00.0E+00	2.75E-03
Total	Ci	2.07E-01	3.66E-01	2.30E-02	5.05E-02	6.47E-01
Iodines & Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
¹³¹ I	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
¹³² I	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁶³ Ni	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
⁶⁰ Co	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
³ H	Ci	3.87E-02	4.39E-01	6.25E-02	4.97E-02	5.90E-01
Gross alpha	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
¹⁴ C	Ci	4.28E-01	4.28E-01	4.28E-01	4.28E-01	1.71E+00

Table A-1B: Gaseous Effluents- Ground Level Release- Continuous Mode						
Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁴¹ Ar	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
⁸⁵ Kr	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
^{85m} Kr	Ci	1.88E-03	0.00E+00	0.00E+00	0.00E+00	1.88E-03
⁸⁸ Kr	Ci	3.29E-03	0.00E+00	0.00E+00	0.00E+00	3.59E-03
^{131m} Xe	Ci	0.00E+00	0.00E+00	2.07E-01	0.00E+00	2.07E-01
¹³³ Xe	Ci	6.18E-01	9.71E-01	0.00E+00	0.00E+00	1.59E+00
^{133m} Xe	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
¹³⁵ Xe	Ci	1.93E-01	4.56E-03	0.00E+00	0.00E+00	1.98E-01
Total	Ci	8.16E-01	9.76E-01	2.07E-01	00.0E+00	2.00E+00
Iodines & Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
¹³¹ I	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
¹³² I	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁶³ Ni	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
⁶⁰ Co	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
³ H	Ci	3.73E+00	1.53E+01	1.06E+01	7.77E+00	3.74E+01
Gross alpha	Ci	2.07E-07	1.43E-07	1.04E-07	1.02E-07	5.56E-07
¹⁴ C	Ci	2.17E+00	2.17E+00	2.17E+00	2.17E+00	8.69E+00

Table A-2: Liquid Effluents- Summation of All Releases							
Summation of All Liquid Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Est. Uncert. (%) ^f
Fission and Activation Products^g	Ci	2.60E-02	6.21E-02	1.20E-02	3.57E-03	1.04E-01	20
<i>Avg Diluted Conc</i>	μCi/ml	7.74E-08	2.05E-07	7.33E-08	7.53E-08	1.22E-07	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
³H	Ci	8.23E+02	2.10E+02	1.20E+02	7.72E+01	1.23E+03	14
<i>Avg Diluted Conc</i>	μCi/ml	2.45E-03	6.94E-04	7.33E-04	1.63E-03	1.45E-03	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
Dissolved & Entrained Gases	Ci	1.60E-03	1.08E-03	8.49E-05	00.0E+00	2.76E-03	27
<i>Avg Diluted Conc</i>	μCi/ml	4.75E-09	3.56E-09	5.19E-10	00.0E+00	3.25E-09	
<i>% of Limit</i>	%	N/A	N/A	N/A	N/A	N/A	
Gross alpha	Ci	1.16E-03	2.47E-04	5.89E-05	8.01E-05	1.55E-03	29
<i>Avg Diluted Conc</i>	μCi/ml	3.46E-09	8.16E-10	3.60E-10	1.69E-09	1.82E-09	
Vol Liquid Effluent^h	Liters	5.64E+06	1.03E+07	5.72E+06	1.63E+06	2.32E+07	
Dilution Volumeⁱ	Liters	3.30E+08	2.93E+08	1.58E+08	4.58E+07	8.26E+08	
Avg river flow^j	m ³ /s	1.35E+03	3.98E+03	1.85E+03	1.22E+03	2.10E+03	

^f Safety Analysis calculation 87-063-00, January 6, 1988

^g Excludes ³H, noble gases, and gross alpha.

^h Primary system liquid effluent plus secondary liquid effluent, prior to dilution.

ⁱ Does not include Missouri River dilution.

^j Average Missouri River flow for the year at the Hermann, MO monitoring station as reported by the United States Geological Survey.

