Entergy

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360

May 14, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No.: 50-293
License No.: DPR-35

Annual Radioactive Effluent Release Report for January 1 through December 31, 2011

LETTER NUMBER: 2.12.039

Dear Sir or Madam:

In accordance with Pilgrim Technical Specification 5.6.3, Entergy Nuclear Operations, Inc submits the attached Annual Radioactive Effluent Release Report for January 1, 2011 through December 31, 2011.

This letter contains no commitments.

Should you have questions or require additional information, I can be contacted at (508) 830-8403.

Sincerely,

Joseph R. Lynch
Licensing Manager

FXM

Attachment: Pilgrim Annual Radioactive Effluent Release Report for January 1 through December 31, 2011

cc: U.S. Nuclear Regulatory Commission
Region 1
2100 Renaissance Blvd, Suite 100
King of Prussia, PA 19406-2713

USNRC Senior Resident Inspector
Pilgrim Nuclear Power Station

Mr. Richard V. Guzman, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop O-8-C2
11555 Rockville Pike
Rockville, MD. 20852

IE48
NRR

Attachment 1
Letter Number 2.12.039

Pilgrim Annual Radioactive Effluent Release Report
for January 1 through December 31, 2011

PILGRIM NUCLEAR POWER STATION

Facility Operating License DPR-35

Annual Radioactive Effluent Release Report

January 1 through December 31, 2011

PILGRIM NUCLEAR POWER STATION
Facility Operating License DPR-35

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY 01 THROUGH DECEMBER 31, 2011

Prepared by: _____
K.J. Sejkora
Senior HP/Chemistry Specialist

Reviewed by: _____
G.W. Blankenbiller
Chemistry Manager

Reviewed by: _____
J.M. Priest
Radiation Protection Manager

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PILGRIM NUCLEAR POWER STATION
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
JANUARY 01 THROUGH DECEMBER 31, 2011

INTRODUCTION

This report quantifies the radioactive gaseous, liquid, and radwaste releases, and summarizes the local meteorological data for the period from January 01 through December 31, 2011. This document has been prepared in accordance with the requirements set forth in the Pilgrim Nuclear Power Station (PNPS) Technical Specifications and Revision 1 of Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Material in Liquid and Gaseous Effluents from Light Water Cooled Nuclear Power Plants". This document has been prepared in accordance with the requirements of PNPS Technical Specifications section 5.6.3.

The quantity of radioactive material released from PNPS was determined from sample analyses and continuous on-line monitoring of gaseous releases from the main stack, reactor building vent, turbine building, and various decontamination facilities, and liquid releases into the discharge canal.

The quantity and volume of radioactive waste shipped offsite from PNPS for processing and burial were determined from data contained on the radwaste shipping documentation. The meteorological data were obtained from monitoring instruments located on the 220-foot meteorological tower located at Pilgrim Station.

GASEOUS EFFLUENTS

Gaseous radioactive releases for the reporting period are quantified in Tables 2.2-A, 2.2-B, and 2.2-C. Radioactive noble gases released during the period totaled 11.5 Curies. Releases of radioactive iodines and particulates with half-life of greater than 8 days totaled 0.00738 Curies, tritium releases totaled 38.0 Curies, and carbon-14 totaled 7.36 Curies. No gross alpha radioactivity was detected in gaseous effluents.

Noble gases released in gaseous effluents resulted in a maximum total body dose of 0.0020 mrem, with a corresponding skin dose of 0.0068 mrem. The release of radioactive particulates, iodines, tritium, and carbon-14 in gaseous effluents from PNPS during the reporting period resulted in a total body dose to the maximum-exposed hypothetical individual of about 0.027 mrem. The maximum hypothetical dose to any organ from radioactive particulates, iodines, tritium, and carbon-14 was about 0.079 mrem. The maximum, hypothetical total body dose from the combined release of all airborne radioactivity in gaseous effluents was 0.081 mrem.

The maximum individual doses from gaseous radioactive effluents were compared to the applicable ODCM dose limits. Noble gas doses were less than 0.051% of the corresponding 10CFR50 dose objectives. Maximum doses resulting from releases of particulates, iodines, tritium, and carbon-14 in gaseous effluents were less than 0.53% of corresponding 10CFR50 objectives.

LIQUID EFFLUENTS

Liquid radioactive releases for the reporting period are quantified in Tables 2.3-A and 2.3-B. Twenty-nine discharges of liquid effluents containing radioactivity occurred during the reporting period. These discharges contained 4.4 Curies of tritium and 0.0038 Curies of fission and activation products. The resulting maximum total body dose was 0.00032 mrem, with a corresponding organ dose of 0.0012 mrem. All doses from liquid discharges were less than 0.029% of corresponding 10CFR50 objectives.

METEOROLOGICAL DATA

Meteorological joint frequency distributions are listed in Appendix A. Data recovery for the entire annual period was 100% for the 33-ft and 100% for the 220-ft levels of the tower. The predominant wind direction was from the south-southwest, which occurred approximately 16% of the time during the reporting period. The predominant stability class was Class D, which occurred about 43% of the time during the reporting period

OFFSITE AMBIENT RADIATION MEASUREMENTS

Ambient radiation exposure was evaluated to complete the assessment of radiological impact on humans. A small number of thermoluminescent dosimeters (TLDs) indicated an elevation in ambient radiation exposure on Entergy property in close proximity to the station, when compared to background levels in the region. This elevation is due to nitrogen-16 contained within the plant steam system, as opposed to radioactive effluent released from the plant. The dose to the maximum-exposed member of the public at the PNPS Health Club, even though they are within the owner-controlled area, was estimated as being about 1.5 mrem during 2011. There was no measurable increase during 2011 in ambient radiation measurements at the location of the nearest resident 0.8 km southeast of PNPS.

COMBINED DOSE IMPACT

The collective total body dose to a maximum-exposed hypothetical member of the public from airborne radioactivity, liquid-borne radioactivity, and ambient radiation exposure resulting from PNPS operation during 2011 was calculated as being about 0.62 mrem. This amount is about 0.2% of the typical dose of 300 to 400 mrem received each year by an average person from other sources of natural and man-made radiation. Although this calculated collective dose occurs to a maximum-exposed hypothetical individual, it is also well below the NRC dose limit of 100 mrem/yr specified in 10CFR20.1301, as well as the EPA dose limit of 25 mrem/yr specified in 40CFR190. Both of these limits are to be applied to real members of the general public, so the fact that the dose to the hypothetical maximum-exposed individual is within the limits ensures that any dose received by a real member of the public would be smaller and well within any applicable limit.

RADIOACTIVE SOLID WASTE DISPOSAL

Solid radioactive wastes shipped offsite for processing and disposal during the reporting period are described in Table 7.0. Approximately 900 cubic meters of solid waste, containing almost 191 Curies of radioactivity, were shipped during the reporting period.

ONSITE GROUNDWATER MONITORING PROGRAM

In response to the Nuclear Energy Institute Groundwater Protection Initiative, Pilgrim Station instituted a groundwater monitoring program during 2007. Four monitoring wells were installed onsite during the fourth quarter of 2007, and the first samples were collected in late November 2007. This sampling program was continued in 2011, and twelve additional sampling wells were added to the program in 2011. Low levels of tritium, a radioactive isotope of hydrogen, were detected in these onsite wells. No other plant-related radioactivity was detected in the samples. Concentrations of tritium ranged from non-detectable at less than 295 picoCuries per Liter up to 25,552 picoCuries per Liter. The average concentration of tritium detected in these onsite monitoring wells was well below the voluntary communications reporting level established by the EPA Drinking Water Standard of 20,000 pCi/L. Although the EPA Standard provides a standard for comparison, no drinking water sources are affected by this tritium. Results of the groundwater monitoring program are presented in Appendix B.

CONCLUSION

The PNPS Offsite Dose Calculation Manual contains effluent controls to limit doses resulting from releases of radioactivity to the environment. None of the effluent controls associated with liquid or gaseous effluents were exceeded during the reporting period, as confirmed by conservative dose assessments performed at weekly and monthly intervals. Conformance to the PNPS ODCM effluent control limits ensures that releases of radioactivity in liquid and gaseous effluents are kept as low as reasonably achievable in accordance with 10 CFR Part 50, Appendix I. Compliance with the ODCM also demonstrates that requirements of the Environmental Protection Agency's nuclear fuel cycle standard, 40CFR190.10, Subpart B, have been met. Based on the dose assessment results for 2011, there was no significant radiological impact on the general public from PNPS operation.

2.0 RADIOACTIVE EFFLUENT DATA

Radioactive gaseous and liquid releases for the reporting period are given in the standard format presented in Tables 1A, 1B, 1C, 2A, 2B, and Supplemental Information table from NRC Regulatory Guide 1.21 (Reference 1) format.

2.1 Supplemental Effluent Release Data

Supplemental information related to radioactive gaseous and liquid releases for the reporting period are given in the standard NRC Regulatory Guide 1.21 format in Table 2.1.

2.2 Gaseous Effluent Data

Gaseous radioactivity is released from Pilgrim Station to the atmosphere from the main stack, reactor building vent, turbine building, and various decontamination facilities. Combined gaseous effluent releases from all release points are summarized in Table 2.2-A. No alpha activity was detected on any of the particulate filters collected during the reporting period. The total gaseous releases for various categories of radionuclides, as well as the corresponding average release rates, can be summarized as follows:

- Noble gases: 11.5 Ci, 0.366 μCi/sec
- Iodines and particulates with half-life greater than 8 days: 0.00738 Ci, 0.000234 μCi/sec
- Tritium: 38.0 Ci, 1.20 μCi/sec
- Carbon-14: 7.36 Ci, 0.233 uCi/sec

Effluent releases from the main stack are detailed in Table 2.2-B. The main stack is 335 feet tall, and represents an elevated release point with a total height of approximately 400 feet above sea level. The main stack is located about 700 feet west-northwest of the reactor building.

Ground-level effluent releases are detailed in Table 2.2-C. Data in this table include releases from the reactor building vent, turbine building, and assorted equipment decontamination facilities (e.g., hot machine shop, carbon dioxide pellet decon trailer, plastic media decon trailer, etc.) used during the period. Due to the close proximity of the reactor building, all of these release points are considered to be mixed-mode/ground level release points.

Following the revision of Regulatory Guide 1.21 in 2009, the nuclear industry re-assessed their gaseous effluent releases in accordance with the new definition of "principal radionuclide". Under this new definition, any radionuclide that contributed greater than 1% of the effluent dose calculated to demonstrate compliance with 10CFR50 Appendix I, or contributed more than 1% of the total activity for that type of effluent release, would be classified as a principal radionuclide. Although Carbon-14 (C-14) had been exempted from gaseous effluent calculations in the 1970s, industry assessments in 2009 revealed that Carbon-14 would qualify as a principal radionuclide. Based on this 2009 re-assessment, licensees were required to begin reporting C-14 gaseous effluents in the Annual Radioactive Effluent Release Report beginning with calendar-year 2010. Carbon-14 releases for 2011 are summarized in Tables 2.2-A through 2.2-C, and the dose consequences from C-14 are incorporated into the dose assessments documented in Section 4.2 of this report.

2.3 Liquid Effluent Data

Liquid radioactivity is released from PNPS to Cape Cod Bay via the circulating water discharge canal. These effluents enter Cape Cod Bay at the outfall of the canal, which is located about 1100 feet north of the reactor building.

Liquid effluent releases are summarized in Table 2.3-A. Detailed breakdowns for individual radionuclides are listed in Table 2.3-B. There were twenty-nine discharges of liquid effluents containing radioactivity during the reporting period. Total releases for the various categories of radionuclides, as well as their corresponding mean concentrations, can be summarized as follows:

- Total Effluent Volume: 1,240,000 Liters
- Total Dilution Volume: 582 billion Liters
- Fission/Activation products: 0.00375 Ci, 0.00000000000646 μCi/mL
- Tritium: 4.43 Ci, 0.00000000762 μCi/mL
- Dissolved/entrained noble gases: 0 Ci, 0 μCi/mL

Table 2.1
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Supplemental Information
January-December 2011

FACILITY: PILGRIM NUCLEAR POWER STATION **LICENSE: DPR-35**

1. REGULATORY LIMITS					
a. Fission and activation gases:	500 mrem/yr total body and 3000 mrem/yr for skin at site boundary				
b,c. Iodines, particulates with half-life: >8 days, tritium	1500 mrem/yr to any organ at site boundary				
d. Liquid effluents:	0.06 mrem/month for whole body and 0.2 mrem/month for any organ (without radwaste treatment)				
2. EFFLUENT CONCENTRATION LIMITS					
a. Fission and activation gases:	10CFR20 Appendix B Table II				
b. Iodines:	10CFR20 Appendix B Table II				
c. Particulates with half-life > 8 days:	10CFR20 Appendix B Table II				
d. Liquid effluents:	2E-04 µCi/mL for entrained noble gases; 10CFR20 Appendix B Table II values for all other radionuclides				
3. AVERAGE ENERGY	Not Applicable				
4. MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY					
a. Fission and activation gases: b. Iodines: c. Particulates: d. Liquid effluents:	High purity germanium gamma spectroscopy for all gamma emitters; radiochemistry analysis for H-3, Fe-55 (liquid effluents), Sr-89, and Sr-90				
5. BATCH RELEASES	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
a. Liquid Effluents					
1. Total number of releases:	12	14	0	3	29
2. Total time period (minutes):	1.31E+03	1.29E+03	N/A	3.48E+02	2.95E+03
3. Maximum time period (minutes):	1.52E+02	1.50E+02	N/A	1.35E+02	1.52E+02
4. Average time period (minutes):	1.09E+02	9.22E+01	N/A	1.16E+02	1.02E+02
5. Minimum time period (minutes):	8.30E+01	7.70E+01	N/A	1.05E+02	7.70E+01
6. Average stream flow during periods of release of effluents into a flowing stream (Liters/min):	1.19E+06	9.61E+05	N/A	1.19E+06	1.09E+06
b. Gaseous Effluents	None	None	None	None	None
6. ABNORMAL RELEASES					
a. Liquid Effluents	None	None	None	None	None
b. Gaseous Effluents	None	None	None	None	None

Table 2.2-A
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents - Summation of All Releases
January-December 2011

RELEASE PERIOD	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011	Est. Total Error
A. FISSION AND ACTIVATION GASES						
Total Release: Ci	6.46E+00	3.52E-01	1.78E-01	4.56E+00	1.15E+01	±22%
Average Release Rate: µCi/sec	8.19E-01	4.46E-02	2.26E-02	5.78E-01	3.66E-01	
Percent of Effluent Control Limit*	*	*	*	*	*	
B. IODINE-131						
Total Iodine-131 Release: Ci	6.69E-04	3.47E-04	2.03E-04	1.47E-04	1.37E-03	±20%
Average Release Rate: µCi/sec	8.49E-05	4.40E-05	2.58E-05	1.86E-05	4.33E-05	
Percent of Effluent Control Limit*	*	*	*	*	*	
C. PARTICULATES WITH HALF-LIVES > 8 DAYS						
Total Release: Ci	1.76E-03	5.55E-04	2.56E-04	1.17E-04	2.69E-03	±21%
Average Release Rate: µCi/sec	2.23E-04	7.04E-05	3.24E-05	1.49E-05	8.52E-05	
Percent of Effluent Control Limit*	*	*	*	*	*	
Gross Alpha Radioactivity: Ci	NDA	NDA	NDA	NDA	NDA	
D. TRITIUM						
Total Release: Ci	1.01E+01	5.88E+00	1.35E+01	8.46E+00	3.80E+01	±20%
Average Release Rate: µCi/sec	1.29E+00	7.46E-01	1.72E+00	1.07E+00	1.20E+00	
Percent of Effluent Control Limit*	*	*	*	*	*	
E. CARBON-14						
Total Release: Ci	1.99E+00	1.34E+00	2.15E+00	1.88E+00	7.36E+00	N/A
Average Release Rate: µCi/sec	2.53E-01	1.70E-01	2.73E-01	2.38E-01	2.33E-01	
Percent of Effluent Control Limit*	*	*	*	*	*	

Notes for Table 2.2-A:

* Percent of Effluent Control Limit values based on dose assessments are provided in Section 6 of this report.

1. NDA stands for No Detectable Activity.
2. LLD for airborne gross alpha activity listed as NDA is 1E-11 µCi/cc.
3. N/A stands for not applicable.

