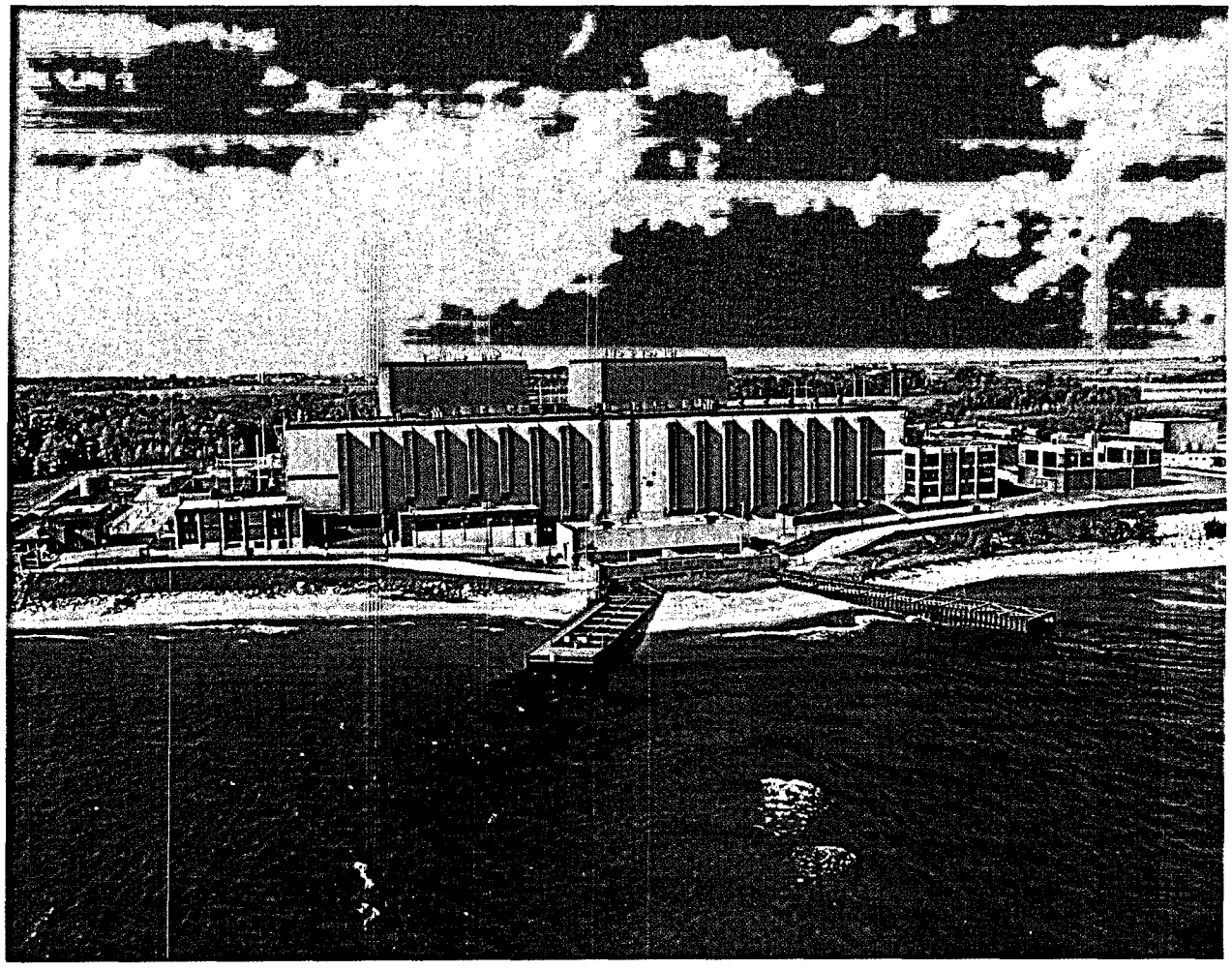
ANNUAL MONITORING REPORT 2005

NUCLEAR MANAGEMENT COMPANY, LLC
POINT BEACH NUCLEAR PLANT



January 1, 2005, through December 31, 2005
April 2006

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EXECUTIVE SUMMARY

This Annual Monitoring Report for the period of January 1, 2005, through December 31, 2005, is submitted in accordance with Point Beach Nuclear Plant (PBNP) Units 1 and 2 Technical Specification 5.6.2 and filed under Dockets 50-266 and 50-301 for Facility Operating Licenses DPR-24 and DPR-27, respectively. The report presents the results of effluent and environmental monitoring programs, solid waste shipments, non-radioactive chemical releases, and circulating water system operation.

During 2005, the following Curies (Ci) of radioactive material were released via the liquid and atmospheric pathways:

	Liquid	Atmospheric
Tritium (Ci)	553	65.6
Particulate (Ci)	0.053	0.501
Noble Gas (Ci)	(-)	0.659

(-)Noble gases in the liquids are added to the atmospheric release totals.
Atmospheric particulate includes radioiodines in this table.

For the purpose of regulatory compliance with the effluent design objectives of Appendix I to 10 CFR 50, doses from effluents are calculated for the hypothetical maximally exposed individual (MEI) for each age group and compared to the Appendix I objectives. Doses less than or equal to the Appendix I values are considered to be evidence that PBNP releases are as low as reasonably achievable (ALARA). The maximum annual calculated doses in millirem (mrem) or millirad (mrad) are shown below and compared to the corresponding design objectives of 10 CFR 50, Appendix I.

LIQUID RELEASES

Dose Category	Calculated Dose	Appendix I Dose
Whole body dose	0.0067 mrem	6 mrem
Organ dose	0.0071 mrem	20 mrem

ATMOSPHERIC RELEASES

Dose Category	Calculated Dose	Appendix I Dose
Organ dose	0.028 mrem	30 mrem
Noble gas beta air dose	0.00010 mrad	40 mrad
Noble gas gamma ray air dose	0.00024 mrad	20 mrad
Noble gas dose to the skin	0.00034 mrem	30 mrem
Noble gas dose to the whole body	0.00023 mrem	10 mrem

The results show that during 2005, the doses from PBNP effluents were a small percentage (0.11% at the most) of the Appendix I design objectives and therefore operation of PBNP continues to be ALARA.

In addition to collecting and analyzing environmental samples, a survey of land use with respect to the location of dairy cattle was made pursuant to Section 2.5 of the PBNP Environmental Manual. As in previous years, no dairy cattle were found to be grazing at the site boundary. Therefore, the assumption that cattle graze at the site boundary used in the evaluation of doses from PBNP effluents remains conservative.

The 2005 Radiological Environmental Monitoring Program (REMP) collected 805 samples for radiological analyses and 115 sets of thermoluminescent dosimeters (TLDs) to measure ambient radiation in the vicinity of PBNP and the Independent Spent Fuel Storage Installation (ISFSI). Air monitoring from six different sites showed only background radioactivity from naturally occurring radionuclides. Terrestrial monitoring consisting of soil, vegetation, and milk found no influence from PBNP. Similarly, samples from the aquatic environment, consisting of lake and well water, fish, and algae, revealed no buildup of PBNP radionuclides released in liquid effluents. Therefore, the data show no plant effect on its environs.

As of December 2005, the ISFSI contained a total of 20 dry storage casks. Sixteen are the ventilated, vertical storage casks (VSC-24) and four are the NUHOMS, horizontally stacked storage modules. No dry storage units were added to the ISFSI in 2005. The subset of the PBNP REMP samples used to evaluate the environmental impact of the PBNP ISFSI showed no environmental impact from its operation.

The environmental monitoring conducted during 2005 confirms that the effluent control program at PBNP ensures that its operations minimally impact the environs.

Part A
EFFLUENT MONITORING

1.0 INTRODUCTION

The PBNP effluent monitoring program is designed to comply with federal regulations for ensuring the safe operation of PBNP with respect to releases of radioactive material to the environment and its subsequent impact on the public. Pursuant to 10 CFR 50.34a, operations should be conducted to keep the levels of radioactive material in effluents to unrestricted areas as low as reasonably achievable (ALARA). In 10 CFR 50, Appendix I, the Nuclear Regulatory Commission (NRC) provides the numerical values for what it considers to be the appropriate ALARA design objectives to which the licensee's calculated effluent doses may be compared. These doses are a small fraction of the dose limits specified by 10 CFR 20.1301 and lower than the Environmental Protection Agency (EPA) limits specified in 40 CFR 190.

10 CFR 20.1302 directs PBNP to make the appropriate surveys of radioactive materials in effluents released to unrestricted and controlled areas. Liquid wastes are monitored by inline radiation monitors as well as by isotopic analyses of samples of the waste stream prior to discharge from PBNP. Airborne releases of radioactive wastes are monitored in a similar manner. Furthermore, for both liquid and atmospheric releases, the appropriate portions of the radwaste treatment systems are used as required to keep releases ALARA. Prior to release, results of isotopic analyses are used to adjust the release rate of discrete volumes of liquid and atmospheric wastes (from liquid waste holdup tanks and from gas decay tanks) such that the concentrations of radioactive material in the air and water beyond PBNP are below the PBNP Technical Specification concentration limits for liquid effluents and release rate limits for gaseous effluents.

Solid wastes are shipped offsite for disposal at NRC licensed facilities. The amount of radioactivity in the solid waste is determined prior to shipment in order to determine the proper shipping configuration as regulated by the Department of Transportation and the NRC.

Also operated at PBNP, under the General License granted pursuant to 10 CFR 72.210, is an Independent Spent Fuel Storage Installation (ISFSI). The release of radioactive materials from the operation of the ISFSI must also comply with the limits of Part 20 and Part 50 Appendix I design objectives. Per 10 CFR 72.44(d)(3), the results of radiological effluent monitoring are to be

reported annually.* The dose criteria for effluents and direct radiation specified by 10 CFR 72.104 states that during normal operations and anticipated occurrences, the annual dose equivalent to any real individual beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ. The dose from naturally occurring radon and its decay products are exempt. Because the loading of the storage casks occurs within the primary auxiliary building of PBNP, the doses from effluents due to the loading process will be assessed and quantified as part of the PBNP Radiological Effluent Control Program.

2.0 RADIOACTIVE LIQUID RELEASES

The radioactive liquid release path to the environment is via the circulating water discharge. A liquid waste treatment system in conjunction with administrative controls is used to minimize the impact on the environment and maintain doses to the public ALARA from the liquid releases.

2.1 Doses From Liquid Effluent

Doses from liquid effluent are calculated using the methodology of the Offsite Dose Calculation Manual (ODCM). These calculated doses use parameters such as the amount of radioactive material released, the total volume of liquid, the total volume of dilution water, and usage factors (e.g., water and fish consumption, shoreline and swimming factors). These calculations produce a conservative estimation of the dose. For compliance with 10 CFR 50, Appendix I design objectives, the annual dose is calculated to the hypothetical maximally exposed individual (MEI). The MEI is assumed to reside at the site boundary in the highest χ/Q sector and is maximized with respect to occupancy, food consumption, and other uses of this area. As such, the MEI represents an individual with reasonable deviations from the average for the general population in the vicinity of PBNP. A comparison of the calculated doses to the 10 CFR 50, Appendix I design objectives is presented in Table 2-1. The conservatively calculated dose to the MEI is a very small fraction of the Appendix I design objective.

Table 2-1
Comparison of 2005 Liquid Effluent Calculated Doses to 10 CFR 50 Appendix I Design Objectives

Annual Limit [mrem]	Highest Total Calculated Dose [mrem]	% of Design Objective
6 (whole body)	0.0067	0.11 %
20 (any organ)	0.0071	0.04 %

* Holders of a Part 72 license are allowed to submit the report required by 72.44(d)(3) concurrent with the effluent report required by 10 CFR 50.36a (a)(2). (Reference: 64 FR 33178)

2.2 2005 Circulating Water Radionuclide Release Summary

Radioactive liquid releases via the circulating water discharge are summarized by individual source and total curies released on a monthly basis and presented in Table 2-2. These releases are composed of processed waste, wastewater effluent, and blowdown from Units 1 and 2. The wastewater effluent consists of liquid from turbine hall sumps, plant well house backwashes, sewage treatment plant effluent and the Unit 1 and 2 façade sumps.

2.3 2005 Isotopic Composition of Circulating Water Discharges

The isotopic composition of circulating water discharges during the current reporting period is presented in Table 2-3. The noble gases released in liquids are reported with the airborne releases, Section 3. The isotopic distribution shows little change from 2004 with tritium, down slightly from 2004, continuing to be the major radionuclide released via liquid discharges.

2.4 Subsoil Drain System Releases Tritium Summary

The quarterly and annual results of monitoring the subsoil drains are presented in Table 2-4. These six drains are sampled once a month. The total monthly flow is calculated assuming that the flow rate at the time of sampling persists for the whole month. No tritium was observed in any of the drains during 2005.

