4 Air Quality

Brookhaven National Laboratory monitors both radioactive and nonradioactive emissions at several facilities on site to ensure compliance with the requirements of the Clean Air Act. In addition, BNL conducts ambient air monitoring to verify local air quality and assess possible environmental impacts from Laboratory operations.

During 2011, BNL facilities released a total of 5,793 curies of short-lived radioactive gases. Oxygen-15 and carbon-11 emitted from the Brookhaven Linac Isotope Producer constituted 99.99 percent of the site's radiological air emissions.

Since natural gas prices were comparatively lower than residual fuel prices throughout the year, BNL's Central Steam Facility used natural gas to meet more than 99 percent of the heating and cooling needs of the Laboratory's major facilities in 2011. As a result, annual facility emissions of particulate matter, sulfur dioxide, and oxides of nitrogen were at their lowest in the last decade.

4.1 RADIOLOGICAL EMISSIONS

Federal air quality laws and DOE regulations that govern the release of airborne radioactive material include 40 CFR 61 Subpart H: National Emission Standards for Hazardous Air Pollutants (NESHAPs)—part of the Clean Air Act (CAA), and DOE Order 458.1 Chg 2, Radiation Protection of the Public and the Environment. Under NESHAPs Subpart H, facilities that have the potential to deliver an annual radiation dose of greater than 0.1 mrem (1 μSv) to a member of the public must be continuously monitored for emissions. Facilities capable of delivering radiation doses below that limit require periodic, confirmatory monitoring. BNL has one facility that is continuously monitored with an in-line detection system, the Brookhaven Linac Isotope Producer (BLIP). Periodic monitoring was conducted at one active facility, the Target Processing Laboratory (TPL), and two inactive facilities, the High Flux Beam Reactor (HFBR) and the Brookhaven Graphite Research Reactor (BGRR) in 2011. Figure 4-1 indicates the locations of these monitored facilities, and Table 4-1 presents the airborne release data from each of these facilities during 2011. Annual emissions from monitored facilities are discussed in the following sections of this chapter. Also discussed is a fourth inactive facility, the Evaporator Facility, which was periodically monitored in past years. The associated radiation dose estimates are presented in Chapter 8, Table 8-4.

4.1.1 Brookhaven Medical Research Reactor

In 2011, the BMRR facility remained in a cold-shutdown mode as a radiological facility and periodic inspections were conducted.

4.1.2 High Flux Beam Reactor

In 1997, a plume of tritiated groundwater was traced back to a leak in the HFBR spent fuel storage pool. Consequently, the HFBR was put in standby mode, the pool was pumped out, and the heavy tritiated water (HTO) from the pool was properly disposed of as radioactive waste. The pool was repaired and double lined in accordance with Suffolk County Article 12 regulations (SCDHS 1993) and remained empty while the facility was in a standby mode.

The HFBR continued in standby mode until November 1999, when DOE declared that it was to be permanently shut down. Residual tritium in water in the reactor vessel and piping systems continued to diffuse into the building's air