Table 2.2-B
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Elevated Release
January-December 2011

CONTINUOUS MODE RELEASES FROM ELEVATED RELEASE POINT					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	9.47E-03	7.15E-02	0.00E+00	0.00E+00	8.10E-02
Kr-87	2.79E-02	0.00E+00	0.00E+00	0.00E+00	2.79E-02
Kr-88	1.68E-02	0.00E+00	0.00E+00	0.00E+00	1.68E-02
Xe-131m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	5.84E-03	0.00E+00	0.00E+00	1.07E-01	1.13E-01
Xe-135m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total for Period	6.00E-02	7.15E-02	0.00E+00	1.07E-01	2.39E-01
2. IODINES: Ci					
I-131	2.47E-05	1.93E-05	1.57E-05	1.48E-05	7.44E-05
I-133	3.95E-05	2.30E-05	1.78E-05	4.40E-06	8.47E-05
Total for Period	6.42E-05	4.23E-05	3.35E-05	1.92E-05	1.59E-04
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	0.00E+00	6.88E-07	0.00E+00	0.00E+00	6.88E-07
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	1.02E-06	0.00E+00	0.00E+00	1.02E-06
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	0.00E+00	0.00E+00	9.37E-07	0.00E+00	9.37E-07
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba/La-140	0.00E+00	0.00E+00	2.50E-06	0.00E+00	2.50E-06
Total for Period	0.00E+00	1.71E-06	3.44E-06	0.00E+00	5.14E-06
4. TRITIUM: Ci					
H-3	3.15E-02	2.48E-02	4.87E-02	2.76E-02	1.33E-01
5. CARBON-14: Ci					
C-14	1.93E+00	1.30E+00	2.09E+00	1.82E+00	7.14E+00

Notes for Table 2.2-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Iodines: 1E-12 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.2-B (continued)
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Elevated Release
January-December 2011

BATCH MODE RELEASES FROM ELEVATED RELEASE POINT					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	N/A	N/A	N/A	N/A	N/A
Kr-85	N/A	N/A	N/A	N/A	N/A
Kr-85m	N/A	N/A	N/A	N/A	N/A
Kr-87	N/A	N/A	N/A	N/A	N/A
Kr-88	N/A	N/A	N/A	N/A	N/A
Xe-131m	N/A	N/A	N/A	N/A	N/A
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-133m	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Xe-135m	N/A	N/A	N/A	N/A	N/A
Xe-137	N/A	N/A	N/A	N/A	N/A
Xe-138	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. IODINES: Ci					
I-131	N/A	N/A	N/A	N/A	N/A
I-133	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Ru-103	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
4. TRITIUM: Ci					
H-3	N/A	N/A	N/A	N/A	N/A
5. CARBON-14: Ci					
C-14	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.2-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Iodines: 1E-12 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.2-C
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Ground-Level Release
January-December 2011

CONTINUOUS MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	0.00E+00	0.00E+00	0.00E+00	1.71E+00	1.71E+00
Xe-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	1.66E+00	2.80E-01	1.78E-01	2.74E+00	4.87E+00
Xe-135m	1.75E-01	0.00E+00	0.00E+00	0.00E+00	1.75E-01
Xe-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	4.56E+00	0.00E+00	0.00E+00	0.00E+00	4.56E+00
Total for period	6.40E+00	2.80E-01	1.78E-01	4.45E+00	1.13E+01
2. IODINES: Ci					
I-131	6.45E-04	3.27E-04	1.88E-04	1.32E-04	1.29E-03
I-133	1.97E-03	5.42E-04	4.46E-04	2.97E-04	3.25E-03
Total for period	2.61E-03	8.69E-04	6.34E-04	4.29E-04	4.54E-03
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	0.00E+00	2.95E-05	0.00E+00	0.00E+00	2.95E-05
Mn-54	2.78E-06	2.44E-06	5.62E-07	0.00E+00	5.78E-06
Fe-59	2.23E-06	4.48E-05	2.42E-06	1.27E-06	5.07E-05
Co-58	0.00E+00	4.43E-06	0.00E+00	0.00E+00	4.43E-06
Co-60	2.93E-06	8.53E-05	1.05E-05	0.00E+00	9.87E-05
Zn-65	0.00E+00	2.48E-05	0.00E+00	0.00E+00	2.48E-05
Sr-89	0.00E+00	3.56E-05	4.38E-05	3.25E-05	1.12E-04
Sr-90	0.00E+00	0.00E+00	1.27E-06	0.00E+00	1.27E-06
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba/La-140	1.75E-03	3.27E-04	1.94E-04	8.36E-05	2.36E-03
Total for period	1.76E-03	5.53E-04	2.52E-04	1.17E-04	2.68E-03
4. TRITIUM: Ci					
H-3	1.01E+01	5.85E+00	1.35E+01	8.44E+00	3.79E+01
5. CARBON-14: Ci					
C-14	5.98E-02	4.02E-02	6.46E-02	5.63E-02	2.21E-01

Notes for Table 2.2-C:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Iodines: 1E-12 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.2-C (continued)
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Gaseous Effluents – Ground-Level Release
January-December 2011

BATCH MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION GASES: Ci					
Ar-41	N/A	N/A	N/A	N/A	N/A
Kr-85	N/A	N/A	N/A	N/A	N/A
Kr-85m	N/A	N/A	N/A	N/A	N/A
Kr-87	N/A	N/A	N/A	N/A	N/A
Kr-88	N/A	N/A	N/A	N/A	N/A
Xe-131m	N/A	N/A	N/A	N/A	N/A
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-133m	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Xe-135m	N/A	N/A	N/A	N/A	N/A
Xe-137	N/A	N/A	N/A	N/A	N/A
Xe-138	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. IODINES: Ci					
I-131	N/A	N/A	N/A	N/A	N/A
I-133	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Ru-103	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
4. TRITIUM: Ci					
H-3	N/A	N/A	N/A	N/A	N/A
5. CARBON-14: Ci					
C-14	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.2-C:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for airborne radionuclides listed as NDA are as follows:
   Fission Gases: 1E-04 μCi/cc
   Iodines: 1E-12 μCi/cc
   Particulates: 1E-11 μCi/cc

Table 2.3-A
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents - Summation of All Releases
January-December 2011

RELEASE PERIOD	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011	Est. Total Error
A. FISSION AND ACTIVATION PRODUCTS						
Total Release (not including tritium, gases, alpha): Ci	7.87E-05	3.68E-03	N/A	NDA	3.75E-03	±12%
Average Diluted Concentration During Period: μCi/mL	5.18E-13	3.00E-11	N/A	NDA	6.46E-12	
Percent of Effluent Concentration Limit*	4.62E-05%	3.24E-04%	N/A	0.00E+00%	8.03E-05%	
B. TRITIUM						
Total Release: Ci	1.58E-01	4.22E+00	N/A	5.18E-02	4.43E+00	±9.4%
Average Diluted Concentration During Period: μCi/mL	1.04E-09	3.45E-08	N/A	3.37E-10	7.62E-09	
Percent of Effluent Concentration Limit*	1.04E-04%	3.45E-03%	N/A	3.37E-05%	7.62E-04%	
C. DISSOLVED AND ENTRAINED GASES						
Total Release: Ci	NDA	NDA	N/A	NDA	NDA	±16%
Average Diluted Concentration During Period: μCi/mL	NDA	NDA	N/A	NDA	NDA	
Percent of Effluent Concentration Limit*	0.00E+00%	0.00E+00%	N/A	0.00E+00%	0.00E+00%	
D. GROSS ALPHA RADIOACTIVITY						
Total Release: Ci	N/A	NDA	N/A	NDA	NDA	±34%
E. VOLUME OF WASTE RELEASED PRIOR TO DILUTION						
Waste Volume: Liters	3.96E+05	7.42E+05	N/A	1.00E+05	1.24E+06	±5.7%
F. VOLUME OF DILUTION WATER USED DURING PERIOD						
Dilution Volume: Liters	1.52E+11	1.22E+11	1.53E+11	1.54E+11	5.82E+11	±10%

Notes for Table 2.3-A:

* Additional percent of Effluent Control Limit values based on dose assessments are provided in Section 6 of this report.

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLD for dissolved and entrained gases listed as NDA is 1E-05 μCi/mL.
4. LLD for liquid gross alpha activity listed as NDA is 1E-07 μCi/mL.

Table 2.3-B
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents
January-December 2011

CONTINUOUS MODE RELEASES					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION PRODUCTS: Ci					
Cr-51	N/A	N/A	N/A	N/A	N/A
Mn-54	N/A	N/A	N/A	N/A	N/A
Fe-55	N/A	N/A	N/A	N/A	N/A
Fe-59	N/A	N/A	N/A	N/A	N/A
Co-58	N/A	N/A	N/A	N/A	N/A
Co-60	N/A	N/A	N/A	N/A	N/A
Zn-65	N/A	N/A	N/A	N/A	N/A
Zn-69m	N/A	N/A	N/A	N/A	N/A
Sr-89	N/A	N/A	N/A	N/A	N/A
Sr-90	N/A	N/A	N/A	N/A	N/A
Zr/Nb-95	N/A	N/A	N/A	N/A	N/A
Mo/Tc-99	N/A	N/A	N/A	N/A	N/A
Ag-110m	N/A	N/A	N/A	N/A	N/A
Sb-124	N/A	N/A	N/A	N/A	N/A
I-131	N/A	N/A	N/A	N/A	N/A
I-133	N/A	N/A	N/A	N/A	N/A
Cs-134	N/A	N/A	N/A	N/A	N/A
Cs-137	N/A	N/A	N/A	N/A	N/A
Ba/La-140	N/A	N/A	N/A	N/A	N/A
Ce-141	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A
2. DISSOLVED AND ENTRAINED GASES: Ci					
Xe-133	N/A	N/A	N/A	N/A	N/A
Xe-135	N/A	N/A	N/A	N/A	N/A
Total for period	N/A	N/A	N/A	N/A	N/A

Notes for Table 2.3-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for liquid radionuclides listed as NDA are as follows:
   - Strontium: 5E-08 μCi/mL
   - Iodines: 1E-06 μCi/mL
   - Noble Gases: 1E-05 μCi/mL
   - All Others: 5E-07 μCi/mL

Table 2.3-B (continued)
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Liquid Effluents
January-December 2011

BATCH MODE RELEASES					
Nuclide Released	Jan-Mar 2011	Apr-Jun 2011	Jul-Sep 2011	Oct-Dec 2011	Jan-Dec 2011
1. FISSION AND ACTIVATION PRODUCTS: Ci					
Na-24	4.56E-06	NDA	N/A	NDA	4.56E-06
Cr-51	NDA	1.00E-03	N/A	NDA	1.00E-03
Mn-54	3.86E-06	1.30E-03	N/A	NDA	1.30E-03
Fe-55	NDA	NDA	N/A	NDA	NDA
Fe-59	NDA	2.32E-04	N/A	NDA	2.32E-04
Co-58	NDA	1.04E-04	N/A	NDA	1.04E-04
Co-60	2.41E-07	8.49E-04	N/A	NDA	8.49E-04
Zn-65	NDA	1.54E-04	N/A	NDA	1.54E-04
Zn-69m	NDA	NDA	N/A	NDA	NDA
Sr-89	8.43E-08	NDA	N/A	NDA	8.43E-08
Sr-90	NDA	NDA	N/A	NDA	NDA
Zr/Nb-95	NDA	8.66E-06	N/A	NDA	8.66E-06
Mo/Tc-99	NDA	NDA	N/A	NDA	NDA
Ag-110m	NDA	2.37E-05	N/A	NDA	2.37E-05
Sb-124	NDA	NDA	N/A	NDA	NDA
I-131	NDA	NDA	N/A	NDA	NDA
I-133	NDA	NDA	N/A	NDA	NDA
Cs-134	NDA	NDA	N/A	NDA	NDA
Cs-137	7.00E-05	4.81E-06	N/A	NDA	7.48E-05
Ba/La-140	NDA	NDA	N/A	NDA	NDA
Ce-141	NDA	NDA	N/A	NDA	NDA
Ce-144	NDA	NDA	N/A	NDA	NDA
Total for period	7.87E-05	3.68E-03	N/A	NDA	3.75E-03
2. DISSOLVED AND ENTRAINED GASES: Ci					
Xe-133	NDA	NDA	N/A	NDA	NDA
Xe-135	NDA	NDA	N/A	NDA	NDA
Total for period	NDA	NDA	N/A	NDA	NDA

Notes for Table 2.3-B:

1. N/A stands for not applicable.
2. NDA stands for No Detectable Activity.
3. LLDs for liquid radionuclides listed as NDA are as follows:
   - Strontium: 5E-08 μCi/mL
   - Iodines: 1E-06 μCi/mL
   - Noble Gases: 1E-05 μCi/mL
   - All Others: 5E-07 μCi/mL

3.0 METEOROLOGICAL DATA

Meteorological data are summarized for the reporting period in Appendix A, in the standard joint frequency distribution format as given in NRC Regulatory Guide 1.21.

The predominant meteorological conditions observed during the annual reporting period can be summarized with their corresponding frequencies as follows:

- Stability Class: Class D, 43%
- 33-ft Wind Direction (from): South-southwest, 17%
- 33-ft Wind Speed: 3.5-7.5 mph, 56%
- 220-ft Wind Direction (from): South-southwest, 15%
- 220-ft Wind Speed: 12.5-18.5 mph, 36%

Joint data recovery for both the 33-ft level and 220-ft level of the tower was 100%, well in excess of the 90% annual data recovery goal specified by the NRC.

4.0 MAXIMUM INDIVIDUAL DOSES

Doses to the maximum exposed individual resulting from radionuclides in effluents released offsite were calculated using methods presented in the PNPS Offsite Dose Calculation Manual (ODCM, Reference 2), NRC Regulatory Guide 1.109 (Reference 3), NRC Regulatory Guide 1.111 (Reference 4), and the Pilgrim Station Unit 1 Appendix I Evaluation (Reference 5). Maximum individual doses are calculated separately for: (1) noble gases in gaseous effluents, (2) particulates, iodines, and tritium in gaseous effluents; and, (3) liquid effluents. Maximum consumption and use factors for various pathways from Table E-5 of the PNPS ODCM are used for calculating the doses to the maximum exposed individual.

Information related to liquid and gaseous effluent releases are summarized Section 2 of this report. These effluent release data were used as input to computer programs to calculate the resulting doses. PNPS ODCM methodologies were used to calculate the dose contributions to the various organs in each age class from major exposure pathways.

4.1 Doses From Noble Gas Releases

Gaseous effluent release data presented in Tables 2.2-A, 2.2-B, and 2.2-C from this effluent release report were used as input to a dose assessment computer program to calculate radiation doses. These data include gaseous releases from the PNPS main stack, reactor building vent, and turbine building roof exhausters. Meteorological data obtained from the PNPS 220-foot meteorological tower during the 10-year period from 1994 through 2003 were used as input to the "AEOLUS-3" computer program (Reference 6). This program was used to calculate the annual average atmospheric dispersion and deposition factors used in the dose assessment computer program to calculate maximum individual doses.

The maximum individual doses resulting from radioactive noble gases released in gaseous effluents are presented in Table 4.1 according to specific receptor locations. This table includes all noble gas doses for the individual calendar quarters and total calendar year.

Noble gases released in gaseous effluents from PNPS during 2011 resulted in a maximum total body dose of 0.0020 mrem. The maximum skin dose was 0.0068 mrem. Both of these doses occurred to a hypothetical individual, assumed to be present 24 hours per day, 365 days per year, at the site boundary location yielding the highest dose (0.64 km ESE of the Reactor Building). For the more "realistic" individuals at offsite locations, the maximum total body dose was 0.0015 mrem (nearest residence, 0.80 kilometers ESE from the Reactor Building), while the maximum skin dose was 0.0048 mrem (nearest residence, 0.80 kilometers ESE from the Reactor Building).

Table 4.1

Maximum Doses From Noble Gas Releases During 2011[a]

Release Period	Gamma Air Dose mrad/period (location)	Beta Air Dose mrad/period (location)	Total Body Dose mrem/period (location)	Skin Dose mrem/period (location)
Jan-Mar	2.54E-03 (0.64 km ESE)	4.15E-03 (0.64 km ESE)	1.70E-03 (0.64 km ESE)	5.51E-03 (0.64 km ESE)
Apr-Jun	3.01E-05 (0.64 km ESE)	1.11E-04 (0.64 km ESE)	1.99E-05 (0.64 km ESE)	1.07E-04 (0.64 km ESE)
Jul-Sep	1.90E-05 (0.64 km ESE)	7.03E-05 (0.64 km ESE)	1.25E-05 (0.64 km ESE)	6.79E-05 (0.64 km ESE)
Oct-Dec	3.26E-04 (0.64 km ESE)	1.37E-03 (0.64 km ESE)	2.13E-04 (0.64 km ESE)	1.16E-03 (0.64 km ESE)
Jan-Dec	2.92E-03 (0.64 km ESE)	5.70E-03 (0.64 km ESE)	1.95E-03 (0.64 km ESE)	6.84E-03 (0.64 km ESE)

[a] All directions and distances are with respect to the reactor building vent.

4.2 Doses From Gaseous Effluent Releases

Gaseous effluent release data presented in Tables 2.2-A, 2.2-B, and 2.2-C from this effluent release report were used as input to a dose assessment computer program to calculate radiation doses. These data include gaseous releases from the PNPS main stack, reactor building vent, and turbine building roof exhausters. Meteorological data obtained from the PNPS 220-foot meteorological tower during the 10-year period from 1994 through 2003 were used as input to the "AEOLUS-3" computer program (Reference 6). This program was used to calculate the annual average atmospheric dispersion and deposition factors used in the dose assessment computer program to calculate maximum individual doses.

The maximum individual doses resulting from radioactive particulates, radioiodines, tritium and carbon-14 released in gaseous effluents are presented in Tables 4.2-A through 4.2-E. These tables cover the individual calendar quarters and the total calendar year, respectively. Doses resulting from releases of noble gases are addressed independently in the PNPS ODCM. Therefore, none of these tables for maximum individual doses include any dose contribution from noble gases. The presentation and analysis of doses resulting from noble gases are addressed in Section 4.1 of this report.

Tables 4.2-A through 4.2-E summarize the maximum total body and organ doses for the adult, teen, child, and infant age classes resulting from the major gaseous exposure pathways. These tables present the dose data according to specific receptor location and the exposure pathways assumed to occur at that location. For example, the second column of the tables presents the information for the hypothetical maximum-exposed at the most restrictive site boundary location, where only inhalation and ground deposition exposure pathways are assumed to occur. Since this is a shoreline location controlled by Entergy, the other pathways of garden vegetable production, milk production, and meat production are assumed not to occur. Doses for other offsite locations not under Entergy control, where other exposure pathways can and do occur, are presented in subsequent columns of the tables, and represent the potential maximum doses to individuals at these locations. For consistency, all distances listed in the first row of Tables 4.2-A through 4.2-E are measured from the Reactor Building Vent. However, doses at the specific receptor locations are calculated based on the actual distances from the applicable release points (PNPS main stack, reactor building vent, and turbine building roof exhausters).

Radioactivity (particulates, radioiodines, tritium, and carbon-14) released in gaseous effluents from PNPS during 2011 resulted in a maximum total body dose of 0.027 mrem (child age class at nearest garden location, 0.84 kilometers SE from the Reactor Building), while the maximum organ dose was 0.079 mrem (child bone at nearest garden location, 0.84 kilometers SE from the Reactor Building). Carbon-14 contributed 0.015 mrem (57%) of the 0.027 mrem child total body dose, and 0.077 mrem (98%) of the 0.079 mrem child bone dose at the location of the nearest garden.