2.5 Changes to the Waste Liquid Treatment System in 2005

There were no changes to the liquid waste treatment system in 2005.

Table 2-2
Summary of Circulating Water Discharge
January 1, 2005, through December 31, 2005

	Jan	Feb	Mar	Apr	May	Jun	Total Jan-Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Total Activity Released (Ci)														
Gamma Scan (+Fe-55)	1.27E-03	2.92E-03	4.10E-03	3.94E-03	1.36E-03	8.37E-04	1.44E-02	2.63E-02	7.37E-03	1.22E-03	1.23E-03	1.28E-03	1.50E-03	5.33E-02
Gross Alpha	0.00E+00	0.00E+00	3.46E-06	0.00E+00	0.00E+00	7.79E-07	4.24E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-06
Tritium	1.07E+02	1.29E+01	8.90E+01	3.16+01	2.14E+01	1.07E+01	2.73E+02	1.10E+02	3.50E+01	5.52E+01	3.74E+01	2.53E+01	1.71E+01	5.53E+02
Strontium (89/90/92)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Vol Released (gal)														
Processed Waste	7.07E+04	3.47E+04	9.82E+04	7.82E+04	5.79E+04	3.32E+04	3.73E+05	1.58E+05	5.24E+04	9.56E+04	1.64E+05	1.65E+05	4.75E+04	1.06E+06
Waste Water Effluent*	4.88E+06	4.24E+06	4.18E+06	2.40E+06	2.57E+06	3.13E+06	2.14E+07	3.61E+06	3.95E+06	3.57E+06	3.09E+06	4.13E+06	4.08E+06	4.38E+07
U1 SG Blowdown	2.65E+06	2.22E+06	2.66E+06	2.48E+06	2.66E+06	2.59E+06	1.53E+07	2.67E+06	2.68E+06	1.89E+06	1.74E+06	1.39E+06	3.47E+06	2.91E+07
U2 SG Blowdown	2.65E+06	2.23E+06	2.66E+06	1.41E+05	6.93E+03	0.00E+00	7.69E+06	2.50E+06	2.68E+06	2.34E+06	2.64E+06	2.57E+06	2.13E+06	2.26E+07
Total Gallons	1.02E+07	8.73E+06	9.60E+06	5.10E+06	5.30E+06	5.76E+06	1.31E+08	8.95E+06	9.36E+06	7.89E+06	5.91E+06	8.25E+06	9.74E+06	1.81E+08
Total cc	3.86E+10	3.30E+10	3.63E+10	1.93E+10	2.01E+10	2.18E+10	1.69E+11	3.39E+10	3.54E+10	2.99E+10	2.24E+10	3.12E+10	3.69E+10	3.59E+11
Vol of dilution water (cc)**	6.62E+13	5.98E+13	6.62E+13	5.72E+13	5.41E+13	5.43E+13	3.57E+14	9.94E+13	1.15E+14	9.99E+13	5.61E+13	6.99E+13	6.62E+13	8.64E+13
Avg diluted discharge conc (µCi/cc)														
Gamma Scan (+Fe-55)	1.91E-11	4.89E-11	6.19E-11	6.89E-11	2.52E-11	1.54E-11		2.64E-10	6.42E-11	1.23E-11	2.19E-11	1.83E-11	2.26E-11	
Gross Alpha	0.00E+00	0.00E+00	5.52E-14	0.00E+00	0.00E+00	1.43E-14		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Tritium	1.62E-06	2.15E-07	1.34E-06	5.53E-07	3.96E-07	1.98E-07		1.10E-06	3.04E-07	5.52E-07	6.67E-07	3.61E-07	2.59E-07	
Strontium (89/90/92)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Max Batch Discharge Conc (µ l/cc)														
Tritium	3.17E-05	1.20E-05	2.92E-05	1.35E-05	2.17E-05	8.10E-06		2.95E-05	1.58E-05	1.69E-05	1.21E-05	8.24E-06	9.10E-06	
Gamma Scan (+Fe-55)	7.16E-10	4.92E-09	1.82E-09	6.21E-09	1.06E-09	4.69E-10		6.57E-09	3.51E-09	7.15E-10	1.14E-09	1.15E-09	1.14E-09	

* The Retention Pond was taken out of service in September 2002 and replaced with the waste water effluent filter system.
** Circulating water discharge from both units.

Note: The Dissolved noble gases detected in liquid effluents (e.g., Xe-133 and Xe-135) are added to the atmospheric release summaries.

Table 2-3
Isotopic Composition of Circulating Water Discharges (Ci)
January, 2005 through December 31, 2005

							Total							Total
Nuclide	Jan	Feb	Mar	Apr	May	Jun	Jan-Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Dec
H-3	1.07E+02	1.29E+01	8.90E+01	3.16E+01	2.14E+01	1.07E+01	2.73E+02	1.10E+02	3.50E+01	5.52E+01	3.74E+01	2.53E+01	1.71E+01	5.53E+02
F-18	7.70E-05	2.48E-05	7.89E-05	7.93E-05	1.60E-04	1.99E-04	6.19E-04	8.12E-05	1.14E-04	2.46E-05	8.84E-05	1.39E-05	2.60E-04	1.20E-03
Cr-51	0.00E+00	0.00E+00	2.43E-05	0.00E+00	0.00E+00	0.00E+00	2.43E-04	1.95E-03	1.96E-04	5.06E-05	1.75E-05	1.47E-04	1.66E-04	2.55E-03
Mn-54	7.06E-06	1.29E-04	1.27E-05	1.41E-04	8.09E-06	1.03E-05	3.08E-04	3.40E-04	1.29E-05	1.91E-05	5.45E-06	4.95E-06	5.99E-06	6.97E-04
Fe-55	0.00E+00	2.10E-04	4.46E-04	3.85E-04	1.88E-04	3.39E-04	1.57E-03	1.19E-03	2.58E-04	0.00E+00	0.00E+00	0.00E+00	2.12E-04	3.23E-03
Fe-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-05	0.00E+00	1.04E-05
Co-57	0.00E+00	9.56E-06	0.00E+00	1.11E-05	0.00E+00	0.00E+00	2.06E-05	9.19E-06	0.00E+00	0.00E+00	0.00E+00	6.30E-07	0.00E+00	3.04E-05
Co-58	2.47E-05	3.57E-04	7.07E-05	3.01E-04	7.60E-05	9.96E-05	9.29E-04	2.33E-03	8.68E-05	7.14E-05	6.02E-04	4.89E-04	4.11E-04	4.92E-03
Co-60	1.51E-04	9.85E-04	2.00E-04	1.56E-03	3.79E-04	1.08E-04	3.38E-03	3.32E-03	4.23E-04	5.04E-04	2.32E-04	8.26E-05	7.93E-05	8.02E-03
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.13E-05
As-76	0.00E+00	0.00E+00	0.00E+00	4.25E-06	0.00E+00	0.00E+00	4.25E-06	1.44E-05	0.00E+00	0.00E+00	0.00E+00	1.12E-06	0.00E+00	1.97E-05
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	0.00E+00	3.06E-04	2.02E-05	2.22E-04	0.00E+00	0.00E+00	5.48E-04	8.95E-04	4.31E-05	0.00E+00	1.69E-06	5.24E-05	8.33E-05	1.62E-03
Nb-97	0.00E+00	0.00E+00	0.00E+00	2.30E-06	0.00E+00	0.00E+00	2.30E-06	2.22E-06	0.00E+00	0.00E+00	2.56E-06	0.00E+00	0.00E+00	7.07E-06
Zr-95	0.00E+00	1.34E-04	0.00E+00	1.01E-04	0.00E+00	0.00E+00	2.35E-04	3.82E-04	1.53E-05	0.00E+00	0.00E+00	2.41E-05	2.93E-05	6.85E-04
Ag-110m	1.93E-05	5.35E-04	6.94E-05	4.78E-04	3.13E-05	6.32E-05	1.20E-03	1.76E-03	1.15E-04	3.00E-05	5.60E-05	4.59E-05	8.43E-05	3.29E-03
Sn-113	0.00E+00	2.06E-05	0.00E+00	2.27E-05	0.00E+00	0.00E+00	4.33E-05	7.10E-05	0.00E+00	6.08E-06	3.47E-06	1.54E-05	2.46E-05	1.64E-04
Sn-117m	3.16E-05	0.00E+00	1.87E-06	8.79E-06	1.49E-04	0.00E+00	1.91E-04	1.33E-03	2.22E-04	5.74E-05	1.67E-04	3.63E-04	1.21E-04	2.45E-03
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.75E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.75E-06
Sb-124	1.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-05	0.00E+00	3.05E-05	0.00E+00	0.00E-00	0.00E+00	0.00E+00	4.76E-05
Sb-125	9.37E-04	2.09E-04	3.18E-03	6.21E-04	3.67E-04	0.00E+00	5.31E-03	1.24E-02	5.77E-03	4.48E-04	1.15E-05	1.62E-05	9.54E-06	2.40E-02
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	1.07E-05	0.00E+00	1.74E-05	1.74E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-05
Cs-136	0.00E+00	0.00E+00	0.00E+00	1.51E-06	0.00E+00	0.00E+00	1.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-06
Cs-137	1.71E-06	2.91E-06	1.08E-06	6.63E-06	4.59E-06	0.00E+00	1.69E-05	8.72E-05	8.15E-05	1.32E-05	3.94E-05	1.24E-05	1.14E-05	2.62E-04

Note: The dissolved noble gases detected in liquid effluents (e.g., Xe-133, Xe-135, etc.) are added to the atmospheric release summaries.

Table 2-4
Subsoil System Drains - Tritium Summary
January 1, 2005, through December 31, 2005

	S-1	S-3	S-7	S-8	S-9	S-10
1st Qtr						
H-3 (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flow (gal)	2.41E+05	6.18E+05	4.03E+04	0.00E+00	0.00E+00	0.00E+00
2nd Qtr						
H-3 (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flow (gal)	1.75E+06	4.45E+06	0.00E+00	0.00E+00	1.12E+06	0.00E+00
3rd Qtr						
H-3 (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flow (gal)	6.29E+05	2.31E+05	0.00E+00	0.00E+00	5.18E+05	0.00E+00
4th Qtr						
H-3 (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flow (gal)	2.69E+06	5.97E+05	6.48E+04	6.48E+04	8.64E+04	6.48E+04

2.6 Land Application of Sewage Sludge

The Wisconsin Department of Natural Resources has approved the disposal of PBNP sewage by land application on various Wisconsin Electric Power Company properties surrounding PBNP. This sewage sludge, which may contain trace amounts of radionuclides, are to be applied in accordance with methodologies approved by the NRC on January 13, 1988, pursuant to 10 CFR 20.302(a). The approved methodology requires analyses prior to every disposal. Based upon an investigation of the source of the radionuclides, a combination of engineering modifications and administrative controls has eliminated plant generated radiological inputs to the sewage. This was verified by sludge analyses using the environmental lower level of detection (LLD) criteria. No byproduct radionuclides were found in the sludge after the controls and modifications were completed. Sludge is routinely monitored and no radionuclides attributable to PBNP have been found.

There was no disposal of sewage by land application during 2005. All disposals were done at the Manitowoc Sewage Treatment Plant.

3.0 RADIOACTIVE AIRBORNE RELEASES

The release paths to the environment contributing to radioactive airborne release totals during this reporting period were the Auxiliary Building Vent Stack, the Drumming Area Vent Stack, the Letdown Gas Stripper, the Unit 1 Containment Purge Stack, and the Unit 2 Containment Purge Stack. A gaseous radioactive effluent treatment system in conjunction with administrative controls is used to minimize the impact on the environment from the airborne releases and maintain doses to the public ALARA.

3.1 Doses From Airborne Effluent

Doses from airborne effluent are calculated for the maximum exposed individual (MEI) following the methodology contained in the PBNP ODCM. These calculated doses use parameters such as the amount of radioactive material released, the concentration at and beyond the site boundary, the average site weather conditions, the locations of the exposure pathways (e.g., cow milk, vegetable gardens and residences), and usage factors (e.g., breathing rates, food consumption). In addition to the MEI doses, the energy deposited in the air by noble gas beta particles and gamma rays is calculated and compared to the corresponding Appendix I design objectives. A comparison of the annual Appendix I design objectives for atmospheric effluents to the highest organ dose and the noble gas doses calculated using ODCM methodology is listed in Table 3-1. The doses demonstrate that releases from PBNP to the atmosphere continue to be ALARA.

3.2 Radioactive Airborne Release Summary

Radioactivity released in airborne effluents for 2005 are summarized in Table 3-2.