Table A-2A: Liquid Effluents- Batch Mode						
Fission & Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁷ Be	Ci	2.35E-05	0.00E+00	0.00E+00	0.00E+00	2.35E-05
²⁴ Na	Ci	0.00E+00	3.18E-05	0.00E+00	0.00E+00	3.18E-05
⁵¹ Cr	Ci	5.53E-05	1.08E-03	0.00E+00	0.00E+00	1.14E-03
⁵⁴ Mn	Ci	1.65E-05	9.34E-05	0.00E+00	0.00E+00	1.10E-04
⁵⁸ Co	Ci	0.00E+00	1.65E-03	1.29E-04	1.54E-06	1.78E-03
⁶⁰ Co	Ci	1.64E-02	1.37E-02	2.70E-03	3.22E-04	3.31E-02
⁶³ Ni	Ci	7.32E-04	4.00E-03	4.04E-03	8.48E-04	9.62E-03
⁶⁵ Zn	Ci	0.00E+00	2.54E-05	0.00E+00	0.00E+00	2.54E-05
⁹⁷ Zr	Ci	0.00E+00	5.09E-06	0.00E+00	0.00E+00	5.09E-06
^{110m} Ag	Ci	0.00E+00	2.29E-05	0.00E+00	0.00E+00	2.29E-05
¹²² Sb	Ci	0.00E+00	3.15E-04	0.00E+00	0.00E+00	3.15E-04
¹²⁴ Sb	Ci	0.00E+00	4.15E-03	6.19E-05	0.00E+00	4.21E-03
¹²⁵ Sb	Ci	8.65E-03	3.65E-02	5.01E-03	2.39E-03	5.26E-02
¹³² Te	Ci	0.00E+00	2.90E-05	0.00E+00	0.00E+00	2.90E-05
¹³² I	Ci	0.00E+00	8.62E-05	0.00E+00	0.00E+00	8.62E-05
¹³⁷ Cs	Ci	1.20E-04	4.12E-04	4.91E-05	8.51E-06	5.90E-04
¹³⁸ Cs	Ci	0.00E+00	1.50E-05	0.00E+00	0.00E+00	1.50E-05
Total	Ci	2.60E-02	6.21E-02	1.20E-02	3.57E-03	1.04E-01
Dissolved & Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
⁸⁹ Kr	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
^{131m} Xe	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
¹³³ Xe	Ci	1.60E-03	1.08E-03	7.91E-05	0.00E+00	2.76E-03
^{133m} Xe	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
^{135m} Xe	Ci	0.00E+00	0.00E+00	5.74E-06	0.00E+00	5.74E-06
¹³⁷ Xe	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	1.60E-03	1.08E-03	8.48E-05	0.00E+00	2.76E-03
³ H	Ci	8.23E+02	2.10E+02	1.20E+02	7.72E+01	1.23E+03
Gross alpha	Ci	1.16E-03	2.47E-04	5.89E-05	8.01E-05	1.55E-03

Table A-3: Solid Waste & Irradiated Fuel Shipments

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)

1. TYPE OF WASTE	Units	Period Jan – Jun	Period Jul - Dec	Est. Total Error (%)
Spent resins, filter sludge, evaporator bottoms, etc.	m ³	4.53E+00	N/A	± 25%
	Ci	7.86E-01	N/A	
Dry compressible waste, contaminated equip., etc.	m ³	2.65E+02	N/A	± 25%
	Ci	4.64E-02	N/A	
Irradiated components, control rods, etc.	m ³	N/A	N/A	± 25%
	Ci	N/A	N/A	
Other (low level secondary resin, oily waste)	m ³	N/A	N/A	± 25%
	Ci	N/A	N/A	

Table A-3: Solid Waste & Irradiated Fuel Shipments (continued)