Table 4.2-A

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jan-Mar 2011

Receptor: Direction: Distance[1]: Pathway[2]:	Bound NW 0.54 km DI	Resident ESE 0.80 km DI	Garden SE 0.84 km DIV[3]	Cow/Goat WSW 3.97 km DIVCG[3]	Cow/Meat W 5.77 km DIVCM[3]	Meat S 3.80 km DIVM[3]
Age Class: Adult						
Bone	1.89E-04	1.41E-04	5.43E-03	2.18E-03	1.91E-03	3.32E-03
GI-LLI	1.25E-03	8.46E-04	3.21E-03	6.12E-04	4.87E-04	7.92E-04
Kidney	1.17E-03	7.95E-04	3.10E-03	6.10E-04	4.85E-04	7.85E-04
Liver	1.17E-03	7.92E-04	3.09E-03	6.07E-04	4.84E-04	7.84E-04
Lung	1.34E-03	9.07E-04	3.16E-03	6.08E-04	4.84E-04	7.87E-04
Thyroid	2.89E-03	1.93E-03	7.44E-03	1.89E-03	1.17E-03	1.07E-03
T.Body	1.17E-03	7.89E-04	3.08E-03	6.05E-04	4.83E-04	7.84E-04
Age Class: Teen						
Bone	2.71E-04	2.02E-04	8.76E-03	3.67E-03	2.88E-03	4.68E-03
GI-LLI	1.28E-03	8.67E-04	4.06E-03	9.33E-04	6.91E-04	1.07E-03
Kidney	1.20E-03	8.16E-04	3.97E-03	9.36E-04	6.92E-04	1.06E-03
Liver	1.20E-03	8.11E-04	3.96E-03	9.32E-04	6.90E-04	1.06E-03
Lung	1.48E-03	9.96E-04	4.09E-03	9.33E-04	6.90E-04	1.07E-03
Thyroid	3.38E-03	2.26E-03	7.95E-03	2.82E-03	1.69E-03	1.31E-03
T.Body	1.19E-03	8.07E-04	3.96E-03	9.29E-04	6.88E-04	1.06E-03
Age Class: Child						
Bone	3.73E-04	2.78E-04	2.09E-02	8.85E-03	6.78E-03	1.08E-02
GI-LLI	1.11E-03	7.57E-04	7.28E-03	2.05E-03	1.51E-03	2.34E-03
Kidney	1.09E-03	7.40E-04	7.24E-03	2.06E-03	1.52E-03	2.34E-03
Liver	1.08E-03	7.35E-04	7.23E-03	2.05E-03	1.52E-03	2.34E-03
Lung	1.32E-03	8.93E-04	7.33E-03	2.05E-03	1.51E-03	2.34E-03
Thyroid	3.68E-03	2.46E-03	1.29E-02	5.69E-03	3.43E-03	2.70E-03
T.Body	1.08E-03	7.32E-04	7.23E-03	2.05E-03	1.51E-03	2.33E-03
Age Class: Infant						
Bone	2.76E-04	2.06E-04	1.71E-04	5.57E-03	3.87E-03	7.42E-05
GI-LLI	6.47E-04	4.40E-04	3.30E-04	1.32E-03	8.91E-04	3.11E-05
Kidney	6.42E-04	4.37E-04	3.27E-04	1.35E-03	9.05E-04	3.10E-05
Liver	6.40E-04	4.36E-04	3.26E-04	1.35E-03	9.03E-04	3.09E-05
Lung	8.57E-04	5.79E-04	4.32E-04	1.33E-03	8.93E-04	3.61E-05
Thyroid	3.03E-03	2.02E-03	1.49E-03	9.54E-03	5.15E-03	8.88E-05
T.Body	6.34E-04	4.32E-04	3.23E-04	1.33E-03	8.95E-04	3.08E-05

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

Table 4.2-B

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Apr-Jun 2011

Receptor: Direction: Distance[1]: Pathway[2]:	Bound NW 0.54 km DI	Resident ESE 0.80 km DI	Garden SE 0.84 km DIV	Cow/Goat WSW 3.97 km DIVCG	Cow/Meat W 5.77 km DIVCM	Meat S 3.80 km DIVM
Age Class: Adult						
Bone	1.25E-04	9.35E-05	3.73E-03	1.47E-03	1.29E-03	2.23E-03
GI-LLI	7.00E-04	4.74E-04	2.02E-03	3.99E-04	3.22E-04	5.28E-04
Kidney	6.81E-04	4.62E-04	1.90E-03	3.94E-04	3.17E-04	5.16E-04
Liver	6.80E-04	4.61E-04	1.90E-03	3.94E-04	3.18E-04	5.18E-04
Lung	8.01E-04	5.41E-04	1.94E-03	3.93E-04	3.16E-04	5.18E-04
Thyroid	1.41E-03	9.44E-04	3.99E-03	1.04E-03	6.65E-04	6.58E-04
T.Body	6.78E-04	4.59E-04	1.90E-03	3.92E-04	3.16E-04	5.17E-04
Age Class: Teen						
Bone	1.79E-04	1.34E-04	6.01E-03	2.47E-03	1.94E-03	3.15E-03
GI-LLI	7.16E-04	4.86E-04	2.58E-03	6.13E-04	4.57E-04	7.12E-04
Kidney	6.99E-04	4.74E-04	2.47E-03	6.12E-04	4.55E-04	7.03E-04
Liver	6.97E-04	4.73E-04	2.48E-03	6.11E-04	4.55E-04	7.05E-04
Lung	8.81E-04	5.95E-04	2.54E-03	6.09E-04	4.54E-04	7.07E-04
Thyroid	1.61E-03	1.08E-03	4.36E-03	1.56E-03	9.58E-04	8.26E-04
T.Body	6.94E-04	4.71E-04	2.48E-03	6.08E-04	4.54E-04	7.04E-04
Age Class: Child						
Bone	2.47E-04	1.84E-04	1.44E-02	5.97E-03	4.56E-03	7.28E-03
GI-LLI	6.38E-04	4.34E-04	4.65E-03	1.35E-03	1.00E-03	1.56E-03
Kidney	6.34E-04	4.31E-04	4.59E-03	1.36E-03	1.01E-03	1.55E-03
Liver	6.32E-04	4.30E-04	4.61E-03	1.36E-03	1.01E-03	1.56E-03
Lung	7.84E-04	5.31E-04	4.64E-03	1.35E-03	1.00E-03	1.56E-03
Thyroid	1.70E-03	1.14E-03	7.30E-03	3.19E-03	1.97E-03	1.73E-03
T.Body	6.30E-04	4.29E-04	4.62E-03	1.36E-03	1.01E-03	1.56E-03
Age Class: Infant						
Bone	1.82E-04	1.36E-04	1.13E-04	3.75E-03	2.60E-03	4.98E-05
GI-LLI	3.74E-04	2.55E-04	1.92E-04	8.82E-04	5.96E-04	1.93E-05
Kidney	3.75E-04	2.55E-04	1.92E-04	8.93E-04	6.02E-04	1.93E-05
Liver	3.74E-04	2.55E-04	1.91E-04	8.95E-04	6.03E-04	1.93E-05
Lung	4.88E-04	3.30E-04	2.47E-04	8.78E-04	5.93E-04	2.20E-05
Thyroid	1.35E-03	9.03E-04	6.70E-04	5.04E-03	2.75E-03	4.32E-05
T.Body	3.72E-04	2.54E-04	1.90E-04	8.84E-04	5.97E-04	1.92E-05

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

Table 4.2-C

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jul-Sep 2011

Receptor: Direction: Distance[1]: Pathway[2]:	Bound NW 0.54 km DI	Resident ESE 0.80 km DI	Garden SE 0.84 km DIV	Cow/Goat WSW 3.97 km DIVCG	Cow/Meat W 5.77 km DIVCM	Meat S 3.80 km DIVM
Age Class: Adult						
Bone	2.03E-04	1.51E-04	6.21E-03	2.38E-03	2.07E-03	3.60E-03
GI-LLI	1.55E-03	1.05E-03	3.88E-03	6.97E-04	5.48E-04	8.80E-04
Kidney	1.54E-03	1.05E-03	3.83E-03	6.96E-04	5.47E-04	8.77E-04
Liver	1.54E-03	1.04E-03	3.83E-03	6.95E-04	5.47E-04	8.77E-04
Lung	1.58E-03	1.07E-03	3.85E-03	6.95E-04	5.46E-04	8.78E-04
Thyroid	2.00E-03	1.35E-03	5.07E-03	1.08E-03	7.52E-04	9.61E-04
T.Body	1.54E-03	1.04E-03	3.84E-03	6.95E-04	5.47E-04	8.77E-04
Age Class: Teen						
Bone	2.89E-04	2.16E-04	9.96E-03	3.99E-03	3.13E-03	5.08E-03
GI-LLI	1.58E-03	1.07E-03	4.88E-03	1.05E-03	7.71E-04	1.18E-03
Kidney	1.57E-03	1.07E-03	4.83E-03	1.05E-03	7.71E-04	1.18E-03
Liver	1.57E-03	1.07E-03	4.83E-03	1.05E-03	7.70E-04	1.18E-03
Lung	1.63E-03	1.11E-03	4.86E-03	1.05E-03	7.70E-04	1.18E-03
Thyroid	2.16E-03	1.45E-03	5.96E-03	1.61E-03	1.07E-03	1.25E-03
T.Body	1.57E-03	1.06E-03	4.84E-03	1.05E-03	7.70E-04	1.18E-03
Age Class: Child						
Bone	3.98E-04	2.97E-04	2.37E-02	9.62E-03	7.35E-03	1.17E-02
GI-LLI	1.42E-03	9.63E-04	8.60E-03	2.28E-03	1.67E-03	2.57E-03
Kidney	1.42E-03	9.62E-04	8.57E-03	2.28E-03	1.67E-03	2.57E-03
Liver	1.42E-03	9.61E-04	8.57E-03	2.28E-03	1.67E-03	2.57E-03
Lung	1.47E-03	9.95E-04	8.59E-03	2.28E-03	1.67E-03	2.57E-03
Thyroid	2.10E-03	1.42E-03	1.02E-02	3.35E-03	2.24E-03	2.67E-03
T.Body	1.41E-03	9.60E-04	8.60E-03	2.28E-03	1.67E-03	2.57E-03
Age Class: Infant						
Bone	2.91E-04	2.17E-04	1.81E-04	6.01E-03	4.17E-03	8.00E-05
GI-LLI	8.30E-04	5.65E-04	4.22E-04	1.46E-03	9.79E-04	3.72E-05
Kidney	8.31E-04	5.65E-04	4.22E-04	1.47E-03	9.83E-04	3.73E-05
Liver	8.30E-04	5.65E-04	4.22E-04	1.47E-03	9.82E-04	3.72E-05
Lung	8.75E-04	5.94E-04	4.44E-04	1.46E-03	9.79E-04	3.83E-05
Thyroid	1.46E-03	9.82E-04	7.30E-04	3.89E-03	2.25E-03	5.27E-05
T.Body	8.29E-04	5.64E-04	4.21E-04	1.47E-03	9.80E-04	3.72E-05

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

Table 4.2-D

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Oct-Dec 2011

Receptor: Direction: Distance[1]: Pathway[2]:	Bound NW 0.54 km DI	Resident ESE 0.80 km DI	Garden SE 0.84 km DIV[3]	Cow/Goat WSW 3.97 km DIVCG[3]	Cow/Meat W 5.77 km DIVCM[3]	Meat S 3.80 km DIVM[3]
Age Class: Adult						
Bone	1.72E-04	1.28E-04	5.16E-03	2.06E-03	1.80E-03	3.13E-03
GI-LLI	9.80E-04	6.64E-04	2.70E-03	5.52E-04	4.44E-04	7.26E-04
Kidney	9.76E-04	6.61E-04	2.69E-03	5.51E-04	4.44E-04	7.25E-04
Liver	9.75E-04	6.61E-04	2.68E-03	5.51E-04	4.44E-04	7.25E-04
Lung	9.89E-04	6.70E-04	2.69E-03	5.50E-04	4.43E-04	7.25E-04
Thyroid	1.29E-03	8.72E-04	3.55E-03	8.21E-04	5.90E-04	7.85E-04
T.Body	9.74E-04	6.60E-04	2.69E-03	5.51E-04	4.43E-04	7.25E-04
Age Class: Teen						
Bone	2.46E-04	1.84E-04	8.34E-03	3.46E-03	2.72E-03	4.41E-03
GI-LLI	1.00E-03	6.80E-04	3.51E-03	8.52E-04	6.35E-04	9.88E-04
Kidney	9.99E-04	6.78E-04	3.49E-03	8.53E-04	6.36E-04	9.87E-04
Liver	9.98E-04	6.77E-04	3.49E-03	8.52E-04	6.35E-04	9.87E-04
Lung	1.02E-03	6.92E-04	3.50E-03	8.51E-04	6.35E-04	9.88E-04
Thyroid	1.40E-03	9.44E-04	4.27E-03	1.25E-03	8.47E-04	1.04E-03
T.Body	9.97E-04	6.76E-04	3.49E-03	8.52E-04	6.35E-04	9.87E-04
Age Class: Child						
Bone	3.39E-04	2.54E-04	1.99E-02	8.35E-03	6.39E-03	1.02E-02
GI-LLI	9.05E-04	6.16E-04	6.48E-03	1.90E-03	1.41E-03	2.18E-03
Kidney	9.05E-04	6.16E-04	6.47E-03	1.90E-03	1.41E-03	2.18E-03
Liver	9.04E-04	6.15E-04	6.47E-03	1.90E-03	1.41E-03	2.18E-03
Lung	9.24E-04	6.28E-04	6.48E-03	1.90E-03	1.41E-03	2.18E-03
Thyroid	1.38E-03	9.28E-04	7.60E-03	2.66E-03	1.81E-03	2.26E-03
T.Body	9.03E-04	6.14E-04	6.48E-03	1.90E-03	1.41E-03	2.18E-03
Age Class: Infant						
Bone	2.50E-04	1.87E-04	1.56E-04	5.23E-03	3.64E-03	6.97E-05
GI-LLI	5.33E-04	3.64E-04	2.73E-04	1.23E-03	8.31E-04	2.72E-05
Kidney	5.34E-04	3.64E-04	2.73E-04	1.24E-03	8.34E-04	2.73E-05
Liver	5.34E-04	3.64E-04	2.73E-04	1.23E-03	8.34E-04	2.73E-05
Lung	5.53E-04	3.76E-04	2.82E-04	1.23E-03	8.31E-04	2.77E-05
Thyroid	9.68E-04	6.52E-04	4.85E-04	2.96E-03	1.74E-03	3.80E-05
T.Body	5.33E-04	3.63E-04	2.72E-04	1.23E-03	8.32E-04	2.72E-05

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

Table 4.2-E

Maximum Individual Organ Dose at Receptor Location -- mrem
From Gaseous Release Period: Jan-Dec 2011

Receptor: Direction: Distance[1]: Pathway[2]:	Bound NW 0.54 km DI	Resident ESE 0.80 km DI	Garden SE 0.84 km DIV[3]	Cow/Goat WSW 3.97 km DIVCG[3]	Cow/Meat W 5.77 km DIVCM[3]	Meat S 3.80 km DIVM[3]
Age Class: Adult						
Bone	6.89E-04	5.14E-04	2.05E-02	8.09E-03	7.07E-03	1.23E-02
GI-LLI	4.48E-03	3.04E-03	1.18E-02	2.26E-03	1.80E-03	2.93E-03
Kidney	4.38E-03	2.96E-03	1.15E-02	2.25E-03	1.79E-03	2.90E-03
Liver	4.37E-03	2.96E-03	1.15E-02	2.25E-03	1.79E-03	2.90E-03
Lung	4.71E-03	3.19E-03	1.16E-02	2.25E-03	1.79E-03	2.91E-03
Thyroid	7.59E-03	5.09E-03	2.01E-02	4.83E-03	3.18E-03	3.47E-03
T.Body	4.36E-03	2.95E-03	1.15E-02	2.24E-03	1.79E-03	2.90E-03
Age Class: Teen						
Bone	9.85E-04	7.35E-04	3.31E-02	1.36E-02	1.07E-02	1.73E-02
GI-LLI	4.58E-03	3.11E-03	1.50E-02	3.45E-03	2.56E-03	3.95E-03
Kidney	4.48E-03	3.03E-03	1.48E-02	3.45E-03	2.55E-03	3.94E-03
Liver	4.46E-03	3.03E-03	1.48E-02	3.44E-03	2.55E-03	3.94E-03
Lung	5.01E-03	3.39E-03	1.50E-02	3.44E-03	2.55E-03	3.94E-03
Thyroid	8.55E-03	5.74E-03	2.25E-02	7.24E-03	4.56E-03	4.43E-03
T.Body	4.45E-03	3.02E-03	1.48E-02	3.44E-03	2.55E-03	3.94E-03
Age Class: Child						
Bone	1.36E-03	1.01E-03	7.89E-02	3.28E-02	2.51E-02	4.00E-02
GI-LLI	4.08E-03	2.77E-03	2.70E-02	7.58E-03	5.60E-03	8.65E-03
Kidney	4.04E-03	2.75E-03	2.69E-02	7.60E-03	5.61E-03	8.64E-03
Liver	4.03E-03	2.74E-03	2.69E-02	7.59E-03	5.60E-03	8.64E-03
Lung	4.49E-03	3.05E-03	2.70E-02	7.58E-03	5.59E-03	8.64E-03
Thyroid	8.86E-03	5.94E-03	3.80E-02	1.49E-02	9.45E-03	9.36E-03
T.Body	4.02E-03	2.73E-03	2.69E-02	7.58E-03	5.60E-03	8.64E-03
Age Class: Infant						
Bone	9.99E-04	7.46E-04	6.21E-04	2.06E-02	1.43E-02	2.74E-04
GI-LLI	2.39E-03	1.62E-03	1.22E-03	4.90E-03	3.30E-03	1.15E-04
Kidney	2.38E-03	1.62E-03	1.21E-03	4.95E-03	3.32E-03	1.15E-04
Liver	2.38E-03	1.62E-03	1.21E-03	4.95E-03	3.32E-03	1.15E-04
Lung	2.77E-03	1.88E-03	1.40E-03	4.90E-03	3.30E-03	1.24E-04
Thyroid	6.81E-03	4.55E-03	3.38E-03	2.14E-02	1.19E-02	2.23E-04
T.Body	2.37E-03	1.61E-03	1.21E-03	4.91E-03	3.30E-03	1.14E-04

[1] Distances are measured with respect to the reactor building vent.