3.3 Isotopic Airborne Releases

The monthly isotopic airborne releases for 2005, from which the airborne doses were calculated, are presented in Table 3-3. The main difference between 2004 and 2005 is the increased amount of F-18 and the number of other airborne particulates. The increased F-18 is based on one sample from the Let Down Gas Stripper and conservatively assumed to continue for one week. The increase in the number of particulates is derived from measurements of containment airborne activity during each outage. When both the equipment hatch and the 66' elevation hatch are open, there is a measurable, convective flow out the upper hatch. Because this air is not filtered, whatever is measured in containment air is assumed to be carried out the hatch, through the façade, and into the environment thereby contributing to the calculated dose.

Table 3-1
Comparison of 2005 Airborne Effluent Calculated Doses to 10 CFR 50 Appendix I Design Objectives

Category	Annual Appendix I Design Objective	January-December Calculated Dose	Percent of Appendix I Design Objective
Particulate	30 mrem/organ	0.028 mrem	9.33E-02
Noble gas	40 mrad (beta air)	0.00010 mrad	2.40E-04
Noble gas	20 mrad (gamma air)	0.00024 mrad	1.20E-03
Noble gas	30 mrem/organ	0.00034 mrem	1.14E-03
Noble gas	10 mrem (whole body)	0.00023 mrem	2.27E-03

Table 3-2
Radioactive Airborne Effluent Release Summary
January 1, 2005, through December 31, 2005

							Total							
	Jan	Feb	Mar	Apr	May	Jun	J-Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total NG from Liq (Ci)	8.03E-05	0.00E+00	4.92E-04	6.65E-04	1.22E-04	1.96E-06	1.36E-03	8.45E-04	2.24E-04	9.62E-04	1.23E-04	1.08E-03	7.35E-04	5.33E-03
Total Noble Gas (Ci)1	1.65E-01	4.79E-02	5.12E-02	4.25E-02	2.28E-02	1.73E-02	3.47E-01	3.82E-02	6.71E-02	6.13E-02	3.66E-02	5.58E-02	5.33E-02	6.59E-01
Total Radioiodines (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.80E-10	2.21E-08	1.23E-03	0.00E+00	0.00E+00	1.23E-03
Total Particulate (Ci)2	0.00E+00	1.27E-07	0.00E+00	0.00E+00	8.89E-10	1.13E-05	1.14E-05	6.95E-05	5.00E-01	1.01E-07	2.60E-04	3.95E-08	5.35E-04	5.01E-01
Alpha (Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium(Ci)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All other beta + gamma (Ci)	0.00E+00	1.27E-07	0.00E+00	0.00E+00	8.89E-10	1.13E-05	1.14E-05	6.95E-05	5.00E-01	1.01E-07	2.60E-04	3.95E-08	5.35E-04	5.01E-01
Total Tritium (Ci)	6.53E+00	6.94E+00	6.90E+00	6.88E+00	5.40E+00	3.65E+00	3.63E+01	2.45E+00	2.66E+00	2.45E+00	1.23E+01	4.29E+00	5.13E+00	6.56E+01
Max NG H'rly Rel.(Ci/sec)	1.92E-06	3.80E-08	4.01E-08	3.67E-06	1.31E-06	5.17E-07		3.98E-08	4.87E-08	3.87E-08	5.54E-08	6.03E-08	5.14E-08	

[1] Total noble gas (airborne + liquid releases).
[2] Total Particulate is the sum of alpha, strontium, and others. It does not include radioiodines.

TABLE 3-3
Isotopic Composition of Airborne Releases
January 1, 2005 through December 31, 2005

	Jan	Feb	Mar	Apr	May	Jun	Semi-	Jul	Aug	Sep	Oct	Nov	Dec	Total
Nuclide	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	Annual	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
H-3	6.35E+00	6.94E+00	6.90E+00	6.88E+00	5.40E+00	3.65E+00	3.61E+01	2.45E+00	2.66E+00	2.45E+00	1.23E+01	4.29E+00	5.13E+00	6.54E+01
Ar-41	7.67E-02	4.78E-02	4.88E-02	2.44E-02	2.26E-02	1.51E-02	2.35E-01	3.40E-02	4.92E-02	3.55E-02	2.81E-02	3.61E-02	4.29E-02	4.61E-01
Kr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.63E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.63E-04
Kr-85m	3.01E-03	0.00E+00	0.00E+00	4.85E-04	0.00E+00	2.11E-04	3.71E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-03
Kr-87	7.68E-03	0.00E+00	0.00E+00	1.12E-03	0.00E+00	4.91E-06	8.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E-03
Kr-88	7.74E-03	0.00E+00	0.00E+00	1.12E-03	0.00E+00	2.60E-04	9.12E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.12E-03
Xe-133	1.71E-03	9.40E-05	1.99E-03	4.15E-03	1.22E-04	3.75E-04	8.44E-03	3.82E-03	1.77E-02	2.50E-02	8.05E-03	1.82E-02	1.02E-02	9.14E-02
Xe-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.13E-04	4.13E-04	0.00E+00	0.00E+00	1.06E-04	0.00E+00	0.00E+00	0.00E+00	5.19E-04
Xe-135	1.47E-02	0.00E+00	4.57E-04	4.21E-03	0.00E+00	2.97E-04	1.97E-02	0.00E+00	2.24E-04	7.40E-04	4.15E-04	1.38E-03	1.49E-04	2.26E-02
Xe-135m	1.48E-02	0.00E+00	0.00E+00	1.92E-03	0.00E+00	3.97E-04	1.71E-02	7.27E-05	0.00E+00	0.00E+00	0.00E+00	1.98E-04	0.00E+00	1.74E-02
Xe-138	3.89E-02	0.00E+00	0.00E+00	5.17E-03	0.00E+00	2.77E-04	4.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-02
F-18	0.00E+00	1.27E-07	0.00E+00	0.00E+00	8.89E-10	8.17E-06	8.30E-06	6.93E-05	5.00E-01	0.00E+00	1.94E-04	0.00E+00	5.35E-04	5.01E-01
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.78E-06	0.00E+00	0.00E+00	9.78E-06
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-08	2.07E-08	0.00E+00	0.00E+00	7.86E-08	6.90E-07	0.00E+00	0.00E+00	7.89E-07
Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.79E-07	0.00E+00	0.00E+00	5.79E-07
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-07	1.68E-07	0.00E+00	0.00E+00	0.00E+00	4.16E-05	5.42E-09	0.00E+00	4.18E-05
Co-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.64E-07	9.64E-07	0.00E+00	8.97E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-06
Br-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E-10
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.40E-07	7.40E-07	1.79E-07	0.00E+00	0.00E+00	6.78E-06	2.22E-08	0.00E+00	7.72E-06
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.36E-07	4.36E-07	0.00E+00	0.00E+00	0.00E+00	5.34E-06	1.19E-08	0.00E+00	5.79E-06
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.72E-08	4.72E-08	0.00E+00	0.00E+00	0.00E+00	1.46E-07	0.00E+00	0.00E+00	1.93E-07
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E-07	0.00E+00	0.00E+00	3.30E-07
Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.22E-07	6.22E-07	2.96E-07	0.00E+00	0.00E+00	2.64E-08	0.00E+00	0.00E+00	9.44E-07
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-07	1.33E-07	2.21E-07	0.00E+00	0.00E+00	3.76E-07	0.00E+00	0.00E+00	7.30E-07
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-08	4.62E-05	0.00E+00	0.00E+00	4.62E-05
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E-03	0.00E+00	0.00E+00	1.18E-03
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.80E-10	8.33E-09	0.00E+00	0.00E+00	0.00E+00	8.91E-09
Cs-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-08	2.33E-08	0.00E+00	0.00E+00	0.00E+00	2.40E-07	0.00E+00	0.00E+00	2.63E-07

Note: The Noble Gases listed above include the liquid contribution.

4.0 RADIOACTIVE SOLID WASTE SHIPMENTS

4.1 Types, Volumes, and Activity of Shipped Solid Waste

The following types, volumes, and activity of solid waste were shipped from PBNP for offsite disposal or burial during 2005. No types C or D were shipped. No irradiated fuel was shipped offsite. The volume, activity, and type of waste are listed in Table 4-1.

Table 4-1
Quantities and Types of Waste Shipped from PBNP

Type of Waste	Quantity	Activity
A. Spent resins, filter sludge, evaporator bottoms, etc.	16.598 m^3	162.145 Ci
	586.15 ft^3	
B. Dry compressible waste, contaminated equipment, etc	450 m^3	37.36 Ci
	15881 ft^3	
C. Irradiated components, control rods, etc.	0.00 m^3	N/A Ci
	0.00 ft^3	
D. Other	0.00 m^3	N/A Ci
	0.00 ft^3	

4.2 Major Nuclide Composition (by Type of Waste)

The major radionuclide content of the 2005 solid waste was determined by gamma isotopic analysis and the application of scaling factors for certain indicator radionuclides based on the measured isotopic content of representative waste stream samples. The estimated isotopic content is presented in Table 4-2.

Table 4-2
2005 Estimated Solid Waste Major Radionuclide Composition

TYPE A		TYPE B		TYPE C		TYPE D	
	Percent		Percent		Percent		Percent
Nuclide	Abundance	Nuclide	Abundance	Nuclide	Abundance	Nuclide	Abundance
Ni-63	57.09%	Fe-55	35.34%				
Fe-55	18.55%	Nb-95	20.98%				
Co-60	10.71%	Co-60	13.05%				
Co-58	3.66%	Co-58	12.50%				
Ce-144	3.20%	Cr-51	5.79%				
Cs-137	3.13%	Ni-63	5.06%				
H-3	1.49%	Mn-54	1.69%				
Sb-125	1.13%	Zr-95	1.57%				
Ni-59	0.34%	Ag-108m	1.18%				
Mn-54	0.19%	Sr-90	0.53%				
Pu-241	0.15%	Sb-125	0.40%				
Ag-110	0.14%	H-3	0.34%				
Tc-99	0.13%	Zn-65	0.30%				
Sr-90	0.06%	Cs-134	0.24%				
Sb-124	0.01%	Sn-113	0.23%				
C-14	0.01%	Fe-59	0.21%				
Nb-95	0.01%	Sb-124	0.18%				
Pu-238	0.00%	C-14	0.15%				
Am-241	0.00%	Cs-137	0.08%				
Pu-239	0.00%	Co-57	0.07%				
Pu-240	0.00%	Ag-110m	0.07%				
Cm-243	0.00%	Ru-103	0.02%				
Cm-244	0.00%	Am-241	0.01%				
Nb-94	0.00%	Pu-241	0.00%				
Cm-242	0.00%	Ni-59	0.00%				
I-129	0.00%	Nb-94	0.00%				
		Pu-238	0.00%				
		Cm-242	0.00%				
		Pu-239	0.00%				
		Pu-240	0.00%				
		Cm-243	0.00%				
		Cm-244	0.00%				

4.3 Solid Waste Disposition

There were 22 solid waste shipments from PBNP during 2005. The dates and destinations were:

Table 4-3
2005 PBNP Radioactive Waste Shipments

Date	Destination	Date	Destination
01/10/05	Erwin, TN		
01/19/05	Memphis, TN		
02/04/05	Memphis, TN		
02/21/05	Wampum, PA		
03/15/05	Erwin, TN		
03/31/05	Memphis, TN		
04/25/05	Clive, UT		
04/25/05	Clive, UT		
05/11/05	Memphis, TN		
05/17/05	Clive, UT		
07/18/05	Clive, UT		
08/17/05	Wampum, PA		
09/09/05	Erwin, TN		
09/14/05	Memphis, TN		
10/06/05	Clive, UT		
10/06/05	Clive, UT		
10/10/05	Wampum, PA		
10/18/05	Clive, UT		
10/19/05	Clive, UT		
10/19/05	Clive, UT		
10/25/05	Clive, UT		
10/26/05	Memphis, TN		

5.0 NONRADIOACTIVE CHEMICAL RELEASES

5.1 Scheduled Chemical Waste Releases

Scheduled chemical waste releases to the circulating water system from January 1, 2005, to June 30, 2005, included 4.24E+05 gallons of neutralized wastewater. The wastewater contained 2.51E+01 pounds of suspended solids and 1.20E+02 pounds of dissolved solids.

Scheduled chemical waste releases to the circulating water system from July 1, 2005, to December 31, 2005, included 5.33E+05 gallons of neutralized wastewater. The wastewater contained 3.95E+00 pounds of suspended solids and 1.04E+04 pounds of dissolved solids.

Scheduled chemical waste releases are based on the average analytical results obtained from sampling a representative number of neutralizing tanks.

5.2 Miscellaneous Chemical Waste Releases

Miscellaneous chemical waste releases from the Wastewater Effluent (based on effluent analyses) to the circulating water for January 1, 2005, to June 30, 2005, included 2.14E+07 gallons of clarified wastewater. The wastewater contained 2.05E+03 pounds of suspended solids.

Miscellaneous chemical waste releases from the Wastewater Effluent (based on effluent analyses) to the circulating water for July 1, 2005, to December 31, 2005, included 2.24E+07 gallons of clarified wastewater. The wastewater contained 2.10E+03 pounds of suspended solids.

