Entergy

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

Pilgrim Nuclear Power Station

May 14, 2013

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, 2012

LETTER NUMBER: 2.13.045

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, 2012 through December 31, 2012.

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

Attachment: Pilgrim Annual Radioactive Effluent Release Report for January 1, 2012 through December 31, 2012

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 2.13.045

Pilgrim Annual Radioactive Effluent Release Report
for January 1, 2012 through December 31, 2012

PILGRIM NUCLEAR POWER STATION

Facility Operating License DPR-35

Annual Radioactive Effluent Release Report

January 1 through December 31, 2012

Entergy

PILGRIM NUCLEAR POWER STATION
Facility Operating License DPR-35

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY 01 THROUGH DECEMBER 31, 2012

Prepared by: _____ 21-Apr-2013
K.J. Sejkora
Senior HP/Chemistry Specialist

Reviewed by: _____ 5-9-13
G.W. Blankenbiller
Chemistry Manager

Reviewed by: _____ 23-Apr 2013
S.E. Brewer
Radiation Protection Manager

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

PILGRIM NUCLEAR POWER STATION
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
JANUARY 01 THROUGH DECEMBER 31, 2012

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, 2012. 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 0.65 Curies. Releases of radioactive iodines and particulates with half-life of greater than 8 days totaled 0.0041 Curies, tritium releases totaled 29.7 Curies, and carbon-14 totaled 8.6 Curies. No gross alpha radioactivity was detected in gaseous effluents.

Noble gases released in gaseous effluents resulted in a maximum total body dose of 0.000017 mrem, with a corresponding skin dose of 0.000090 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 0.098 mrem. The maximum, hypothetical total body dose from the combined release of all airborne radioactivity in gaseous effluents was 0.027 mrem.

The maximum individual doses from gaseous radioactive effluents were compared to the applicable ODCM dose limits. Noble gas doses were less than 0.00047% of the corresponding 10CFR50 dose objectives. Maximum doses resulting from releases of particulates, iodines, tritium, and carbon-14 in gaseous effluents were less than 0.66% of corresponding 10CFR50 objectives.

LIQUID EFFLUENTS

Liquid radioactive releases for the reporting period are quantified in Tables 2.3-A and 2.3-B. Five discharges of liquid effluents containing radioactivity occurred during the reporting period. These discharges contained 0.099 Curies of tritium. There were no detectable fission and activation products. The resulting maximum total body dose was 0.0000000919 mrem, with a corresponding organ dose of 0.0000000919 mrem. All doses from liquid discharges were less than 0.0000031% of corresponding 10CFR50 objectives.

METEOROLOGICAL DATA

Meteorological joint frequency distributions are listed in Appendix A. Data recovery for the entire annual period was 66% 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 14% of the time during the reporting period. The predominant stability class was Class D, which occurred about 51% 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 1.4 mrem during 2012. There was no measurable increase during 2012 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 2012 was calculated as being about 0.60 mrem. This amount is about 0.17% 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 467 cubic meters of solid waste, containing almost 780 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. Additional sampling wells were added in 2010, 2011, and 2012. As of the end of 2012, samples are being collected from a total of 21 monitoring wells. Low levels of tritium, a radioactive isotope of hydrogen, were detected in several of these onsite wells. No other plant-related radioactivity was detected in the samples. Concentrations of tritium ranged from non-detectable at less than 337 picoCuries per Liter up to 8,400 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 2012, 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: 0.65 Ci, 0.021 μCi/sec
- Iodines and particulates with half-life greater than 8 days: 0.0041 Ci, 0.00013 μCi/sec
- Tritium: 29.7 Ci, 0.94 μCi/sec
- Carbon-14: 8.6 Ci, 0.27 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 2012 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 five 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: 180,000 Liters
- Total Dilution Volume: 616 billion Liters
- Fission/Activation products: 0.00 Ci, 0.00 μCi/mL
- Tritium: 0.0988 Ci, 0.000000000160 μCi/mL
- Dissolved/entrained noble gases: 0.00 Ci, 0.00 μCi/mL

One discrepancy was noted with the analysis of radioactivity contained in liquid effluents discharged in 2012. The monthly composite sample collected from the five neutralizing sump discharges that occurred in January 2012 was not shipped to the vendor laboratory for the monthly analysis of tritium and gross alpha activity, and the quarterly analysis of Iron-55 and Strontium-89/90. This discrepancy is described in Condition Report CR-PNP-2013-1538. These five discharges were in support of feed-and-bleed activities to reduce chloride levels in the Turbine Building Closed Cooling Water (TBCCW) system. Each of the five discharges was analyzed for gamma radioactivity prior to discharge, and no detectable gamma activity was identified in any of the samples. In addition, no gamma activity has been detected in routine sampling of the TBCCW system. Therefore, it is reasonable to conclude that there would be no detectable activity of gross alpha, Fe-55, or Sr-89/90, as these would have been co-indicated by the presence of gamma-emitting nuclides such as Mn-54, Co-60, and Cs-137, which were not detected in any of the samples. In addition, tritium samples were being collected from the TBCCW during the month of January to monitor the feed-and-bleed operation. Tritium levels in TBCCW during this period ranged from 0.000357 uCi/mL to 0.000843 uCi/mL, for an average concentration of 0.000548 uCi/mL. Based on this average tritium concentration, the total quantity of tritium discharged during the period was 0.0988 Curies.

Table 2.1
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Supplemental Information
January-December 2012

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 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
a. Liquid Effluents					
1. Total number of releases:	5	0	0	0	5
2. Total time period (minutes):	5.45E+02	N/A	N/A	N/A	5.45E+02
3. Maximum time period (minutes):	1.35E+02	N/A	N/A	N/A	1.35E+02
4. Average time period (minutes):	1.09E+02	N/A	N/A	N/A	1.09E+02
5. Minimum time period (minutes):	9.50E+01	N/A	N/A	N/A	9.50E+01
6. Average stream flow during periods of release of effluents into a flowing stream (Liters/min):	1.17E+06	N/A	N/A	N/A	1.17E+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 2012

RELEASE PERIOD	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012	Est. Total Error
A. FISSION AND ACTIVATION GASES						
Total Release: Ci	0.00E+00	1.54E-01	2.61E-01	2.35E-01	6.50E-01	±22%
Average Release Rate: μCi/sec	0.00E+00	1.95E-02	3.31E-02	2.98E-02	2.06E-02	
Percent of Effluent Control Limit*	*	*	*	*	*	
B. IODINE-131						
Total Iodine-131 Release: Ci	1.77E-04	2.00E-04	2.29E-04	1.78E-04	7.83E-04	±20%
Average Release Rate: μCi/sec	2.24E-05	2.53E-05	2.90E-05	2.26E-05	2.48E-05	
Percent of Effluent Control Limit*	*	*	*	*	*	
C. PARTICULATES WITH HALF-LIVES > 8 DAYS						
Total Release: Ci	3.69E-04	1.06E-04	2.08E-04	4.02E-04	1.08E-03	±21%
Average Release Rate: μCi/sec	4.68E-05	1.34E-05	2.64E-05	5.10E-05	3.44E-05	
Percent of Effluent Control Limit*	*	*	*	*	*	
Gross Alpha Radioactivity: Ci	NDA	NDA	NDA	NDA	NDA	
D. TRITIUM						
Total Release: Ci	4.62E+00	9.37E+00	6.95E+00	8.79E+00	2.97E+01	±20%
Average Release Rate: μCi/sec	5.86E-01	1.19E+00	8.82E-01	1.12E+00	9.43E-01	
Percent of Effluent Control Limit*	*	*	*	*	*	
E. CARBON-14						
Total Release: Ci	2.09E+00	2.05E+00	2.12E+00	2.30E+00	8.55E+00	N/A
Average Release Rate: μCi/sec	2.65E-01	2.60E-01	2.68E-01	2.91E-01	2.71E-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 2012

CONTINUOUS MODE RELEASES FROM ELEVATED RELEASE POINT					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
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	2.15E-02	2.99E-02	0.00E+00	5.14E-02
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	1.15E-01	2.31E-01	0.00E+00	3.46E-01
Xe-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	0.00E+00	1.69E-02	0.00E+00	0.00E+00	1.69E-02
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	0.00E+00	1.54E-01	2.61E-01	0.00E+00	4.15E-01
2. IODINES: Ci					
I-131	8.59E-06	1.11E-05	1.28E-05	6.06E-06	3.86E-05
I-133	3.10E-06	6.98E-06	1.71E-05	0.00E+00	2.72E-05
Total for Period	1.17E-05	1.81E-05	3.00E-05	6.06E-06	6.58E-05
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	0.00E+00	0.00E+00	0.00E+00
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	0.00E+00	0.00E+00	0.00E+00
Total for Period	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4. TRITIUM: Ci					
H-3	2.69E-02	2.41E-02	2.52E-02	2.38E-02	1.00E-01
5. CARBON-14: Ci					
C-14	2.03E+00	1.99E+00	2.05E+00	2.23E+00	8.29E+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 2012

BATCH MODE RELEASES FROM ELEVATED RELEASE POINT					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
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 2012

CONTINUOUS MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
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	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	0.00E+00	0.00E+00	0.00E+00	2.35E-01	2.35E-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	0.00E+00	0.00E+00	0.00E+00	2.35E-01	2.35E-01
2. IODINES: Ci					
I-131	1.68E-04	1.88E-04	2.16E-04	1.72E-04	7.45E-04
I-133	4.96E-04	4.59E-04	6.87E-04	5.75E-04	2.22E-03
Total for period	6.64E-04	6.47E-04	9.03E-04	7.47E-04	2.96E-03
3. PARTICULATES WITH HALF-LIVES > 8 DAYS: Ci					
Cr-51	2.84E-06	0.00E+00	0.00E+00	0.00E+00	2.84E-06
Mn-54	1.16E-05	0.00E+00	2.15E-06	0.00E+00	1.38E-05
Fe-59	1.45E-06	0.00E+00	0.00E+00	0.00E+00	1.45E-06
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	6.21E-06	0.00E+00	9.01E-07	0.00E+00	7.11E-06
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	2.95E-05	3.29E-05	1.57E-05	3.95E-04	4.73E-04
Sr-90	0.00E+00	0.00E+00	0.00E+00	7.26E-06	7.26E-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	3.38E-06	0.00E+00	0.00E+00	1.60E-07	3.54E-06
Ba/La-140	3.14E-04	7.30E-05	1.89E-04	0.00E+00	5.76E-04
Total for period	3.69E-04	1.06E-04	2.08E-04	4.02E-04	1.08E-03
4. TRITIUM: Ci					
H-3	4.59E+00	9.35E+00	6.93E+00	8.77E+00	2.96E+01
5. CARBON-14: Ci					
C-14	6.27E-02	6.15E-02	6.35E-02	6.89E-02	2.57E-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 2012