[2] Pathway designations are as follows:

D = Deposition (Ground Plane) I = Inhalation V = Vegetable Garden
C = Cow Milk G = Goat Milk M = Meat

[3] Doses are conservative since it is unlikely for vegetables to be grown outside or for animals to be fed on pasture during winter months.

4.3 Doses From Liquid Effluent Releases

Liquid effluent release data presented in Tables 2.3-A and 2.3-B were used as input to the dose assessment computer program to calculate radiation doses. The maximum individual doses resulting from radionuclides released in liquid effluents are presented in Tables 4.3-A through 4.3-E. These tables cover the individual calendar quarters and the total calendar year, respectively.

Tables 4.3-A through 4.3-E summarize the maximum total body and organ doses for the adult, teen, and child age classes resulting from the major liquid exposure pathways. NRC Regulatory Guide 1.109 does not recognize the infant age class as being exposed to the liquid effluent pathways. Therefore, doses for this age class are not included in any of the tables.

It should be noted that doses calculated for the entire year might not equal the sum of the doses for the individual quarters. Doses from liquid effluents are based on the concentration (activity divided by volume) of radionuclides released in the effluent, as prescribed by the NRC in Regulatory Guide 1.109. If a larger proportion of activity is released with a relatively smaller volume of dilution water during a given quarter, the resulting concentration for that quarter will be higher than concentrations from other quarters. This will result in a proportionally higher dose for that quarter. However, when that quarter's activity values are included in the annual sum, and divided by the total annual dilution flow, the resulting dose contribution will be smaller. In such a situation, the annual dose will actually be less than the sum of the individual quarterly doses.

Radioactivity released in liquid effluents from PNPS during the reporting period resulted in a maximum total body dose (child age class) of 0.000316 mrem. The maximum organ dose (adult age class, GI-LLI) was 0.00122 mrem.

Table 4.3-A

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jan-Mar 2011

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	2.19E-06	3.35E-06	2.92E-06
GI-LLI	7.41E-07	1.66E-06	4.51E-07
Kidney	1.32E-06	2.37E-06	1.21E-06
Liver	3.15E-06	4.22E-06	2.97E-06
Lung	6.86E-07	1.78E-06	6.66E-07
Thyroid	3.84E-07	1.43E-06	3.70E-07
T.Body	2.16E-06	2.39E-06	7.66E-07

* These doses are conservative since the same usage factor was applied for each quarter. In reality, it is unlikely that anyone would be swimming or boating during the entire year. However, the resulting dose is considerably lower than those from other pathways and does not contribute much to the total dose.

Table 4.3-B

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Apr-Jun 2011

Organ	Age Class Organ Dose – mrem		
	Adult	Teen	Child
Bone	2.56E-04	2.58E-04	2.75E-04
GI-LLI	1.45E-03	9.65E-04	3.72E-04
Kidney	3.42E-04	3.27E-04	2.57E-04
Liver	7.65E-04	7.23E-04	6.24E-04
Lung	7.78E-05	1.17E-04	7.10E-05
Thyroid	1.32E-05	4.94E-05	1.27E-05
T.Body	3.43E-04	3.51E-04	3.74E-04

Table 4.3-C

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jul-Sep 2011

Organ	Age Class Organ Dose – mrem		
	Adult	Teen	Child
Bone	0.00E+00	0.00E+00	0.00E+00
GI-LLI	0.00E+00	0.00E+00	0.00E+00
Kidney	0.00E+00	0.00E+00	0.00E+00
Liver	0.00E+00	0.00E+00	0.00E+00
Lung	0.00E+00	0.00E+00	0.00E+00
Thyroid	0.00E+00	0.00E+00	0.00E+00
T.Body	0.00E+00	0.00E+00	0.00E+00

Table 4.3-D

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Oct-Dec 2011

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	0.00E+00	0.00E+00	0.00E+00
GI-LLI	4.83E-08	3.57E-08	3.08E-08
Kidney	4.83E-08	3.57E-08	3.08E-08
Liver	4.83E-08	3.57E-08	3.08E-08
Lung	4.83E-08	3.57E-08	3.08E-08
Thyroid	4.83E-08	3.57E-08	3.08E-08
T.Body	4.83E-08	3.57E-08	3.08E-08

* These doses are conservative since the same usage factor was applied for each quarter. In reality, it is unlikely that anyone would be swimming or boating during these months. However, the resulting dose is considerably lower than those from other pathways and does not contribute much to the total dose.

Table 4.3-E

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jan-Dec 2011

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	2.18E-04	2.21E-04	2.34E-04
GI-LLI	1.22E-03	8.14E-04	3.14E-04
Kidney	2.89E-04	2.77E-04	2.18E-04
Liver	6.47E-04	6.13E-04	5.28E-04
Lung	6.63E-05	1.01E-04	6.05E-05
Thyroid	1.15E-05	4.31E-05	1.11E-05
T.Body	2.91E-04	2.98E-04	3.16E-04

* These doses are conservative since the same usage factor was applied for each quarter. In reality, it is unlikely that anyone would be swimming or boating during the entire year. However, the resulting dose is considerably lower than those from other pathways and does not contribute much to the total dose.

5.0 OFFSITE AMBIENT RADIATION MEASUREMENTS

The PNPS ODCM does not contain control limits related specifically to offsite ambient radiation exposure. However, Regulatory Guide 1.21 (Reference 1) recommends calculation of ambient radiation exposure as part of the overall assessment of radiological impact on man.

Thermoluminescent dosimeters (TLDs) are located at 83 sites beyond the boundary of the PNPS restricted/protected area. A number of these TLDs are located within the site boundary, on Entergy property in close proximity to the station proper. The TLDs are collected on a quarterly basis and used to calculate the ambient radiation exposure in milliRoentgen (mR) over the exposure period. These TLDs are grouped into four zones of increasing distance from the station. Average exposure values for each of these zones were calculated for each calendar quarter and the total year. The average exposure values (mR) for the four zones are presented in Table 5.0.

In addition to responding to ambient radiation exposure, TLDs will also record radiation resulting from noble gases (plume and immersion exposure), particulate materials deposited on the ground, cosmic rays from outer space, and from naturally-occurring radioactivity in the soil and air. Typically, the exposure from cosmic rays and other natural radioactivity components is about 40 to 70 mR/year. As calculated in Sections 4.1 and 4.2 of this report, the ambient radiation component of doses from PNPS effluent emissions are below 1 mrem/yr and would not be discernible above the natural radiation exposure levels.

The major source of ambient radiation exposure from PNPS results from high-energy gamma rays emitted from nitrogen-16 (N-16) contained in steam flowing through the turbine. Although the N-16 is enclosed in the process lines and turbine and is not released into the environment, the ambient radiation exposure and sky shine from this contained source accounts for the majority of the radiation dose, especially in close proximity to the station. Other sources of ambient radiation exposure include radiation emitted from contained radioactive materials and/or radwaste at the facility. Despite these sources of ambient radiation exposure at PNPS, increases in exposure from ambient radiation are typically not observable above background levels at locations beyond Entergy controlled property.

The average exposure values presented in Table 5.0 appear to indicate an elevation in ambient exposures in Zone 1, those TLDs within 2 miles of PNPS. Most of this elevation is due to increases in exposure levels measured at TLD locations on Entergy property in close proximity to the station proper. For example, the annual exposure at TLD location OA, located at the Overlook Area near the PNPS Health Club (I&S Building), was 193 mR for the entire year. This location is immediately adjacent to the station proper and overlooks the turbine building, therefore receiving the highest direct ambient and sky shine exposure. When the near-site TLDs (those located within 0.6 km of the Reactor Building) are removed from the calculation of averages, the mean annual exposure in Zone 1 falls from 77.0 ± 26.1 mR/yr to 65.9 ± 8.8 mR/yr. Such a corrected dose is not statistically different from the Zone 4 average of 63.7 ± 6.8 mR/yr, and is indicative of natural background radiation.

Although the annual exposure at TLD location OA was 129 mR above the average Zone 4 exposure, members of the general public do not continuously occupy this area. When adjusted for such occupancy, a hypothetical member of the public who was at this location for 40 hours per year would only receive an incremental dose of 0.59 mrem over natural background radiation levels. At the nearest residence 0.8 kilometers (0.5 miles) southeast of the PNPS Reactor Building, the annual exposure was calculated as being 61.1 ± 8.4 mR (based on continuous occupancy at this location), which compares quite well to the Zone 4 annual average background radiation level of 63.7 ± 6.8 mR. Statistically, there is no difference between these two values.

It must be emphasized that the projected ambient exposures discussed on the previous page are calculated to occur to a maximum-exposed hypothetical individual. Even though conservative assumptions are made in the projection of these dose consequences, all of the projected doses are well below the NRC dose limit of 100 mrem/yr specified in 10CFR20.1301, as well as the EPA dose limit of 25 mrem/yr specified in 40CFR190. Both of these limits are to be applied to real members of the general public, so the fact that the dose to the hypothetical maximum-exposed individual is within the limits ensures that any dose received by a real member of the public would be smaller and well within any applicable limit.

In 1994, Pilgrim Station opened the old training facility (I&S Building) overlooking the plant as a health club for its employees. This site is immediately adjacent to the protected area boundary near monitoring location OA and receives appreciable amounts of direct ambient and sky shine exposure from the turbine building. Although personnel using this facility are employees of Entergy, they are considered to be members of the public. Due to their extended presence in the facility (500 hr/yr, assuming utilization of the facility for 2 hr/day, 5 days a week, for 50 weeks/yr), these personnel represent the most conservative case in regards to ambient radiation exposure to a member of the public within the PNPS owner controlled area. Their annual incremental radiation dose above background during 2011 is estimated as being about 1.5 mrem, based on the average exposure measured by the TLD in the building.

The exposures measured by the TLD located in the health club would also include any increase in ambient radiation resulting from noble gases and/or particulate activity deposited on the ground from gaseous releases. However, they would not indicate any internal dose received by personnel in this facility from inhalation of small amounts of PNPS-related radioactivity contained in the air. An environmental air sampler located immediately adjacent to the health club did not indicate any PNPS-related activity during 2011. Dose calculations performed in the same manner as those outlined in Section 4.2 for airborne effluent releases yielded a projected total body dose to the maximum-exposed individual (500 hr/yr exposure) of about 0.00095 mrem, resulting from inhalation.

Again, it must be emphasized that the above-described exposures were received by personnel who are employees or contractors of Entergy, accessing areas or facilities on property under the ownership and control of Entergy. Since this exposure was received within the owner-controlled area, it is not used for comparison to the annual dose limit of 25 mrem/yr specified in 40CFR190. This regulation expressly applies to areas at or beyond the owner-controlled property, and is not applicable in this situation. As stated earlier, TLDs at and beyond the site boundary do not indicate elevated ambient radiation levels resulting from the operation of Pilgrim Station.

Although some of the TLDs in close proximity to PNPS indicate increases in exposure levels from ambient radiation, such increases are localized to areas under Entergy control. For members of the general public who are not employed or contracted with Entergy and are accessing Entergy controlled areas (e.g., parking lots, etc.), such increases in dose from ambient radiation exposure are estimated as being less than 1.0 mrem/year.

Table 5.0

Average TLD Exposures By Distance Zone During 2011

Exposure Period	Average Exposure ± Standard Deviation: mR/period			
	Zone 1* 0-3 km	Zone 2 3-8 km	Zone 3 8-15 km	Zone 4 >15 km
Jan-Mar	20.7 ± 7.0	16.0 ± 2.1	14.5 ± 1.4	15.3 ± 1.4
Apr-Jun	19.1 ± 6.0	15.2 ± 1.8	14.9 ± 1.8	16.6 ± 2.0
Jul-Sep	20.3 ± 8.0	15.0 ± 2.5	14.3 ± 2.4	15.7 ± 1.9
Oct-Dec	16.9 ± 4.0	14.9 ± 1.6	15.0 ± 1.2	16.0 ± 1.6
Jan-Dec	77.0 ± 26.1**	61.2 ± 8.2	58.8 ± 6.8	63.7 ± 6.8

* Zone 1 extends from the PNPS restricted/protected area boundary outward to 3 kilometers (2 miles), and includes several TLDs located within the site boundary.

** When corrected for TLDs located within the site boundary, the Zone 1 annual average is calculated to be 65.9 ± 8.8 mR/yr.

6.0 PERCENT OF ODCM EFFLUENT CONTROL LIMITS

The PNPS ODCM contains dose and concentration limits for radioactive effluents. In addition, the effluent controls specified ensure that radioactive releases are maintained as low as reasonably achievable. The percentage of the PNPS ODCM Control limit values were determined from doses calculated in Section 4, the effluent releases summarized in Section 2, and the ODCM Control limits/objectives listed in Tables 6.1 and 6.2.

The percent of applicable control limit values are provided to supplement the information provided in the Section 2 of this report. The format for the percent of applicable limits is modified from that prescribed in Regulatory Guide 1.21 (Reference 1) to accommodate the Radioactive Effluents Technical Specifications (RETS) that became effective March 01, 1986. The percentages have been grouped according to whether the releases were via liquid or gaseous effluent pathways.

6.1 Gaseous Effluent Releases

Dose-based effluent controls related to exposures arising from gaseous effluent releases are presented in Table 6.1. The maximum quarterly air doses and annual whole body doses listed in Table 4.1 were used to calculate the percentage values shown in Table 6.1. All doses resulting from noble gas exposure were a small percentage of the applicable effluent control.

Organ dose limits for the maximum-exposed individual from radioactive particulates, iodines, and tritium from the PNPS ODCM are also shown in Table 6.1. The maximum quarterly and annual organ doses from Tables 4.2-A through 4.2-E were used to calculate the percentages shown in Table 6.1. The resulting organ doses from Pilgrim Station's gaseous releases during 2011 were a small percentage of the corresponding effluent control.

Table 6.1

Percent of ODCM Effluent Control Limits
for Gaseous Effluent Releases During 2011

A. Instantaneous Dose Rate Limit - Noble Gases
PNPS ODCM Control 3.3.1.a
Limit: 500 mrem/yr Total Body Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	1.95E-03	3.89E-04%

B. Instantaneous Dose Rate Limit - Noble Gases
PNPS ODCM Control 3.3.1.a
Limit: 3000 mrem/yr Skin Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	6.84E-03	2.28E-04%

C. Instantaneous Dose Rate Limit - Particulates, Iodines, & Tritium
PNPS ODCM Control 3.3.1.b
Limit: 1500 mrem/yr Organ Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	7.89E-02	5.26E-03%

D. Quarterly Dose Objective - Noble Gas Gamma Air Dose
PNPS ODCM Control 3.3.2.a
Objective: 5 mrad Gamma Air Dose

Period	Value – mrad	Fraction of Limit
Jan-Mar	2.54E-03	5.08E-02%
Apr-Jun	3.01E-05	6.03E-04%
Jul-Sep	1.90E-05	3.79E-04%
Oct-Dec	3.26E-04	6.53E-03%

E. Annual Dose Objective - Noble Gas Gamma Air Dose
PNPS ODCM Control 3.3.2.b
Objective: 10 mrad Gamma Air Dose

Period	Value - mrad/yr	Fraction of Limit
Jan-Dec	2.92E-03	2.92E-02%

Table 6.1 (continued)

Percent of ODCM Effluent Control Limits
for Gaseous Effluent Releases During 2011

F. Quarterly Dose Objective - Noble Gas Beta Air Dose
PNPS ODCM Control 3.3.2.a
Objective: 10 mrad Beta Air Dose

Period	Value - mrad	Fraction of Limit
Jan-Mar	4.15E-03	4.15E-02%
Apr-Jun	1.11E-04	1.11E-03%
Jul-Sep	7.03E-05	7.03E-04%
Oct-Dec	1.37E-03	1.37E-02%

G. Annual Dose Objective - Noble Gas Beta Air Dose
PNPS ODCM Control 3.3.2.b
Objective: 20 mrad Beta Air Dose

Period	Value - mrad/yr	Fraction of Limit
Jan-Dec	5.70E-03	2.85E-02%

H. Quarterly Dose Objective - Particulates, Iodines, Tritium, and Carbon-14
PNPS ODCM Control 3.3.3.a
Objective: 7.5 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	2.09E-02	2.79E-01%
Apr-Jun	1.44E-02	1.92E-01%
Jul-Sep	2.37E-02	3.16E-01%
Oct-Dec	1.99E-02	2.66E-01%

I. Annual Dose Objective - Particulates, Iodines, Tritium, and Carbon-14
PNPS ODCM Control 3.3.3.b
Objective: 15 mrem Organ Dose

Period	Value - mrem/yr	Fraction of Limit
Jan-Dec	7.89E-02	5.26E-01%

6.2 Liquid Effluent Releases

Liquid effluent concentration limits and dose objectives from the PNPS ODCM are shown in Table 6.2. The quarterly average concentrations from Table 2.3-A were used to calculate the percent concentration limits. The maximum quarterly and annual whole body and organ doses from Tables 4.3-A through 4.3-E were used to calculate the percentages shown in Table 6.2. The resulting concentrations, as well as organ and total body doses from Pilgrim Station's liquid releases during the reporting period were a small percentage of the corresponding effluent controls.