Miscellaneous chemical waste released directly to the circulating water, based on amount of chemicals used from January 1, 2005, to June 30, 2005, included 5.54E+04 pounds of sodium bisulfite and 1.67E+04 pounds of sodium hypochlorite.

Miscellaneous chemical waste released directly to the circulating water, based on amount of chemicals used from July 1, 2005, to December 31, 2005, included 1.26E+05 pounds of sodium bisulfite and 4.26E+04 pounds of sodium hypochlorite.

6.0 CIRCULATING WATER SYSTEM OPERATION

The circulating water system operation during this reporting period for periods of plant operation is described in Table 6-1.

Table 6-1
Circulating Water System Operation for 2005

	UNIT	JAN	FEB	MAR	APR	MAY	JUN
Average Volume Cooling Water Discharge [million gal/day]**	1	282.2	282.2	282.2	477.4	461.1	476.0
	2	282.2	282.2	282.2	270.8	0.0*	39.1*
Average Cooling Water Intake Temperature [°F]	1	36	36	38	44	46	51
	2	36	36	38	39*	*	54*
Average Cooling Water Discharge Temperature [°F]	1	68	68	69	64	67	71
	2	70	70	72	51*	*	55*
Average Ambient Lake Temperature [°F]		41	42	42	50	51	56

*Unit 2 shutdown from Apr 2 - July 10, 2005.
** For days with cooling water discharge flow.

Table 6-1(continued)
Circulating Water System Operation for 2005

	UNIT	JUL	AUG	SEP	OCT	NOV	DEC
Average Volume Cooling Water Discharge [million gal/day]**	1	493.4	489.6	463.4	0.0*	261.7	278.1
	2	406.9	489.6	492.6	479.8	459.1	286.0
Average Cooling Water Intake Temperature [°F]	1	62	61	58*	*	42*	37
	2	62*	59	57	49	42	35
Average Cooling Water Discharge Temperature [°F]	1	81	80	76*	*	52*	66
	2	77*	81	78	72	65	71
Average Ambient Lake Temperature [°F]		59	56	53	46	40	32

* Unit 1 shutdown Sept 25-Nov 24, 2005. Unit 2 shutdown April 2-July 10, 2005
** For days with cooling water discharge flow.

Part B
Miscellaneous Reporting Requirements

7.0 ADDITIONAL REPORTING REQUIREMENTS

7.1 Revisions to the PBNP Effluent and Environmental Programs

The PBNP Offsite Dose Calculation Manual and the Environmental Manual were revised during 2005.

Changes to the ODCM and EM consisted of redefining program responsibilities and revising the description of program audits to reflect the revised PBNP QA program.

A complete copy of each is included with this AMR submittal.

7.2 Interlaboratory Comparison Program

Environmental, Inc, Midwest Laboratory, the analytical laboratory contracted to perform the radioanalyses of the PBNP environmental samples, participated in the interlaboratory comparison studies administered by Environmental Resources Associates (ERA) during 2005. Environmental, Inc., Midwest Laboratory also participated in the Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP). The ERA environmental crosscheck program replaces the Environmental Measurements Laboratory (EML) Quality Assessment Program which discontinued. The results of these comparisons can be found in Appendix A of the AMR.

7.3 Special Circumstances

No special circumstances report regarding operation of the explosive gas monitor for the waste gas holdup system was needed during 2005.

Part C
RADIOLOGICAL ENVIRONMENTAL MONITORING

8.0 INTRODUCTION

The objective of the PBNP Radiological Environmental Monitoring Program (REMP) is to determine whether the operation of PBNP or the ISFSI has radiologically impacted the environment. To this end, the REMP collects and analyzes air, water, milk, soil, vegetation, and fish samples for radionuclides and uses TLDs to determine the ambient radiation background. These measurements also serve as a check of the efficacy of PBNP effluent controls. The REMP fulfills the requirements of 10 CFR 20.1302, PBNP General Design Criterion (GDC) 17, GDC 64 of Appendix A to 10 CFR 50, and Sections IV.B.2 and IV.B.3 of Appendix I to 10 CFR 50 for the operation of the plant. Therefore, the REMP collects samples from various environmental media in order to provide data on measurable levels of radiation and radioactive materials in the principal pathways of environmental exposure.

A subset of the PBNP REMP samples, consisting of air, soil, and vegetation, also fulfills 10 CFR 72.44(d)(2) for operation of the ISFSI. Additionally, thermoluminescent dosimeters (TLDs) provide the means to measure changes in the ambient environmental radiation levels at sites near the ISFSI and at the PBNP site boundary to ensure that radiation levels from the ISFSI are maintained within the dose limits of 10 CFR 72.104. Because the ISFSI is within the PBNP site boundary, radiation doses from PBNP and the ISFSI, combined, must be used to assess compliance with 10 CFR 72.122 and 40 CFR 190. Therefore, radiological environmental monitoring for the ISFSI is provided by selected sampling sites, which are part of the PBNP REMP.

For the aquatic environment, the samples include water as well as the biological integrators, such as fish and filamentous algae. Because of their migratory behavior, fish are wide area integrators. In contrast, the filamentous algae periphyton is attached to shoreline rocks and concentrate nuclides from the water flowing by their point of attachment. Grab samples of lake water provide a snapshot of radionuclide concentrations at the time the sample is taken; whereas analysis of fish and filamentous algae yield concentrations integrated over time.

The air-grass-cow-milk exposure pathway unites the terrestrial and atmospheric environments. This pathway is important because of the many dairy farms around PBNP. Therefore, the REMP includes samples of air, general grasses, and milk from the PBNP environs. An annual land use survey is made to determine whether the assumptions on the location of dairy cattle remain conservative with respect to dose calculations for PBNP effluents. The dose calculations assume that the dairy cattle are located at the south site boundary,

the highest depositional sector. In addition, soil samples are collected and analyzed in order to monitor the potential for long-term buildup of radionuclides in the vicinity of PBNP.

For the measurement of ambient environmental radiation levels that may be affected by direct radiation from PBNP or by noble gas effluents, the REMP employs a series of TLDs situated around PBNP and the ISFSI.

9.0 PROGRAM DESCRIPTION

9.1 Results Reporting Convention

The vendor used by PBNP to analyze the environmental samples is directed to report analysis results as measured by a detector, which can meet the required lower level of detection (LLD) as specified in Table 2-2 of the Environmental Manual for each sample. The report provided by the vendor (see the Appendix) contains values, which can be either negative, positive or zero plus/minus the two sigma counting uncertainty, which provides the 95% confidence level for the measured value.

The lower limit of detection (LLD) is an *a priori* concentration value that specifies the performance capability of the counting system used in the analyses of the REMP samples. The parameters for the *a priori* LLD are chosen such that only a five percent chance exists of falsely concluding a specific radionuclide is present when it is not present at the specified LLD. Based on detector efficiency and average background activity, the time needed to count the sample in order to achieve the desired LLD depends upon the sample size. Hence, the desired LLD may be achieved by adjusting various parameters. When a suite of radionuclides are required to be quantified in an environmental sample such as lake water, the count time used is that required to achieve the LLD for the radionuclide with the longest counting time. Therefore, in fulfilling the requirement for the most difficult to achieve radionuclide LLD, the probability of detecting the other radionuclides is increased because the counting time used is longer than that required to achieve the remaining radionuclide LLDs.

The REMP results in this report are reported as averages of the measurements made throughout the calendar year plus/minus the associated standard deviation. If all net sample concentrations are equal to or less than zero, the result is reported as "Not Detectable" (ND), indicating no detectable level of activity present in the sample. If any of the net sample concentrations indicate a positive result statistically greater than zero, all of the data reported are used to generate the reported statistics. Because of the statistical nature of radioactive decay, when the radionuclide of interest is not present in the sample, negative and positive results centered about zero will be seen. Excluding validly

measured concentrations, whether negative or as small positive values below the LLD, artificially inflates the calculated average value. Therefore, all generated data are used to calculate the statistical values (i.e., average, standard deviation) presented in this report.

In interpreting the data, effects due to the plant must be distinguished from those due to other sources. A key interpretive aid in assessment of these effects is the design of the PBNP REMP, which is based upon the indicator-control concept. Most types of samples are collected at both indicator locations (e.g., nearby, downwind, or downstream) and at control locations (e.g., distant, upwind, or upstream). A plant effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than could be accounted for by typical fluctuation in radiation levels arising from other sources.

9.2 Sampling Parameters

Samples are collected and analyzed at the frequency indicated in Table 9-1 from the locations described in Table 9-2 and shown in Figures 9-1, 9-2, and 9-3. (The latter two figures show sampling locations not shown in preceding figures due to space limitations. The location of the former retention pond, retired and remediated to NRC unrestricted access criteria, is indicated in Fig. 9-3). The list of PBNP REMP sampling sites used to determine environmental impact around the ISFSI is found in Table 9-3. The minimum acceptable sample size is found in Table 9-4. In addition, Table 9-1 indicates the collection and analysis frequency of the ISFSI fence TLDs.

9.3 Deviations from Required Collection Frequency

Deviations from the collection frequency given in Table 9-1 are allowed because of hazardous conditions, automatic sampler malfunction, seasonal unavailability, and other legitimate reasons (Section 2.2.6 of the Environmental Manual). Table 9-5 lists the deviations from the scheduled sampling frequency that occurred during the reporting period.

9.4 Assistance to the State of Wisconsin

The Radiation Protection Unit of the Wisconsin Department of Health and Family Services maintains a radiological environmental monitoring program in order to confirm the results from the PBNP REMP. As a courtesy to the State of Wisconsin, PBNP personnel also collect certain environmental samples (Table 9-6) for the State from sites that are near PBNP sampling sites, or are co-located. The results of the State monitoring program are available from the Radiation Protection Unit of the Wisconsin Department of Health and Family Services.

9.5 Program Modifications

The EM and ODCM were revised in 2005 for minor program modifications.

Table 9-1
PBNP REMP Sample Analysis and Frequency

Sample Type	Sample Codes	Analyses	Frequency
Environmental Radiation Exposure	E-01, -02, -03, -04, -05 -06, -07, -08, -09, -12 -14, -15, -16, -17, -18, -20, -22, -23, -24, -25, -26, -27, -28, -29, -30, -31, -32, -38, -39, -TC	TLD	Quarterly
Vegetation	E-01, -02, -03, -04, -06, -08, -09, -20,	Gross Beta	3x/yr as available
		Gamma Isotopic Analysis	
Algae	E-05, -12	Gross Beta	3x/yr as available
		Gamma Isotopic Analysis	
Fish	E-13	Gross Beta	3x/yr as available
		Gamma Isotopic Analysis (Analysis of edible portions only)	
Well Water	E-10	Gross Beta, H-3	Quarterly
		Sr-89, 90, I-131	
		Gamma Isotopic Analysis (on total solids)	
Lake Water	E-01, -05, -06, -33	Gross Beta	Monthly / Quarterly composite of monthly collections
		I-131	Monthly
		Gamma Isotopic Analysis (on total solids)	Monthly
Milk	E-11, -40, -21	Sr-89, 90	Monthly
		I-131	
		Gamma Isotopic Analysis	
Air Filters	E-01, -02, -03, -04, -08, -20	Gross Beta	Weekly (particulate)
		I-131	Weekly (charcoal)
		Gamma Isotopic Analysis	Quarterly (on composite particulate filters)
Soil	E-01, -02, -03, -04, -06, -08, -09, -20,	Gross Beta	2x/yr
		Gamma Isotopic Analysis	
Shoreline Sediment	E-01, -05, -06, -12, -33,	Gross Beta	2x/yr
		Gamma Isotopic Analysis	
ISFSI Ambient Radiation Exposure	North, East, South, West Fence Sections	TLD	Quarterly