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (by Type of Waste)				
a. Spent resins, filters, evaporator bottoms, etc.				
Nuclide	% Abundance	Jan – Jun Ci	% Abundance	Jul – Dec Ci
⁶⁰ Co	42.78	3.36E-01	N/A	N/A
³ H	24.76	1.94E-01	N/A	N/A
¹³⁷ Cs	20.51	1.61E-01	N/A	N/A
⁶³ Ni	6.46	5.07E-02	N/A	N/A
¹³⁴ Cs	1.61	1.26E-02	N/A	N/A
⁵⁵ Fe	1.03	8.10E-03	N/A	N/A
b. Dry compressible waste, contaminated equipment, etc.				
⁶⁰ Co	35.15	1.63E-02	N/A	N/A
⁶³ Ni	14.43	6.70E-03	N/A	N/A
¹³⁷ Cs	14.03	6.51E-03	N/A	N/A
⁵⁵ Fe	12.31	5.71E-03	N/A	N/A
⁵⁸ Co	5.99	2.78E-03	N/A	N/A
⁵¹ Cr	4.91	2.28E-03	N/A	N/A
⁹⁵ Nb	4.40	2.04E-03	N/A	N/A
⁹⁵ Zr	2.69	1.25E-03	N/A	N/A
¹³⁴ Cs	2.15	9.95E-04	N/A	N/A
⁵⁴ Mn	1.86	8.63E-4	N/A	N/A
c. Irradiated components, control rods, etc.				
None	N/A	N/A	N/A	N/A
d. Other				
None	N/A	N/A	N/A	N/A

Table A-3: Solid Waste & Irradiated Fuel Shipments (continued)

3. SOLID WASTE DISPOSITION				
Number of Shipments	Mode of Transport	Destination	Class of Solid Waste Shipped	Type of Container
5	Hittman Transport	Duratek Services, Inc.	A	Intermodal container
1	Hittman Transport	Studsvik Processing Facility - Erwin	A	Cask

*Sent to waste processors for volume reduction before burial.

4. SOLIDIFICATION AGENT

None used.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

There were no shipments of irradiated fuel during the reporting period.

Table A-4: Dose Assessments, 10 CFR 50, Appendix I					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly total
Liquid Effluent Dose Limit, Total Body (mrem)	1.5	1.5	1.5	1.5	3
Total Body Dose (mrem)	1.70E-03	1.61E-03	2.48E-04	3.69E-04	3.88E-03
% Limit (%)	0.11%	0.11%	0.02%	0.02%	0.13%
Liquid Effluent Dose Limit, Maximum Organ (mrem)	5	5	5	5	10
Maximum Organ Dose (mrem)	1.92E-03	2.25E-03	7.21E-04	5.10E-04	4.70E-03
% Limit (%)	0.04%	0.05%	0.01%	0.01%	0.05%
Gaseous Effluent Dose Limit, Gamma Air (mrem)	5	5	5	5	10
Gamma Air Dose (mrad)	5.47E-05	1.71E-04	1.17E-05	2.23E-05	2.60E-04
% Limit (%)	0.00%	0.00%	0.00%	0.00%	0.00%
Gaseous Effluent Dose Limit, Beta Air (mrem)	10	10	10	10	20
Beta Air Dose (mrad)	7.67E-05	1.04E-04	1.45E-05	7.88E-06	2.03E-04
% Limit (%)	0.00%	0.00%	0.00%	0.00%	0.00%
Gaseous Effluent Dose Limit, Maximum Organ (mrem)	7.5	7.5	7.5	7.5	15
Maximum organ dose ^k (mrem)	1.09E-03	4.55E-03	3.08E-03	2.226E-03	1.10E-02
% Limit (%)	0.01%	0.06%	0.04%	0.03%	0.07%
¹⁴ C Maximum organ dose (mrem) ^l	1.98E-03	1.98E-03	1.98E-03	1.98E-03	7.92E-03

Table A-5: EPA 40 CFR 190 Individual in the Unrestricted Area			
	Whole Body	Thyroid	Max Other Organ
Dose Limit	25 mrem	75 mrem	25 mrem
Dose	1.32E-02	1.31E-02	2.08E-02
% Limit	0.05%	0.02%	0.08%

^k Iodine, ³H, and particulates with greater than an 8 day half- life.