Table 6.2

Percent of ODCM Effluent Control Limits
for Liquid Effluent Releases During 2011

A. Fission and Activation Product Effluent Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 10CFR20 Appendix B, Table 2, Column 2 Value

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	5.18E-13	4.62E-05%
Apr-Jun	3.00E-11	3.24E-04%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	0.00E+00	0.00E+00%
Jan-Dec	6.46E-12	8.03E-05%

B. Tritium Average Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 1.0E-03 μCi/mL

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	1.04E-09	1.04E-04%
Apr-Jun	3.45E-08	3.45E-03%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	3.37E-10	3.37E-05%
Jan-Dec	7.62E-09	7.62E-04%

C. Dissolved and Entrained Noble Gases Concentration Limit
PNPS ODCM Control 3.2.1
Limit: 2.0E-04 μCi/mL

Period	Value - μCi/mL	Fraction of Limit
Jan-Mar	0.00E+00	0.00E+00%
Apr-Jun	0.00E+00	0.00E+00%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	0.00E+00	0.00E+00%
Jan-Dec	0.00E+00	0.00E+00%

Table 6.2 (continued)

Percent of ODCM Effluent Control Limits
for Liquid Effluent Releases During 2011

D. Quarterly Total Body Dose Objective
PNPS ODCM Control 3.2.2.a
Objective: 1.5 mrem Total Body Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	2.39E-06	1.59E-04%
Apr-Jun	3.74E-04	2.50E-02%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	4.83E-08	3.22E-06%

E. Annual Total Body Dose Objective
PNPS ODCM Control 3.2.2.b
Objective: 3 mrem Total Body Dose

Period	Value - mrem	Fraction of Limit
Jan-Dec	3.16E-04	1.05E-02%

F. Quarterly Organ Dose Objective
PNPS ODCM Control 3.2.2.a
Objective: 5 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Mar	4.22E-06	8.44E-05%
Apr-Jun	1.45E-03	2.89E-02%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	4.83E-08	9.66E-07%

G. Annual Organ Dose Objective
PNPS ODCM Control 3.2.2.b
Objective: 10 mrem Organ Dose

Period	Value - mrem	Fraction of Limit
Jan-Dec	1.22E-03	1.22E-02%

7.0 RADIOACTIVE WASTE DISPOSAL DATA

Radioactive wastes that were shipped offsite for processing and disposal during the reporting period are described in Table 7.0, in the standard NRC Regulatory Guide 1.21 format.

The total quantity of radioactivity in Curies and the total volume in cubic meters are summarized in Table 7.0 for the following waste categories:

- Spent resins, filter sludges, and evaporator bottoms;
- Dry activated wastes, contaminated equipment, etc.;
- Irradiated components, control rods, etc.; and,
- Other.

During the reporting period approximately 70.2 cubic meters of spent resins, filter sludges, etc., containing a total activity of about 165 Curies were shipped from PNPS for processing and disposal. Dry activated wastes and contaminated equipment shipped during the period totaled 830 cubic meters and contained 26.0 Curies of radioactivity. No shipments of irradiated components or wastes falling into the "Other" category occurred during the reporting period. No shipments of irradiated fuel were made during the reporting period.

Estimates of major radionuclides, those comprising greater than 1% of the total activity in each waste category shipped, are listed in Table 7.0. There were seventeen shipments to Energy Solutions' Bear Creek Facility; four shipments to Energy Solutions' Gallaher Road Facility; ten shipments to Studsvik Processing Facility in Erwin, TN; one shipment to Studsvik/Race in Memphis, TN; and three shipments to IMPACT Services in Oak Ridge, TN.

Table 7.0
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Solid Waste and Irradiated Fuel Shipments
January-December 2011

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not irradiated fuel)

1. Estimate of volume and activity content by type of waste

Type of waste	Jan-Dec 2011		
	Volume - m^3	Curies	Total Error
a. Spent resins, filters, filter sludges, evaporator bottoms, etc.	7.02 E+01	1.65 E+02	± 25%
b. Dry activated waste, contaminated equipment, etc.	8.30 E+02	2.60 E+01	± 25%
c. Irradiated components, control rods, etc.	0.00E+00	0.00E+00	N/A
d. Other (describe): Hi-Rad Trash/Metals	0.00E+00	0.00E+00	N/A

2. Estimate of major nuclide composition by type of waste[1]

Type of waste	Radionuclide	Abundance	Total Error
a. Spent resins, filters, filter sludges, evaporator bottoms, etc.	Mn-54	6.09%	± 25%
	Fe-55	39.67%	± 25%
	Co-60	28.13%	± 25%
	Ni-63	2.80%	± 25%
	Zn-65	12.11%	± 25%
	Cs-137	10.31%	± 25%
b. Dry activated waste, contaminated equipment, etc.	Mn-54	18.98%	± 25%
	Fe-55	36.37%	± 25%
	Co-60	35.80%	± 25%
	Ni-63	1.01%	± 25%
	Zn-65	2.05%	± 25%
	Cs-137	3.21%	± 25%
c. Irradiated components, control rods, etc.	Not Applicable	Not Applicable	N/A
d. Other (describe): Hi-Rad Trash/Metals	Not Applicable	Not Applicable	N/A

[1] *"Major" is defined as any radionuclide comprising >1% of the total activity in the waste category.*

3. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
17	Tractor-trailer (Hittman Transport)	Energy Solutions Bear Creek Facility[2] Oak Ridge, TN
4	Tractor-trailer (Hittman Transport)	Energy Solutions Gallaher Road Facility[2] Kingston, TN
10	Tractor-trailer (Hittman Transport)	Studsvik Processing Facility,[2] Erwin, TN
1	Tractor-trailer (Hittman Transport)	Studsvik/RACE, LLC[2] Memphis, TN
3	Tractor-trailer (Eastern Technologies)	IMPACT Services Oak Ridge, TN

[2] *This processor provides volume reduction services for dry compressible waste, contaminated equipment, etc. Remaining radioactive wastes will be shipped to Chem Nuclear Systems, Inc. in Barnwell, SC, or Envirocare, Inc. in Clive, UT for final disposal.*

B. IRRADIATED FUEL SHIPMENTS & DISPOSITION

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/A

8.0 OFFSITE DOSE CALCULATION MANUAL REVISIONS

The PNPS Offsite Dose Calculation Manual (ODCM) was not revised during the calendar year of 2011. Information regarding revisions to the ODCM can be found attached as Appendix D of this report.

9.0 PROCESS CONTROL PROGRAM REVISIONS

There was one change to the PNPS Process Control Program (PCP) during the calendar year of 2011. Although Pilgrim Station adopted the Entergy fleet-wide PCP in 2010 as indicated in the 2010 Annual Effluent Release Report, fleet procedure EN-RW-105, "Process Control Program", was not revised until 2011 to reflect the inclusion of Pilgrim Station under the fleet-wide PCP. This revision was strictly administrative in nature, and did not impact the requirements or conduct of the PCP.

10.0 REFERENCES

1. U.S. Nuclear Regulatory Commission, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants", Regulatory Guide 1.21, Revision 1, June 1974.

2. "Pilgrim Nuclear Power Station Offsite Dose Calculation Manual", Revision 9, June 2003.

3. U.S. Nuclear Regulatory Commission, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50 Appendix I", Regulatory Guide 1.109, Revision 1, October 1977.

4. U.S. Nuclear Regulatory Commission, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", Regulatory Guide 1.111, July 1977.

5. Boston Edison Company, "Pilgrim Station Unit 1 Appendix I Evaluation", April 1977.

6. Entech Engineering Inc., P100-R19, "AEOLUS-3 - A Computer Code for the Determination of Atmospheric Dispersion and Deposition of Nuclear Power Plant Effluents During Continuous, Intermittent and Accident Conditions in Open-Terrain Sites, Coastal Sites and Deep-River Valleys"

APPENDIX A

Meteorological Joint Frequency Distributions

Table A-1
Joint Frequency Distribution of Wind Directions and Speeds
For the 33-ft level of the 220-ft Tower

Jan-Mar 2011

Class A Freq: 0.079

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
3.5-7.5	17	21	10	5	9	2	1	0	0	0	0	2	4	31	20	19	141
7.5-12.5	1	0	1	3	0	0	0	0	0	0	1	0	2	9	9	3	29
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	18	21	12	8	9	2	1	0	0	0	1	2	6	40	29	22	171

Class B Freq: 0.035

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
3.5-7.5	1	1	1	6	0	1	0	0	0	1	1	4	10	7	6	8	47
7.5-12.5	0	0	0	2	0	2	0	0	0	1	5	2	0	11	2	0	25
12.5-18.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	1	1	8	1	3	0	0	0	2	7	6	10	18	8	8	75

Class C Freq: 0.043

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	3
3.5-7.5	3	3	3	6	4	1	0	0	2	2	3	9	7	8	6	3	60
7.5-12.5	0	0	0	1	0	3	0	0	2	6	2	0	3	6	4	0	27
12.5-18.5	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	3	4	7	4	4	0	0	4	10	6	9	10	14	11	4	93

Class D Freq: 0.449

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
0.95-3.5	6	6	8	5	8	1	5	6	1	4	4	6	7	14	10	8	99
3.5-7.5	9	14	32	28	22	24	8	7	30	40	44	43	94	97	73	17	582
7.5-12.5	5	4	4	2	4	14	5	7	25	35	13	3	54	46	47	5	273
12.5-18.5	0	3	0	1	0	0	0	0	1	5	0	0	2	0	2	0	14
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	20	27	44	36	34	39	18	20	57	84	61	52	157	157	133	30	969

Table A-1 (continued)

Jan-Mar 2011

Class E Freq: 0.327

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	1	0	1	0	1	0	0	1	2	1	1	8
0.95-3.5	2	4	7	3	1	6	14	15	18	14	19	24	28	22	12	6	195
3.5-7.5	2	1	2	4	1	13	9	19	18	43	62	96	86	36	13	1	406
7.5-12.5	0	1	3	2	1	1	1	3	8	36	7	3	12	7	0	0	85
12.5-18.5	0	1	0	1	0	0	0	2	3	5	0	0	0	0	0	0	12
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	7	12	10	3	21	24	40	47	99	88	123	127	67	26	8	706

Class F Freq: 0.061

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
0.95-3.5	0	0	0	0	0	0	0	0	4	1	10	28	14	1	2	0	60
3.5-7.5	1	0	0	0	0	0	0	3	1	11	35	7	1	1	0	0	60
7.5-12.5	0	0	0	0	0	0	0	0	0	3	7	0	0	0	0	0	10
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	0	0	0	0	0	3	5	15	52	35	16	2	2	0	131

Class G Freq: 0.006

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	5
3.5-7.5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
7.5-12.5	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	0	7
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	4	6	4	0	0	0	0	14

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	1	0	1	0	1	0	0	2	2	2	1	10
0.95-3.5	9	10	17	8	10	7	19	21	23	19	34	62	49	37	25	15	365
3.5-7.5	33	40	48	49	36	41	18	29	51	97	147	161	202	180	118	48	1298
7.5-12.5	6	5	8	10	5	20	6	10	35	85	38	8	71	79	62	8	456
12.5-18.5	0	4	0	2	0	0	0	2	4	12	2	0	2	0	2	0	30
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	48	59	73	69	51	69	43	63	113	214	221	231	326	298	209	72	2159

Table A-1 (continued)

Apr-Jun 2011

Class A Freq: 0.115

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	2	4	0	1	0	0	0	0	0	0	0	0	0	0	2	13
3.5-7.5	18	39	22	24	12	7	5	1	1	6	1	5	8	10	5	4	168
7.5-12.5	2	7	1	0	4	1	0	0	2	24	6	5	7	9	0	0	68
12.5-18.5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	24	48	27	24	17	8	5	1	3	32	7	10	15	19	5	6	251

Class B Freq: 0.053

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	3	2	5	1	0	0	1	0	0	0	0	0	0	1	0	0	13
3.5-7.5	8	5	2	6	8	5	4	2	3	8	5	4	8	6	1	0	75
7.5-12.5	1	0	0	0	0	3	0	0	0	16	3	0	1	1	0	0	25
12.5-18.5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	12	7	7	7	8	8	5	2	3	26	8	4	9	8	1	0	115

Class C Freq: 0.046

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	5	4	0	2	2	2	2	1	0	0	2	1	1	0	0	1	23
3.5-7.5	6	3	2	4	0	2	4	2	3	7	6	6	0	4	0	3	52
7.5-12.5	2	6	0	0	0	1	0	0	4	7	4	0	1	0	0	0	25
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	13	13	2	6	2	5	6	3	7	14	12	7	2	4	0	4	100

Class D Freq: 0.419

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	29	28	36	28	26	15	20	26	26	9	3	1	6	12	11	28	304
3.5-7.5	33	47	12	15	16	23	11	21	49	76	23	14	28	18	21	24	431
7.5-12.5	3	32	5	2	1	7	6	3	10	72	13	0	4	2	3	2	165
12.5-18.5	0	0	0	0	0	0	0	0	1	15	0	0	0	0	0	0	16
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	65	107	53	45	43	45	37	50	86	172	39	15	38	32	35	54	916

Table A-1 (continued)

Apr-Jun 2011

Class E Freq: 0.271

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0.95-3.5	15	12	7	13	19	16	19	21	17	8	7	12	14	12	23	18	233
3.5-7.5	11	9	2	3	4	23	13	6	28	63	40	43	34	11	5	4	299
7.5-12.5	0	4	1	0	1	4	4	1	6	20	7	0	8	0	0	0	56
12.5-18.5	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	27	25	11	16	24	44	36	28	52	91	54	55	56	23	28	22	592

Class F Freq: 0.083

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	0	0	3	14	4	1	2	3	11	6	8	20	12	7	7	3	101
3.5-7.5	0	0	0	0	2	2	0	0	2	4	47	13	4	1	1	0	76
7.5-12.5	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	3	15	6	3	2	3	13	10	59	33	16	8	8	3	182

Class G Freq: 0.013

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	2	1	0	1	0	0	1	2	0	0	1	0	8
3.5-7.5	0	0	0	0	0	0	0	0	0	1	14	2	0	0	1	0	18
7.5-12.5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	2	1	0	1	0	1	17	4	0	0	2	0	28

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
0.95-3.5	56	48	55	58	54	35	44	52	54	23	21	36	33	32	42	52	695
3.5-7.5	76	103	40	52	42	62	37	32	86	165	136	87	82	50	34	35	1119
7.5-12.5	8	49	7	2	6	16	10	4	22	139	39	5	21	12	3	2	345
12.5-18.5	0	0	0	0	0	1	0	0	2	19	0	0	0	0	0	0	22
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	141	200	103	113	102	114	91	88	164	346	196	128	136	94	79	89	2184

Table A-1 (continued)

Jul-Sep 2011

Class A Freq: 0.056

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	10	3	9	5	6	0	0	0	0	0	0	0	0	0	0	2	35
3.5-7.5	2	38	13	10	10	2	0	0	1	2	0	1	0	1	5	4	89
7.5-12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	12	41	22	15	16	2	0	0	1	2	0	1	0	1	5	6	124

Class B Freq: 0.025

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	3	1	3	4	2	0	1	0	0	2	0	1	1	0	0	0	18
3.5-7.5	0	0	1	2	4	0	0	1	3	11	4	3	2	2	1	0	34
7.5-12.5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	1	4	6	6	0	1	1	3	16	4	4	3	2	1	0	55

Class C Freq: 0.057

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	6	7	8	4	3	0	2	0	0	0	0	1	4	4	4	4	47
3.5-7.5	0	1	1	2	4	3	1	1	10	16	16	7	2	0	1	1	66
7.5-12.5	0	0	0	0	0	0	0	0	0	12	1	0	0	0	0	0	13
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	6	8	9	6	7	3	3	1	10	28	17	8	6	4	5	5	126

Class D Freq: 0.366

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
0.95-3.5	23	32	24	26	28	17	19	17	13	10	8	9	16	18	12	23	295
3.5-7.5	4	8	9	10	9	21	11	3	73	181	48	12	13	13	8	5	428
7.5-12.5	0	0	0	0	0	2	2	1	10	55	4	3	0	0	1	0	78
12.5-18.5	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	27	40	33	36	37	40	32	21	102	246	60	24	29	32	21	28	808

Table A-1 (continued)

Jul-Sep 2011

Class E Freq: 0.334

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	1	0	0	0	1	0	0	2	0	1	0	0	1	0	7
0.95-3.5	14	19	11	21	26	27	30	37	42	15	9	24	23	20	22	16	356
3.5-7.5	2	4	10	10	10	17	2	2	43	145	68	30	3	3	2	4	355
7.5-12.5	0	0	0	0	0	0	1	0	1	6	10	0	0	0	0	0	18
12.5-18.5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	16	24	22	31	36	44	34	40	86	168	87	55	26	23	25	20	737

Class F Freq: 0.134

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	1	1	2	2	4	1	0	0	1	12
0.95-3.5	0	0	0	0	2	1	4	10	19	17	22	40	29	9	1	0	154
3.5-7.5	0	0	0	0	0	0	0	0	3	21	87	10	0	0	0	1	122
7.5-12.5	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	7
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	2	1	4	11	23	42	116	54	30	9	1	2	295

Class G Freq: 0.029

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2
0.95-3.5	2	0	0	0	0	0	0	0	0	5	12	12	2	0	0	1	34
3.5-7.5	0	0	0	0	0	0	0	0	0	1	21	5	0	0	0	0	27
7.5-12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	0	0	0	0	0	0	0	0	6	34	18	2	0	0	1	63

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	1	0	0	0	1	1	1	4	3	6	1	1	1	1	22
0.95-3.5	58	62	55	60	67	45	56	64	74	49	51	87	75	51	39	46	939
3.5-7.5	8	51	34	34	37	43	14	7	133	377	244	68	20	19	17	15	1121
7.5-12.5	0	0	0	0	0	2	3	1	11	78	20	3	0	0	1	0	119
12.5-18.5	0	0	0	0	0	0	0	1	6	0	0	0	0	0	0	0	7
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	66	114	90	94	104	90	74	74	225	508	318	164	96	71	58	62	2208

Table A-1 (continued)