Table 9-2
PBNP REMP Sampling Locations

Location Code	Location Description
E-01	Primary Meteorological Tower South of the Plant
E-02	Site Boundary Control Center - East Side of Building
E-03	Tapawingo Road, about 0.4 Miles West of Lakeshore Road
E-04	North Boundary
E-05	Two Creeks Park
E-06	Point Beach State Park - Coast Guard Station; TLD located South of the Lighthouse on Telephone pole
E-07	WPSC Substation on County V, about 0.5 Miles West of Hwy 42
E-08	G.J. Francar Property at Southeast Corner of the Intersection of Cty. B and Zander Road
E-09	Nature Conservancy
E-10	PBNP Site Well
E-11	Dairy Farm about 3.75 Miles West of Site
E-12	Discharge Flume/Pier
E-13	Pumphouse
E-14	South Boundary, about 0.2 miles East of Site Boundary Control Center
E-15	Southwest Corner of Site
E-16	WSW, Hwy 42, a residence about 0.25 miles North of Nuclear Road
E-17	North of Mishicot, Cty. B and Assman Road, Northeast Corner of Intersection
E-18	Northwest of Two Creeks at Zander and Tannery Roads
E-40	Local Dairy Farm, W side of Hwy 42, about 1.8 miles north of the Nuclear Rd intersection
E-20	Reference Location, 17 miles Southwest, at Silver Lake College
E-21	Local Dairy Farm just South of Site on Lakeshore and Irish Roads
E-22	West Side of Hwy 42, about 0.25 miles North of Johanek Road
E-23	Greenfield Lane, about 4.5 Miles South of Site, 0.5 Miles East of Hwy 42
E-24	North Side of County Rt. V, near intersection of Saxonburg Road
E-25	South Side of County Rt. BB, about 0.5 miles West of Norman Road
E-26	804 Tapawingo Road, about 0.4 miles East of Cty. B, North Side of Road
E-27	Intersection of Saxonburg and Nuclear Roads, Southwest Corner, about 4 Miles WSW
E-28	TLD site on western most pole between the 2nd and 3rd parking lots.
E-29	Area of North Meteorological Tower.
E-30	NE corner at Intersection of Tapawingo and Lakeshore Roads.
E-31	On utility pole North side of Tapawingo Road closest to the gate at the West property line.
E-32	On a tree located at the junction of property lines, as indicated by trees and shrubs, about 500 feet east of the west gate on Tapawingo Road and about 1200 feet south of Tapawingo Road. The location is almost under the power lines between the blue and gray transmission towers.
E-33	Lake Michigan shoreline accessed from the SE corner of KNPP parking lot. Sample South of creek.
E-38	Tree located at the West end of the area previously containing the Retention Pond.
E-39	Tree located at the East end of the area previously containing the Retention Pond.
E-TC	Transportation Control; Reserved for TLDs

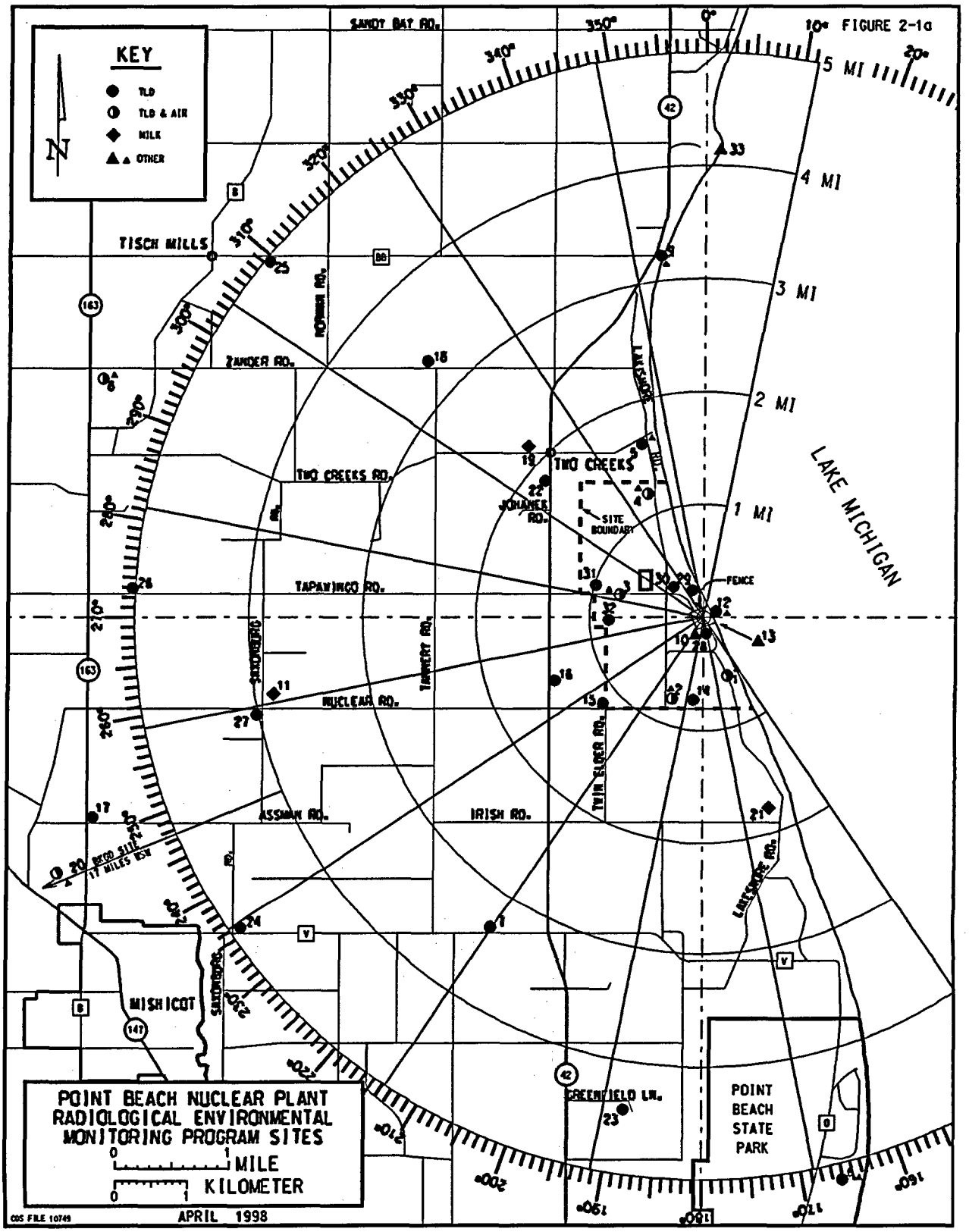


Figure 9-1
PBNP REMP Sampling Sites

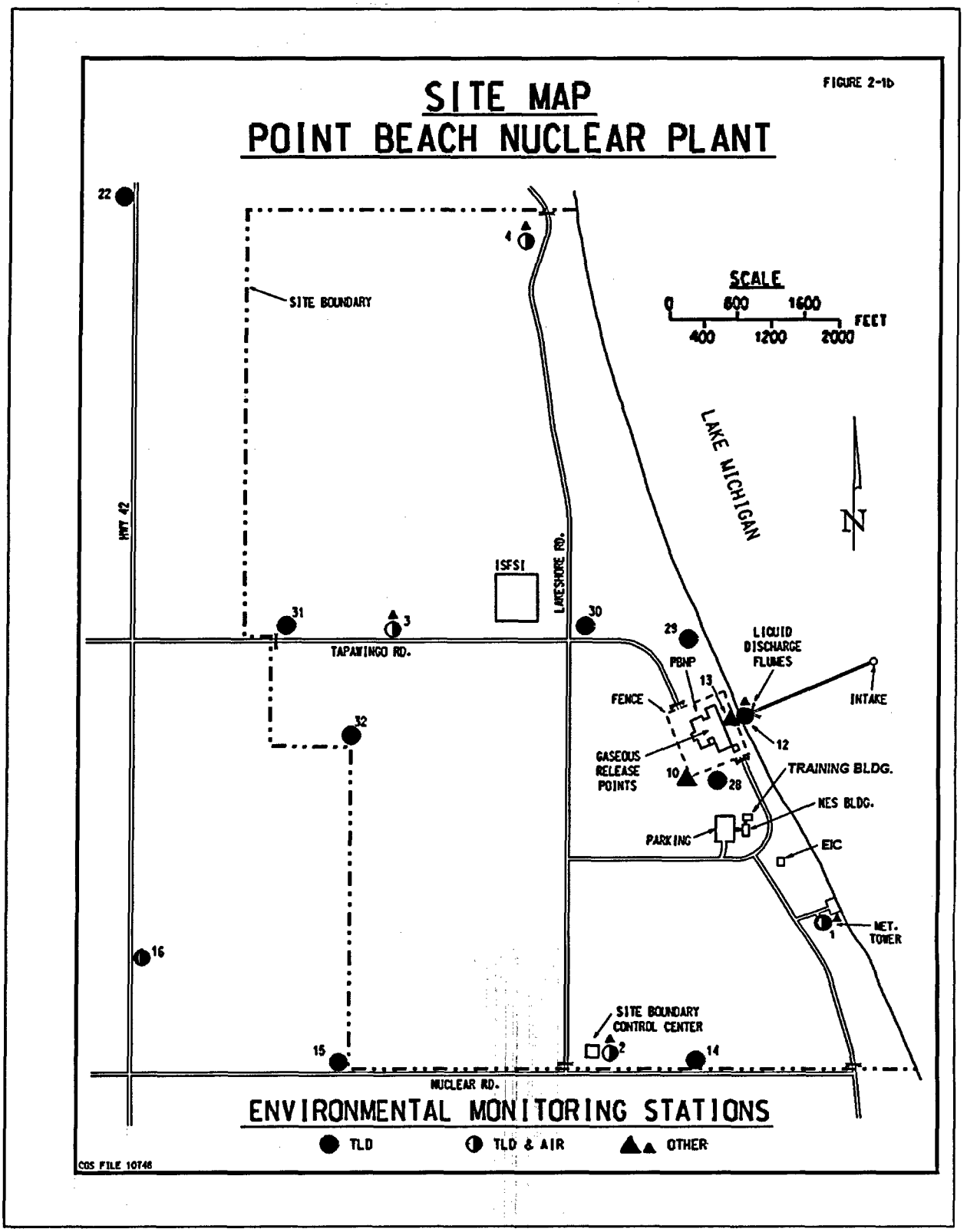


Figure 9-2
Map of REMP Sampling Sites Located Around PBNP

FIGURE 2-1C

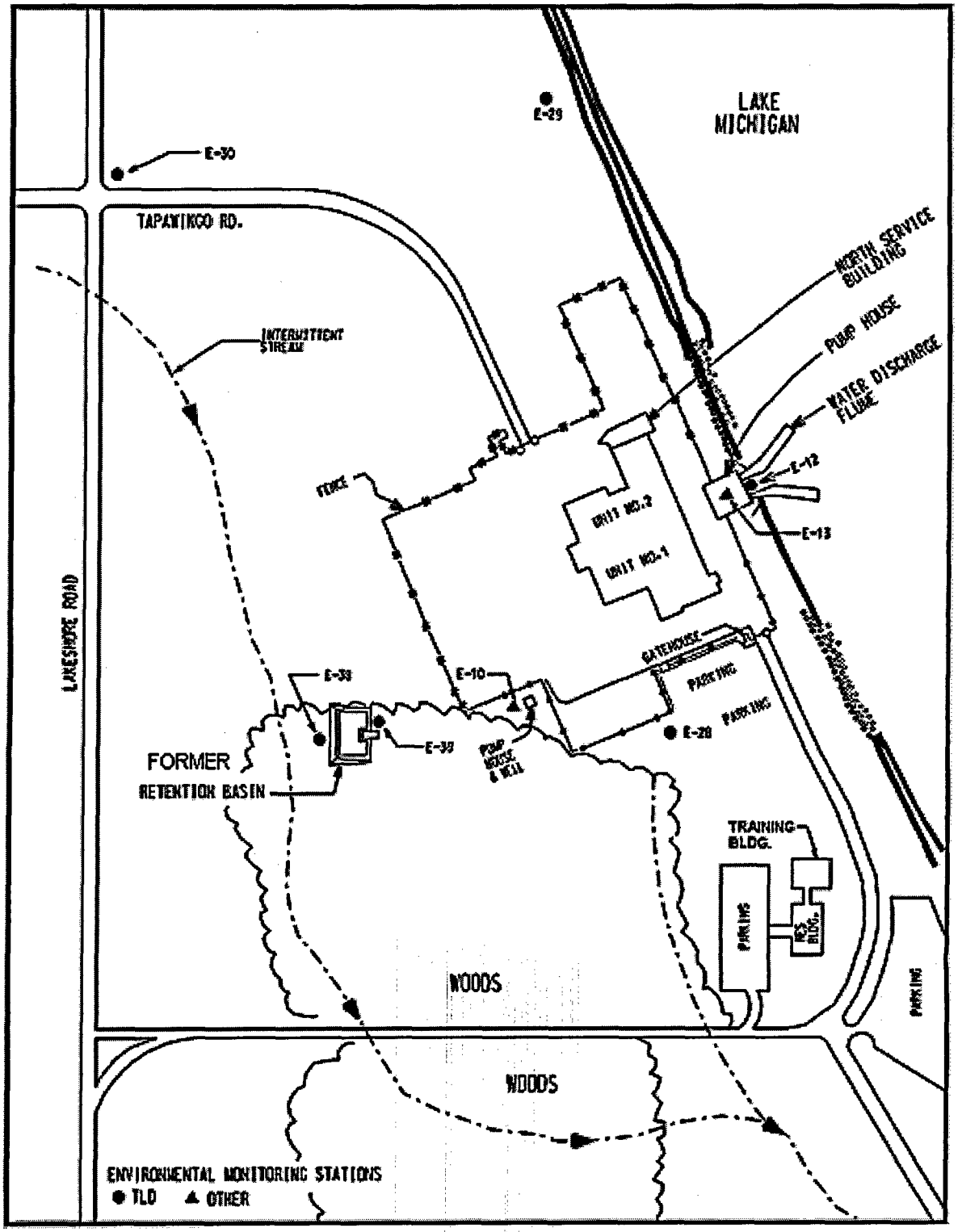


Figure 9-3
Enhanced Map Showing REMP Sampling Sites Closest to PBNP

Table 9-3
ISFSI Sampling Sites

Ambient Radiation Monitoring (TLD)	Soil, Vegetation, and Airborne Monitoring
E-03	E-02
E-28	E-03
E-30	E-04
E-31	
E-32	