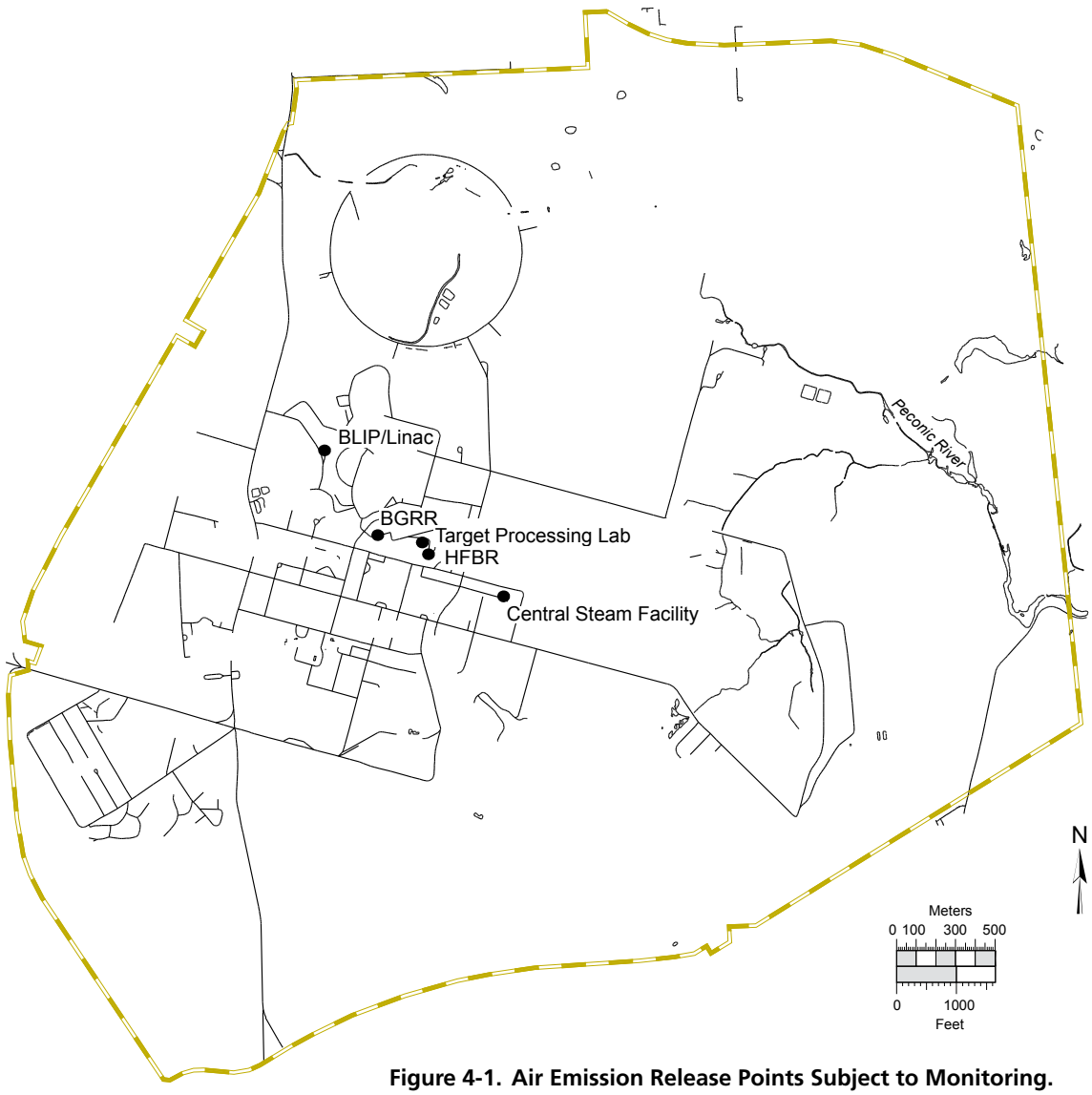


Figure 4-1. Air Emission Release Points Subject to Monitoring.

through valve seals and other system penetrations, though emission rates were much lower than during the years of operation.

As shown in Figure 4-2, the increase in emissions in 2003 was attributed to evaporative losses when HTO remaining in the reactor core was pumped out for approved disposal. In 2004, the downward trend in emissions resumed: the level dropped from 9.0 Ci (the 2003 value) to 3.94 Ci. In 2005, tritium emissions climbed to 17.9 Ci, apparently due to evaporation of residual heavy water through an open drain-tank vent line. In 2006, tritium emissions dropped to 4.03 Ci, a level consistent with 2004 emissions. In 2007, the downward trend continued, as tritium emissions fell to 1.33 Ci. The rise in tritium emissions in 2008 to 20.06 Ci was due to periodic venting of the reactor vessel when domestic water was added to the reactor vessel in preparation for the removal of the HFBR control rod blades. Observed tritium emission increases in 2009 were due to HFBR decontamination and decommissioning (D&D) activities that included the removal of control rod blades from January through March; draining and properly disposing of tritiated heavy water from the reactor vessel, piping systems, and the fuel canal from late spring into the summer; and the opening of contaminated piping systems to allow for the removal of residual

volumes of tritiated heavy water. Tritium emissions in 2010 were primarily due to the draining of residual heavy tritiated water from tanks and piping components from January through June in preparation for long-term facility surveillance and maintenance. The low levels of tritium in 2011, 0.41 Ci, were due to the presence of residual tritium and only periodic sampling of the facility for entry during the structural integrity inspections conducted.

From 2002 through 2008, emissions from the HFBR facility were monitored via air sampling of the building at a frequency of one week per month. In 2009, the frequency of monitoring was increased to bi-weekly to better account for changes in tritium emissions during planned D&D activities. In 2010, the HFBR was disconnected from the 100-meter stack, and a new HFBR exhaust system was installed in 2011. Consistent with the HFBR Long-Term Surveillance and Maintenance Manual, prior to scheduled surveillance and maintenance activities, air samples are now collected from outside the HFBR confinement using a permanently installed sample port. The samples are collected by bubbling air through a container of water using a fritted sampling device to ensure better collection efficiency. Samples are analyzed in-house for tritium, to ensure that air quality within the building is acceptable to permit staff entry. Samples are also collected from the fixed sampling system for mold analysis. Additionally, samples are collected one week per month from the HFBR exhaust system using a standard desiccant sampling system for tritium analysis. Desiccant samples are analyzed by an off-site contract laboratory.

Table 4-1. Airborne Radionuclide Releases from Monitored Facilities.