Oct-Dec 2011

Class A Freq: 0.054

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	2	0	0	1	1	0	0	0	0	0	1	2	0	0	8
3.5-7.5	4	8	9	6	0	1	11	5	1	9	4	2	9	8	11	4	92
7.5-12.5	2	1	2	1	2	1	0	1	1	1	5	0	1	0	0	0	18
12.5-18.5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7	9	14	7	2	3	12	6	2	10	9	2	11	10	11	4	119

Class B Freq: 0.034

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	1	1	0	0	0	1	0	0	0	0	1	2	0	1	7
3.5-7.5	4	4	6	3	0	0	0	2	2	11	4	2	6	2	3	3	52
7.5-12.5	3	3	1	0	0	0	0	0	0	1	2	0	1	3	0	1	15
12.5-18.5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7	8	9	4	0	0	0	3	2	12	6	2	8	7	3	5	76

Class C Freq: 0.085

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	4	0	1	2	0	0	1	0	1	0	0	3	2	4	0	19
3.5-7.5	9	5	4	0	0	1	3	1	4	28	6	7	8	6	3	5	90
7.5-12.5	4	3	3	0	1	0	0	1	2	39	16	0	3	0	4	2	78
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	14	12	7	1	3	1	3	3	6	68	22	7	14	8	11	7	187

Class D Freq: 0.468

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	7	6	7	11	4	5	8	4	13	13	16	14	8	13	14	147
3.5-7.5	39	64	23	15	10	24	14	25	39	91	75	69	60	32	70	40	690
7.5-12.5	9	13	0	2	0	2	1	4	6	63	23	3	42	6	12	5	191
12.5-18.5	2	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	6
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	54	85	29	24	22	30	20	37	49	168	111	88	116	46	95	60	1034

Table A-1 (continued)

Oct-Dec 2011

Class E Freq: 0.265

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
0.95-3.5	6	6	10	9	6	9	14	21	32	35	24	31	18	9	12	7	249
3.5-7.5	3	11	2	1	3	7	5	29	30	52	82	56	16	6	3	4	310
7.5-12.5	1	0	0	0	0	0	0	0	0	3	17	1	2	0	0	1	25
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	10	18	12	10	10	16	19	50	62	90	123	88	36	15	15	12	586

Class F Freq: 0.080

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	0	0	1	2	2	8	8	12	10	20	11	1	1	1	78
3.5-7.5	0	0	0	0	0	0	0	2	3	13	39	28	3	0	0	0	88
7.5-12.5	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	10
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	0	0	1	2	2	10	11	25	59	48	14	1	1	1	176

Class G Freq: 0.014

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
0.95-3.5	0	0	0	0	0	0	0	0	0	0	8	5	2	2	0	0	17
3.5-7.5	0	0	0	0	0	0	0	0	0	0	5	6	0	0	0	0	11
7.5-12.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	14	11	2	3	0	0	30

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	3
0.95-3.5	13	17	19	18	20	16	22	39	44	61	55	72	50	26	30	23	525
3.5-7.5	59	92	44	25	13	33	33	64	79	204	215	170	102	54	90	56	1333
7.5-12.5	19	20	6	3	3	3	1	6	9	107	74	4	49	9	16	9	338
12.5-18.5	2	2	2	0	1	0	0	0	0	1	0	0	0	0	0	1	9
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	93	132	71	46	38	52	56	109	132	373	344	246	201	90	136	89	2208

Table A-1 (continued)

Jan-Dec 2011

Class A Freq: 0.076

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	15	5	16	5	7	1	1	0	0	0	0	0	1	2	0	4	57
3.5-7.5	41	106	54	45	31	12	17	6	3	17	5	10	21	50	41	31	490
7.5-12.5	5	8	4	4	6	2	0	1	3	25	12	5	10	18	9	3	115
12.5-18.5	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	3
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	61	119	75	54	44	15	18	7	6	44	17	15	32	70	50	38	665

Class B Freq: 0.037

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	7	3	9	6	3	0	2	1	0	2	0	1	2	3	0	1	40
3.5-7.5	13	10	10	17	12	6	4	5	8	31	14	13	26	17	11	11	208
7.5-12.5	4	3	1	2	0	5	0	0	0	21	10	2	2	15	2	1	68
12.5-18.5	0	1	1	0	0	0	0	0	0	2	1	0	0	0	0	0	5
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	24	17	21	25	15	11	6	6	8	56	25	16	30	35	13	13	321

Class C Freq: 0.058

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	12	15	9	7	7	2	4	2	0	1	2	2	8	6	9	6	92
3.5-7.5	18	12	10	12	8	7	8	4	19	53	31	29	17	18	10	12	268
7.5-12.5	6	9	3	1	1	4	0	1	8	64	23	0	7	6	8	2	143
12.5-18.5	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	36	36	22	20	16	13	12	7	27	120	57	31	32	30	27	20	506

Class D Freq: 0.426

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
0.95-3.5	62	73	74	66	73	37	49	57	44	36	28	32	43	52	46	73	845
3.5-7.5	85	133	76	68	57	92	44	56	191	388	190	138	195	160	172	86	2131
7.5-12.5	17	49	9	6	5	25	14	15	51	225	53	9	100	54	63	12	707
12.5-18.5	2	4	0	1	1	0	0	0	8	21	0	0	2	0	2	1	42
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	166	259	159	141	136	154	107	128	294	670	271	179	340	267	284	172	3727

Table A-1 (continued)

Jan-Dec 2011

Class E Freq: 0.299

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	2	2	0	1	1	1	1	0	3	0	1	1	2	2	1	19
0.95-3.5	37	41	35	46	52	58	77	94	109	72	59	91	83	63	69	47	1033
3.5-7.5	18	25	16	18	18	60	29	56	119	303	252	225	139	56	23	13	1370
7.5-12.5	1	5	4	2	2	5	6	4	15	65	41	4	22	7	0	1	184
12.5-18.5	0	1	0	1	0	1	0	3	4	5	0	0	0	0	0	0	15
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	57	74	57	67	73	125	113	158	247	448	352	321	245	128	94	62	2621

Class F Freq: 0.090

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	1	0	0	0	1	1	2	2	4	2	0	0	1	14
0.95-3.5	1	0	3	14	7	4	8	21	42	36	50	108	66	18	11	4	393
3.5-7.5	1	0	0	0	2	2	0	5	9	49	208	58	8	2	1	1	346
7.5-12.5	0	0	0	0	0	0	0	0	0	5	26	0	0	0	0	0	31
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	0	3	15	9	6	8	27	52	92	286	170	76	20	12	6	784

Class G Freq: 0.015

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3
0.95-3.5	2	0	0	0	2	1	0	1	0	5	22	23	4	2	1	1	64
3.5-7.5	0	0	0	0	0	0	0	0	0	2	42	13	0	0	1	0	58
7.5-12.5	0	0	0	0	0	0	0	0	0	4	6	0	0	0	0	0	10
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	0	0	0	2	1	0	1	0	11	71	37	4	3	2	1	135

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	2	2	1	1	1	1	2	1	5	3	6	3	4	3	2	38
0.95-3.5	136	137	146	144	151	103	141	176	195	152	161	257	207	146	136	136	2524
3.5-7.5	176	286	166	160	128	179	102	132	349	843	742	486	406	303	259	154	4871
7.5-12.5	33	74	21	15	14	41	20	21	77	409	171	20	141	100	82	19	1258
12.5-18.5	2	6	2	2	1	1	0	3	12	32	2	0	2	0	2	1	68
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	348	505	337	322	295	325	264	334	634	1441	1079	769	759	553	482	312	8759

Table A-2
Joint Frequency Distribution of Wind Directions and Speeds
For the 220-ft level of the 220-ft Tower

Jan-Mar 2011

Class A Freq: 0.079

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	1	6	3	0	2	0	0	0	0	0	0	0	0	0	0	0	12
7.5-12.5	4	9	2	2	3	5	0	0	0	0	0	0	0	8	7	4	44
12.5-18.5	2	3	1	1	0	3	1	0	0	0	1	2	1	15	11	13	54
18.5-24	1	1	1	3	0	0	0	0	0	0	0	0	1	20	9	6	42
>24	1	0	0	0	0	0	0	0	0	0	0	0	0	5	9	4	19
TOTAL	9	19	7	6	5	8	1	0	0	0	1	2	2	48	36	27	171

Class B Freq: 0.035

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	5
7.5-12.5	0	0	1	1	2	1	0	0	0	1	0	4	4	2	1	2	19
12.5-18.5	0	0	0	1	1	0	0	0	0	0	6	2	4	2	3	4	23
18.5-24	0	0	0	2	0	2	0	0	0	0	1	0	2	6	2	0	15
>24	0	0	0	0	0	0	0	0	0	0	1	0	0	7	5	0	13
TOTAL	1	0	2	5	3	3	0	0	0	1	8	6	10	17	11	8	75

Class C Freq: 0.043

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	0	1	3	0	0	0	0	0	0	0	0	3	0	0	3	0	10
7.5-12.5	0	2	1	3	2	2	1	0	4	0	2	5	3	1	1	0	27
12.5-18.5	0	1	0	1	0	1	0	0	0	2	3	3	1	1	5	1	19
18.5-24	0	0	0	1	0	3	0	0	3	3	0	0	1	8	2	3	24
>24	0	0	0	0	0	0	0	0	0	2	1	0	0	5	5	0	13
TOTAL	0	4	4	5	2	6	1	0	7	7	6	11	5	15	16	4	93

Class D Freq: 0.449

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	1	2	1	2	0	1	0	1	0	0	0	1	1	0	2	13
3.5-7.5	3	2	7	2	3	4	2	2	1	1	4	4	7	7	6	7	62
7.5-12.5	1	5	11	4	5	5	3	7	18	17	24	21	13	11	11	2	158
12.5-18.5	3	4	16	19	12	13	2	9	9	32	33	18	38	49	43	11	311
18.5-24	4	4	4	9	8	17	10	7	16	22	7	2	24	52	35	9	230
>24	9	2	4	1	2	2	2	2	1	5	1	0	15	72	67	10	195
TOTAL	21	18	44	36	32	41	20	27	46	77	69	45	98	192	162	41	969

Table A-2 (continued)

Jan-Mar 2011

Class E Freq: 0.327

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	2	0	1	2	2	3	1	0	1	0	0	1	2	1	0	20
3.5-7.5	6	5	8	4	1	3	4	9	2	2	5	5	4	3	5	3	69
7.5-12.5	2	2	2	5	1	6	8	10	11	12	15	9	21	25	15	6	150
12.5-18.5	2	1	0	2	2	3	8	13	14	29	33	36	78	50	20	2	293
18.5-24	1	0	0	0	4	4	6	7	6	28	22	1	14	20	6	3	122
>24	0	2	3	3	2	0	0	5	2	10	0	1	11	11	2	0	52
TOTAL	15	12	13	15	12	18	29	45	35	82	75	52	129	111	49	14	706

Class F Freq: 0.061

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	1	2	1	2	1	0	0	1	0	1	0	1	1	1	0	12
3.5-7.5	2	2	2	2	0	0	1	0	0	1	1	1	5	2	5	2	26
7.5-12.5	0	0	0	0	0	0	0	1	3	1	4	0	10	10	3	3	35
12.5-18.5	1	0	0	0	0	0	0	4	1	1	11	9	6	2	1	0	36
18.5-24	0	0	0	0	0	0	0	0	0	4	8	7	0	0	1	0	20
>24	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
TOTAL	3	3	4	3	2	1	1	5	5	9	25	17	22	15	11	5	131

Class G Freq: 0.006

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	4
3.5-7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
7.5-12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
18.5-24	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
>24	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	5
TOTAL	1	0	1	1	0	0	0	1	0	0	7	1	0	0	2	0	14

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	6	4	5	4	6	3	4	2	2	1	1	0	3	4	2	2	49
3.5-7.5	13	16	24	9	6	7	7	11	3	4	10	13	16	12	21	14	186
7.5-12.5	7	18	17	15	13	19	12	18	36	31	45	39	51	57	38	17	433
12.5-18.5	8	9	17	24	15	20	11	26	24	64	87	71	128	119	83	31	737
18.5-24	6	5	5	15	12	26	16	14	25	57	40	10	42	106	55	21	455
>24	10	4	7	4	4	2	2	7	3	19	8	1	26	100	88	14	299
TOTAL	50	56	75	71	56	77	52	78	93	176	191	134	266	398	287	99	2159

Table A-2 (continued)

Apr-Jun 2011

Class A Freq: 0.115

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	5	3	7	2	1	0	0	0	0	0	0	0	0	0	0	0	18
7.5-12.5	11	13	10	11	9	5	2	0	1	4	0	2	4	3	0	6	81
12.5-18.5	8	7	2	2	3	3	8	1	7	16	5	8	0	3	1	1	75
18.5-24	17	5	0	0	0	3	0	0	1	5	1	0	5	9	2	4	52
>24	5	0	0	0	1	1	0	0	0	2	0	0	5	7	1	3	25
TOTAL	46	28	19	15	14	12	10	1	9	27	6	10	14	22	4	14	251

Class B Freq: 0.053

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	1	3	4	4	2	0	0	0	0	0	1	0	0	1	0	0	16
7.5-12.5	3	2	0	1	3	9	5	2	2	3	1	4	4	0	0	1	40
12.5-18.5	0	2	0	0	0	0	1	1	3	14	4	1	4	1	1	1	33
18.5-24	5	0	0	0	0	3	0	0	0	3	0	1	5	1	0	0	18
>24	2	0	0	0	0	0	0	0	0	4	0	0	0	1	0	1	8
TOTAL	11	7	4	5	5	12	6	3	5	24	6	6	13	4	1	3	115

Class C Freq: 0.046

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	6	3	2	2	2	0	0	0	0	1	1	1	0	1	0	3	22
7.5-12.5	1	0	0	1	2	0	8	2	1	2	5	3	1	2	1	1	30
12.5-18.5	1	1	0	0	0	1	2	0	6	7	4	2	1	2	0	0	27
18.5-24	2	1	0	0	0	1	0	0	0	2	2	0	0	0	0	2	10
>24	8	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	11
TOTAL	18	5	2	3	4	2	10	2	7	13	13	6	2	6	1	6	100

Class D Freq: 0.419

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	3	2	9	2	1	0	1	0	1	0	0	0	0	1	0	2	22
3.5-7.5	11	14	29	18	13	13	5	9	15	9	4	1	2	4	7	15	169
7.5-12.5	14	9	15	5	10	16	17	25	25	34	8	2	6	4	7	10	207
12.5-18.5	29	22	4	5	6	8	5	14	26	54	32	10	14	12	17	26	284
18.5-24	10	10	1	1	10	9	4	2	4	37	10	0	10	7	4	14	133
>24	26	8	2	1	0	4	5	0	1	37	1	0	1	5	6	4	101
TOTAL	93	65	60	32	40	50	37	50	72	171	55	13	33	33	41	71	916

Table A-2 (continued)

Apr-Jun 2011

Class E Freq: 0.271

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	1	6	2	6	1	6	1	1	1	1	1	1	5	0	1	38
3.5-7.5	5	7	8	3	3	5	10	6	7	9	1	0	0	4	4	7	79
7.5-12.5	13	3	3	3	8	16	7	8	12	7	1	6	1	7	2	7	104
12.5-18.5	7	4	0	1	6	10	10	7	10	40	26	15	31	17	13	12	209
18.5-24	3	1	0	0	3	2	3	8	9	34	20	2	25	9	3	4	126
>24	3	8	0	0	3	4	4	0	2	2	0	0	3	5	1	1	36
TOTAL	35	24	17	9	29	38	40	30	41	93	49	24	61	47	23	32	592

Class F Freq: 0.083

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	0	2	2	3	0	0	1	1	1	0	0	4	0	1	16
3.5-7.5	1	1	2	1	3	3	0	5	2	2	4	3	0	1	3	2	33
7.5-12.5	4	1	0	0	2	2	4	5	4	5	4	3	5	5	4	3	51
12.5-18.5	0	0	1	3	2	0	0	2	1	1	8	21	11	3	3	2	58
18.5-24	0	0	0	0	1	0	0	2	0	2	14	0	2	0	1	0	22
>24	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
TOTAL	6	2	3	6	10	8	4	14	8	11	31	27	19	14	11	8	182

Class G Freq: 0.013

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
3.5-7.5	0	0	0	1	0	2	0	0	1	1	1	0	0	0	1	0	7
7.5-12.5	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	3
12.5-18.5	0	0	0	0	0	0	0	0	0	1	4	2	1	0	0	0	8
18.5-24	0	0	0	2	0	0	0	0	0	0	5	2	0	0	0	0	9
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	3	0	2	0	0	1	3	10	4	1	2	2	0	28

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	8	3	15	6	9	4	7	1	3	2	2	1	1	10	1	4	77
3.5-7.5	29	31	52	31	24	23	15	20	25	22	12	5	2	11	15	27	344
7.5-12.5	46	28	28	21	34	48	43	42	45	56	19	20	21	23	14	28	516
12.5-18.5	45	36	7	11	17	22	26	25	53	133	83	59	62	38	35	42	694
18.5-24	37	17	1	3	14	18	7	12	14	83	52	5	47	26	10	24	370
>24	44	16	2	1	4	9	9	0	3	46	2	0	10	20	8	9	183
TOTAL	209	131	105	73	102	124	107	100	143	342	170	90	143	128	83	134	2184

Table A-2 (continued)

Jul-Sep 2011

Class A Freq: 0.056

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	6	13	4	2	3	1	0	0	0	0	0	0	0	0	0	0	29
7.5-12.5	14	19	2	7	8	4	1	0	2	1	0	1	0	1	1	4	65
12.5-18.5	3	1	5	2	2	2	0	0	0	0	0	0	0	2	1	1	19
18.5-24	0	4	0	1	0	0	0	0	0	0	0	0	0	0	1	3	9
>24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	24	38	11	12	13	7	1	0	2	1	0	1	0	3	3	8	124