^l Not included in above totals

Appendix B

Dispersion Parameters for the Reporting Period

Joint Frequency Tables; Totals of Hours at Each Wind Speed & Direction for the period January 1, 2013- December 31, 2013

Dispersion Parameters for the Reporting Period

Nearest Resident

Direction: NNW

Distance: 2897 meters

X/Q, Undecayed and Undepleted: 1.10E-06 sec/m³

X/Q Decayed and Undepleted: 1.00E-06sec/m³

X/Q Decayed and Depleted: 9.00E-07 sec/m³

D/Q Deposition rate: 3.30E-09 m⁻²

Site Boundary

Direction: NNW

Distance: 2200 meters

X/Q, Undecayed and Undepleted: 1.50E-06 sec/m³

X/Q Decayed and Undepleted: 1.50E-06 sec/m³

X/Q Decayed and Depleted: 1.30E-06 sec/m³

D/Q Deposition rate: 4.90E-09 m⁻²

Joint Frequency Distribution												
January- December, 2013												
All Stabilities												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	29	36	65	111	117	79	27	13	0	0	477
NNE	0	24	53	44	102	51	35	14	3	0	0	326
NE	0	13	57	36	68	63	15	8	6	0	0	266
ENE	0	20	36	57	85	65	26	11	2	0	0	302
E	0	20	33	41	83	51	24	12	2	0	0	266
ESE	0	22	50	50	117	67	43	8	0	0	0	357
SE	0	48	135	160	307	149	53	2	0	0	0	854
SSE	0	46	85	165	497	218	90	32	8	0	0	1141
S	0	34	51	71	227	214	143	102	88	10	0	940
SSW	0	3	24	58	158	183	95	37	19	3	0	580
SW	0	22	37	57	154	131	60	20	15	2	0	498
WSW	0	20	44	42	100	81	45	12	11	3	0	358
W	0	29	37	58	120	83	74	49	22	1	2	475
WNW	0	39	65	82	143	113	89	46	28	0	0	605
NW	0	27	46	72	163	147	87	38	13	0	0	593
NNW	0	15	32	56	187	201	110	52	18	0	0	671
Tot	0	411	821	1114	2622	1934	1068	470	248	19	2	8709
Hours of Calm												48
Hours of Variable Direction												0
Hours of Valid Data												8757
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
Class A Extremely Unstable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	0	0	3	0	0	0	0	0	3
NNE	0	0	0	0	1	1	1	0	0	0	0	3
NE	0	0	0	0	1	4	1	0	0	0	0	6
ENE	0	0	0	1	1	0	1	0	0	0	0	3
E	0	0	0	0	1	3	1	0	0	0	0	5
ESE	0	0	0	0	0	1	1	0	0	0	0	2
SE	0	0	0	0	9	21	10	0	0	0	0	40
SSE	0	0	0	0	14	12	7	0	0	0	0	33
S	0	0	0	0	9	5	8	2	2	1	0	27
SSW	0	0	0	0	6	9	6	5	3	0	0	29
SW	0	0	0	0	4	13	13	2	2	0	0	34
WSW	0	0	0	0	4	16	5	1	2	0	0	28
W	0	0	0	0	1	13	8	8	6	0	0	36
WNW	0	0	0	0	2	7	16	10	0	0	0	35
NW	0	0	0	0	2	12	9	6	1	0	0	30
NNW	0	0	0	0	0	8	7	2	0	0	0	17
Tot	0	0	0	1	55	128	94	36	16	1	0	331
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	331											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class B Moderately Unstable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	1	5	7	0	0	0	0	0	13
NNE	0	0	0	0	3	4	1	1	2	0	0	11
NE	0	0	0	0	2	8	1	0	0	0	0	11
ENE	0	0	0	0	3	4	6	0	0	0	0	13
E	0	0	0	0	3	4	2	0	0	0	0	9
ESE	0	0	0	0	5	1	2	0	0	0	0	8
SE	0	0	0	1	16	12	8	0	0	0	0	37
SSE	0	0	0	1	19	11	5	4	0	0	0	40
S	0	0	0	1	11	7	8	7	2	3	0	39
SSW	0	0	0	0	4	19	10	4	2	0	0	39
SW	0	0	0	0	7	17	4	2	4	0	0	34
WSW	0	0	0	1	2	3	9	1	1	0	0	17
W	0	0	0	0	5	5	9	2	1	0	0	22
WNW	0	0	0	0	8	14	6	3	2	0	0	33
NW	0	0	0	0	6	16	12	3	2	0	0	39
NNW	0	0	0	0	6	17	14	2	5	0	0	44
Tot	0	0	0	5	105	149	97	29	21	3	0	409
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	409											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class C Slightly Unstable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	0	4	6	13	3	0	0	0	26
NNE	0	0	1	2	9	10	1	2	0	0	0	25
NE	0	0	0	3	10	5	3	0	0	0	0	21
ENE	0	0	1	1	6	7	5	1	0	0	0	21
E	0	0	0	1	4	4	1	0	0	0	0	10
ESE	0	0	0	1	7	4	7	0	0	0	0	19
SE	0	0	1	1	36	15	8	0	0	0	0	61
SSE	0	0	0	3	24	16	5	3	1	0	0	52
S	0	0	1	1	17	18	11	7	10	2	0	67
SSW	0	0	0	4	19	18	13	2	3	2	0	61
SW	0	0	0	2	9	12	9	4	0	0	0	36
WSW	0	0	0	1	9	10	3	1	0	0	0	24
W	0	0	0	4	9	7	4	3	1	0	1	29
WNW	0	0	0	6	16	10	5	5	3	0	0	45
NW	0	0	1	2	12	13	5	2	2	0	0	37
NNW	0	0	0	1	10	16	10	6	2	0	0	45
Tot	0	0	5	33	201	171	103	39	22	4	1	579
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	579											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class D Neutral based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	5	7	17	37	78	64	24	13	0	0	245