BATCH MODE RELEASES FROM GROUND-LEVEL RELEASE POINT					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
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 2012

RELEASE PERIOD	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012	Est. Total Error
A. FISSION AND ACTIVATION PRODUCTS						
Total Release (not including tritium, gases, alpha): Ci	NDA	N/A	N/A	N/A	NDA	±12%
Average Diluted Concentration During Period: μCi/mL	NDA	N/A	N/A	N/A	NDA	
Percent of Effluent Concentration Limit*	0.00E+00%	N/A	N/A	N/A	0.00E+00%	
B. TRITIUM						
Total Release: Ci	9.88E-02	N/A	N/A	N/A	9.88E-02	±9.4%
Average Diluted Concentration During Period: μCi/mL	6.47E-10	N/A	N/A	N/A	1.60E-10	
Percent of Effluent Concentration Limit*	6.47E-05%	N/A	N/A	N/A	1.60E-05%	
C. DISSOLVED AND ENTRAINED GASES						
Total Release: Ci	NDA	N/A	N/A	N/A	NDA	±16%
Average Diluted Concentration During Period: μCi/mL	NDA	N/A	N/A	N/A	NDA	
Percent of Effluent Concentration Limit*	0.00E+00%	N/A	N/A	N/A	0.00E+00%	
D. GROSS ALPHA RADIOACTIVITY						
Total Release: Ci	NDA	N/A	N/A	N/A	NDA	±34%
E. VOLUME OF WASTE RELEASED PRIOR TO DILUTION						
Waste Volume: Liters	1.80E+05	0.00E+00	0.00E+00	0.00E+00	1.80E+05	±5.7%
F. VOLUME OF DILUTION WATER USED DURING PERIOD						
Dilution Volume: Liters	1.53E+11	1.53E+11	1.55E+11	1.55E+11	6.16E+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 2012

CONTINUOUS MODE RELEASES					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
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 2012

BATCH MODE RELEASES					
Nuclide Released	Jan-Mar 2012	Apr-Jun 2012	Jul-Sep 2012	Oct-Dec 2012	Jan-Dec 2012
1. FISSION AND ACTIVATION PRODUCTS: Ci					
Na-24	NDA	N/A	N/A	N/A	NDA
Cr-51	NDA	N/A	N/A	N/A	NDA
Mn-54	NDA	N/A	N/A	N/A	NDA
Fe-55	NDA	N/A	N/A	N/A	NDA
Fe-59	NDA	N/A	N/A	N/A	NDA
Co-58	NDA	N/A	N/A	N/A	NDA
Co-60	NDA	N/A	N/A	N/A	NDA
Zn-65	NDA	N/A	N/A	N/A	NDA
Zn-69m	NDA	N/A	N/A	N/A	NDA
Sr-89	NDA	N/A	N/A	N/A	NDA
Sr-90	NDA	N/A	N/A	N/A	NDA
Zr/Nb-95	NDA	N/A	N/A	N/A	NDA
Mo/Tc-99	NDA	N/A	N/A	N/A	NDA
Ag-110m	NDA	N/A	N/A	N/A	NDA
Sb-124	NDA	N/A	N/A	N/A	NDA
I-131	NDA	N/A	N/A	N/A	NDA
I-133	NDA	N/A	N/A	N/A	NDA
Cs-134	NDA	N/A	N/A	N/A	NDA
Cs-137	NDA	N/A	N/A	N/A	NDA
Ba/La-140	NDA	N/A	N/A	N/A	NDA
Ce-141	NDA	N/A	N/A	N/A	NDA
Ce-144	NDA	N/A	N/A	N/A	NDA
Total for period	NDA	N/A	N/A	N/A	NDA
2. DISSOLVED AND ENTRAINED GASES: Ci					
Xe-133	NDA	N/A	N/A	N/A	NDA
Xe-135	NDA	N/A	N/A	N/A	NDA
Total for period	NDA	N/A	N/A	N/A	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, 51%
- 33-ft Wind Direction (from): South-southwest, 15%
- 33-ft Wind Speed: 3.5-7.5 mph, 55%
- 220-ft Wind Direction (from): South-southwest, 14%
- 220-ft Wind Speed: 12.5-18.5 mph, 35%

Joint data recovery for both the 33-ft level and 220-ft level of the tower was 66%, which did not meet the 90% annual data recovery goal specified by the NRC. A break occurred in the wiring supplying power to the aspirator fan in the upper-level temperature sensor on 18-Mar-2012 and was repaired on 19-Jul-2012. This event is described in Condition Reports CR-PNP-2012-2884 and CR-PNP-2012-4759. This resulted in invalid delta-temperature readings during this period, for a loss of 2954 hours of joint data for the year. Although the loss of the delta-temperature data affected the calculation of atmospheric stability class, wind speed and wind direction data were unaffected and were used to summarize wind speed and wind direction values for the quarterly and annual summary tables.

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 2012 resulted in a maximum total body dose of 0.000017 mrem. The maximum skin dose was 0.000090 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 0.000013 mrem (nearest residence, 0.80 kilometers ESE from the Reactor Building), while the maximum skin dose was 0.000062 mrem (nearest residence, 0.80 kilometers ESE from the Reactor Building).

Table 4.1

Maximum Doses From Noble Gas Releases During 2012[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	0.00E+00 (0.64 km ESE)	0.00E+00 (0.64 km ESE)	0.00E+00 (0.64 km ESE)	0.00E+00 (0.64 km ESE)
Apr-Jun	5.78E-07 (0.63 km SSW)	8.89E-07 (0.63 km SSW)	3.64E-07 (0.63 km SSW)	8.75E-07 (0.63 km SSW)
Jul-Sep	6.88E-07 (0.63 km SSW)	1.31E-06 (0.63 km SSW)	4.19E-07 (0.63 km SSW)	1.03E-06 (0.63 km SSW)
Oct-Dec	2.50E-05 (0.64 km ESE)	9.27E-05 (0.64 km ESE)	1.65E-05 (0.64 km ESE)	8.96E-05 (0.64 km ESE)
Jan-Dec	2.58E-05 (0.64 km ESE)	9.31E-05 (0.64 km ESE)	1.70E-05 (0.64 km ESE)	9.03E-05 (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 2012 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 0.098 mrem (child bone at nearest garden location, 0.84 kilometers SE from the Reactor Building). Carbon-14 contributed 0.018 mrem (66%) of the 0.027 mrem child total body dose, and 0.089 mrem (91%) of the 0.098 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 2012

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	1.92E-04	1.43E-04	5.74E-03	2.29E-03	2.00E-03	3.48E-03
GI-LLI	5.66E-04	3.85E-04	2.08E-03	5.35E-04	4.47E-04	7.52E-04
Kidney	5.52E-04	3.75E-04	2.05E-03	5.35E-04	4.46E-04	7.49E-04
Liver	5.51E-04	3.74E-04	2.05E-03	5.35E-04	4.46E-04	7.50E-04
Lung	5.94E-04	4.03E-04	2.06E-03	5.34E-04	4.46E-04	7.50E-04
Thyroid	9.93E-04	6.67E-04	3.17E-03	8.71E-04	6.27E-04	8.24E-04
T.Body	5.49E-04	3.73E-04	2.05E-03	5.34E-04	4.46E-04	7.49E-04
Age Class: Teen						
Bone	2.75E-04	2.05E-04	9.27E-03	3.85E-03	3.02E-03	4.91E-03
GI-LLI	5.87E-04	4.00E-04	2.87E-03	8.58E-04	6.55E-04	1.04E-03
Kidney	5.73E-04	3.90E-04	2.84E-03	8.59E-04	6.55E-04	1.04E-03
Liver	5.71E-04	3.89E-04	2.85E-03	8.59E-04	6.55E-04	1.04E-03
Lung	6.41E-04	4.35E-04	2.87E-03	8.57E-04	6.55E-04	1.04E-03
Thyroid	1.13E-03	7.62E-04	3.87E-03	1.35E-03	9.17E-04	1.10E-03
T.Body	5.69E-04	3.88E-04	2.84E-03	8.57E-04	6.54E-04	1.04E-03
Age Class: Child						
Bone	3.79E-04	2.83E-04	2.22E-02	9.28E-03	7.11E-03	1.13E-02
GI-LLI	5.36E-04	3.67E-04	5.78E-03	1.98E-03	1.49E-03	2.34E-03
Kidney	5.31E-04	3.64E-04	5.77E-03	1.98E-03	1.49E-03	2.34E-03
Liver	5.30E-04	3.63E-04	5.78E-03	1.98E-03	1.49E-03	2.34E-03
Lung	5.89E-04	4.02E-04	5.78E-03	1.98E-03	1.49E-03	2.34E-03
Thyroid	1.20E-03	8.06E-04	7.24E-03	2.93E-03	1.99E-03	2.44E-03
T.Body	5.28E-04	3.62E-04	5.77E-03	1.98E-03	1.49E-03	2.34E-03
Age Class: Infant						
Bone	2.79E-04	2.09E-04	1.74E-04	5.83E-03	4.05E-03	7.75E-05
GI-LLI	3.21E-04	2.21E-04	1.67E-04	1.30E-03	8.93E-04	2.28E-05
Kidney	3.21E-04	2.21E-04	1.67E-04	1.31E-03	8.97E-04	2.28E-05
Liver	3.21E-04	2.21E-04	1.67E-04	1.31E-03	8.98E-04	2.28E-05
Lung	3.73E-04	2.55E-04	1.92E-04	1.30E-03	8.93E-04	2.41E-05
Thyroid	9.34E-04	6.27E-04	4.67E-04	3.46E-03	2.01E-03	3.77E-05
T.Body	3.19E-04	2.19E-04	1.66E-04	1.31E-03	8.94E-04	2.28E-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 2012