Facility	Nuclide	Half-Life	Ci Released
BGRR	Tritium	12.3 years	3.46E-01
HFBR	Tritium	12.3 years	4.06E-01
BLIP	Carbon-11	20.4 minutes	1.91E+03
	Oxygen-15	122 seconds	3.88E+03
	Tritium	12.3 years	9.98E-04
TPL - Bldg. 801	Arsenic-74	17.8 days	3.11E-10
	Bromine-77	57.0 hours	3.69E-08
	Germanium-68	270.8 days	3.99E-08
	Selenium-75	119.8 days	8.94E-09
Total			**5.79E+03**

Notes:
Ci = 3.7E+10 Bq
BGRR = Brookhaven Graphite Research Reactor
BLIP = Brookhaven Linac Isotope Producer
HFBR = High Flux Beam Reactor (operations were terminated in November 1999)
TPL = Target Processing Laboratory

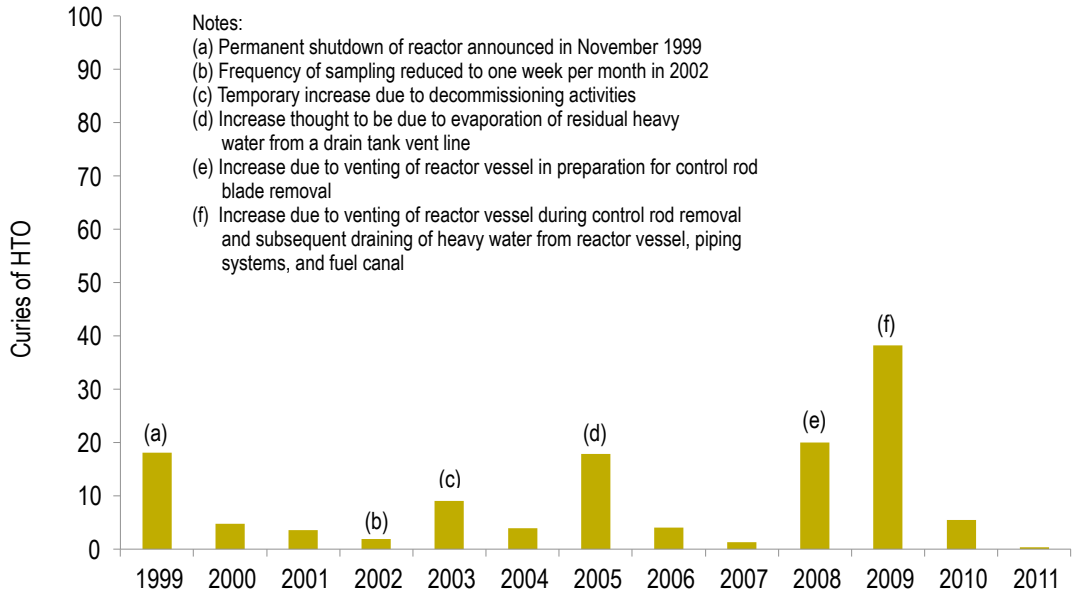


Figure 4-2. High Flux Beam Reactor Tritium Emissions, Multi-Year Trend (1999–2011).

4.1.3 Brookhaven Linac Isotope Producer

Protons from the Linear Accelerator (Linac) are sent via an underground beam tunnel to the BLIP, where they strike various metal targets to produce new radionuclides for medical diagnostics. The activated metal targets are transferred to the TPL in Building 801 for separation and shipment to various radiopharmaceutical research laboratories. During irradiation, the targets become hot and are cooled by a continuously recirculating water system. The cooling water also becomes activated during the process, producing secondary radionuclides. The most significant of these radionuclides are oxygen-15 (O-15, half-life: 122 seconds) and carbon-11 (C-11, half-life: 20.4 minutes). Both of these isotopes are released as gaseous, airborne emissions through the facility's 33-foot stack. Emissions of these radionuclides are dependent on the current and energy of the proton beam used to manufacture the radioisotopes.

In 2011, BLIP operated over a period of 26 weeks, during which 1,911 Ci of C-11 and 3,881 Ci of O-15 were released. Tritium produced from activation of the target cooling water was also released, but in a much smaller quantity, 3.31 E-4 Ci. Combined emissions of C-11 and O-15 were 4 percent less than the combined emission of these isotopes in 2010.

4.1.4 Former Evaporator Facility

In the past, liquid waste generated on site that contained residual radioactivity was accumulated at the Waste Concentration Facility (WCF) in Building 811. At this facility, the water was treated to remove suspended solids and then was transferred to the Evaporator Facility in Building 802B, where it was converted to steam and released as an airborne emission. The Evaporator Facility was constructed primarily to reduce the amount of tritiated water released to the Peconic River through the BNL Sewage Treatment Plant (STP).