NNE	0	2	6	19	49	32	30	11	1	0	0	150
NE	0	0	6	15	28	44	10	8	6	0	0	117
ENE	0	3	8	17	48	50	14	10	2	0	0	152
E	0	0	9	10	41	29	18	12	2	0	0	121
ESE	0	0	15	19	57	34	28	7	0	0	0	160
SE	0	1	14	33	114	73	22	1	0	0	0	258
SSE	0	4	10	29	89	52	28	12	4	0	0	228
S	0	1	10	17	45	51	42	39	52	4	0	261
SSW	0	0	2	16	29	47	31	14	8	1	0	148
SW	0	3	4	21	47	42	19	9	8	2	0	155
WSW	0	4	3	12	42	24	21	8	5	2	0	121
W	0	0	9	25	45	33	46	32	13	1	1	205
WNW	0	2	11	29	71	70	56	27	23	0	0	289
NW	0	6	7	20	86	86	52	25	7	0	0	289
NNW	0	0	4	10	74	130	74	42	11	0	0	345
Tot	0	31	125	309	902	875	555	281	155	10	1	3244
Hours of Calm												1
Hours of Variable Direction												0
Hours of Valid Data												3245
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
Class E Slightly Stable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	6	8	27	50	23	2	0	0	0	0	116
NNE	0	3	16	9	30	3	2	0	0	0	0	63
NE	0	2	8	8	21	2	0	0	0	0	0	41
ENE	0	4	7	18	22	4	0	0	0	0	0	55
E	0	5	11	24	32	10	2	0	0	0	0	84
ESE	0	5	18	18	42	27	5	1	0	0	0	116
SE	0	9	53	90	118	28	5	1	0	0	0	304
SSE	0	10	18	51	171	88	44	13	3	0	0	398
S	0	4	13	20	74	111	72	47	22	0	0	363
SSW	0	0	8	15	53	63	32	12	3	0	0	186
SW	0	6	16	16	54	40	15	3	1	0	0	151
WSW	0	6	23	14	39	27	7	1	3	1	0	121
W	0	11	20	17	49	25	7	4	1	0	0	134
WNW	0	15	22	23	37	12	6	1	0	0	0	116
NW	0	5	17	24	44	20	9	2	1	0	0	122
NNW	0	3	10	28	65	27	5	0	0	0	0	138
Tot	0	94	268	402	901	510	213	85	34	1	0	2508
Hours of Calm	7											
Hours of Variable Direction	0											
Hours of Valid Data	2515											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class F Moderately Stable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	7	12	12	11	0	0	0	0	0	0	42
NNE	0	6	15	8	8	1	0	0	0	0	0	38
NE	0	7	26	6	6	0	0	0	0	0	0	45
ENE	0	6	17	18	5	0	0	0	0	0	0	46
E	0	11	9	6	2	0	0	0	0	0	0	28
ESE	0	13	15	11	6	0	0	0	0	0	0	45
SE	0	22	55	31	13	0	0	0	0	0	0	121
SSE	0	9	26	58	142	32	1	0	0	0	0	268
S	0	11	7	21	67	22	2	0	0	0	0	130
SSW	0	0	9	20	42	25	3	0	0	0	0	99
SW	0	7	16	15	32	7	0	0	0	0	0	77
WSW	0	5	14	14	4	1	0	0	0	0	0	38
W	0	15	8	11	10	0	0	0	0	0	0	44
WNW	0	13	22	21	8	0	0	0	0	0	0	64
NW	0	9	16	20	9	0	0	0	0	0	0	54
NNW	0	2	9	11	31	3	0	0	0	0	0	56
Tot	0	143	276	283	396	91	6	0	0	0	0	1195
Hours of Calm												12
Hours of Variable Direction												0
Hours of Valid Data												1207
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
Class G Extremely Stable based on lapse rate												
Elevations: Winds 10m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	11	9	8	4	0	0	0	0	0	0	32
NNE	0	13	15	6	2	0	0	0	0	0	0	36
NE	0	4	17	4	0	0	0	0	0	0	0	25
ENE	0	7	3	2	0	0	0	0	0	0	0	12
E	0	4	4	0	0	1	0	0	0	0	0	9
ESE	0	4	2	1	0	0	0	0	0	0	0	7
SE	0	16	12	4	1	0	0	0	0	0	0	33
SSE	0	23	31	23	38	7	0	0	0	0	0	122
S	0	18	20	11	4	0	0	0	0	0	0	53
SSW	0	3	5	3	5	2	0	0	0	0	0	18
SW	0	6	1	3	1	0	0	0	0	0	0	11
WSW	0	5	4	0	0	0	0	0	0	0	0	9
W	0	3	0	1	1	0	0	0	0	0	0	5
WNW	0	9	10	3	1	0	0	0	0	0	0	23
NW	0	7	5	6	4	0	0	0	0	0	0	22
NNW	0	10	9	6	1	0	0	0	0	0	0	26
Tot	0	143	147	81	62	10	0	0	0	0	0	443
Hours of Calm												28
Hours of Variable Direction												0
Hours of Valid Data												471
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
All Stabilities												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	6	7	18	43	86	105	128	70	10	2	475
NNE	0	2	9	12	51	73	85	65	37	1	0	335
NE	0	0	6	11	55	62	65	44	25	10	0	278
ENE	0	0	8	21	50	53	108	69	26	2	0	337
E	0	1	10	18	41	66	89	60	25	4	0	314
ESE	0	3	13	20	45	80	110	75	25	1	0	372
SE	0	4	22	64	302	242	146	49	3	0	0	832
SSE	0	0	11	28	117	194	199	169	117	11	0	846
S	0	1	8	19	77	110	155	226	256	101	22	975
SSW	0	2	6	12	44	96	121	175	208	42	4	710
SW	0	1	6	6	44	80	112	111	192	31	11	594
WSW	0	1	3	13	37	72	53	87	82	16	12	376
W	0	2	7	9	48	60	91	82	125	48	16	488
WNW	0	1	2	5	74	57	107	133	181	58	30	648
NW	0	6	6	7	64	60	117	170	145	48	7	630
NNW	0	1	4	7	39	70	137	148	118	17	4	545
Tot	0	31	128	270	1131	1461	1800	1791	1635	400	108	8755