Receptor:	Bound	Resident	Garden	Cow/Goat	Cow/Meat	Meat
Direction:	NW	ESE	SE	WSW	W	S
Distance[1]:	0.54 km	0.80 km	0.84 km	3.97 km	5.77 km	3.80 km
Pathway[2]:	DI	DI	DIV	DIVCG	DIVCM	DIVM
Age Class: Adult						
Bone	1.88E-04	1.40E-04	5.63E-03	2.25E-03	1.97E-03	3.41E-03
GI-LLI	1.08E-03	7.35E-04	2.98E-03	6.04E-04	4.86E-04	7.94E-04
Kidney	1.08E-03	7.33E-04	2.96E-03	6.05E-04	4.86E-04	7.93E-04
Liver	1.08E-03	7.32E-04	2.96E-03	6.04E-04	4.86E-04	7.93E-04
Lung	1.09E-03	7.40E-04	2.96E-03	6.03E-04	4.85E-04	7.93E-04
Thyroid	1.55E-03	1.04E-03	4.21E-03	9.81E-04	6.89E-04	8.77E-04
T.Body	1.08E-03	7.31E-04	2.96E-03	6.04E-04	4.85E-04	7.93E-04
Age Class: Teen						
Bone	2.68E-04	2.01E-04	9.10E-03	3.78E-03	2.97E-03	4.82E-03
GI-LLI	1.11E-03	7.52E-04	3.86E-03	9.33E-04	6.95E-04	1.08E-03
Kidney	1.11E-03	7.51E-04	3.84E-03	9.35E-04	6.96E-04	1.08E-03
Liver	1.11E-03	7.50E-04	3.84E-03	9.33E-04	6.95E-04	1.08E-03
Lung	1.13E-03	7.64E-04	3.84E-03	9.32E-04	6.94E-04	1.08E-03
Thyroid	1.70E-03	1.14E-03	4.97E-03	1.49E-03	9.89E-04	1.15E-03
T.Body	1.10E-03	7.49E-04	3.84E-03	9.33E-04	6.95E-04	1.08E-03
Age Class: Child						
Bone	3.71E-04	2.77E-04	2.17E-02	9.11E-03	6.97E-03	1.11E-02
GI-LLI	1.00E-03	6.81E-04	7.12E-03	2.07E-03	1.54E-03	2.38E-03
Kidney	1.00E-03	6.82E-04	7.11E-03	2.08E-03	1.54E-03	2.38E-03
Liver	1.00E-03	6.81E-04	7.11E-03	2.08E-03	1.54E-03	2.38E-03
Lung	1.02E-03	6.93E-04	7.11E-03	2.07E-03	1.54E-03	2.38E-03
Thyroid	1.70E-03	1.14E-03	8.74E-03	3.14E-03	2.10E-03	2.49E-03
T.Body	1.00E-03	6.80E-04	7.11E-03	2.07E-03	1.54E-03	2.38E-03
Age Class: Infant						
Bone	2.73E-04	2.04E-04	1.70E-04	5.71E-03	3.97E-03	7.61E-05
GI-LLI	5.90E-04	4.02E-04	3.02E-04	1.34E-03	9.08E-04	3.00E-05
Kidney	5.92E-04	4.04E-04	3.02E-04	1.35E-03	9.13E-04	3.00E-05
Liver	5.91E-04	4.03E-04	3.02E-04	1.35E-03	9.12E-04	3.00E-05
Lung	6.08E-04	4.14E-04	3.10E-04	1.34E-03	9.08E-04	3.04E-05
Thyroid	1.23E-03	8.26E-04	6.14E-04	3.76E-03	2.16E-03	4.55E-05
T.Body	5.90E-04	4.02E-04	3.02E-04	1.35E-03	9.10E-04	2.99E-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 2012

Receptor:	Bound	Resident	Garden	Cow/Goat	Cow/Meat	Meat
Direction:	NW	ESE	SE	WSW	W	S
Distance[1]:	0.54 km	0.80 km	0.84 km	3.97 km	5.77 km	3.80 km
Pathway[2]:	DI	DI	DIV	DIVCG	DIVCM	DIVM
Age Class: Adult						
Bone	1.94E-04	1.45E-04	5.77E-03	2.32E-03	2.03E-03	3.52E-03
GI-LLI	8.20E-04	5.56E-04	2.54E-03	5.79E-04	4.75E-04	7.87E-04
Kidney	8.14E-04	5.52E-04	2.52E-03	5.79E-04	4.75E-04	7.86E-04
Liver	8.12E-04	5.51E-04	2.52E-03	5.78E-04	4.74E-04	7.86E-04
Lung	8.33E-04	5.65E-04	2.52E-03	5.78E-04	4.74E-04	7.86E-04
Thyroid	1.40E-03	9.38E-04	3.98E-03	1.01E-03	7.10E-04	8.84E-04
T.Body	8.10E-04	5.50E-04	2.52E-03	5.78E-04	4.74E-04	7.86E-04
Age Class: Teen						
Bone	2.77E-04	2.07E-04	9.32E-03	3.90E-03	3.06E-03	4.97E-03
GI-LLI	8.43E-04	5.73E-04	3.38E-03	9.11E-04	6.88E-04	1.08E-03
Kidney	8.38E-04	5.69E-04	3.37E-03	9.13E-04	6.89E-04	1.08E-03
Liver	8.35E-04	5.68E-04	3.37E-03	9.12E-04	6.88E-04	1.08E-03
Lung	8.70E-04	5.90E-04	3.38E-03	9.11E-04	6.87E-04	1.08E-03
Thyroid	1.58E-03	1.06E-03	4.71E-03	1.55E-03	1.03E-03	1.17E-03
T.Body	8.33E-04	5.66E-04	3.37E-03	9.11E-04	6.88E-04	1.08E-03
Age Class: Child						
Bone	3.82E-04	2.86E-04	2.23E-02	9.40E-03	7.19E-03	1.15E-02
GI-LLI	7.65E-04	5.22E-04	6.53E-03	2.07E-03	1.54E-03	2.41E-03
Kidney	7.66E-04	5.22E-04	6.52E-03	2.07E-03	1.55E-03	2.41E-03
Liver	7.63E-04	5.21E-04	6.52E-03	2.07E-03	1.55E-03	2.41E-03
Lung	7.93E-04	5.40E-04	6.53E-03	2.07E-03	1.54E-03	2.41E-03
Thyroid	1.65E-03	1.11E-03	8.44E-03	3.30E-03	2.20E-03	2.54E-03
T.Body	7.62E-04	5.19E-04	6.52E-03	2.07E-03	1.55E-03	2.41E-03
Age Class: Infant						
Bone	2.82E-04	2.11E-04	1.76E-04	5.90E-03	4.10E-03	7.86E-05
GI-LLI	4.54E-04	3.11E-04	2.34E-04	1.35E-03	9.20E-04	2.67E-05
Kidney	4.56E-04	3.12E-04	2.35E-04	1.36E-03	9.24E-04	2.67E-05
Liver	4.55E-04	3.12E-04	2.35E-04	1.36E-03	9.24E-04	2.67E-05
Lung	4.82E-04	3.29E-04	2.47E-04	1.35E-03	9.20E-04	2.73E-05
Thyroid	1.27E-03	8.51E-04	6.33E-04	4.14E-03	2.37E-03	4.66E-05
T.Body	4.53E-04	3.10E-04	2.34E-04	1.35E-03	9.21E-04	2.66E-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 2012

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	2.56E-04	1.88E-04	8.83E-03	2.66E-03	2.28E-03	3.97E-03
GI-LLI	1.04E-03	7.05E-04	3.19E-03	6.61E-04	5.34E-04	8.81E-04
Kidney	1.02E-03	6.93E-04	2.98E-03	6.49E-04	5.28E-04	8.69E-04
Liver	1.02E-03	6.92E-04	2.98E-03	6.48E-04	5.27E-04	8.69E-04
Lung	1.11E-03	7.50E-04	3.02E-03	6.50E-04	5.28E-04	8.70E-04
Thyroid	1.49E-03	1.01E-03	4.15E-03	9.93E-04	7.12E-04	9.45E-04
T.Body	1.02E-03	6.92E-04	3.04E-03	6.51E-04	5.29E-04	8.72E-04
Age Class: Teen						
Bone	3.58E-04	2.63E-04	1.37E-02	4.44E-03	3.43E-03	5.60E-03
GI-LLI	1.07E-03	7.24E-04	4.17E-03	1.03E-03	7.68E-04	1.20E-03
Kidney	1.05E-03	7.12E-04	3.93E-03	1.01E-03	7.61E-04	1.19E-03
Liver	1.05E-03	7.11E-04	3.93E-03	1.01E-03	7.60E-04	1.19E-03
Lung	1.20E-03	8.12E-04	4.00E-03	1.02E-03	7.62E-04	1.19E-03
Thyroid	1.65E-03	1.11E-03	5.00E-03	1.52E-03	1.03E-03	1.26E-03
T.Body	1.05E-03	7.10E-04	4.01E-03	1.02E-03	7.63E-04	1.19E-03
Age Class: Child						
Bone	4.86E-04	3.58E-04	3.20E-02	1.07E-02	8.05E-03	1.29E-02
GI-LLI	9.60E-04	6.54E-04	7.64E-03	2.29E-03	1.70E-03	2.65E-03
Kidney	9.54E-04	6.50E-04	7.46E-03	2.28E-03	1.70E-03	2.64E-03
Liver	9.52E-04	6.49E-04	7.45E-03	2.28E-03	1.70E-03	2.64E-03
Lung	1.09E-03	7.39E-04	7.51E-03	2.28E-03	1.70E-03	2.64E-03
Thyroid	1.67E-03	1.13E-03	9.00E-03	3.25E-03	2.21E-03	2.74E-03
T.Body	9.53E-04	6.49E-04	7.64E-03	2.29E-03	1.70E-03	2.65E-03
Age Class: Infant						
Bone	3.43E-04	2.53E-04	2.09E-04	6.54E-03	4.51E-03	8.62E-05
GI-LLI	5.66E-04	3.87E-04	2.91E-04	1.49E-03	1.01E-03	3.10E-05
Kidney	5.66E-04	3.86E-04	2.90E-04	1.49E-03	1.01E-03	3.09E-05
Liver	5.65E-04	3.86E-04	2.90E-04	1.49E-03	1.01E-03	3.09E-05
Lung	6.90E-04	4.69E-04	3.51E-04	1.49E-03	1.01E-03	3.39E-05
Thyroid	1.23E-03	8.25E-04	6.14E-04	3.68E-03	2.14E-03	4.70E-05
T.Body	5.64E-04	3.85E-04	2.90E-04	1.49E-03	1.01E-03	3.09E-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 2012