No aqueous waste has been processed at the WCF for transfer to the Evaporator Facility since 2001. As a result, the Evaporator Facility has not been used and has produced no emissions of tritiated water vapor. Wastes are now solidified and sent to an approved off-site disposal facility. The Evaporator Facility was demolished in 2011.

4.1.5 Target Processing Laboratory

As mentioned in Section 4.1.3, metal targets irradiated at the BLIP are transported to the TPL in Building 801, where isotopes are chemically extracted for radiopharmaceutical production. Airborne radionuclides released during the extraction process are drawn through multistage HEPA and charcoal filters and then vented to the atmosphere. The types of radionuclides that are released depend on the isotopes chemically extracted from the irradiated metal targets, which may change from year to year. Annual radionuclide quantities released from this facility are very small, typically in the µCi to mCi range. In 2011, the total release from the TPL was 0.0861 µCi (see Table 4-1 for details).

4.1.6 Brookhaven Graphite Research Reactor

The BGRR was constructed in 1950 for the sole purpose of providing neutrons for research projects. When the air-cooled graphite-moderated reactor operated, filtered outside air was drawn though a reactor pile, cooled in the ductwork, and then exhausted to a 100-meter stack. The reactor was shut down in 1969 and fuel was removed and transported from the site in June of 1972. Commencing in 2010 and continuing into 2012, the graphite pile and the biological shield housing it, which acted as a neutron moderator for the reactor, were removed. During this project, approximately 1.4 million pounds of activated graphite blocks and 5,000 tons of activated concrete from the bioshield were removed from Building 701 and then packaged, transported, and disposed of at an off-site location. Much of the removal, packaging, and waste transfer work was conducted under a 46-foot long, 32-feet wide, and 26-foot high contamination control envelope (CCE) supported with steel trusses and draped with a flame-retardant polyvinyl chloride covering that was constructed over the biological shield. A temporary HEPA ventilation system consisting of four 6,000 cfm HEPA-filtered fans was used to maintain the CCE under a negative pressure with respect to Building 701. Throughout the

project, emissions discharged through a 36-inch diameter galvanized steel stack erected on the east exterior wall and extending 5 feet above the roof line were monitored for the presence of airborne radiological constituents such as tritium, particulates, and iodine. Continuous monitoring from November 2010 to November 2011 showed that 0.346 Ci of tritium were released (see Table 4-1 for details).

4.1.7 Additional Minor Sources

Several research departments at BNL use designated fume hoods for work that involves small quantities of radioactive materials (in the µCi to mCi range). The work typically involves labeling chemical compounds and transferring material between containers using pipettes. Due to the use of HEPA filters and activated charcoal filters, the nature of the work conducted, and the small quantities involved, these operations have a very low potential for atmospheric releases of any significant quantities of radioactive materials. Compliance with NESHAPs Subpart H is demonstrated through the use of an inventory system that allows an upper estimate of potential releases to be calculated. Facilities that demonstrate compliance in this way include Buildings 463, 490A, 510A, 535, 555, 725, 801, and 830, where research is conducted in the fields of biology, high energy physics, chemistry, photon science, advanced technology, and environmental sciences. See Table 8-4 in Chapter 8 for the calculated dose from these facility emissions.

4.1.8 Nonpoint Radiological Emission Sources

Nonpoint radiological emissions from a variety of diffuse sources were evaluated in 2011 for compliance with NESHAPs Subpart H. Diffuse sources evaluated included planned research and planned D&D activities. The EPA-approved CAP88-PC dose modeling computer program was used to calculate the possible dose to members of the public from each of the planned activities. The evaluations determined whether NESHAPs permitting and continuous monitoring requirements were applicable, or whether periodic confirmatory sampling was needed to ensure compliance with Subpart H standards for radionuclide emissions. Chapter 8 discusses the NESHAPs evaluations of environmental restoration activities that occurred in 2011.

4.2 FACILITY MONITORING

In the past, potential sources of radioactive emissions have been monitored at the BMRR, HFBR, Evaporator Facility, TPL, and BLIP. Because the BMRR and HFBR are permanently shut down and the Evaporator Facility was removed, no particulate sampling was conducted at these facilities in 2011.

The samplers in the TPL exhaust duct and the exhaust stack for BLIP are equipped with glass-fiber filters that capture samples of airborne particulate matter generated at these facilities (see Figure 4-3 for locations). The filters are collected and analyzed weekly for gross alpha and beta activity. Particulate filter analytical results for gross alpha and beta activity in 2011 are reported in Table 4-2. The average gross alpha and beta airborne activity levels for samples collected from the BLIP exhaust stack were 0.0006 and 0.2520 pCi/m^3, respectively. Annual average gross alpha and beta airborne activity levels for samples collected from the TPL were 0.0011 and 0.0240 pCi/m^3, respectively.