Class B Freq: 0.025

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	3	3	0	1	3	0	0	0	0	2	0	0	1	0	0	0	13
7.5-12.5	1	0	0	3	2	3	0	1	1	3	2	4	2	2	0	0	24
12.5-18.5	0	1	0	0	0	0	0	1	3	10	0	1	0	1	0	0	17
18.5-24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	4	0	4	5	3	0	2	4	15	2	5	3	4	0	0	55

Class C Freq: 0.057

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	6	6	6	3	0	1	0	0	0	1	1	0	1	2	2	5	34
7.5-12.5	3	1	0	0	3	4	2	1	2	5	11	8	3	3	1	1	48
12.5-18.5	0	0	0	1	0	2	1	0	9	14	2	2	0	2	0	0	33
18.5-24	0	1	0	0	0	0	0	0	0	7	1	0	0	1	1	0	11
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	9	8	6	4	3	7	3	1	11	27	15	10	4	8	4	6	126

Class D Freq: 0.366

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	5	3	0	1	0	0	0	0	1	2	0	0	0	2	0	18
3.5-7.5	8	8	20	12	17	13	11	5	4	5	2	3	3	7	6	10	134
7.5-12.5	11	10	4	5	5	16	24	13	22	45	24	11	6	9	8	11	224
12.5-18.5	13	3	4	7	3	14	9	4	50	128	39	8	9	13	2	13	319
18.5-24	4	0	0	1	1	5	0	1	4	44	10	1	0	5	4	0	80
>24	0	1	0	0	0	2	3	1	4	9	4	3	0	1	4	1	33
TOTAL	40	27	31	25	27	50	47	24	84	232	81	26	18	35	26	35	808

Table A-2 (continued)

Jul-Sep 2011

Class E Freq: 0.334

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	2	3	3	1	2	2	3	0	0	0	0	0	2	1	0	0	19
3.5-7.5	7	5	5	13	8	10	15	5	5	2	3	1	3	4	2	4	92
7.5-12.5	10	6	10	4	11	20	19	15	16	21	11	4	11	6	12	8	184
12.5-18.5	8	2	2	17	6	14	7	20	32	92	45	13	24	13	4	22	321
18.5-24	0	2	0	1	0	2	2	2	0	51	29	5	3	2	3	5	107
>24	0	0	0	5	0	1	1	1	0	3	0	0	0	0	1	1	13
TOTAL	27	19	20	41	27	49	47	43	53	169	88	23	43	26	22	40	737

Class F Freq: 0.134

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	0	0	0	2	0	0	1	1	1	0	0	0	0	0	6
3.5-7.5	1	1	0	1	2	2	6	4	3	3	3	1	3	2	1	1	34
7.5-12.5	0	0	0	2	3	9	9	6	4	4	4	15	11	9	11	4	91
12.5-18.5	0	0	0	0	0	0	1	5	8	10	15	20	27	10	19	8	123
18.5-24	0	0	0	0	0	0	0	0	2	10	23	3	0	1	1	1	41
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	1	0	3	5	13	16	15	18	28	46	39	41	22	32	14	295

Class G Freq: 0.029

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
3.5-7.5	0	0	0	0	3	5	0	0	1	0	2	2	3	1	2	0	19
7.5-12.5	0	0	0	0	0	0	0	0	2	1	3	2	5	1	2	0	16
12.5-18.5	1	0	0	0	0	0	0	0	0	1	2	2	10	6	1	1	24
18.5-24	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
>24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	3	0	0	0	4	5	0	0	4	2	7	6	18	8	5	1	63

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	7	8	6	1	4	4	3	0	1	2	3	0	2	1	2	0	44
3.5-7.5	31	36	35	32	36	32	32	14	13	13	11	7	14	16	13	20	355
7.5-12.5	39	36	16	21	32	56	55	36	49	80	55	45	38	31	35	28	652
12.5-18.5	25	7	11	27	11	32	18	30	102	255	103	46	70	47	27	45	856
18.5-24	5	7	0	3	1	7	2	3	7	112	63	9	3	10	10	9	251
>24	2	2	0	5	0	3	4	2	4	12	4	3	0	1	5	2	49
TOTAL	109	97	68	89	84	134	114	85	176	474	239	110	127	106	92	104	2208

Table A-2 (continued)

Oct-Dec 2011

Class A Freq: 0.054

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	1	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	5
7.5-12.5	1	1	3	1	0	0	0	1	0	2	1	0	0	4	1	1	16
12.5-18.5	4	3	2	6	0	0	9	2	1	4	11	0	5	4	6	4	61
18.5-24	0	0	1	1	0	2	4	1	0	0	1	0	3	6	4	1	24
>24	3	0	3	1	2	0	0	2	0	0	0	0	0	0	2	0	13
TOTAL	9	6	10	9	2	2	14	6	1	6	13	0	8	14	13	6	119

Class B Freq: 0.034

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
3.5-7.5	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	4
7.5-12.5	0	1	1	1	0	0	1	0	1	0	1	1	1	0	2	1	11
12.5-18.5	0	1	0	1	0	0	0	1	0	9	7	1	3	2	0	2	27
18.5-24	0	5	1	1	0	0	0	0	0	1	1	0	1	3	3	5	21
>24	4	1	1	2	0	0	0	0	0	0	0	0	0	1	1	2	12
TOTAL	4	9	4	7	0	0	1	1	2	10	9	2	5	6	6	10	76

Class C Freq: 0.085

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	0	2	2	0	1	1	0	0	0	0	0	1	2	2	1	1	13
7.5-12.5	0	1	1	0	1	0	0	1	3	5	3	0	0	1	0	0	16
12.5-18.5	3	1	1	0	0	1	3	0	2	35	12	6	3	5	2	3	77
18.5-24	2	1	2	1	0	0	1	0	0	23	13	0	2	5	2	6	58
>24	7	0	3	0	1	0	1	0	0	0	0	0	0	1	6	4	23
TOTAL	12	5	9	1	3	2	5	1	5	63	28	7	7	14	11	14	187

Class D Freq: 0.468

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	1	2	0	1	1	0	1	1	1	0	0	0	0	0	0	1	9
3.5-7.5	3	2	9	3	5	5	0	2	0	4	6	4	2	4	5	5	59
7.5-12.5	6	13	18	7	8	3	8	15	22	28	23	17	23	11	3	11	216
12.5-18.5	12	19	2	14	6	3	9	12	26	56	78	43	30	35	26	11	382
18.5-24	16	8	0	7	10	0	2	0	4	45	22	4	30	13	44	35	240
>24	21	4	0	5	8	0	1	3	0	4	1	0	16	11	25	28	127
TOTAL	59	48	29	37	39	11	21	33	53	137	130	68	101	74	103	91	1034

Table A-2 (continued)

Oct-Dec 2011

Class E Freq: 0.265

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	2	2	2	2	2	1	1	0	2	0	0	0	1	2	0	1	18
3.5-7.5	4	4	4	4	7	8	7	2	3	3	4	5	3	4	10	5	77
7.5-12.5	2	7	4	7	9	9	13	17	12	21	16	8	15	26	3	3	172
12.5-18.5	2	5	0	4	5	4	4	31	16	20	69	25	28	8	7	0	228
18.5-24	0	3	0	0	1	1	0	2	0	8	41	7	10	6	1	3	83
>24	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	4	8
TOTAL	10	21	10	17	24	23	25	52	33	52	133	45	57	46	22	16	586

Class F Freq: 0.080

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	1	0	0	0	1	0	1	0	0	0	1	1	1	1	1	8
3.5-7.5	3	0	0	2	2	0	2	0	4	0	4	3	2	4	0	0	26
7.5-12.5	0	0	0	0	1	2	1	5	3	6	4	5	5	9	1	1	43
12.5-18.5	0	0	0	0	0	0	0	8	3	6	19	5	15	4	2	0	62
18.5-24	1	0	0	0	0	0	0	0	0	0	11	7	11	3	0	1	34
>24	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
TOTAL	4	1	0	2	3	3	3	14	10	12	41	21	34	21	4	3	176

Class G Freq: 0.014

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
3.5-7.5	0	0	0	0	0	0	0	1	2	0	0	4	4	1	0	0	12
7.5-12.5	0	0	0	0	0	0	0	2	0	1	1	1	1	0	0	0	6
12.5-18.5	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	3
18.5-24	0	0	0	0	0	0	0	0	0	0	1	0	7	0	0	0	8
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	3	2	1	2	7	13	1	1	0	30

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	3	5	2	3	3	2	2	2	4	0	0	1	2	3	2	3	37
3.5-7.5	11	11	17	11	15	14	10	5	9	7	14	17	13	15	16	11	196
7.5-12.5	9	23	27	16	19	14	23	41	41	63	49	32	45	51	10	17	480
12.5-18.5	21	29	5	25	11	8	25	54	48	130	196	82	85	58	43	20	840
18.5-24	19	17	4	10	11	3	7	3	4	77	90	18	64	36	54	51	468
>24	35	5	7	8	11	0	2	5	0	4	7	0	16	13	35	38	186
TOTAL	98	90	62	73	71	41	69	110	106	281	356	150	225	176	160	140	2208

Table A-2 (continued)

Jan-Dec 2011

Class A Freq: 0.076

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	13	24	15	4	6	1	1	0	0	0	0	0	0	0	0	0	64
7.5-12.5	30	42	17	21	20	14	3	1	3	7	1	3	4	16	9	15	206
12.5-18.5	17	14	10	11	5	8	18	3	8	20	17	10	6	24	19	19	209
18.5-24	18	10	2	5	0	5	4	1	1	5	2	0	9	35	16	14	127
>24	10	1	3	1	3	1	0	2	0	2	0	0	5	12	12	7	59
TOTAL	88	91	47	42	34	29	26	7	12	34	20	13	24	87	56	55	665

Class B Freq: 0.037

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
3.5-7.5	5	7	6	8	5	0	0	0	0	2	1	0	1	1	0	2	38
7.5-12.5	4	3	2	6	7	13	6	3	4	7	4	13	11	4	3	4	94
12.5-18.5	0	4	0	2	1	0	1	3	6	33	17	5	11	6	4	7	100
18.5-24	5	5	1	3	0	5	0	0	0	4	2	1	8	11	5	5	55
>24	6	1	1	2	0	0	0	0	0	4	1	0	0	9	6	3	33
TOTAL	20	20	10	21	13	18	7	6	11	50	25	19	31	31	18	21	321

Class C Freq: 0.058

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5-7.5	12	12	13	5	3	2	0	0	0	2	2	5	3	5	6	9	79
7.5-12.5	4	4	2	4	8	6	11	4	10	12	21	16	7	7	3	2	121
12.5-18.5	4	3	1	2	0	5	6	0	17	58	21	13	5	10	7	4	156
18.5-24	4	3	2	2	0	4	1	0	3	35	16	0	3	14	5	11	103
>24	15	0	3	0	1	0	1	0	0	3	2	0	0	7	11	4	47
TOTAL	39	22	21	13	12	17	19	4	30	110	62	34	18	43	32	30	506

Class D Freq: 0.426

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	9	10	14	4	5	0	3	1	3	1	2	0	1	2	2	5	62
3.5-7.5	25	26	65	35	38	35	18	18	20	19	16	12	14	22	24	37	424
7.5-12.5	32	37	48	21	28	40	52	60	87	124	79	51	48	35	29	34	805
12.5-18.5	57	48	26	45	27	38	25	39	111	270	182	79	91	109	88	61	1296
18.5-24	34	22	5	18	29	31	16	10	28	148	49	7	64	77	87	58	683
>24	56	15	6	7	10	8	11	6	6	55	7	3	32	89	102	43	456
TOTAL	213	158	164	130	138	152	125	134	255	617	335	152	250	334	332	238	3727

Table A-2 (continued)

Jan-Dec 2011

Class E Freq: 0.299

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	12	8	11	6	12	6	13	2	3	2	1	1	5	10	1	2	95
3.5-7.5	22	21	25	24	19	26	36	22	17	16	13	11	10	15	21	19	317
7.5-12.5	27	18	19	19	29	51	47	50	51	61	43	27	48	64	32	24	610
12.5-18.5	19	12	2	24	19	31	29	71	72	181	173	89	161	88	44	36	1051
18.5-24	4	6	0	1	8	9	11	19	15	121	112	15	52	37	13	15	438
>24	3	10	3	8	5	5	5	6	4	15	3	1	14	16	5	6	109
TOTAL	87	76	60	82	92	128	141	170	162	396	345	144	290	230	116	102	2621

Class F Freq: 0.090

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	2	2	2	3	4	7	0	1	3	2	3	1	2	6	2	2	42
3.5-7.5	7	4	4	6	7	5	9	9	9	6	12	8	10	9	9	5	119
7.5-12.5	4	1	0	2	6	13	14	17	14	16	16	23	31	33	19	11	220
12.5-18.5	1	0	1	3	2	0	1	19	13	18	53	55	59	19	25	10	279
18.5-24	1	0	0	0	1	0	0	2	2	16	56	17	13	4	3	2	117
>24	0	0	0	0	0	0	0	0	0	2	3	0	1	1	0	0	7
TOTAL	15	7	7	14	20	25	24	48	41	60	143	104	116	72	58	30	784

Class G Freq: 0.015

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	1	0	1	1	1	0	0	1	0	0	0	0	0	0	2	0	7
3.5-7.5	0	0	0	1	3	7	0	1	4	1	3	6	7	2	5	0	40
7.5-12.5	0	0	0	0	0	0	0	2	2	3	4	3	6	3	2	0	25
12.5-18.5	1	0	0	0	0	0	0	0	0	2	6	7	12	6	1	1	36
18.5-24	1	0	0	2	0	0	0	0	1	0	8	2	7	0	0	0	21
>24	1	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	6
TOTAL	4	0	1	4	4	7	0	4	7	6	26	18	32	11	10	1	135

Class All Freq: 1.000

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
0.95-3.5	24	20	28	14	22	13	16	5	10	5	6	2	8	18	7	9	207
3.5-7.5	84	94	128	83	81	76	64	50	50	46	47	42	45	54	65	72	1081
7.5-12.5	101	105	88	73	98	137	133	137	171	230	168	136	155	162	97	90	2081
12.5-18.5	99	81	40	87	54	82	80	135	227	582	469	258	345	262	188	138	3127
18.5-24	67	46	10	31	38	54	32	32	50	329	245	42	156	178	129	105	1544
>24	91	27	16	18	19	14	17	14	10	81	21	4	52	134	136	63	717
TOTAL	466	374	310	306	313	376	342	373	518	1273	956	484	761	808	622	477	8759

APPENDIX B

Results of Onsite Groundwater Monitoring Program

In response to the Nuclear Energy Institute (NEI) Groundwater Protection Initiative, Pilgrim Station instituted a groundwater monitoring program during 2007. Four monitoring wells were installed during the fourth quarter of 2007, and the first samples were collected in late November 2007. All four wells were installed onsite, within the protected area fence. Since these are onsite wells, they are not considered part of the Radiological Environmental Monitoring Program (REMP), and data from these wells are being reported in the annual Radiological Effluent Release Report. Also, there were no leaks or spills of radioactive material at Pilgrim Station during 2011 that could have affected onsite or offsite groundwater

Two pre-existing wells were incorporated into the groundwater monitoring program in early 2008. Monitoring well MW3 is located in the owner-controlled area near Rocky Hill Road, and was added to the program during the first quarter of 2008. Since monitoring well MW3 is located slightly uphill of Pilgrim Station approximately 0.2 mile southwest of the power block, it is upgradient of the PNPS power block and outside of natural groundwater flow direction. As such, it is considered to be a control well indicative of baseline levels in the vicinity of Pilgrim Station. Monitoring well MW4 is located within the protected area near the main transformer, and was added to the program during the 2nd quarter of 2008 as an additional onsite monitoring well.

In response to recommendations from assessments performed in 2009 by Entergy and NEI, six new monitoring wells were installed within the Pilgrim Station protected area in April 2010 to better characterize groundwater flow characteristics and perform monitoring closer to selected systems, structures and components (SSCs) the contain radioactive material and could lead to groundwater contamination if leaks were to develop. One of the wells MW202-I was an intermediate-level (45-feet deep) well installed adjacent to MW202 that had been installed in 2007. Monitoring well MW205 was a 25-ft well installed slightly down-gradient from the Condensate Storage Tanks (CSTs), and MW206 was a 25-ft well installed near the radwaste truck lock. MW207 was a 25-ft well installed on the southwest corner of the power block. Two additional wells were installed upgradient, approximately 300 yards southeast of the power block; MW208-S was a 25-ft shallow-level well, and was installed adjacent to MW208-I, a 45-ft intermediate level well.

The first samples were collected from these new wells in May-2010, and the radioactivity content was assessed. Analyses of samples from wells MW202-I, MW207, MW208-S, and MW208-I were consistent with the other wells installed in 2007. Tritium levels in MW205 and MW206 were higher than those observed from the wells installed in 2007, and the sampling frequency was changed from the normal quarterly sampling interval to once per week to obtain more information.

Both wells MW205 and MW206 continued to show wide fluctuations during the summer of 2010, and six additional sampling wells were installed in August 2010. All six of the wells installed in August were shallow wells, approximately 25-ft in depth. Monitoring well MW209 was installed on the north side of the reactor building truck lock. Monitoring well MW210 was installed immediately adjacent to the condensate storage tank to provide indication of any CST leakage that would be anticipated to move toward MW205, one of the wells indicating higher concentrations. Monitoring well MW211 was installed on the south side of the reactor building truck lock, in an area that could potentially be affected by storm drain leakage and the underground liquid radwaste discharge line. MW212 was installed between the underground radwaste discharge line and the intake screenhouse, and was intended to monitor for lateral flow of groundwater at the site. MW213 was installed on the north side of the PNPS Warehouse, and was intended to characterize groundwater on the east side of the plant site. Finally, MW214 was installed on the north side of the trash compaction facility to characterize groundwater flows along the northeast boundary of the site.