Hours of Calm												2
Hours of Variable Direction												0
Hours of Valid Data												8757
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
Class A Extremely Unstable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	0	0	1	1	0	0	0	0	2
NNE	0	0	0	0	0	1	2	0	0	0	0	3
NE	0	0	0	0	0	2	4	0	0	0	0	6
ENE	0	0	0	1	1	0	2	0	0	0	0	4
E	0	0	0	0	0	3	0	1	0	0	0	4
ESE	0	0	0	0	0	0	1	1	0	0	0	2
SE	0	0	0	0	6	12	14	3	0	0	0	35
SSE	0	0	0	0	6	11	14	6	1	0	0	38
S	0	0	0	0	1	9	4	7	2	1	2	26
SSW	0	0	0	0	0	7	5	6	5	4	0	27
SW	0	0	0	0	0	3	11	7	11	2	0	34
WSW	0	0	0	0	0	2	3	15	8	2	1	31
W	0	0	0	0	0	1	7	10	7	6	6	37
WNW	0	0	0	0	0	2	3	3	20	7	0	35
NW	0	0	0	0	0	1	9	14	10	4	0	38
NNW	0	0	0	0	0	0	4	4	0	1	0	9
Tot	0	0	0	1	14	55	84	77	64	27	9	331
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	331											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class B Moderately Unstable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	0	2	5	3	0	0	0	0	10
NNE	0	0	0	0	1	4	3	0	3	0	0	11
NE	0	0	0	0	1	8	2	1	0	0	0	12
ENE	0	0	0	0	1	3	5	4	1	0	0	14
E	0	0	0	0	0	5	2	2	0	0	0	9
ESE	0	0	0	0	0	2	2	1	0	0	0	5
SE	0	0	0	1	14	8	15	2	0	0	0	40
SSE	0	0	0	0	10	11	7	4	4	0	0	36
S	0	0	0	1	7	8	7	6	8	1	3	41
SSW	0	0	0	0	1	9	9	10	7	1	0	37
SW	0	0	0	0	1	5	15	5	2	5	0	33
WSW	0	0	0	0	1	1	4	7	3	5	0	21
W	0	0	0	0	0	6	4	5	6	1	1	23
WNW	0	0	0	0	3	6	9	8	8	3	2	39
NW	0	0	0	0	2	3	14	12	6	8	0	45
NNW	0	0	0	0	2	4	13	8	3	3	0	33
Tot	0	0	0	2	46	88	114	75	51	27	6	409
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	409											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class C Slightly Unstable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	0	1	0	4	6	11	2	0	0	24
NNE	0	0	1	0	6	7	8	1	3	0	0	26
NE	0	0	0	2	8	7	4	1	0	0	0	22
ENE	0	0	1	0	6	4	8	2	2	0	0	23
E	0	0	0	0	4	4	0	1	0	0	0	9
ESE	0	0	0	1	3	3	2	3	2	0	0	14
SE	0	0	0	0	18	24	11	5	0	0	0	58
SSE	0	0	1	1	15	19	9	5	3	1	0	54
S	0	0	0	2	8	20	11	8	11	7	2	69
SSW	0	0	1	1	8	18	11	11	4	1	2	57
SW	0	0	0	0	1	9	6	9	10	1	0	36
WSW	0	0	0	1	3	7	3	5	7	0	0	26
W	0	0	0	0	10	7	5	7	5	1	1	36
WNW	0	0	0	1	14	5	6	9	5	7	3	50
NW	0	0	0	0	4	7	10	9	6	1	1	38
NNW	0	0	0	1	3	6	11	7	7	2	0	37
Tot	0	0	4	11	111	151	111	94	67	21	9	579
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	579											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class D Neutral based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	3	5	10	19	32	61	57	43	10	2	242
NNE	0	1	4	8	33	29	31	22	24	1	0	153
NE	0	0	4	6	21	25	25	17	15	10	0	123
ENE	0	0	4	13	32	28	37	22	14	2	0	152
E	0	0	6	11	22	25	26	12	18	4	0	124
ESE	0	1	6	12	26	39	32	22	11	1	0	150
SE	0	0	5	14	79	76	54	21	1	0	0	250
SSE	0	0	7	14	41	51	36	27	25	4	0	205
S	0	0	5	8	35	27	39	43	60	39	14	270
SSW	0	0	3	4	21	17	36	29	31	11	2	154
SW	0	0	2	3	20	26	40	25	33	6	10	165
WSW	0	0	1	5	11	23	16	23	35	7	7	128
W	0	0	4	1	21	21	28	17	56	32	7	187
WNW	0	1	2	1	34	26	49	52	95	36	24	320
NW	0	3	3	1	33	29	62	71	80	33	5	320
NNW	0	1	2	3	19	38	69	84	72	10	4	302
Tot	0	10	63	114	467	512	641	544	613	206	75	3245
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	3245											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class E Slightly Stable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	2	1	4	14	28	25	43	15	0	0	132
NNE	0	0	2	1	9	17	27	25	4	0	0	85
NE	0	0	2	3	9	10	15	8	2	0	0	49
ENE	0	0	1	3	5	9	22	6	1	0	0	47
E	0	1	3	4	5	19	32	16	6	0	0	86
ESE	0	1	1	1	8	23	44	33	11	0	0	122
SE	0	3	5	27	120	98	42	12	2	0	0	309
SSE	0	0	2	4	21	67	82	86	56	5	0	323
S	0	1	3	5	10	17	38	80	139	52	1	346
SSW	0	1	1	4	8	19	23	42	106	24	0	228
SW	0	0	0	1	9	23	20	36	73	10	1	173
WSW	0	0	2	2	12	20	20	26	21	2	4	109
W	0	1	2	4	8	15	30	33	44	8	1	146
WNW	0	0	0	2	11	11	24	42	32	5	1	128
NW	0	2	1	6	16	12	16	45	32	2	1	133
NNW	0	0	0	2	6	16	30	29	15	0	0	98
Tot	0	12	26	73	271	404	490	562	559	108	9	2514
Hours of Calm												1
Hours of Variable Direction												0
Hours of Valid Data												2515
Hours of Missing Data												3
Hours in Period												8760