4.3 AMBIENT AIR MONITORING

As part of the Environmental Monitoring Program, air monitoring stations are in place around the perimeter of the BNL site (see Figure 4-3 for locations). Samples are collected using equipment at six blockhouse stations and three pole-mounted, battery-powered silica-gel samplers. The blockhouses are fenced to control access and protect costly sampling equipment.

At each blockhouse, vacuum pumps draw air through columns where particulate matter is captured on a glass-fiber filter. Particulate filters are collected weekly and are analyzed for gross alpha and beta activity using a gas-flow proportional counter. Also, water vapor for tritium analysis is collected on silica-gel absorbent material for processing by liquid scintillation analysis. In 2011, silica-gel samples were collected every 2 weeks.

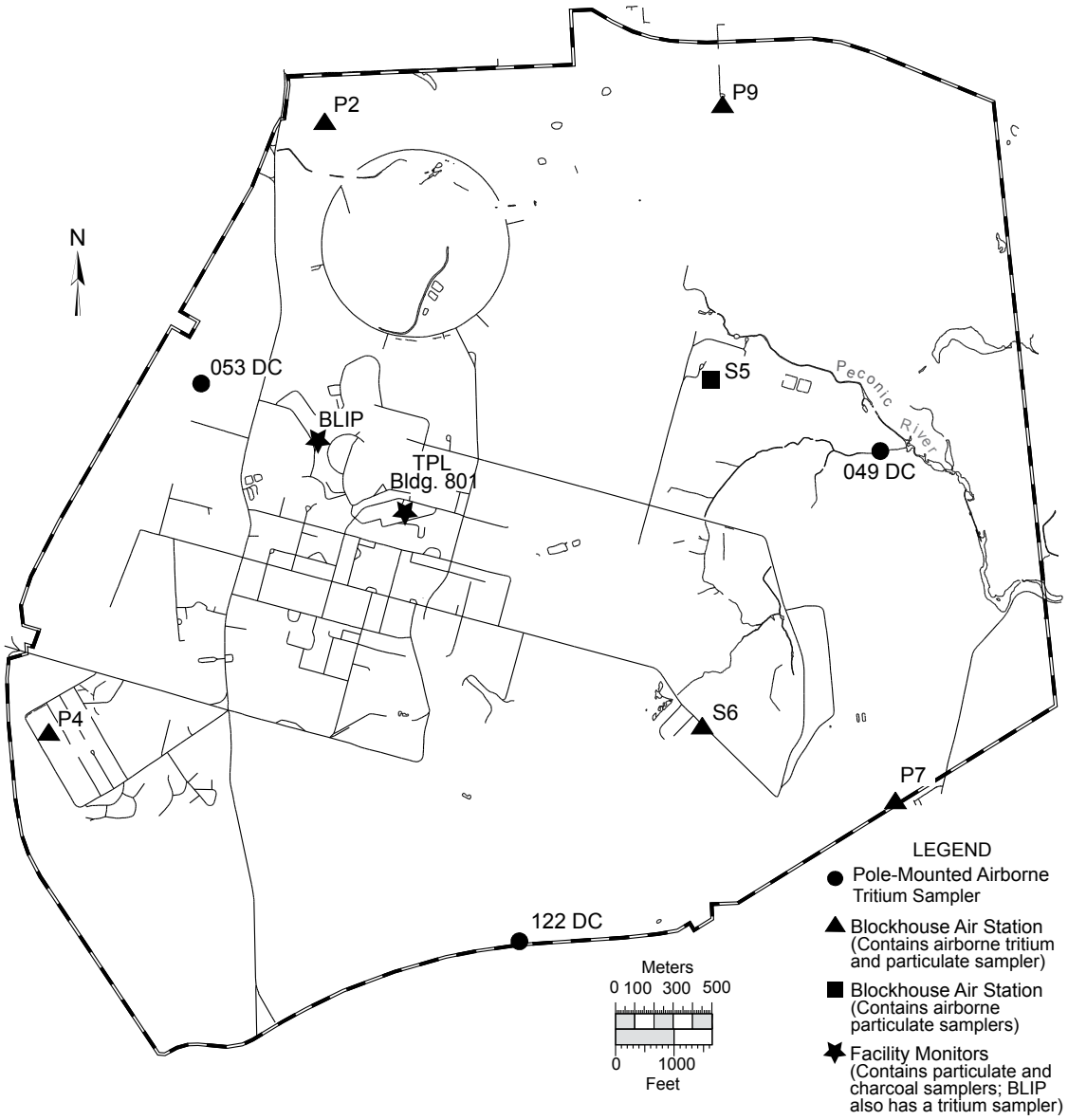


Figure 4-3. BNL On-Site Ambient Air Monitoring Stations.