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	8.29E-04	6.16E-04	2.60E-02	9.51E-03	8.28E-03	1.44E-02
GI-LLI	3.51E-03	2.38E-03	1.08E-02	2.38E-03	1.94E-03	3.21E-03
Kidney	3.47E-03	2.35E-03	1.05E-02	2.37E-03	1.94E-03	3.20E-03
Liver	3.46E-03	2.35E-03	1.05E-02	2.37E-03	1.93E-03	3.20E-03
Lung	3.63E-03	2.46E-03	1.06E-02	2.36E-03	1.93E-03	3.20E-03
Thyroid	5.43E-03	3.65E-03	1.55E-02	3.86E-03	2.74E-03	3.53E-03
T.Body	3.46E-03	2.35E-03	1.06E-02	2.37E-03	1.93E-03	3.20E-03
Age Class: Teen						
Bone	1.18E-03	8.76E-04	4.14E-02	1.60E-02	1.25E-02	2.03E-02
GI-LLI	3.61E-03	2.45E-03	1.43E-02	3.73E-03	2.81E-03	4.40E-03
Kidney	3.57E-03	2.42E-03	1.40E-02	3.72E-03	2.80E-03	4.39E-03
Liver	3.56E-03	2.42E-03	1.40E-02	3.72E-03	2.80E-03	4.39E-03
Lung	3.84E-03	2.60E-03	1.41E-02	3.72E-03	2.80E-03	4.39E-03
Thyroid	6.06E-03	4.08E-03	1.86E-02	5.91E-03	3.96E-03	4.68E-03
T.Body	3.55E-03	2.41E-03	1.41E-02	3.72E-03	2.80E-03	4.39E-03
Age Class: Child						
Bone	1.62E-03	1.20E-03	9.82E-02	3.85E-02	2.93E-02	4.68E-02
GI-LLI	3.26E-03	2.22E-03	2.71E-02	8.41E-03	6.27E-03	9.79E-03
Kidney	3.25E-03	2.22E-03	2.69E-02	8.41E-03	6.28E-03	9.78E-03
Liver	3.25E-03	2.21E-03	2.69E-02	8.41E-03	6.27E-03	9.78E-03
Lung	3.49E-03	2.37E-03	2.69E-02	8.40E-03	6.27E-03	9.78E-03
Thyroid	6.22E-03	4.18E-03	3.34E-02	1.26E-02	8.50E-03	1.02E-02
T.Body	3.24E-03	2.21E-03	2.70E-02	8.41E-03	6.28E-03	9.79E-03
Age Class: Infant						
Bone	1.18E-03	8.77E-04	7.30E-04	2.40E-02	1.66E-02	3.18E-04
GI-LLI	1.93E-03	1.32E-03	9.93E-04	5.48E-03	3.73E-03	1.10E-04
Kidney	1.93E-03	1.32E-03	9.95E-04	5.52E-03	3.74E-03	1.10E-04
Liver	1.93E-03	1.32E-03	9.94E-04	5.51E-03	3.74E-03	1.10E-04
Lung	2.15E-03	1.47E-03	1.10E-03	5.49E-03	3.73E-03	1.16E-04
Thyroid	4.66E-03	3.13E-03	2.33E-03	1.50E-02	8.69E-03	1.77E-04
T.Body	1.93E-03	1.32E-03	9.91E-04	5.50E-03	3.73E-03	1.10E-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 (adult age class) of 0.0000000919 mrem. The maximum organ dose (adult age class, all organs) was 0.0000000919 mrem.

Table 4.3-A

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jan-Mar 2012

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	0.00E+00	0.00E+00	0.00E+00
GI-LLI	9.26E-08	6.85E-08	5.91E-08
Kidney	9.26E-08	6.85E-08	5.91E-08
Liver	9.26E-08	6.85E-08	5.91E-08
Lung	9.26E-08	6.85E-08	5.91E-08
Thyroid	9.26E-08	6.85E-08	5.91E-08
T.Body	9.26E-08	6.85E-08	5.91E-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 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 2012

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-C

Maximum Individual Organ Doses -- mrem
From Liquid Release Period: Jul-Sep 2012

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 2012

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

* 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 2012

Organ	Age Class Organ Dose – mrem *		
	Adult	Teen	Child
Bone	0.00E+00	0.00E+00	0.00E+00
GI-LLI	9.19E-08	6.79E-08	5.86E-08
Kidney	9.19E-08	6.79E-08	5.86E-08
Liver	9.19E-08	6.79E-08	5.86E-08
Lung	9.19E-08	6.79E-08	5.86E-08
Thyroid	9.19E-08	6.79E-08	5.86E-08
T.Body	9.19E-08	6.79E-08	5.86E-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 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 185 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 71.7 ± 24.7 mR/yr to 60.7 ± 68.8 mR/yr. Such a corrected dose is not statistically different from the Zone 4 average of 60.8 ± 7.3 mR/yr, and is indicative of natural background radiation.

Although the annual exposure at TLD location OA was 124 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 0.57 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 59.9 ± 6.2 mR (based on continuous occupancy at this location), which compares quite well to the Zone 4 annual average background radiation level of 60.8 ± 7.3 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 2012 is estimated as being about 1.4 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 2012. 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 0.00075 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 2012

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	17.7 ± 5.7	14.1 ± 1.8	13.9 ± 1.5	15.5 ± 1.8
Apr-Jun	18.0 ± 5.9	14.6 ± 1.6	14.3 ± 2.0	14.9 ± 2.0
Jul-Sep	18.1 ± 7.2	14.2 ± 1.9	14.2 ± 1.8	15.1 ± 2.1
Oct-Dec	17.9 ± 6.1	14.2 ± 1.8	14.4 ± 1.4	15.3 ± 1.9
Jan-Dec	71.7 ± 24.7**	57.1 ± 7.1	56.7 ± 6.4	60.8 ± 7.3

* 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 60.7 ± 6.8 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 2012 were a small percentage of the corresponding effluent control.

Table 6.1

Percent of ODCM Effluent Control Limits
for Gaseous Effluent Releases During 2012

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	1.70E-05	3.39E-06%

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	9.03E-05	3.01E-06%

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	9.82E-02	6.55E-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	0.00E+00	0.00E+00%
Apr-Jun	5.78E-07	1.16E-05%
Jul-Sep	6.88E-07	1.38E-05%
Oct-Dec	2.50E-05	5.01E-04%

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	2.58E-05	2.58E-04%

Table 6.1 (continued)

Percent of ODCM Effluent Control Limits
for Gaseous Effluent Releases During 2012

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	0.00E+00	0.00E+00%
Apr-Jun	8.89E-07	8.89E-06%
Jul-Sep	1.31E-06	1.31E-05%
Oct-Dec	9.27E-05	9.27E-04%

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	9.31E-05	4.66E-04%

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	2.22E-02	2.95E-01%
Apr-Jun	2.17E-02	2.90E-01%
Jul-Sep	2.23E-02	2.97E-01%
Oct-Dec	3.20E-02	4.27E-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	9.82E-02	6.55E-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 2012

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	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%

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	6.47E-10	6.47E-05%
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	1.60E-10	1.60E-05%

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 2012

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	9.26E-08	6.17E-06%
Apr-Jun	0.00E+00	0.00E+00%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	0.00E+00	0.00E+00%

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	9.19E-08	3.06E-06%

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	9.26E-08	1.85E-06%
Apr-Jun	0.00E+00	0.00E+00%
Jul-Sep	0.00E+00	0.00E+00%
Oct-Dec	0.00E+00	0.00E+00%

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	9.19E-08	9.19E-07%

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 54.6 cubic meters of spent resins, filter sludges, etc., containing a total activity of about 779 Curies were shipped from PNPS for processing and disposal. Dry activated wastes and contaminated equipment shipped during the period totaled 412 cubic meters and contained 0.56 Curies of radioactivity. No shipment of irradiated components was shipped 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 12 shipments to Energy Solutions' Bear Creek Facility; 2 shipments to Energy Solutions' Gallaher Road Facility; 8 shipments to Studsvik Processing Facility in Erwin, TN and 1 shipment to Energy Solutions Facility in Memphis, TN.

Table 7.0
Pilgrim Nuclear Power Station
Annual Radioactive Effluent Release Report
Solid Waste and Irradiated Fuel Shipments
January-December 2012

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 2012		
	Volume - m^3	Curies	Total Error
a. Spent resins, filters, filter sludges, evaporator bottoms, etc.	5.46 E+01	7.79 E+02	± 25%
b. Dry activated waste, contaminated equipment, etc.	4.12 E+02	5.60 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	9.44%	± 25%
	Fe-55	65.65%	± 25%
	Co-60	20.21%	± 25%
	Zn-65	3.20%	± 25%
b. Dry activated waste, contaminated equipment, etc.	Mn-54	8.23%	± 25%
	Fe-55	50.35%	± 25%
	Co-60	24.95%	± 25%
	Ni-63	4.05%	± 25%
	Zn-65	3.39%	± 25%
	Cs-137	8.54%	± 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
12	Tractor-trailer (Hittman Transport)	Energy Solutions Bear Creek Facility[2] Oak Ridge, TN
2	Tractor-trailer (Hittman Transport)	Energy Solutions Gallaher Road Facility[2] Kingston, TN
8	Tractor-trailer (Hittman Transport)	Studsvik Processing Facility,[2] Erwin, TN
1	Tractor-trailer (Hittman Transport)	Studsvik/RACE, LLC[2] Memphis, 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 2012. Information regarding revisions to the ODCM can be found attached as Appendix D of this report.