Additional efforts were undertaken to try to identify potential sources of the elevated tritium detected in the monitoring wells. A technical team was assembled to review various systems and processes that might influence introduction of tritium into groundwater, and Pilgrim Station has contracted the services of a professional hydrogeological firm to assist in the effort. Samples of roof runoff, storm drain runoff, and accumulated water in manholes were collected and analyzed for tritium, but provided inconclusive results. Soil samples were collected from borings performed in the vicinity of wells MW205 and MW206 to determine the possibility of "pockets" of tritium that might be suspended above the water table that could lead to "spikes" of tritium as precipitation percolated through the soil. These results also proved inconclusive, as no detectable tritium was detected in the soil samples. A dye tracer study was conducted in January 2011 on four underground systems to detect any potential for leakage in these systems that might carry tritium to the monitoring wells. However, due to slow rate of water movement through the soil (approximately 6-inches/day), it may take several months for dye to migrate from the underground systems to the monitoring wells. Despite the extensive efforts to date, no likely candidates for the sources of tritium in the groundwater have been identified.

All samples collected were analyzed for tritium, a radioactive isotope of hydrogen, and well as for gamma emitting radionuclides and hard-to-detect beta emitting nuclides. In accordance with industry practice established under the NEI initiative, lower limits of detection (LLDs) used for analysis of REMP samples were used when assessing these samples for the presence of radioactivity. Tritium was the only radionuclide detected in the samples that is attributed to operations of Pilgrim Station. No plant-related gamma emitting radionuclides or hard-to-detect beta emitting radioactivity was detected in any of the samples. Naturally-occurring radioactivity was detected in the samples. Such levels of natural radioactivity are expected as these radionuclides are dissolved into the groundwater from the rocks and soil. The fact that these low levels of naturally-occurring radioactivity can be detected demonstrated the ability of the gamma spectroscopy analyses to detect radioactivity in groundwater. If any plant-related gamma activity was contained in the groundwater, the analytical techniques used would be able to detect them.

Results of the tritium analyses are presented in the following tables. In these tables, a value of "NDA < xx" in the columns indicates that no activity was detected in the sample when analyzed to the minimum-detectable level following the "<" sign. For example, the sample collected from MW201 on 19-Apr-2011 contained no detectable tritium, and a minimum detectable concentration of 347 pCi/L was achieved on that sample. The achieved sensitivity of 347 pCi/L is well below the required REMP LLD of 3000 pCi/L, and no tritium was detected even when counted to this more sensitive level of detection.

Analyses for hard-to-detect nuclides, such as iron-55 (Fe-55), nickel-63 (Ni-63), strontium-89 (Sr-89), strontium-90 (Sr-90), and gross alpha were performed on the samples collected during the fourth quarter of 2007 and the first quarter of 2008. Analyses for these hard-to-detect radionuclides were also performed on initial samples collected from all of the new wells installed during 2010, and for wells MW215 and MW217 installed in Dec-2011. Since no plant-related gamma activity and no Fe-55, Ni-63, Sr-89, or Sr-90 was detected in any of these samples, further analyses for these hard-to-detect nuclides will not be performed unless there is a significant increase in tritium levels, or if plant-related gamma activity is detected.

Low levels of tritium, a radioactive isotope of hydrogen, were detected in the onsite wells. Although gamma spectroscopy and gross alpha analyses indicated the presence of naturally-occurring radioactivity, such as potassium-40 and radon daughters from the uranium/thorium decay chains, there was no indication of any plant-related radioactivity in the samples, other than tritium.

Concentrations of tritium detected in the onsite wells ranged from non-detectable at less than 301 pCi/L, up to a maximum concentration of 13,400 pCi/L. The average concentrations from these onsite wells are well below the voluntary communication reporting level of 20,000 pCi/L as established by the EPA Drinking Water Standard. Although the EPA Standard provides a baseline

for comparison, no drinking water sources are affected by this tritium. All of the affected wells are onsite, and the general groundwater flow pathway is under Pilgrim Station and out into the salt water of Cape Cod Bay. As such, there is no potential to influence any off-site drinking water wells. Even if worst-case assumptions were made and the water from monitoring well MW-205 (average concentration = 4200 pCi/L) was consumed as drinking water for an entire year, the maximum dose consequence would be less than 0.26 mrem/yr. In actuality, any dose consequence would be much less than this, as any tritium-laden water potentially leaving the site would be diluted into the seawater of Cape Cod Bay before being incorporated into any ingestion pathways. No drinking water ingestion pathway exists.

The following tables list the tritium concentrations observed in the samples collected from the monitoring wells during 2011. The first two tables list the results from the priority wells sampled on a weekly basis during the first and second halves of the year, respectively, while the third and fourth tables list results from the non-priority wells sampled on a less frequent basis.

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty						
	MW201	MW205	MW206	MW209	MW211	MW215	MW217
01/04/11	875 ± 123	1410 ± 138	4360 ± 198				
01/10/11	928 ± 118	2430 ± 151	3700 ± 176	1370 ± 129	927 ± 121		
01/17/11	928 ± 120	7240 ± 222	3450 ± 169				
01/25/11	647 ± 125	830 ± 129	3820 ± 195	1010 ± 137	763 ± 126		
01/31/11	704 ± 125	1080 ± 136	Inaccessible				
02/07/11	768 ± 130	1060 ± 142	2500 ± 183	1280 ± 147	Inaccessible		
02/14/11	499 ± 117	10900 ± 263	2650 ± 169				
02/22/11	446 ± 108	1330 ± 129	3640 ± 171	1130 ± 124	956 ± 121		
03/01/11	546 ± 111	9080 ± 279	1990 ± 139	758 ± 114	856 ± 144		
03/08/11	592 ± 119	1080 ± 156	2700 ± 211	1240 ± 162	1170 ± 161		
03/15/11	477 ± 109	5470 ± 215	2320 ± 157	1320 ± 133	940 ± 123		
03/22/11	712 ± 121	1460 ± 141	3600 ± 187	1030 ± 129	1020 ± 129		
03/29/11	546 ± 124	4250 ± 211	1750 ± 158	985 ± 124	1010 ± 124		
04/05/11	454 ± 117	5190 ± 225	Lost in Transit	Lost in Transit	1070 ± 136		
04/12/11	324 ± 97.6	6320 ± 226	975 ± 118	1030 ± 120	1450 ± 130		
04/19/11	NDA<347	921 ± 136	1560 ± 153	932 ± 137	973 ± 137		
04/27/11	695 ± 116	2630 ± 164	2090 ± 152	979 ± 124	1120 ± 139		
05/03/11	461 ± 122	5680 ± 237	905 ± 137	1040 ± 140	970 ± 138		
05/11/11	529 ± 122	13400 ± 358	1840 ± 162	1070 ± 140	1410 ± 150		
05/19/11	NDA<374	1920 ± 168	2430 ± 181	898 ± 140	921 ± 139		
05/24/11	422 ± 127	1790 ± 170	1110 ± 149	908 ± 145	835 ± 142		
06/02/11	342 ± 104	5340 ± 197	975 ± 120	1030 ± 121	1250 ± 126		
06/07/11	422 ± 106	9250 ± 246	1230 ± 126	923 ± 118	1120 ± 123		
06/15/11	362 ± 110	6710 ± 240	1250 ± 138	1060 ± 133	1040 ± 132		
06/21/11	399 ± 111	1950 ± 237	620 ± 132	1080 ± 162	979 ± 152		
06/28/11	541 ± 120	7900 ± 255	953 ± 133	969 ± 129	Inaccessible		

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty						
	MW201	MW205	MW206	MW209	MW211	MW215	MW217
07/07/11	585 ± 119	3330 ± 189	1750 ± 155	948 ± 132	949 ± 131		
07/13/11	542 ± 130	3240 ± 197	804 ± 137	970 ± 142	803 ± 137		
07/19/11	588 ± 121	1710 ± 154	845 ± 131	1160 ± 141	847 ± 131		
07/27/11	572 ± 131	9100 ± 300	1220 ± 147	736 ± 133	1030 ± 143		
08/02/11	NDA<376	2520 ± 192	1840 ± 171	669 ± 138	626 ± 137		
08/09/11	529 ± 128	5320 ± 237	1380 ± 152	833 ± 137	1240 ± 149		
08/16/11	557 ± 135	4730 ± 237	NDA<342	729 ± 139	1150 ± 122		
08/23/11	685 ± 125	7330 ± 274	953 ± 135	1320 ± 147	1330 ± 146		
08/30/11	653 ± 132	2140 ± 173	2280 ± 176	879 ± 139	1380 ± 153		
09/06/11	Inaccessible	1500 ± 144	2010 ± 159	1120 ± 135	Inaccessible		
09/13/11	399 ± 121	1190 ± 146	1400 ± 149	1060 ± 140	1290 ± 147		
09/19/11	600 ± 107	1890 ± 139	2970 ± 159	1370 ± 127	1240 ± 124		
09/27/11	493 ± 122	4650 ± 240	3740 ± 222	1570 ± 152	1270 ± 139		
10/04/11	Inaccessible	2040 ±167	2650 ± 182	1520 ± 153	1720 ± 158		
10/11/11	618 ± 124	7110 ± 238	1950 ± 153	1280 ± 140	1620 ± 146		
10/18/11	533 ± 132	4340 ± 224	1590 ± 164	1170 ± 153	1370 ± 158		
10/25/11	512 ± 102	4900 ± 166	1400 ± 111	1160 ± 108	1130 ± 107		
11/01/11	Inaccessible	712 ± 140	1110 ± 151	1240 ± 156	1290 ± 156		
11/08/11	661 ± 123	3840 ± 183	3380 ± 174	1450 ± 135	1790 ± 143		
11/15/11	967 ± 127	2880 ± 191	1960 ± 174	1180 ± 153	1010 ± 143		
11/22/11	Inaccessible	6790 ± 227	3050 ± 169	1080 ± 128	1260 ± 132		
11/29/11	413 ± 127	3530 ± 207	3060 ± 198	1180 ± 151	1320 ± 154		
12/06/11	NDA<395	6860 ± 275	3730 ± 218	1010 ± 153	1200 ± 158		
12/13/11	419 ± 130	2550 ± 183	5050 ± 230	1290 ± 153	1330 ± 154		
12/22/11	454 ± 115	5390 ± 228	3330 ± 187	1570 ± 149	1420 ± 144	1820 ± 152	542 ± 116
12/29/11	348 ± 110	2380 ± 170	3610 ± 194	1210 ± 137	1240 ± 138	1330 ± 140	530 ± 117

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty						
	MW202	MW202-I	MW203	MW204	MW207	MW208-S	MW208-I
01/10/11	308 ± 95.2	365 ± 96.8	NDA<347	375 ± 116	589 ± 123	NDA<351	NDA<346
01/25/11	NDA<339	NDA<342	NDA<352	NDA<380	582 ± 126	NDA<353	NDA<381
02/07/11	NDA<342	NDA<333	NDA<390	NDA<395	648 ± 126	NDA<334	NDA<393
03/01/11	NDA<396	NDA<398	NDA<400	547 ± 116	438 ± 106	NDA<328	NDA<398
03/29/11	384 ± 120	NDA<326	NDA<325	NDA<329	467 ± 112	NDA<328	NDA<329
04/27/11	NDA<390	NDA<391	NDA<390	NDA<390	494 ± 135	NDA<391	NDA<390
05/24/11	NDA<366	NDA<370	NDA<355	NDA<373	NDA<372	NDA<373	NDA<370
06/21/11	NDA<329	NDA<313	NDA<319	NDA<318	521±114	NDA<318	NDA<317
07/19/11	NDA<310	337±112	345±105	470±118	NDA<309	NDA<306	359±106
08/16/11	NDA<375	NDA<376	NDA<375	NDA<375	427 ± 130	NDA<377	NDA<377
09/13/11	NDA<373	NDA<374	NDA<375	NDA<375	NDA<372	NDA<339	NDA<376
10/11/11	NDA<301	483 ± 106	373 ± 104	NDA<306	NDA<302	322 ± 103	341 ± 103
11/08/11	NDA<399	NDA<402	NDA<398	NDA<401	NDA<393	NDA<400	NDA<401

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty					
	MW210	MW212	MW213	MW214	MW3	MW4
01/10/11	769 ± 109	583 ± 111	NDA<346	NDA<342	NDA<345	NDA<364
01/25/11	520 ± 122	415 ± 118	NDA<353	Inaccessible	Inaccessible	NDA<356
02/07/11	529 ± 123	628 ± 129	NDA<391	Inaccessible	NDA<391	NDA<390
03/01/11	421 ± 114	578 ± 111	NDA<398	NDA<397	NDA<397	NDA<337
03/29/11	484 ±122	Inaccessible	385 ± 120	NDA<327	NDA<329	NDA<328
04/27/11	NDA<389	NDA<389	NDA<390	NDA<390	NDA<390	NDA<391
05/24/11	429 ± 123	569 ± 132	NDA<358	NDA<370	NDA<372	NDA<374
06/21/11	312±108	428±112	377±109	NDA<318	NDA<319	NDA<320
07/19/11	461±110	640±115	450±110	NDA<307	NDA<306	451±109
08/16/11	NDA<380	503 ± 134	NDA<306	NDA<377	NDA<377	No sample
09/13/11	397 ± 127	402 ± 127	NDA<376	NDA<374	NDA<374	No sample
10/11/11	664 ± 111	792 ± 115	333 ± 103	NDA<305	NDA<301	NDA<302
11/08/11	782 ± 145	685 ± 145	NDA<401	NDA<410	NDA<399	No Sample

Although there are no indications that the groundwater containing low concentrations of tritium is actually migrating offsite, a bounding calculation was performed to assess the potential dose impact of such a scenario. Based on the tritium concentrations detected during 2011, the annual average concentrations of tritium in groundwater in the four monitoring wells most closely adjacent to the shoreline (MW204, MW205, MW202, and MW201) were used to estimate tritium migration into the intake bay. Hydrological characteristics of the compacted backfill in the vicinity of these wells were measured in 2010 and indicate the hydraulic conductivity ranges from 0.002 cm/sec to about 0.006 cm/sec. When coupled with the hydraulic slope of 0.014 and average porosity of 0.3, the flow velocity was calculated as being between 0.08 and 0.23 meters per day. Using an assumed horizontal shoreline interface area 236 meters long by 3 meters deep that could potentially transmit groundwater into the intake bay, the annual discharge of groundwater would be about 12.5 million Liters of water per year. Assuming this volume of 12.5 million liters contained the segment-weighted average concentration of 1150 pCi/L, the annual discharge of tritium into the intake bay under this hypothetical scenario would be 0.0144 Curies. This activity represents less than 0.038% of the annual airborne effluent of tritium released from the reactor building vent (see Table 2.2-C). Such airborne effluents can be washed down to the ground surface during precipitation events and infiltrate into the ground, thereby introducing tritium into the groundwater.

In the hypothetical scenario described above, the 0.0144 Curies of tritium entering the intake bay would be further diluted into the circulating water flow of the plant. As documented in Table 2.3-A, the total volume of circulating water flow during 2011 was 582 billion Liters, yielding an effective concentration of tritium in the intake bay of about 0.025 pCi/L. Such a concentration would be well below the detection sensitivity of about 450 pCi/L used to analyze water collected from the discharge canal as part of the radiological environmental monitoring program (REMP). The calculated dose to the maximum-exposed member of the public from such a hypothetical release would be 0.000000014 millirem, resulting from tritium incorporated into fish and shellfish. Since the tritium would be incorporated into seawater, there is no drinking water ingestion pathway in the described scenario.

The following table lists the hydrological characteristics in the vicinity of each of the monitoring wells used to estimate tritium migration. Predicted flow velocities, annual discharge volumes, average tritium concentrations, and hypothetical tritium discharges are listed for each shoreline segment represented by each monitoring well.

Shoreline Segment Number	1	2	3	4
Monitoring Well Number	MW204	MW205	MW202	MW201
Hydraulic Conductivity - cm/sec	1.99E-03	4.27E-03	3.13E-03	5.64E-03
Hydraulic Slope	0.014	0.014	0.014	0.014
Porosity	0.300	0.300	0.300	0.300
Flow Velocity - m/day	8.02E-02	1.72E-01	1.26E-01	2.27E-01
Flow Velocity - ft/yr	9.61E+01	2.06E+02	1.51E+02	2.72E+02
Length of Shoreline Segment – m	61.0	38.1	45.7	91.4
Thickness of Water Layer – m	3.0	3.0	3.0	3.0
Volumetric Discharge - m^3/day	4.40E+00	5.90E+00	5.19E+00	1.87E+01
Volumetric Discharge - Liter/yr	1.61E+06	2.16E+06	1.90E+06	6.84E+06
Annual Average H-3 Concentration - pCi/L	4.64E+02	4.20E+03	3.77E+02	5.74E+02
Annual Segment Tritium Discharge - Ci/yr	7.46E-04	9.05E-03	7.15E-04	3.92E-03
Total Volumetric Discharge - L/yr	1.25E+07			
Total H-3 Discharge - Ci/yr	1.44E-02			
Annual Circulating Water Flow - Liter/yr	5.82E+11			
Discharge Canal H-3 Concentration - Ci/L	2.48E-14			
Discharge Canal H-3 Concentration - pCi/L	2.48E-02			
Max. Indiv. Dose Factor - mrem/yr per Ci/L	5.73E+05			
Maximum Individual Dose - mrem/yr	1.42E-08			

In conclusion, there were no known leaks or spills of radioactive material at Pilgrim Station during 2011 that could have affected onsite or offsite groundwater. The only radionuclide detected in groundwater during the 2011 monitoring effort that is attributable to Pilgrim Station operations is tritium, and all concentrations were well below any reporting criteria established in the Pilgrim Station Offsite Dose Calculation Manual and through EPA safe drinking water standards.

APPENDIX C

CORRECTIONS TO PREVIOUS EFFLUENT REPORTS

There were no corrections to past effluent reports to include in the 2011 annual report.

APPENDIX D

CHANGES TO PNPS
OFFSITE DOSE CALCULATION MANUAL

No revisions were made to the PNPS Offsite Dose Calculation Manual (ODCM) during calendar year 2011.