4.3.1 Gross Alpha and Beta Airborne Activity

Particulate filter analytical results for gross alpha and beta airborne activity are reported in Table 4-3. Validated samples are those not rejected due to equipment malfunction or other factors (e.g., sample air volumes were not acceptable). The annual average gross alpha and beta airborne activity levels for the six monitoring stations were 0.0022 and 0.0143 pCi/m^3, respectively. Annual gross beta activity trends recorded at Station P7 are plotted in Figure 4-4. The results for this location are typical for the site. The trend shows seasonal variation in activity within a range that is representative of natural background levels. The New York State Department of Health (NYSDOH) received duplicate filter samples that were collected at Station P7, using a sampler they provided. These samples were collected weekly and analyzed by the NYSDOH laboratory for gross beta activity only. The analytical results found were comparable to the Station P7 samples analyzed by General Engineering Lab, an analytical laboratory contracted by BNL. New York State's analytical results for gross beta activity at the Laboratory were between 0.0025 and 0.0200 pCi/m^3, with an average concentration of 0.0120 pCi/m^3. BNL results ranged

Table 4-2. Gross Activity in Facility Air Particulate Filters.

Facility Monitor		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
BLIP	N	28	28
	Max.	0.0018 ± 0.0007	0.8100 ± 0.0067
	Avg.	0.0006 ± 0.0004	0.2520 ± 0.0038
	MDL	0.0005*	0.0007*
TPL-Bldg. 801	N	50	50
	Max.	0.0041 ± 0.0008	0.5650 ± 0.0050
	Avg.	0.0011 ± 0.0003	0.0240 ± 0.0009
	MDL	0.0002*	0.0004*

Notes:
See Figure 4-3 for sample station locations.
All values shown with a 95% confidence interval.
BLIP = Brookhaven Linac Isotope Producer
MDL = Minimum Detection Limit
N = Number of validated samples collected
TPL = Target Processing Laboratory
*Average MDL for all validated samples taken at this location

Table 4-3. Gross Activity Detected in Ambient Air Monitoring Particulate Filters.

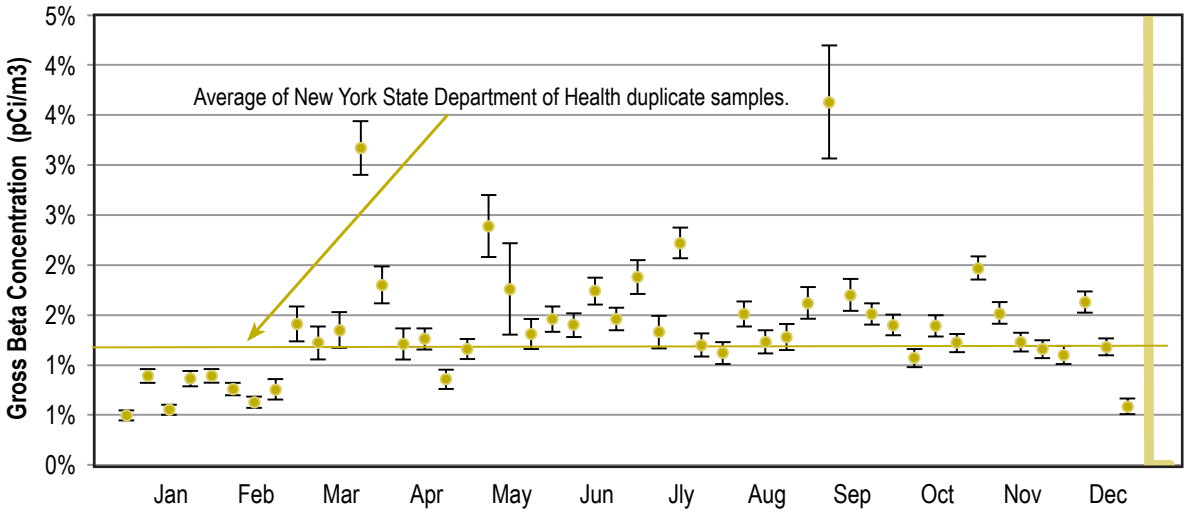
Sample Station		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
P2	N	49	49
	Max	0.0047 ± 0.0010	0.0263 ± 0.0017
	Avg.	0.0024 ± 0.0008	0.0154 ± 0.0014
	MDL	0.0005*	0.0008*
P4	N	51	51
	Max	0.0046 ± 0.0009	0.0233 ± 0.0015
	Avg.	0.0018 ± 0.0006	0.0124 ± 0.0011
	MDL	0.0004*	0.0006*
P7	N	47	47
	Max	0.0076 ± 0.0031	0.0363 ± 0.0056
	Avg.	0.0022 ± 0.0008	0.0140 ± 0.0014
	MDL	0.0006*	0.0009*
P9	N	47	47
	Max	0.0044 ± 0.0013	0.0291 ± 0.0021
	Avg.	0.0026 ± 0.0009	0.0173 ± 0.0017
	MDL	0.0007*	0.0010*
S5	N	52	52
	Max	0.0058 ± 0.0015	0.0246 ± 0.0021
	Avg.	0.0016 ± 0.0005	0.0105 ± 0.0008
	MDL	0.0003*	0.0004*
S6	N	49	49
	Max	0.0057 ± 0.0012	0.0252 ± 0.0017
	Avg.	0.0026 ± 0.0008	0.0165 ± 0.0015
	MDL	0.0006*	0.0009*
Grand Average		**0.0022 ± 0.0007**	**0.0143 ± 0.0013**