Joint Frequency Distribution												
January- December, 2013												
Class F Moderately Stable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	1	0	1	7	11	8	14	7	0	0	49
NNE	0	1	1	0	1	13	7	13	2	0	0	38
NE	0	0	0	0	10	7	7	7	2	0	0	33
ENE	0	0	2	2	3	8	22	21	8	0	0	66
E	0	0	1	0	3	7	16	21	1	0	0	49
ESE	0	0	2	2	5	7	20	14	1	0	0	51
SE	0	0	5	14	59	19	10	2	0	0	0	109
SSE	0	0	0	4	15	27	44	37	24	0	0	151
S	0	0	0	2	11	16	40	63	28	1	0	161
SSW	0	0	1	2	3	12	21	58	50	1	0	148
SW	0	1	2	1	6	11	10	20	59	5	0	115
WSW	0	1	0	1	5	13	5	11	8	0	0	44
W	0	0	1	0	3	8	8	9	6	0	0	35
WNW	0	0	0	1	9	7	10	16	21	0	0	64
NW	0	0	1	0	5	8	4	15	8	0	0	41
NNW	0	0	1	1	8	6	8	14	14	1	0	53
Tot	0	4	17	31	153	180	240	335	239	8	0	1207
Hours of Calm	0											
Hours of Variable Direction	0											
Hours of Valid Data	1207											
Hours of Missing Data	3											
Hours in Period	8760											