Table 9-4
Minimum Acceptable Sample Size

Sample Type	Size
Vegetation	100-1000 grams
Lake Water	8 liters
Air Filters	250 m3 (volume of air)
Well Water	8 liters
Milk	8 liters
Algae	100-1000 grams
Fish (edible portions)	1000 grams
Soil	500-1000 grams
Shoreline Sediment	500-1000 grams

Table 9-5
Deviations from Scheduled Sampling and Frequency

Sample Type	Location	Collection Date	Reason for not conducting REMP as required	Plans for Preventing Recurrence
LW	E-06	1/13/2005	Sample unavailable due to ice.	Ice conditions are not controlable. Samples missed due to environmental conditions are expected and is so noted in Section 2.2.6 of the Environmental Manual.
AP/AI	E-02 E 02 E- 03 E- 03 E- 01	1/20/2005 1/26/2005 2/23/2005 3/23/2005 9/21/05	Sample unavailable due to loss of power to the pump at E-02/03 The sampling volume could not be quantified. Power at E-01 shut off for Met Tower instrumentation upgrade.	Although the cause of breaker trips at E-02/03 are unknown, none have occurred since the electrical upgrades of sampler sites have been completed. Power at E-01 was turned off in September for met tower replacement and instrumentation upgrade.
TLDs	E-32	4th Q	The cage holding the TLD was missing as was the TLD card. The wire holding the cage was found on the ground.	Vandelism or animal actions suspected. No plans.

Table 9-6
Sample Collections for State of Wisconsin

Sample Type	Location	Frequency
Lake Water	E-01	Weekly, Composited Monthly
Air Filters	E-07 E-08	Weekly
Fish	E-13	Quarterly, As Available
Precipitation	E-04 E-08	Twice a month, As Available
Milk	E-11 E-19	Monthly
Well Water	E-10	Twice per year

9.6 Analytical Parameters

The types of analyses and their frequencies are given in Table 9-1. The LLDs for the various analyses are found in the Section 10 (Table 10-1) with the summary of the REMP results. All environmental LLDs listed in Table 2-2 of the Environmental Manual (also in Table 10-1) were achieved during 2005.

9.7 Brief Description of Analytical Parameters in Table 9-1

9.7.1 Gamma isotopic analysis

Gamma isotopic analysis consists of a computerized scan of the gamma ray spectrum from 80 keV to 2048 keV. Specifically included in the scan are Mn-54, Fe-59, Co-58, Co-60, Zr-95, Nb-95, Ru-103, Ru-106, I-131, Ba-La-140, Cs-134, Cs-137, Ce-141, and Ce-144. However, any other detected nuclear power plant produced radionuclides also are noted. All of the above radionuclides detected by gamma isotopic analysis are decay corrected to the time of collection. Frequently detected, but not normally reported in this Annual Monitoring Report, are the naturally occurring radionuclides Ra-226, Bi-214, Pb-212, Tl-208, Ac-228, Be-7, and K-40.

9.7.2 Gross Beta Analysis

Gross beta analysis is a non-specific analysis that consists of measuring the total beta activity of the sample. No individual radionuclides are identifiable by this method. Gross beta analysis is a quick method of screening samples for the presence of elevated activity that may require additional, immediate analyses.

9.7.3 Water Samples

Water samples include both Lake Michigan and well water. The Lake Michigan samples are collected along the shoreline at two locations north and two locations south of PBNP. The well water is sampled from the on-site PBNP well. Gross beta and gamma isotopic analytical results for water are obtained by measurements on the solids remaining after evaporation of the unfiltered sample to dryness. Hence, the results are indicated as "on total solids" in Table 10-1.

9.7.4 Air Samples

Particulate air filters are allowed to decay at least 72 hours before gross beta measurements are made in order for naturally occurring radionuclides to become a negligible part of the total activity. Gross beta measurements serve as a quick check for any unexpected activity that may require immediate investigation. Quarterly composites of the particulate air filters are analyzed for long-lived radionuclides such as Cs-134 and Cs-137. Charcoal canisters for radioiodine are counted as soon as possible so the I-131 will undergo only minimal decay prior to analyses. The weekly charcoal canisters are screened for I-131 by counting them at the same time to achieve a lower LLD. If a positive result is obtained, each canister is counted individually.

In order to ensure that the air sampling pumps are operating satisfactorily, a gross leak check is performed weekly. The pumps are changed out annually for calibration and maintenance beyond what can be accomplished in the field.

9.7.5 Vegetation

Vegetation samples consist predominantly of green, growing plant material (grasses and weeds most likely to be eaten by cattle if they were present at the sampling site). Care is taken not to include any dirt associated with roots by cutting the vegetation off above the soil line.

9.7.6 Environmental Radiation Exposure

The 2005 environmental radiation exposure measurements were made using thermoluminescent dosimeter (TLD) cards. The TLD card is a small passive detector, which integrates radiation exposure. Each TLD consists of a Teflon sheet coated with a crystalline, phosphorus material (calcium sulfate containing dysprosium) which absorbs the gamma ray energy deposited in them. Each TLD is read in four distinct areas to yield four exposure values which are averaged. Prior to the third quarter of 2001, exposure data were obtained using three lithium fluoride (LiF) TLD chips sealed in black plastic. The difference in material types can impact the amount of exposure measured. As seen in 2001, the Environmental Inc. TLD cards typically produce a slightly higher measured exposure value, although within the uncertainty of that value recorded by the TLD chips.

The reported field exposure is the arithmetic average of the four exposure values obtained minus the exposure received while the field TLD is in storage and transit.

The gamma rays may originate from PBNP produced radionuclides or from naturally occurring radionuclides. The TLDs remain at the monitoring site for roughly three months prior to analyses and the results are reported as mrem per seven days. Because the TLDs are constantly bombarded by naturally occurring gamma radiation, even during shipment to and from PBNP, the amount of exposure during transportation is measured using transportation controls with each shipment of TLDs to and from the laboratory. The doses recorded on the transportation controls are subtracted from the monitoring TLDs in order to obtain the net *in situ* dose.

9.7.7 ISFSI Ambient Radiation Exposure

Although the ISFSI fence TLDs are not considered part of the REMP because of their location directly on site, their results can be used indirectly to determine whether the operation of the ISFSI is having an impact on the ambient environmental radiation beyond the site boundary. Impacts are determined by comparison of fence TLD results to the results of the monitoring at PBNP site boundary and other selected locations.

10.0 RESULTS

Summary of 2005 REMP Results

Radiological environmental monitoring conducted at PBNP from January 1, 2005, through December 31, 2005, consisted of analysis of air filters, milk, lake water, well water, soil, fish, shoreline sediments, algae, and vegetation as well as TLDs. The results are summarized in Table 10-1.

Table 10-1 contains the following information:

Sample:	Type of the sample medium
Description:	Type of measurement
LLD:	*a priori* lower limit of detection
N:	Number of samples analyzed
Average:	Average value ± the standard deviation of N samples
High:	Highest measured value ± its associated 2 sigma counting error
Units:	Units of measurement

For certain analyses, an LLD, which is lower than that required by REMP, is used because the lower value derives from the counting time required to obtain the LLDs for radionuclides that are more difficult to detect. For these analyses, both LLDs are listed with the REMP LLD given in parentheses. The results are discussed in the narrative portion of this report (Section 11). Blank values have not been subtracted from the results presented in Table 10-1. A complete listing of all the individual results obtained from the contracted analytical laboratory and the laboratory's radioanalytical quality assurance results and Interlaboratory Crosscheck Program results are presented in the Appendix.

In Table 10-1, no results are reported as <LLD. A non-detectable (ND) radionuclide is one for which none of the individual measurements was statistically different from zero. When one or more of the measured radionuclide concentrations was positive and statistically different from zero, the average reported in Table 10-1 is the average ± one standard deviation. Both the positive and negative results were used to calculate the average and standard deviation. Some of the reported averages are negative because many of the measured concentrations for that sample category were negative. The highest positive value and its 2-sigma error are reported only when one or more measured values are statistically greater than zero.

The method of determining averages follows the recommendation made in NUREG-0475 (1978) "Radiological Environmental Monitoring by NRC Licensees for Routine Operations of Nuclear Facilities Task Force Report," and in Health Physics Society Committee Report HPSR-1 (1980) "Upgrading Environmental Radiation Data" released as document EPA 520/1-80-012 and in more recent documents such as ANSI N42.23-1996, "Instrument Quality Assurance for Radioassay Laboratories;" ANSI N13.30-1996, "Performance Criteria for Radiobioassay;" and DE91-013607, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance."

Table 10-2 contains the ISFSI fence TLD results.

Table 10-1
Summary of Radiological Environmental Monitoring Results for 2005

Sample	Description	N	LLD (a)	Average ± Standard Deviation (b)	High ± 2 sigma	Units
TLD	Environmental Radiation	111	1 mrem	1.04 ± 0.21	1.56 ± 0.16	mR/7days
	Control (E-20)	4	1 mrem	1.00 ± 0.15	1.11 ± 0.14	mR/7days
Air	Gross Beta	255	0.01	0.024 ± 0.009	0.052 ± 0.006	pCi/m3
	Control (E-20) Gross beta	52	0.01	0.024 ± 0.009	0.047 ± 0.005	pCi/m3
	I-131	255	0.030 (0.07)	ND	-	pCi/m3
	Control (E-20) I-131	52	0.030 (0.07)	ND	-	pCi/m3
	Cs-134	20	0.05	ND	-	pCi/m3
	Control (E-20) Cs-134	4	0.05	ND	-	pCi/m3
	Cs-137	20	0.06	ND	-	pCi/m3
	Control (E-20) Cs-137	4	0.06	0.0000 ± 0.0004	0.0005 ± 0.0004	pCi/m3
	Other gamma emitters	20	0.1	0.0000 ± 0.0004	0.0011 ± 0.0006	pCi/m3
	Control (E-20) Other	4	0.1	0.0002 ± 0.0006	0.0008 ± 0.0007	pCi/m3
Milk	Sr-89	36	5	ND	-	pCi/L
	Sr-90	36	1	0.9 ± 0.4	2.4 ± 0.5	pCi/L
	I-131	36	0.5	ND	-	pCi/L
	Cs-134	36	5 (15)	-1.0 ± 3.7	3.2 ± 2.8	pCi/L
	Cs-137	36	5 (15)	-0.1 ± 1.5	3.1 ± 2.3	pCi/L
	Ba-La-140	36	5 (15)	0.2 ± 1.9	3.6 ± 2.2	pCi/L
	Other gamma emitters	36	15	ND	-	pCi/L
Well	Gross beta	4	4	ND	-	pCi/L
Water	H-3	4	500 (3000)	28.2 ± 54.5	104.5 ± 90.1	pCi/L
	Sr-89	4	10	ND	-	pCi/L
	Sr-90	4	1 (2)	ND	-	pCi/L
	I-131	4	0.5 (2)	ND	-	pCi/L
	Mn-54	4	10 (15)	ND	-	pCi/L
	Fe-59	4	30	ND	-	pCi/L
	Co-58	4	15	ND	-	pCi/L
	Co-60	4	15	2.2 ± 2.3	5.6 ± 5.4	pCi/L
	Zn-65	4	30	ND	-	pCi/L
	Zr-Nb-95	4	15	ND	-	pCi/L
	Cs-134	4	15	ND	-	pCi/L
	Cs-137	4	18	ND	-	pCi/L
	Ba-La-140	4	15	2.1 ± 5.1	9.4 ± 5.9	pCi/L
	Other gamma emitters	4	30	ND	-	pCi/L
Algae	Gross beta	6	0.25	5.2 ± 1.5	5.15 ± 0.91	pCi/g
	Co-58	6	0.25	ND	-	pCi/g
	Co-60	6	0.25	ND	-	pCi/g
	Cs-134	6	0.25	0.010 ± 0.012	0.017 ± 0.013	pCi/g
	Cs-137	6	0.25	0.014 ± 0.016	0.041 ± 0.019	pCi/g

(a) The required LLD per the PBNP REMP is enclosed in the parentheses.
(b) "ND" indicates that the sample result is Not Detectable, i.e., sample concentrations were statistically equivalent to zero.