9.0 PROCESS CONTROL PROGRAM REVISIONS

There were no changes to the PNPS Process Control Program (PCP) during the calendar year of 2012. 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 2012

Class A Freq: 0.003

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	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	4
7.5-12.5	0	0	1	0	0	0	0	0	0	1	0	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	2	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	6

Class B Freq: 0.005

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	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	6
7.5-12.5	0	1	1	0	1	0	0	0	0	0	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	1	0	1	0	0	0	0	1	0	1	1	0	0	0	9

Class C Freq: 0.020

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	1	0	0	0	1
3.5-7.5	4	5	5	0	0	0	0	0	1	1	0	0	2	2	1	1	22
7.5-12.5	0	3	4	0	1	2	0	0	0	1	0	0	2	2	0	0	15
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	4	8	9	0	1	2	0	0	1	2	0	0	5	4	1	1	38

Class D Freq: 0.672

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	1	0	0	0	0	0	0	0	1
0.95-3.5	6	2	4	5	8	2	9	11	10	17	11	21	16	14	15	7	158
3.5-7.5	43	49	17	13	23	22	27	10	41	65	66	82	133	72	79	31	773
7.5-12.5	15	19	4	6	10	5	6	2	7	44	54	22	46	25	32	1	298
12.5-18.5	0	0	0	0	0	0	0	0	0	13	11	0	0	0	0	0	24
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	64	70	25	24	41	29	42	23	59	139	142	125	195	111	126	39	1254

Table A-1 (continued)

Jan-Mar 2012

Class E Freq: 0.273

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	1	0	0	1	0	0	0	2
0.95-3.5	5	11	5	4	5	2	8	10	22	19	17	23	31	12	7	4	185
3.5-7.5	3	6	2	2	4	4	17	19	24	30	53	54	30	16	10	1	275
7.5-12.5	0	0	0	0	1	0	0	0	2	23	16	1	4	1	0	0	48
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	8	17	7	6	10	6	25	29	48	73	86	78	66	29	17	5	510

Class F Freq: 0.024

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	0	0	1	2	2	0	2	1	1	0	0	10
3.5-7.5	0	0	1	0	0	0	0	1	0	1	17	2	0	0	1	0	23
7.5-12.5	0	0	0	0	0	0	0	0	0	4	7	0	0	0	0	0	11
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	1	1	0	0	0	0	2	2	7	24	4	1	1	1	0	44

Class G Freq: 0.002

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	1	0	0	0	0	0	0	0	0	0	1
0.95-3.5	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2
3.5-7.5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
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	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	4

All+Missing 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	1	0	1	1	1	0	1	0	0	0	5
0.95-3.5	19	17	13	19	19	7	21	26	39	43	33	53	56	37	26	14	442
3.5-7.5	71	65	36	30	40	34	46	33	73	107	150	151	174	100	95	42	1247
7.5-12.5	17	23	10	6	13	7	6	2	11	86	108	30	52	28	49	13	461
12.5-18.5	0	0	0	0	0	0	0	0	0	13	15	0	0	0	0	0	28
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	107	105	59	55	72	48	74	61	124	250	307	234	283	165	170	69	2183

Table A-1 (continued)

Apr-Jun 2012

Class A Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class B Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class C Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class D Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-1 (continued)

Apr-Jun 2012

Class E Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class F Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class G Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All+Missing 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	1	0	0	0	1	0	0	0	1	3
0.95-3.5	53	30	35	35	71	36	36	53	68	42	37	56	70	45	39	32	738
3.5-7.5	42	98	85	39	65	44	49	37	89	212	148	111	66	64	40	34	1223
7.5-12.5	0	3	7	0	0	1	9	1	17	113	35	7	16	10	0	0	219
12.5-18.5	0	0	0	0	0	0	0	0	0	1	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	95	131	127	74	136	81	94	92	174	368	220	175	152	119	79	67	2184

Jul-Sep 2012

Class A Freq: 0.060

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	10	15	10	5	0	0	0	0	0	0	0	0	0	0	5	57
3.5-7.5	5	7	14	7	4	3	0	0	3	2	0	0	0	1	2	0	48
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	17	17	29	17	9	3	0	0	3	2	0	0	0	1	2	5	105

Class B Freq: 0.027

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	2	1	2	5	0	1	0	0	1	0	1	0	2	3	3	22
3.5-7.5	0	1	0	2	3	2	3	1	2	7	1	1	0	2	0	0	25
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	1	3	1	4	8	2	4	1	2	8	1	2	0	4	3	3	47

Class C 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	3	0	7	8	4	0	0	0	0	0	0	0	1	2	0	0	25
3.5-7.5	0	0	0	0	2	1	1	1	7	14	6	0	0	1	1	0	34
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	3	0	7	8	6	1	1	1	7	14	6	0	1	3	1	0	59

Class D Freq: 0.352

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	25	26	20	14	33	9	8	7	3	18	6	16	13	23	28	21	270
3.5-7.5	0	3	2	2	1	13	12	7	63	127	46	10	6	0	5	1	298
7.5-12.5	0	0	0	0	0	0	0	0	24	26	1	0	0	0	0	0	51
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	25	29	22	16	34	22	20	14	90	171	53	26	19	23	33	22	619

Table A-1 (continued)

Jul-Sep 2012

Class E Freq: 0.322

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	1	2	1	1	0	1	0	1	1	0	1	0	11
0.95-3.5	11	13	8	23	16	15	19	14	41	28	19	24	16	14	19	5	285
3.5-7.5	1	1	8	0	1	2	3	2	29	113	69	16	5	5	7	3	265
7.5-12.5	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	5
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	15	17	23	18	19	23	17	70	145	90	41	22	19	27	8	566

Class F Freq: 0.165

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	2	1	1	1	1	2	1	4	1	1	0	1	17
0.95-3.5	2	3	0	2	2	2	1	13	16	19	19	36	22	14	6	3	160
3.5-7.5	0	1	0	0	0	0	0	0	2	18	75	11	1	3	0	0	111
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	2	5	0	2	4	3	2	14	19	39	97	51	24	18	6	4	290

Class G Freq: 0.040

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	0	5	11	15	8	3	0	0	42
3.5-7.5	0	0	0	0	0	0	0	0	0	1	20	7	0	0	0	0	28
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	0	0	0	0	0	0	0	0	0	6	31	22	9	3	0	0	71

All+Missing 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	2	1	0	3	3	2	2	1	3	1	6	3	1	1	1	30
0.95-3.5	64	71	66	77	76	39	38	38	68	79	67	128	80	72	68	44	1075
3.5-7.5	6	16	26	16	24	24	20	13	113	352	307	67	16	13	15	7	1035
7.5-12.5	0	0	0	0	0	0	0	0	25	32	11	0	0	0	0	0	68
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	70	89	93	93	103	66	60	53	207	466	386	201	99	86	84	52	2208

Table A-1 (continued)

Oct-Dec 2012

Class A 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	7	3	3	0	1	0	0	0	0	0	0	0	0	1	4	1	20
3.5-7.5	13	13	20	4	1	1	0	0	0	0	0	0	5	15	11	10	93
7.5-12.5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
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	20	17	24	4	2	1	0	0	0	0	0	0	5	17	15	11	116

Class B Freq: 0.024

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	3	1	1	0	0	0	0	0	0	0	0	0	1	1	9
3.5-7.5	2	7	7	1	1	1	0	0	1	0	0	0	3	5	3	2	33
7.5-12.5	0	3	1	0	1	0	0	0	0	0	0	0	2	1	0	1	9
12.5-18.5	0	0	2	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	3	11	13	2	3	1	0	0	1	0	0	0	5	6	4	4	53

Class C Freq: 0.033

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	1	1	0	0	1	0	0	0	0	0	0	0	0	0	5
3.5-7.5	3	10	4	2	1	1	1	0	0	2	0	1	14	7	2	2	50
7.5-12.5	0	3	1	0	0	3	0	0	0	0	0	0	3	6	1	0	17
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	4	14	7	3	1	4	2	0	0	2	0	1	17	13	3	2	73

Class D Freq: 0.491

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0.95-3.5	4	9	9	10	12	5	6	9	3	16	8	5	12	13	7	6	134
3.5-7.5	15	66	72	46	31	25	20	9	36	68	34	45	72	43	67	15	664
7.5-12.5	6	27	25	12	11	15	0	0	11	32	9	4	30	30	32	5	249
12.5-18.5	7	15	8	0	3	2	1	0	0	0	0	0	0	0	0	0	36
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	33	117	114	68	57	47	27	18	50	116	51	54	114	86	106	26	1084

Table A-1 (continued)

Oct-Dec 2012

Class E Freq: 0.307

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	1	0	1	0	1	1	1	1	6
0.95-3.5	5	6	9	5	12	15	16	20	21	26	22	24	22	25	13	5	246
3.5-7.5	3	8	15	2	12	7	19	11	24	48	56	115	47	17	6	4	394
7.5-12.5	0	0	1	0	2	2	1	0	5	7	2	1	0	0	0	0	21
12.5-18.5	0	0	2	3	5	0	0	0	0	0	0	0	0	0	0	0	10
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	8	14	27	10	31	24	36	31	51	81	81	140	70	43	20	10	677

Class F 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	1	1	2	0	2	1	0	0	0	7
0.95-3.5	0	0	0	0	1	0	2	12	19	22	20	20	7	2	0	0	105
3.5-7.5	0	0	0	0	0	0	0	0	0	19	39	5	0	0	0	0	63
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	0	0	0	0	1	0	2	13	20	43	59	27	8	2	0	0	175

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	1	0	0	0	1	5	12	5	1	0	0	25
3.5-7.5	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	5
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	0	0	0	0	0	1	0	0	0	2	9	12	5	1	0	0	30

All+Missing 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	0	0	0	0	0	1	2	2	1	2	2	1	1	1	14
0.95-3.5	18	20	25	17	27	21	25	41	43	65	55	61	46	42	25	13	544
3.5-7.5	36	104	118	55	46	35	40	20	61	138	133	166	141	87	89	33	1302
7.5-12.5	6	34	28	12	14	20	1	0	16	39	11	5	35	38	33	6	298
12.5-18.5	7	15	14	3	8	2	1	0	0	0	0	0	0	0	0	0	50
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	68	173	185	87	95	78	67	62	122	244	200	234	224	168	148	53	2208

Table A-1 (continued)

Jan-Dec 2012

Class A Freq: 0.039

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	19	13	18	10	6	0	0	0	0	0	0	0	0	1	4	6	77
3.5-7.5	20	20	34	11	5	4	0	0	3	2	0	0	6	17	13	10	145
7.5-12.5	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	4
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	39	34	54	21	11	4	0	0	3	3	0	0	6	19	17	16	227

Class B Freq: 0.019

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	3	4	3	6	0	1	0	0	1	0	1	0	2	4	4	31
3.5-7.5	5	8	7	3	4	3	3	1	3	8	1	2	4	7	3	2	64
7.5-12.5	0	4	2	0	2	0	0	0	0	0	0	0	2	1	0	1	12
12.5-18.5	0	0	2	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	15	15	6	12	3	4	1	3	9	1	3	6	10	7	7	109