Joint Frequency Distribution												
January- December, 2013												
Class G Extremely Stable based on lapse rate												
Elevations: Winds 60m Stability 60m												
Wind Direction Sector	Wind Speed Range (m/s)											Total
	<0.50	0.5- 1	1.1- 1.5	1.6- 2	2.1- 3	3.1- 4	4.1- 5	5.1- 6	6.1- 8	8.1- 10	>10.00	
N	0	0	1	2	1	5	1	3	3	0	0	16
NNE	0	0	1	3	1	2	7	4	1	0	0	19
NE	0	0	0	0	6	3	8	10	6	0	0	33
ENE	0	0	0	2	2	1	12	14	0	0	0	31
E	0	0	0	3	7	3	13	7	0	0	0	33
ESE	0	1	4	4	3	6	9	1	0	0	0	28
SE	0	1	7	8	6	5	0	4	0	0	0	31
SSE	0	0	1	5	9	8	7	4	4	1	0	39
S	0	0	0	1	5	13	16	19	8	0	0	62
SSW	0	1	0	1	3	14	16	19	5	0	0	59
SW	0	0	2	1	7	3	10	9	4	2	0	38
WSW	0	0	0	4	5	6	2	0	0	0	0	17
W	0	1	0	4	6	2	9	1	1	0	0	24
WNW	0	0	0	0	3	0	6	3	0	0	0	12
NW	0	1	1	0	4	0	2	4	3	0	0	15
NNW	0	0	1	0	1	0	2	2	7	0	0	13
Tot	0	5	18	38	69	71	120	104	42	3	0	470
Hours of Calm												1
Hours of Variable Direction												0
Hours of Valid Data												471
Hours of Missing Data												3
Hours in Period												8760