Table 10-1 (continued)
Summary of Radiological Environmental Monitoring Results for 2005

Sample	Description	N	LLD (a)	Standard Deviation (b)	High ± 2 sigma	Units
Lake Water	Gross beta	47	4	3.0 ± 1.6	10.6 ± 1.1	pCi/L
	I-131	47	0.5 (2)	ND	-	pCi/L
	Mn-54	47	10 (15)	-0.2 ± 1.5	2.7 ± 2.0	pCi/L
	Fe-59	47	30	ND	-	pCi/L
	Co-58	47	15	-0.1 ± 1.5	4.2 ± 3.0	pCi/L
	Co-60	47	15	0.0 ± 1.6	4.8 ± 5.0	pCi/L
	Zn-65	47	30	ND	-	pCi/L
	Zr-Nb-95	47	15	-0.1 ± 2.0	3.2 ± 3.2	pCi/L
	Cs-134	47	10 (15)	-0.4 ± 2.2	2.8 ± 2.4	pCi/L
	Cs-137	47	10 (18)	0.0 ± 1.3	3.2 ± 3.1	pCi/L
	Ba-La-140	47	15	-0.4 ± 2.8	6.1 ± 4.2	pCi/L
	Ru-103 (Other gamma)	47	30	-0.9 ± 2.3	3.3 ± 2.7	pCi/L
	Sr-89	16	5	ND	-	pCi/L
	Sr-90	16	1 (2)	0.44 ± 0.17	0.78 ± 0.32	pCi/L
	H-3	16	500 (3000)	251 ± 369	1576 ± 144	pCi/L
Fish	Gross beta	8	0.5	3.34 ± 1.02	4.66 ± 0.09	pCi/g
	Mn-54	8	0.13	ND	-	pCi/g
	Fe-59	8	0.26	0.004 ± 0.029	0.034 ± 0.025	pCi/g
	Co-58	8	0.13	ND	-	pCi/g
	Co-60	8	0.13	0.006 ± 0.008	0.015 ± 0.014	pCi/g
	Zn-65	8	0.26	ND	-	pCi/g
	Cs-134	8	0.13	ND	-	pCi/g
	Cs-137	8	0.15	0.049 ± 0.053	0.172 ± 0.055	pCi/g
	Other gamma emitters	8	0.5	ND	-	pCi/g
Shoreline Sediment	Gross beta	10	2	10.36 ± 2.34	13.2 ± 2.03	pCi/g
	Cs-137	10	0.15	0.015 ± 0.008	0.025 ± 0.015	pCi/g
Soil	Gross beta	16	2	29.09 ± 5.95	37.26 ± 2.85	pCi/g
	Cs-137	16	0.15	0.25 ± 0.17	0.67 ± 0.06	pCi/g
Vegetation	Gross beta	24	0.25	7.60 ± 1.46	8.25 ± 0.20	pCi/g
	I-131	24	0.06	-0.002 ± 0.011	0.023 ± 0.005	pCi/g
	Cs-134	24	0.06	ND	-	pCi/g
	Cs-137	24	0.08	0.005 ± 0.012	0.040 ± 0.019	pCi/g
	Other gamma emitters	24	0.06	0.001 ± 0.008	0.017 ± 0.020	pCi/g

(a) The required LLD per the PBNP REMP is enclosed in the parentheses.
(b) "ND" indicates that the sample result is Not Detectable, i.e., sample concentrations were statistically equal to zero.

Other gamma emitters typically refers to Co-60 if not specifically called out in the analyses. See explanation on page 1 of the Environmental Inc report which is Appendix A of this Annual Monitoring Report.

Table 10-2
ISFSI Fence TLD Results for 2005

Fence Location	Average ± Standard Deviation
North	2.54 ± 0.19 mR/7 days
East	2.05 ± 0.14 mR/7 days
South	1.44 ± 0.22 mR/7 days
West	5.63 ± 0.52 mR/7 days

11.0 DISCUSSION

11.1 TLD Cards

The ambient radiation was measured in the general area of the site boundary, at an outer ring four – five miles from the plant, at special interest areas, and at one control location, roughly 17 miles Southwest of the plant. The average of the indicator TLD cards is 1.04 mR/7-days and 1.00 mR/7-days at the control location. These results are not significantly different from each other nor from those observed from 1993 through 2004 (tabulated below in Table 11-1). A change in TLD types accounts for the increase in average TLD readings (i.e., prior to third quarter 2001 TLD LiF chips were used versus the TLD cards – see section 9.7.6 for additional information). Therefore, the operation of the plant has had no effect on the ambient gamma radiation.

Table 11-1
Average Indicator TLD Results from 1993 – 2004

Year	Average ± St. Dev*	Units
1993	0.82 ± 0.15	mR/7 days
1994	0.90 ± 0.12	mR/7 days
1995	0.87 ± 0.13	mR/7 days
1996	0.85 ± 0.12	mR/7 days
1997	0.87 ± 0.11	mR/7 days
1998	0.79 ± 0.13	mR/7 days
1999	0.79 ± 0.21	mR/7 days
2000	0.91 ± 0.15	mR/7 days
2001	1.06 ± 0.19	mR/7 days
2002	1.17 ± 0.21	mR/7 days
2003	1.10 ± 0.20	mR/7 days
2004	1.10 ± 0.22	mR/7 days

*St. Dev = Standard Deviation

With no new cask additions in 2005, the annual ISFSI fence TLD results listed in Table 11-2 remain similar to the 2004 results. The North and

West fence TLDs continue to record higher doses than the South and East fence TLDs (Table 11-2) corresponding to the location of the storage units at the NW corner of the site. Compared to the background site (E-20), most of the indicator sites for the ISFSI (Table 11-3) show increases with the placement of casks at the ISFSI with the highest values at E-03 which is the closest to the ISFSI [see Figs. 9-1 and 9-2 for locations]. The results near the site boundary (E-31, E-32) are comparable to the background site E-20, within the associated measurement error, indicating no measurable increase in ambient gamma radiation at the site boundary due to the operation of the ISFSI.

Table 11-2
Average ISFSI Fence TLD Results (mR/7 days)

	TLD FENCE LOCATION			
	North	East	South	West
1995	1.29	1.28	1.10	1.26
1996	2.12	1.39	1.10	1.68
1997	2.05	1.28	1.00	1.66
1998	2.08	1.37	1.02	1.86
1999	2.57	1.84	1.11	3.26
2000	2.72	2.28	1.25	5.05
2001	2.78	2.54	1.36	6.08
2002	2.79	2.74	1.42	6.46
2003	2.70	2.60	1.50	6.88
2004	2.61	2.12	1.41	6.50
2005	2.54	2.05	1.44	5.63

Table 11-3
Average TLD Results Surrounding the ISFSI (mR/7 days)

	E-03	E-28	E-30	E-31**	E-32**	E-20***
Pre-Operation*	0.93	0.87	0.81	0.93	0.98	0.88
1996	0.87	0.78	0.79	0.93	1.00	0.78
1997	0.91	0.89	0.84	0.89	0.97	0.79
1998	0.82	0.68	0.82	0.91	0.85	0.77
1999	0.88	0.83	0.80	0.90	0.99	0.78
2000	0.98	0.88	0.99	0.98	1.06	0.90
2001	1.31	0.95	1.02	1.10	1.04	1.03
2002	1.45	0.91	1.10	1.26	1.25	1.14
2003	1.29	0.82	1.02	1.20	1.15	0.99
2004	1.35	0.80	1.05	1.23	1.18	1.06
2005	1.30	0.72	0.98	1.15	1.04	1.00

*Pre-Operation data are the averages of the years 2/92 through 3/95.
**Sites E-31 and E-32 are located at the Site Boundary to the West and South-West of the ISFSI, respectively.
***E-20 is located approximately 17 miles WSW of the ISFSI.

11.2 Milk

Except for Sr-90, the annual average radionuclide concentrations in milk continue to be statistically not different from zero. The few statistically positive, individual monthly results for Ba/La-140 (8 of 36), Cs-134 (2 of 36), and Cs-137 (1 of 36) are attributed to variations in the analyses resulting from the statistical nature of radioactive decay. This conclusion is supported by the fact that PBNP did not release Cs-134 or Ba/La-140 during 2005 and that the one positive Cs-137 result occurred at an upwind location during the month of December when the cows are on feed and not on pasture. The Sr-90 concentrations result from the cycling of this radionuclide in the biosphere after the large-scale atmospheric weapons tests of the '50s, '60s, and '70s and the Chernobyl accident. Although these test also introduced Cs-137 into the environment, Cs-137 binds more strongly to soils and therefore less likely to get into cows and milk. Although minute amounts of Sr-90 were emitted by PBNP in 2004, none was emitted in 2005 (see Table 3-2). The 2005 average Sr-90 (0.9 ± 0.4) is identical to previous years : 1.1 ± 0.4 pCi/l in 2004, 1.1 ± 0.4 in 2003, 1.1 ± 0.7 in 2002, 1.2 ± 0.5 in 2001, 1.2 ± 0.6 in 2000, pCi/L, 1.0 ± 0.3 in 1999, 1.1 ± 0.5 in 1998, and 1.2 ± 0.5 in 1997. These results are common throughout the Great Lakes region and North America. Therefore, it is concluded that the milk data for 2005 show no radiological effects of the plant operation.

11.3 Air

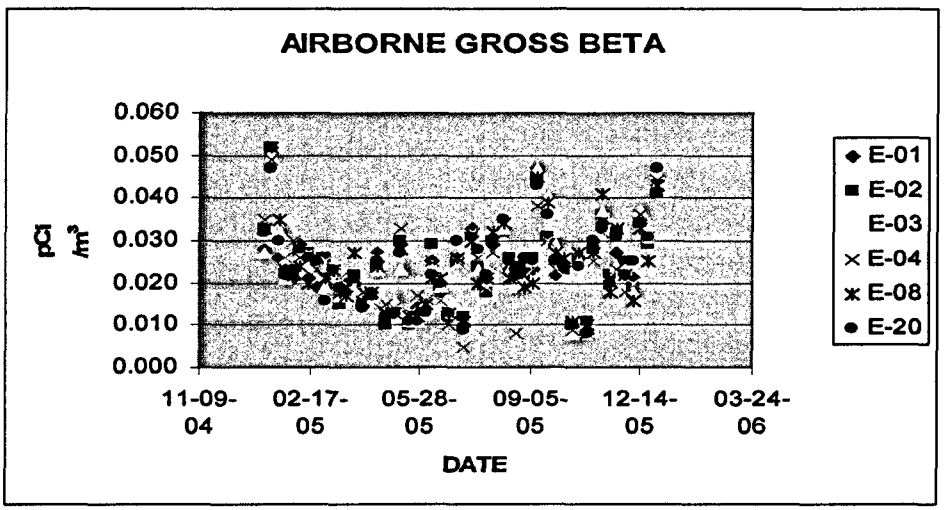
The average annual gross beta concentrations (plus/minus the one-sigma uncertainty) in weekly airborne particulates at the indicator and control locations were 0.024 ± 0.009 pCi/m^3 and 0.024 ± 0.009 pCi/m^3, respectively, and are similar to levels observed from 1993 through 2004 (Table 11-4).

Table 11-4
Average Gross Beta Measurements in Air

Year	Average (pCi/m3)
1993	0.022
1994	0.022
1995	0.021
1996	0.021
1997	0.021
1998	0.022
1999	0.024
2000	0.022
2001	0.023
2002	0.023
2003	0.023
2004	0.021
2005	0.024

Examination of the gross beta concentration variation over the year reveals higher concentrations in the fall and winter as compared to the spring and summer (Figure 11-1). This annual pattern is found throughout the region and is indicative of the different air masses and environmental conditions during the year which contribute long-lived, naturally-occurring radionuclides. Additionally, there is more scatter in the data for the spring and summer months.

Figure 11-1
2005 Airborne Gross Beta Concentration (pCi/m^3) vs. Time



For 2005, the new method of evaluating airborne I-131 was instituted. Instead of counting each charcoal cartridge separately, all six cartridges for the week are counted as one sample in a predetermined geometry to screen the samples for I-131. If any airborne radioiodine were detected, each sample cartridge is counted individually. With no detectable I-131, the reported analytical result is the minimum detectable activity (MDA) conservatively calculated using the smallest of the six sample volumes. The reported MDAs ranged from 0.008 to 0.029 pCi/m^3. Because the analysis LLD is based on counting only one cartridge, the use of six cartridges or roughly six times the sample volume with the same count time as would be needed to achieve the desired LLD for only one sample, the actual LLD is about six times lower than the programmatic value given in Table 10-1. Similarly, the actual MDA is about one-sixth of that reported, or in the range of 0.001 to 0.005 pCi/m^3. Therefore, because no I-131 was detected, it is concluded that the release of small amounts of radioiodine during August - October had no measurable impact on the environment.