Class C 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	4	1	8	9	4	0	1	0	0	0	0	0	2	2	0	0	31
3.5-7.5	7	15	9	2	3	2	2	1	8	17	6	1	16	10	4	3	106
7.5-12.5	0	6	5	0	1	5	0	0	0	1	0	0	5	8	1	0	32
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	11	22	23	11	8	7	3	1	8	18	6	1	23	20	5	3	170

Class D Freq: 0.507

mph	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Calm-0.95	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
0.95-3.5	35	37	33	29	53	16	23	27	16	51	25	42	41	50	50	34	562
3.5-7.5	58	118	91	61	55	60	59	26	140	260	146	137	211	115	151	47	1735
7.5-12.5	21	46	29	18	21	20	6	2	42	102	64	26	76	55	64	6	598
12.5-18.5	7	15	8	0	3	2	1	0	0	13	11	0	0	0	0	0	60
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	122	216	161	108	132	98	89	55	199	426	246	205	328	220	265	87	2957

Table A-1 (continued)

Jan-Dec 2012

Class E Freq: 0.301

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	1	2	1	1	1	2	1	1	3	1	2	1	19
0.95-3.5	21	30	22	32	33	32	43	44	84	73	58	71	69	51	39	14	716
3.5-7.5	7	15	25	4	17	13	39	32	77	191	178	185	82	38	23	8	934
7.5-12.5	0	0	1	0	3	2	1	0	7	33	20	2	4	1	0	0	74
12.5-18.5	0	0	2	3	5	0	0	0	0	0	0	0	0	0	0	0	10
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	28	46	51	39	59	49	84	77	169	299	257	259	158	91	64	23	1753

Class F Freq: 0.087

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	2	1	1	2	2	4	1	6	2	1	0	1	24
0.95-3.5	2	4	0	2	3	2	3	26	37	43	39	58	30	17	6	3	275
3.5-7.5	0	1	1	0	0	0	0	1	2	38	131	18	1	3	1	0	197
7.5-12.5	0	0	0	0	0	0	0	0	0	4	9	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	2	6	1	2	5	3	4	29	41	89	180	82	33	21	7	4	509

Class G Freq: 0.018

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	1	0	0	0	0	0	1	0	0	0	2
0.95-3.5	0	0	0	0	1	1	0	0	0	6	16	27	14	4	0	0	69
3.5-7.5	0	0	0	1	0	0	0	0	0	2	24	7	0	0	0	0	34
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	0	0	0	1	1	1	1	0	0	8	40	34	15	4	0	0	105

All+Missing 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	1	0	3	3	3	4	4	6	3	9	6	2	2	3	52
0.95-3.5	154	138	139	148	193	103	120	158	218	229	192	298	252	196	158	103	2799
3.5-7.5	155	283	265	140	175	137	155	103	336	809	738	495	397	264	239	116	4807
7.5-12.5	23	60	45	18	27	28	16	3	69	270	165	42	103	76	82	19	1046
12.5-18.5	7	15	14	3	8	2	1	0	0	14	15	0	0	0	0	0	79
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	340	498	464	309	406	273	295	268	627	1328	1113	844	758	538	481	241	8783

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

Jan-Mar 2012

Class A Freq: 0.003

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	4
>24	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
TOTAL	1	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1	6

Class B Freq: 0.005

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5-12.5	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
12.5-18.5	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
18.5-24	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	3
>24	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	2	1	1	0	1	0	0	0	0	1	0	1	0	1	0	1	9

Class C Freq: 0.020

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5-12.5	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
12.5-18.5	0	4	6	1	0	0	0	0	2	0	0	0	2	1	1	0	17
18.5-24	3	2	1	0	1	0	0	0	0	1	0	0	0	2	0	2	12
>24	0	2	0	0	2	0	0	0	0	0	0	0	2	1	0	0	7
TOTAL	4	8	7	1	3	0	0	0	2	1	0	1	4	4	1	2	38

Class D Freq: 0.672

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	0	0	0	0	0	0	0	2	0	0	0	0	0	6
3.5-7.5	2	4	5	6	4	3	7	4	3	2	4	5	6	2	3	4	64
7.5-12.5	7	12	7	11	12	20	10	2	13	32	24	27	24	22	19	16	258
12.5-18.5	27	12	5	0	5	15	10	6	25	52	75	41	86	50	41	17	467
18.5-24	13	8	2	2	3	3	15	1	1	21	40	15	37	46	44	25	276
>24	24	6	0	7	14	0	1	0	0	13	24	5	21	32	31	5	183
TOTAL	74	43	21	26	38	41	43	13	42	120	169	93	174	152	138	67	1254

Table A-2 (continued)

Jan-Mar 2012

Class E Freq: 0.273

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	3	1	2	1	0	3	1	0	0	0	1	0	2	3	3	23
3.5-7.5	13	4	3	3	8	3	11	4	3	5	6	7	2	12	10	5	99
7.5-12.5	1	2	0	0	1	5	8	6	15	21	8	12	21	23	11	4	138
12.5-18.5	0	0	0	0	0	4	10	11	12	15	27	17	40	14	6	1	157
18.5-24	0	0	0	1	0	0	7	3	1	11	26	2	7	12	2	1	73
>24	0	0	0	1	0	0	0	0	0	3	10	0	2	3	0	1	20
TOTAL	17	9	4	7	10	12	39	25	31	55	77	39	72	66	32	15	510

Class F Freq: 0.024

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	0	0	0	0	0	0	0	0	0	0	0	1
3.5-7.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2
7.5-12.5	0	0	0	0	0	0	0	1	0	3	0	2	1	2	1	0	10
12.5-18.5	0	0	0	0	0	0	0	1	1	1	8	5	3	1	0	0	20
18.5-24	0	0	0	0	0	0	0	0	0	1	4	3	0	0	0	0	8
>24	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3
TOTAL	1	0	0	0	0	0	0	2	2	6	14	10	4	3	1	1	44

Class G Freq: 0.002

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	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
7.5-12.5	0	0	0	0	0	1	0	0	0	1	0	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	0	1	0	0	0	3	0	0	0	0	0	0	4

All+Missing 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	5	3	2	1	0	4	1	0	0	6	1	0	3	3	3	38
3.5-7.5	15	9	16	17	15	8	23	10	9	9	11	15	12	17	16	11	213
7.5-12.5	14	21	14	18	23	37	24	11	29	65	37	47	47	49	39	23	498
12.5-18.5	34	19	11	3	6	21	20	26	40	76	123	80	131	72	51	27	740
18.5-24	21	10	5	3	4	3	22	4	3	39	76	27	46	67	52	35	417
>24	26	9	0	8	17	0	1	0	0	20	58	7	25	37	51	18	277
TOTAL	116	73	49	51	66	69	94	52	81	209	311	177	261	245	212	117	2183

Table A-2 (continued)

Apr-Jun 2012

Class A Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class B Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class C Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class D Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-2 (continued)

Apr-Jun 2012

Class E Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class F Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Class G Freq: ####

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All+Missing 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	10	10	1	4	5	3	5	6	2	2	2	1	2	3	5	67
3.5-7.5	25	30	34	28	31	25	17	27	23	25	15	6	7	13	27	19	352
7.5-12.5	40	45	40	22	46	60	47	47	54	64	21	35	38	47	23	29	658
12.5-18.5	39	28	8	8	4	11	27	39	74	178	65	67	82	64	22	19	735
18.5-24	17	22	2	1	0	6	14	4	11	66	35	9	25	30	14	23	279
>24	4	4	0	0	0	1	11	0	0	15	13	0	2	16	6	21	93
TOTAL	131	139	94	60	85	108	119	122	168	350	151	119	155	172	95	116	2184

Table A-2 (continued)

Jul-Sep 2012

Class A Freq: 0.060

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	6	4	8	3	0	0	0	0	0	0	0	0	0	0	1	27
7.5-12.5	9	6	15	4	5	5	0	0	2	0	0	0	0	1	0	4	51
12.5-18.5	6	2	2	1	0	2	2	0	1	2	0	0	0	1	0	3	22
18.5-24	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	5
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	22	14	21	13	8	7	2	0	3	2	0	0	0	3	0	10	105

Class B Freq: 0.027

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	2	2	0	2	2	0	0	0	0	2	1	0	0	1	1	0	13
7.5-12.5	1	1	0	1	2	5	2	0	3	1	0	2	0	3	0	1	22
12.5-18.5	0	0	0	0	1	1	3	0	3	1	0	0	0	1	0	2	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	3	3	0	3	5	6	5	0	6	4	1	2	0	5	1	3	47

Class C 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	0	0	0	0	0	0	0	0	0
3.5-7.5	1	1	2	3	4	1	0	0	0	1	1	0	2	1	0	1	18
7.5-12.5	0	0	3	0	3	4	1	0	6	6	4	0	0	1	0	0	28
12.5-18.5	1	0	0	0	0	0	0	2	6	1	1	0	0	1	0	1	13
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	5	3	7	5	1	2	12	8	6	0	2	3	0	2	59

Class D Freq: 0.352

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	3	2	1	1	1	0	0	0	0	0	0	0	0	0	2	12
3.5-7.5	10	4	5	9	7	13	7	2	1	8	11	8	12	2	7	7	113
7.5-12.5	8	8	8	3	5	7	11	3	22	33	21	9	12	13	13	5	181
12.5-18.5	11	4	3	3	3	7	9	6	33	89	41	4	4	4	7	19	247
18.5-24	1	0	0	0	0	5	1	3	13	21	3	0	0	1	1	4	53
>24	0	0	0	0	0	0	0	9	3	1	0	0	0	0	0	0	13
TOTAL	32	19	18	16	16	33	28	23	72	152	76	21	28	20	28	37	619

Table A-2 (continued)

Jul-Sep 2012

Class E Freq: 0.322

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	4	3	5	1	1	1	0	1	0	0	1	1	1	0	23
3.5-7.5	2	5	3	6	9	5	5	6	4	2	5	1	2	3	3	4	65
7.5-12.5	5	7	0	6	14	10	14	10	19	38	16	7	5	10	13	3	177
12.5-18.5	4	2	8	3	4	1	3	9	9	79	40	13	8	15	3	9	210
18.5-24	1	1	0	0	0	0	1	1	1	37	27	3	0	1	7	4	84
>24	1	0	0	0	0	0	0	0	0	1	0	0	0	0	3	2	7
TOTAL	16	16	15	18	32	17	24	27	33	158	88	24	16	30	30	22	566