Notes:
See Figure 4-3 for sample station locations.
All values shown with a 95% confidence interval.
MDL = Minimum Detection Limit
N = Number of validated samples collected
*Average MDL for all validated samples taken at this location

from 0.0050 to 0.0363 pCi/m³, with an average concentration of 0.0140 pCi/m³. As part of a statewide monitoring program, NYSDOH also collects air samples in Albany, New York, a control location with no potential to be influenced by nuclear facility emissions. In 2011, NYSDOH reported that airborne gross beta activity at that location varied between 0.0039 and 0.0230 pCi/m³, and the average concentration was 0.0119 pCi/m³. Ninety-five percent of the sample results measured at the Laboratory fell within this range, demonstrating that on-site radiological air quality was consistent with that observed at locations in New York State not located near radiological facilities.

4.3.2 Airborne Tritium

Airborne tritium in the form of HTO is monitored throughout the BNL site. In addition to the five blockhouses containing tritium samplers, three pole-mounted monitors used for tritium sampling are located at or near the Laboratory's property boundary (see Figure 4-3 for sample locations). Observed concentrations of tritium at the sampling stations in 2011 were higher than concentrations observed in 2010, but comparable to concentrations observed in 2007 and 2008. Table 4-4 lists the number of validated samples collected at each location, the maximum value observed, and the annual average concentration. Validated samples are those not rejected due to equipment malfunction or other factors (e.g., a battery failure in the sampler, frozen or super-saturated silica gel, insufficient sample volumes, or the loss of sample during preparation at the contract analytical laboratory). Airborne tritium samples were collected every 2 weeks from each sampling station during 2011; however, the contract laboratory rejected numerous samples



Note: All values are presented with a 95 percent confidence interval.

Figure 4-4. Airborne Gross Beta Concentration Trend Recorded at Station P7.

because moisture captured on silica gel was insufficient for analysis. The average tritium concentrations at all of the sampling locations were less than the typical minimum detection limit (MDL), which ranged from 2.0 to 13.0 pCi/m^3.

4.4 NONRADIOLOGICAL AIRBORNE EMISSIONS

Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emission monitoring to demonstrate compliance with emission limits. The Central Steam Facility (CSF) is the only BNL facility that requires monitoring for nonradiological emissions. The Laboratory has several other emission sources subject to state and federal regulatory requirements that do not require emission monitoring (see Chapter 3 for more details). The CSF supplies steam for heating and cooling to major BNL facilities through an underground steam distribution and condensate grid. The location of the CSF is shown in Figure 4-1. The combustion units at the CSF are designated as Boilers 1A, 5, 6, and 7. Boiler 1A, which was installed in 1962, has a heat input of 16.4 MW (56.7 million British thermal units [MMBtu] per hour). Boiler 5, installed in 1965, has a heat input of 65.3 MW (225 MMBtu/hr). The newest units, Boilers 6 and 7, were installed in 1984 and 1996, and each has a heat input of 42.6 MW (147 MMBtu/hr). For perspective, National Grid's Northport, New York, power station has four utility-sized turbine/generator boilers, each with a maximum rated heat input of 1,082 MW (3,695 MMBtu/hr).

Because of their design, heat inputs, and dates of installation, Boilers 6 and 7 are subject to Title 6 of the New York Code, Rules, and Regulations (NYCRR) Part 227-2, and the Federal New Source Performance Standard (40 CFR 60 Subpart Db: Standards of Performance for Industrial-Commercial-Institutional Steam Boilers). These boilers are equipped with continuous emission monitors to measure nitrogen oxides (NO_x) and with continuous opacity monitors to demonstrate compliance with Subpart Db opacity monitoring requirements. To measure combustion efficiency, the boilers are also monitored for carbon dioxide (CO_2). Continuous emission monitoring results from the two boilers are reported quarterly to EPA and the New York State Department of Environmental Conservation (NYSDEC).

From May 1 to September 15, 2011, (the peak ozone period), compliance with the 0.30 lbs/MMBtu (129 ng/J) NOx emission standard for No. 6 oil and the 0.20 lbs/MMBtu (86 ng/J) NOx emission standard for No. 2 oil and natural gas is demonstrated by calculating the 24-hour average emission rate from continuous emission

Table 4-4. Ambient Airborne Tritium Measurements in 2011.