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Neither

the indicator nor the control locations show results which, on average, are significantly different than zero. The small, positive values for Cs-137 and Ba/La-140 are false positives attributable to the statistical variation in radioactive decay because no Ba/La-130 was emitted during 2005. Also, the one positive Cs-137 result occurred in a quarter during which no airborne Cs-137 was released by PBNP. Be-7, a naturally occurring radionuclide, was measured in quarterly composites of all indicator samples with an average of 0.066 pCi/m^3. This is comparable to the average of 0.069 pCi/m^3 at the control site. Be-7 is not required to be measured by the PBNP REMP; however, its quantification serves as a means to monitor the internal consistency of the vendor's analytical program.

In summary, the air data for 2005 demonstrate the operation of PBNP did not have an impact on the surrounding environment.

11.4 Lake Water

For the suite of REMP-specified gamma emitting radionuclides listed in Table 10-1, reported concentrations continue to occur as small negative and positive values scattered around zero, indicating no radiological impact from the operation of PBNP. Aliquots of the monthly samples are composted quarterly and analyzed for Sr-89/90 and for tritium. Sr-90 still persists in Lake Michigan from radioactive fallout. Tritium, in addition to being produced by water-cooled reactors such as PBNP, also is a naturally occurring radionuclide. The quarterly composite lake water samples collected and analyzed in 2005 for H-3 range from ND (non-detectable) to 1576 pCi/l (4^{th} quarter) at a site four miles north of PBNP near the Kewaunee Nuclear Power Plant (KNPP). Because typical REMP H-3 values are in the range of 100-400 pCi/l, the individual months of Oct. - Dec. from this sampling site were analyzed for tritium and the following results obtained: Oct., 2 ± 112; Nov., 3146 ± 189; and Dec., 1758 ± 159. The 3146 pCi/l value is 0.31% of the liquid effluent concentration limit of 10 CFR 20, Appendix B, Table 2. The November sample on the tenth is concurrent with a liquid discharge from KNPP. The December sample was obtained on the thirteenth, three days after a KNPP discharge. Therefore, the high November and December 2005 tritium values at this site result from lake water samples containing diluted KNPP liquid discharges. By the time these water masses reached REMP sampling points immediately north (1.6 miles) and south (0.5 miles) of PBNP, dilution had reduced the concentrations to the range of 200 - 400 pCi/l. These results indicate a minimal impact upon the waters of Lake Michigan from PBNP liquid discharges.

11.5 Algae

Filamentous algae attached to rocks along the Lake Michigan shoreline are known to concentrate radionuclides from the water with concentration factor over a thousand for certain radionuclides. Three small, positive concentrations of Cs-134 and Cs-137 were found. The one occurrence of Cs-134 is attributable to the statistical nature of radioactive decay because no Cs-134 was released from PBNP during the last several years. Typically, the only fission product observed is Cs-137 with averages over years 1995–2004 of 0.034, 0.050, 0.030, 0.027, 0.031, 0.027, 0.019, 0.019, 0.010, and 0.018 pCi/g; all of which are less than the LLD (0.25 pCi/g). Although all the quantified Cs-137 concentrations were below the LLD in 2005, two small positive values statistically different from zero (0.020 and 0.041 pCi/l) were found. The remaining four analyses were not statistically distinguishable from zero.

The occurrence of Cs-137 in the environment can be attributed to the fallout from past events such as atmospheric weapons testing and Chernobyl. After fallout Cs-137 has settled to the lake bottom, massive resuspension events due to wind stress redistribute Cs-137 throughout Lake Michigan and make the Cs-137 more available to the algae. These resuspension events are visible on satellite photographs. In 1976 after a Chinese weapons test, Cs-137 concentration in algae reached 1.2 pCi/g. By comparison, during 2005, the concentrations of the naturally occurring radionuclides Be-7 (0.32 – 1.55 pCi/g) and K-40 (0.97 – 3.44 pCi/g) in the algae continue to be 10 and 100 times higher than Cs-137.

Because PBNP released small amounts of Cs-137 during the year, these results also may be the result of plant activities. However, the results are low and only 2 of the 6 results are statistically above zero. Therefore, the results also could be representative of the distribution of analytical results around zero expected from the statistical nature of radioactive decay when the specific radionuclide is either not present or present in small amounts well below the LLD. If the measured Cs-137 concentrations were from PBNP effluents, then the algae data indicate only a minor effect in the vicinity of PBNP during 2005.

11.6 Fish

No specified fission/corrosion radionuclide concentrations in fish greater than the required LLD were found in 2005. Low levels of Fe-59 and Co-60 (March sample) were found in 1 of 8 fish sampled during the year. Although PBNP released these radionuclides during the year, Co-58 which PBNP also released in monthly amounts comparable to Co-60 (all 12 months of 2005), was not found. Therefore, given the single occurrence of these radionuclides, the non-occurrence of Co-58 and the

similar aquatic chemistry of iron and cobalt, it is likely that the Fe-59 and Co-60 results represent analytical fluctuations due to the statistical nature of radioactive decay. Statistically positive Cs-137 concentrations were found in 5 of the 8 fish. The highest Cs-137 value of 0.172 pCi/g is considerably less than the high of 2.8 pCi/g as seen in PBNP samples obtained in the mid-1970s during the Chinese weapons tests. However, the Cs-137 results in fish are consistent with accumulation due to the recycling of atmospheric weapons testing fallout Cs-137 in Lake Michigan. Again, the aforementioned resuspension events make the Cs-137 more readily available to be associated with items eaten by the fish. By comparison, the concentration of naturally occurring K-40 (1.47–2.95 pCi/g) is about 40-100 times higher than the highest Cs-137 concentration. Therefore, it is concluded that there is no indication of a plant effect.

Note: CORRECTION TO THE 2004 Annual Monitoring Report. The discussion of results in this section of the 2004 AMR stated that "...it is unlikely that the Mn-54, Fe-59, and Co-58 few positive results [in fish] represent analytical fluctuations due to the statistical nature of radioactivity." The wording should have been "... it is likely that the ...few positive results represent analytical fluctuations due to the statistical nature of radioactivity." None of the results were of such magnitude or specificity that plant contributions could be distinguished from the variability resulting from the statistical nature of radioactive decay.

11.7 Well Water

There were three well water results statistically greater than zero. No gross beta results were statistically significant. In the first quarter, Co-60 and Ba/La-140 were statistically above zero. These results are concluded to be false positives because the impermeability of the clay layer which separates the surface ground water from the aquifer from which the PBNP well water is obtained precludes surface water from reaching the lower aquifer. Also, in the case of Ba/La-140, the 12.8 day half-life of Ba/La-140 precludes the measured concentration of 9.4 ± 5.9 pCi/l from being a valid result because PBNP has not released any Ba/La-140 in liquids or airborne effluents in the last two years. Furthermore, no Ba/La-140 was detected in 2004 well water samples and none was detected in the remainder of 2005. Finally, because there are no release pathways which could get Ba/La-140 to the well water aquifer, the 9.4 pCi/l value is considered to be a false positive. As previously mentioned, such results may occur due to the statistical nature of radioactive decay, when there is no radionuclide present. The one positive H-3 value (104.5 ± 90.1 pCi/l) occurred in the 4th quarter sample. This also is concluded to be a false positive because of the impermeable geological stratum which separates the surface ground water from the aquifer from which the well water is

obtained. Resampling results yielded (37 ± 89 pCi/l) which is not statistically significant from zero. Had the 4th quarter value been valid, the result would have been repeatable. Therefore, it is concluded that these results do not indicate that PBNP effluents are getting into the aquifer supplying drinking water to PBNP.

11.8 Soil

Cs-137 is present in the soils throughout North America and the world. The main contributor to this worldwide distribution is the weapons testing in the 1950s and 1960s with lesser amounts from Chinese atmospheric nuclear tests in the 1970s and the 1986 Chernobyl accident. Soil is an integrating sample media in that it is a better indicator of long term buildup of Cs-137 as opposed to current deposition for local sources. The main modifiers of soil Cs-137 concentration levels are erosion and radioactive decay. The PBNP REMP results indicate that low levels of Cs-137 from fallout continue to be present in soil samples at about 1% of the levels of naturally occurring K-40. The current results are consistent with previous years. Although the 2005 gross beta result is higher than the 2004 value, the 2005 value's associated error of 5.95 (see Table 10-1) encompasses the 2004 value. Therefore, as seen in Table 11-5, the average gross beta result is not significantly different from those values observed in the past. There is no indication of a plant effect

Table 11-5
Average Gross Beta Concentrations In Soil

Year	Activity (pCi/g)
1993	23.6
1994	19.4
1995	18.0
1996	19.4
1997	22.8
1998	20.0
1999	23.1
2000	22.1
2001	23.5
2002	21.9
2003	22.5
2004	24.3
2005	29.1

11.9 Shoreline Sediment

Shoreline sediment consists of sand and other sediments washed up on the Lake Michigan shore. As in soil samples, the only non-naturally occurring radionuclide found in these samples is Cs-137. The Cs-137

concentrations of the shoreline sediment are about one-tenth of that found in soils. This is expected because Cs-137 in the geological media is bound to clay as opposed to the sand found on the beach. Wave action winnows clay particles from the beach leaving the heavier sand; hence the lower Cs-137 concentrations in beach samples. In contrast to K-40 which is actually part of the minerals making up the clay and sand, Cs-137 is attached to soil/sand particle surfaces. Therefore it is not surprising that Cs-137 is present at concentrations 1% or less of the naturally occurring concentrations of K-40. The shoreline sediment data indicate no radiological effects from plant operation.

11.10 Vegetation

The naturally occurring radionuclides Be-7 and K-40 are found in all of the vegetation samples. In contrast, the programmatically specified radionuclides I-131 and Cs-134 were not detected and Cs-137 was detected only in 4 of the 24 samples. All the positive Cs-137 results were below the required LLD at concentrations about 100 times lower than Be-7 and K-40 concentrations. The source of Be-7 is atmospheric deposition. It is continuously formed in the atmosphere by cosmic ray spallation of oxygen, carbon, and nitrogen atoms. In contrast, K-40 is a primordial radionuclide which is incorporated into vegetation from the soil during the growing process. Cs-137 can represent both pathways. Fresh Cs-137 fallout is associated, like Be-7, with deposition on the plant surface. Old fallout from the '50s and '60s is now being incorporated into growing plants in the same manner as potassium because it is in the same chemical family as potassium. Cs-137 is consistently present in vegetation from E-06, a campground area in the Point Beach State Forest. As has been demonstrated at other sites in the United States which are far from any nuclear plants, 1950s and 1960s fallout Cs-137 is present in the ash produced by burning the wood in fireplaces. Typically, campground fires are put out using water and the ashes are spread on the ground. The ash acts as a fertilizer, releasing the cesium and potassium into the soil where they are available for uptake by growing plants and trees. Hence, the Cs-137 results from E-06 demonstrate that Cs-137 fallout from the Chernobyl accident and from atmospheric weapons tests continues to be recycled in the environment by the spreading of wood ash at camp sites. The single positive Cs-137 result from the background site E-20 may be an indication of environmental fallout recycling. However, there are not enough data to validate this possibility.

There are two (2 of 24) non-zero results for other gamma emitter category, which for these analyses is Co-60. These results are not true indications of the presence of Co-58/60 because no airborne Co-58 or Co-60 were released during 2004 and the first five months of 2005. Only the airborne pathway presents a way for these radionuclides to reach the

two sites. There are no unmonitored airborne pathways. Therefore, the positive Co-58 and Co-60 values in the May 2005 samples result from the statistical variability in radioactive decay and are not representative of the actual environment.

Based on the 2005 vegetation sampling results, it is concluded that no effect from PBNP effluents are indicated.

11.11 Land Use Census

In accordance with the requirements of Section 2.5 of the Environmental Manual, a visual verification of animals grazing in the vicinity of the Point Beach Nuclear Plant site boundary was completed on July 20, 2005, to ensure that the milk sampling locations remain as conservative as practicable. No significant change in the use of pasturelands or grazing herds was noted. Therefore, the existing milk-sampling program continues to be acceptable. And, the assumption of grazing animals at the south boundary continues to be conservative for the purpose of calculating doses via the grass-cow-milk pathway.

12.0 REMP CONCLUSION

Based on the analytical results from the 805 environmental samples and from 115 sets of TLDs that comprised the PBNP REMP for 2005, PBNP effluents had no discernable, permanent effect on the surrounding environs. These results demonstrate that PBNP continues to have good controls on fuel integrity and on effluent releases. The control of effluents from PBNP continues to be acceptable pursuant to the ALARA criteria of 10 CFR 50.34a.