Class F Freq: 0.165

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	3	1	0	1	0	2	1	1	0	1	0	1	0	0	1	12
3.5-7.5	7	4	2	4	2	5	1	1	6	6	1	0	4	3	0	6	52
7.5-12.5	3	4	0	1	10	8	8	3	3	7	0	4	5	15	13	4	88
12.5-18.5	2	0	0	0	0	0	2	5	6	7	26	24	15	5	1	5	98
18.5-24	1	3	0	0	0	0	0	0	0	6	18	4	0	0	7	0	39
>24	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTAL	13	14	3	5	13	13	13	10	16	26	47	32	25	23	21	16	290

Class G Freq: 0.040

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	1	0	2	1	1	0	0	0	0	0	0	1	0	0	8
3.5-7.5	2	2	2	0	0	0	1	0	1	2	0	0	1	1	1	0	13
7.5-12.5	0	4	0	0	0	0	0	1	1	1	5	4	6	7	1	0	30
12.5-18.5	0	0	0	0	0	0	0	0	0	1	6	3	7	3	0	0	20
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	7	3	0	2	1	2	1	2	4	11	7	14	12	2	0	71

All+Missing 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	9	11	5	10	4	5	2	1	2	2	1	2	3	2	4	71
3.5-7.5	33	29	21	39	36	31	19	12	14	26	21	16	24	17	14	25	377
7.5-12.5	32	36	27	19	45	48	53	20	61	103	62	37	34	62	53	23	715
12.5-18.5	28	10	15	8	9	12	19	23	69	201	141	64	49	52	14	48	762
18.5-24	8	5	1	0	0	5	2	4	16	96	86	8	0	4	15	12	262
>24	1	0	0	0	0	0	0	9	3	2	1	0	0	0	3	2	21
TOTAL	110	89	75	71	100	100	98	70	164	430	313	126	109	138	101	114	2208

Table A-2 (continued)

Oct-Dec 2012

Class A 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	4	6	5	3	1	0	0	0	0	0	0	0	0	1	4	3	27
7.5-12.5	3	5	11	0	0	0	0	0	0	0	0	0	1	4	5	4	33
12.5-18.5	8	3	1	0	0	2	0	0	0	0	0	0	3	5	5	9	36
18.5-24	3	0	0	0	0	0	0	0	0	0	0	0	1	9	3	2	18
>24	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	19	14	18	3	1	2	0	0	0	0	0	0	5	19	17	18	116

Class B Freq: 0.024

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	0	3	1	1	0	0	0	0	0	0	0	0	0	1	1	1	8
7.5-12.5	1	2	4	1	1	2	0	0	0	1	0	0	0	2	1	0	15
12.5-18.5	1	4	0	0	0	0	0	0	0	0	0	0	1	2	1	2	11
18.5-24	0	0	3	0	0	0	0	0	0	0	0	0	2	3	1	1	10
>24	3	0	2	0	1	0	0	0	0	0	0	0	0	1	0	1	8
TOTAL	5	9	11	2	2	2	0	0	0	1	0	0	3	9	4	5	53

Class C Freq: 0.033

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	1	0	0	0	0	0	0	1
3.5-7.5	3	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	5
7.5-12.5	1	4	3	1	0	1	1	0	0	1	0	1	5	1	0	0	19
12.5-18.5	2	3	0	0	0	1	0	0	0	1	0	0	6	3	0	2	18
18.5-24	0	2	0	2	0	1	0	0	0	0	0	0	4	4	2	0	15
>24	2	0	2	1	2	0	0	0	0	0	0	0	0	6	1	1	15
TOTAL	8	9	6	4	2	3	1	0	0	3	0	1	15	15	3	3	73

Class D Freq: 0.491

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	0	1	2	0	0	1	0	0	0	0	0	0	0	1	9
3.5-7.5	1	5	8	7	4	3	3	2	2	8	6	5	4	5	0	2	65
7.5-12.5	4	26	36	18	7	16	6	4	13	25	19	8	12	9	5	4	212
12.5-18.5	19	21	11	36	17	8	13	4	25	57	27	34	35	27	43	10	387
18.5-24	8	20	6	24	11	9	6	1	7	18	8	3	30	20	26	12	209
>24	27	13	21	13	16	8	1	0	0	0	0	0	9	34	46	14	202
TOTAL	61	87	82	99	57	44	29	12	47	108	60	50	90	95	120	43	1084

Table A-2 (continued)

Oct-Dec 2012

Class E Freq: 0.307

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	2	0	3	2	3	1	0	0	0	1	0	0	0	0	1	13
3.5-7.5	0	6	12	3	11	4	4	2	3	4	0	3	2	7	6	5	72
7.5-12.5	3	6	15	6	5	9	7	4	5	16	17	12	11	15	10	10	151
12.5-18.5	7	2	1	4	8	4	23	15	15	31	35	60	66	43	15	7	336
18.5-24	0	1	0	0	5	3	3	1	5	14	7	13	14	15	5	1	87
>24	0	0	2	4	8	1	1	0	0	1	0	0	0	0	1	0	18
TOTAL	10	17	30	20	39	24	39	22	28	66	60	88	93	80	37	24	677

Class F 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	1	0	1	0	1	0	1	0	2	2	0	0	0	0	0	0	8
3.5-7.5	0	1	1	0	5	6	2	1	4	3	5	1	2	4	2	1	38
7.5-12.5	2	0	0	0	0	2	10	8	5	11	9	3	4	6	3	0	63
12.5-18.5	1	0	0	0	0	1	4	4	1	6	17	16	3	6	0	0	59
18.5-24	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	0	7
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	1	2	0	6	9	17	13	12	22	37	21	9	16	5	1	175

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	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0	1	6
3.5-7.5	1	1	0	0	0	0	0	1	0	3	0	1	1	0	1	2	11
7.5-12.5	0	0	0	0	0	0	0	0	2	2	2	1	0	0	0	0	7
12.5-18.5	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	3
18.5-24	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	1	0	0	1	0	0	1	4	6	5	4	1	0	1	4	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	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95-3.5	4	4	2	4	6	3	2	1	3	4	1	1	0	0	0	3	38
3.5-7.5	9	22	28	14	21	13	9	6	9	18	11	10	9	19	14	14	226
7.5-12.5	14	43	69	26	13	30	24	16	25	56	47	25	33	37	24	18	500
12.5-18.5	38	33	13	40	25	16	40	23	42	95	80	110	114	86	64	31	850
18.5-24	11	23	9	26	16	13	9	2	12	32	23	18	51	51	37	16	349
>24	33	13	28	18	27	9	2	0	0	1	0	0	9	41	48	16	245
TOTAL	109	138	149	128	108	84	86	48	91	206	162	164	216	234	187	98	2208

Table A-2 (continued)

Jan-Dec 2012

Class A Freq: 0.039

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	9	12	9	11	4	0	0	0	0	0	0	0	0	1	4	4	54
7.5-12.5	12	11	26	4	5	5	0	0	2	0	0	0	1	5	5	8	84
12.5-18.5	14	5	3	1	0	4	2	0	1	2	0	0	3	6	5	12	58
18.5-24	6	0	1	0	0	0	0	0	0	0	0	0	2	10	3	5	27
>24	1	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	4
TOTAL	42	28	40	16	9	9	2	0	3	3	0	0	6	23	17	29	227

Class B Freq: 0.019

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	2	5	1	3	2	0	0	0	0	2	1	0	0	2	2	1	21
7.5-12.5	3	3	4	2	3	7	2	0	3	3	0	2	0	5	1	1	39
12.5-18.5	2	4	0	0	1	1	3	0	3	1	0	1	1	3	1	4	25
18.5-24	0	0	4	0	0	0	0	0	0	0	0	0	2	4	1	2	13
>24	3	1	2	0	2	0	0	0	0	0	0	0	0	1	0	1	10
TOTAL	10	13	12	5	8	8	5	0	6	6	1	3	3	15	5	9	109

Class C 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	0	0	0	0	0	1	0	0	0	0	0	0	1
3.5-7.5	4	1	3	3	4	1	0	0	0	1	1	0	2	2	0	1	23
7.5-12.5	2	4	6	1	3	5	2	0	6	7	4	2	5	2	0	0	49
12.5-18.5	3	7	6	1	0	1	0	2	8	2	1	0	8	5	1	3	48
18.5-24	3	4	1	2	1	1	0	0	0	1	0	0	4	6	2	2	27
>24	2	2	2	1	4	0	0	0	0	0	0	0	2	7	1	1	22
TOTAL	14	18	18	8	12	8	2	2	14	12	6	2	21	22	4	7	170

Class D Freq: 0.507

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	6	4	2	3	1	0	1	0	0	2	0	0	0	0	3	27
3.5-7.5	13	13	18	22	15	19	17	8	6	18	21	18	22	9	10	13	242
7.5-12.5	19	46	51	32	24	43	27	9	48	90	64	44	48	44	37	25	651
12.5-18.5	57	37	19	39	25	30	32	16	83	198	143	79	125	81	91	46	1101
18.5-24	22	28	8	26	14	17	22	5	21	60	51	18	67	67	71	41	538
>24	51	19	21	20	30	8	2	9	3	14	24	5	30	66	77	19	398
TOTAL	167	149	121	141	111	118	100	48	161	380	305	164	292	267	286	147	2957

Table A-2 (continued)

Jan-Dec 2012

Class E Freq: 0.301

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	6	5	8	8	4	5	2	0	1	1	1	1	3	4	4	59
3.5-7.5	15	15	18	12	28	12	20	12	10	11	11	11	6	22	19	14	236
7.5-12.5	9	15	15	12	20	24	29	20	39	75	41	31	37	48	34	17	466
12.5-18.5	11	4	9	7	12	9	36	35	36	125	102	90	114	72	24	17	703
18.5-24	1	2	0	1	5	3	11	5	7	62	60	18	21	28	14	6	244
>24	1	0	2	5	8	1	1	0	0	5	10	0	2	3	4	3	45
TOTAL	43	42	49	45	81	53	102	74	92	279	225	151	181	176	99	61	1753

Class F Freq: 0.087

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	3	2	0	2	0	3	1	3	2	1	0	1	0	0	1	21
3.5-7.5	7	5	3	4	7	11	3	2	11	9	6	1	6	7	2	8	92
7.5-12.5	5	4	0	1	10	10	18	12	8	21	9	9	10	23	17	4	161
12.5-18.5	3	0	0	0	0	1	6	10	8	14	51	45	21	12	1	5	177
18.5-24	1	3	0	0	0	0	0	0	0	7	28	8	0	0	7	0	54
>24	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	4
TOTAL	18	15	5	5	19	22	30	25	30	54	98	63	38	42	27	18	509

Class G Freq: 0.018

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	1	1	0	3	1	1	0	1	1	0	1	0	1	0	1	14
3.5-7.5	3	3	2	0	0	0	1	1	1	7	0	1	2	1	2	2	26
7.5-12.5	0	4	0	0	0	1	0	1	3	4	7	5	6	7	1	0	39
12.5-18.5	0	0	0	0	0	0	0	0	1	1	7	3	7	3	0	1	23
18.5-24	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3
>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5	8	3	0	3	2	2	2	6	13	16	11	15	12	3	4	105

All+Missing 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	24	28	26	12	21	12	14	9	10	8	11	5	3	8	8	15	214
3.5-7.5	82	90	99	98	103	77	68	55	55	78	58	47	52	66	71	69	1168
7.5-12.5	100	145	150	85	127	175	148	94	169	288	167	144	152	195	139	93	2371
12.5-18.5	139	90	47	59	44	60	106	111	225	550	409	321	376	274	151	125	3087
18.5-24	57	60	17	30	20	27	47	14	42	233	220	62	122	152	118	86	1307
>24	64	26	28	26	44	10	14	9	3	38	72	7	36	94	108	57	636
TOTAL	466	439	367	310	359	361	397	292	504	1195	937	586	741	789	595	445	8783

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 2012 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. Six additional sampling wells were installed in August 2010 to address additional SSCs, and perimeter locations to the northeast of the plant process buildings. Two more wells were installed in November 2011 in locations to characterize groundwater flowing along the deep foundation along the west side of the process buildings. The most recent addition to the well sampling network occurred in November 2012 to characterize groundwater flowing along the deep foundation along the east side of the process buildings. At the end of 2012, the groundwater monitoring well network at Pilgrim Station consisted of twenty-one monitoring wells.

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. Soil samples were also collected during borings for installation of additional monitoring wells in 2011 and 2012, as well as during excavation activities to inspect the integrity of protective coating on sections of underground piping. 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. 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 samples collected from all wells between 06-Mar and 08-Mar-2012. Analyses for these hard-to-detect radionuclides were also performed on initial samples collected from MW216 following its installation in Sep-2012. 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 07-Feb-2012 contained no detectable tritium, and a minimum detectable concentration of 411 pCi/L was achieved on that sample. The achieved sensitivity of 411 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. In many instances, the detection sensitivity was even below 350 pCi/L, with no detection of tritium at these very low levels.

The following tables list the tritium concentrations observed in the samples collected from the monitoring wells during 2012. The first table lists the results from the priority wells sampled on a more frequent basis, while the second and third tables list results from the non-priority wells sampled on a less frequent basis. There were a few instances during which sampling wells were inaccessible due to temporary storage of shipping containers (MW206 on 05/02 and 05/15) or due to onsite construction activities (MW212 on 06/28, 08/22, and 11/15).

Low levels of tritium, a radioactive isotope of hydrogen, were detected in the many of 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.

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty							
	MW201	MW205	MW206	MW209	MW211	MW215	MW216	MW217
01/04/12	348 ± 107	7570 ± 244	2420 ± 158	967 ± 125	1290 ± 134	1480 ± 139		442 ± 112
01/10/12	407 ± 117	4990 ± 207	2890 ± 171	967 ± 131	1170 ± 136	1320 ± 139		NDA<343
01/19/12	582 ± 115	5780 ± 224	2830 ± 170	1180 ± 133	1250 ± 136	1440 ± 137		504 ± 111
01/24/12	646 ± 139	2500 ± 188	3250 ± 204	938 ± 148	852 ± 145	1390 ± 160		434 ± 133
02/07/12	NDA<411	8400 ± 305	2890 ± 206	933 ± 155	1200 ± 164	1170 ± 162		492 ± 143
02/21/12	707 ± 124	4380 ± 209	2180 ± 163	1200 ± 139	1380 ± 143	1600 ± 150		901 ± 130
03/06/12	514 ± 124	5090 ± 240	2480 ± 185	1250 ± 154	1220 ± 153	1490 ± 161		517 ± 132
03/20/12	NDA<370	2260 ± 189	1440 ± 162	769 ± 151	951 ± 154	1200 ± 162		520 ± 141
04/03/12	NDA<393	6940 ± 253	2360 ± 176	1050 ± 148	1230 ± 153	1310± 154		494 ± 132
04/17/12	780 ± 129	3860 ± 199	1930 ± 159	1010 ± 137	1590 ± 151	1320 ± 144		695 ± 128
05/02/12	674 ± 139	5440 ± 247	Inaccessible	1030 ± 150	1230 ± 156	1730 ± 169		660 ± 139
05/15/12	592 ± 146	1820 ± 179	Inaccessible	985 ± 159	1140 ± 163	1200 ± 164		666 ± 147
05/29/12	629 ± 150	5760 ± 248	1550 ± 170	887 ± 156	1190 ± 160	1470 ± 169		462 ± 140
06/19/12	554 ± 123	6440 ± 216	1010 ± 132	1050 ± 132	1130 ± 163	900 ± 157		865 ± 130
07/11/12	648 ± 125	1220 ± 136	1240 ± 137	889 ± 158	1360 ± 139	1360 ± 140		NDA<444
07/26/12	2310 ± 218	4220 ± 277	977 ± 173	1111 ± 179	1310 ± 184	1230 ± 183		925 ± 172
08/07/12	616 ± 153	1180 ± 145	1480 ± 155	907 ± 136	826 ± 159	1210 ± 145		657 ± 124
08/22/12	438 ± 127	1670 ± 161	1320 ± 150	696 ± 134	866 ± 138	1090 ± 145		657 ± 133
09/07/12	NDA<448	1400 ± 192	1080 ± 146	800 ± 137	951 ± 175	831 ± 174		526 ± 124
09/20/12	438 ± 120	2260 ± 167	1640 ± 152	1060 ± 139	901 ± 132	1060 ± 139	3150 ± 186	440 ± 119
09/26/12							3230 ± 186	
10/03/12	NDA<411	1050 ± 156	1080 ± 156	613 ± 143	704 ± 145	1050 ± 155	2250 ± 181	436 ± 140
10/09/12							2670 ± 190	
10/17/12	NDA<351	1900 ± 179	1360 ± 153	584 ± 130	985 ± 142	1110 ± 146	4800 ± 224	424 ± 124
10/25/12							4430 ± 249	
11/01/12	407 ± 121	3520 ± 198	4300 ± 212	864 ± 140	1040 ± 140	1030 ± 140	7620 ± 263	485 ± 124
11/06/12							3060 ± 189	
11/15/12	551 ± 128	1210 ± 144	1510 ± 151	714 ± 130	1070 ± 143	1070 ± 137	2460 ± 172	NDA<381
11/21/12							3670 ± 211	
11/29/12	NDA<371	3680 ± 210	1970 ± 175	810 ± 143	986 ± 148	1010 ± 148	3960 ± 216	NDA<372
12/04/12							3740 ± 212	
12/14/12	NDA<379	1040 ± 144	2820± 205	928 ± 139	685 ± 134	1220 ± 147	5540 ± 261	
12/21/12							5430 ± 233	
12/27/12	507 ± 121	3510 ± 199	3670 ± 202	669 ± 137	1230 ± 152	1130 ± 148	5240 ± 227	

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty						
	MW202	MW202-I	MW203	MW204	MW207	MW208-S	MW208-I
03/06/12	942 ± 148	NDA<385	NDA<379	NDA<384	447 ± 130	NDA<378	NDA<382
06/28/12	985 ± 161	541 ± 128	NDA<430	NDA<420	488 ± 148	NDA<372	NDA<427
08/22/12	871 ± 138	NDA<346	NDA<347	NDA<341	537 ± 129	NDA<345	NDA<354
11/15/12	1160 ± 145	NDA<365	NDA<363	NDA<370	NDA<389	NDA<387	NDA<387

Sample Date	Tritium Concentration by Monitoring Well - pCi/Liter Value ± 1-sigma uncertainty					
	MW210	MW212	MW213	MW214	MW3	MW4
03/06/12	1080 ± 151	534 ± 135	NDA<385	NDA<379	NDA<379	408 ± 130
06/28/12	1010 ± 163	Inaccessible	NDA<428	NDA<434	NDA<427	421 ± 140
08/22/12	738 ± 136	Inaccessible	NDA<345	NDA<337	NDA<347	419 ± 124
11/15/12	844 ± 137	Inaccessible	NDA<363	NDA<381	NDA<388	696 ± 127

Concentrations of tritium detected in the onsite wells ranged from non-detectable at less than 337 pCi/L, up to a maximum concentration of 8,400 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-216 (average concentration = 4083 pCi/L) was consumed as drinking water for an entire year, the maximum dose consequence would be less than 0.35 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 at the Pilgrim Station site.

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 2012, 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 1180 pCi/L, the annual discharge of tritium into the intake bay under this hypothetical scenario would be 0.0148 Curies. This activity represents less than 0.050% 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 0.0148 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 2012 was 616 billion Liters, yielding an effective concentration of tritium in the intake bay of about 0.024 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. Although all four samples collected from monitoring well MW204 indicated no detectable activity, for purposes of conservatism the well was assumed to contain tritium at the average of the detection limits achieved on the four quarterly samples.

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	3.79E+02	3.67E+03	9.90E+02	6.50E+02
Annual Segment Tritium Discharge - Ci/yr	6.09E-04	7.91E-03	1.88E-03	4.44E-03
Total Volumetric Discharge - L/yr	1.25E+07			
Total H-3 Discharge - Ci/yr	1.48E-02			
Annual Circulating Water Flow - Liter/yr	6.16E+11			
Discharge Canal H-3 Concentration - Ci/L	2.41E-14			
Discharge Canal H-3 Concentration - pCi/L	2.41E-02			
Max. Indiv. Dose Factor - mrem/yr per Ci/L	5.73E+05			
Maximum Individual Dose - mrem/yr	1.38E-08			

In conclusion, there were no known leaks or spills of radioactive material at Pilgrim Station during 2012 that could have affected onsite or offsite groundwater. The only radionuclide detected in groundwater during the 2012 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 2012 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 2012.