Sample Station	Wind Sector	Validated Samples	Maximum (pCi/m³)	Average (pCi/m³)
049	E	18	6.9 ± 9.6	1.1 ± 4.2
053	NW	14	46.9 ± 12.6	4.9 ± 4.5
122	SSE	17	29.1 ± 4.0	3.0 ± 4.4
P2	NNW	25	79.5 ± 4.5	8.7 ± 3.6
P4	WSW	4	4.2 ± 2.4	1.0 ± 1.0
P9	NE	24	20.8 ± 5.6	2.3 ± 3.4
S6	SE	20	5.2 ± 5.7	1.1 ± 3.0
Grand Average				**3.6 ± 3.7**

Notes:
See Figure 4-3 for station locations.
Sample station P4 is not included in the table since just one valid sample was collected.
Wind sector is the downwind direction of the sample station from the HFBR stack.
All values reported with a 95% confidence interval.
Typical minimum detection limit for tritium is between 3.0 and 12.0 pCi/m³.
DOE Order 5400.5 Air Derived Concentration Guide is 100,000 pCi/m³.

monitoring system readings and comparing the value to the emission standard. During the remainder of the year, the calculated 30-day rolling average emission rate is used to establish compliance. Boiler 6 and 7 opacity levels are recorded as 6-minute averages. Measured opacity levels cannot exceed 20 percent opacity, except for one 6-minute period per hour of not more than 27 percent opacity. In 2011, there were no measured exceedances of the NO_x emission standards for either boiler.

In 2011, there were no excess opacity measurements recorded by the Boiler 6 and Boiler 7 opacity monitors during routine operations. The only recorded opacity excursions were observed during performance testing. While there are no regulatory requirements to continuously monitor opacity for Boilers 1A and 5, surveillance monitoring of visible stack emissions is a condition of BNL's Title V operating permit. Daily observations of stack gases recorded by CSF personnel throughout the year showed no visible emissions, with opacity levels lower than the regulatory limits established for these boilers.

To satisfy quality assurance requirements for the continuous emissions monitoring system of the Laboratory's Title V operating permit, a relative accuracy test audit (RATA) of the Boilers 6 and 7 continuous emissions monitoring systems for NO_x and CO_2 was conducted in December 2011. The results of the RATA demonstrated that the Boiler 6 and 7 NO_x and CO_2 continuous emissions monitoring systems met RATA acceptance criteria, which are defined in 40 CFR 60, Appendix B, Specifications 2 and 3.

In 2011, residual fuel prices exceeded those of natural gas throughout the year. As a result, natural gas was used to supply more than 99 percent of the heating and cooling needs of BNL's major facilities during the year. By comparison, in 2005, residual fuel satisfied more than 99.9 percent of the major facility heating and cooling needs. Consequently, 2011 emissions of particulates, NO_x, and sulfur dioxide (SO_2) were 12.6, 50, and 92.2 tons less than the respective totals for 2005. All emissions were well below the respective permit limits of 113.3, 159, and 445 tons. Table 4-5 shows fuel use and emissions since 2002.

4.5 GREENHOUSE GAS EMISSIONS

One of the overarching goals of Executive Order (EO) 13514, Federal Leadership in Environmental, Energy, and Economic Performance, is for federal agencies to establish agency-wide greenhouse gas (GHG) reduction targets for their combined Scope 1 and 2 greenhouse gas emissions and for their Scope 3 greenhouse gas emissions (see Appendix A for definitions). DOE has set the following GHG emission reduction goals for fiscal year 2020: reduce Scope 1 and 2 GHG emissions by 28 percent relative to their fiscal year (FY) 2008 baseline and reduce Scope 3 GHG emissions by 13 percent relative to their FY 2008 baseline.

BNL included these same goals in its Site Sustainability Plan (SSP), which was submitted to DOE in December of 2010. Due to planned programmatic growth with the addition of the Laboratory's National Synchrotron Light Source-II and other programs, Scope 1 and 2 emissions are projected to increase to 323,000 metric tons carbon dioxide equivalent ($MtCO_2e$) by 2020 compared to the FY 2008 baseline of 205,542 $MtCO_2e$. Due to the projected increase, meeting the Scope 1 and 2 reduction goal will be especially difficult, and BNL's SSP identifies

a number of actions that have or will be taken to help the Laboratory move towards this goal. In November 2011, the Long Island Solar Farm (LISF), a large array of more than 164,000 solar photovoltaic panels constructed on site property and leased to BP Solar, began producing solar power. Annually, the LISF is expected to deliver 44 million kilowatt-hours of solar energy. This equates to 28,000 $MtCO_2e$ that BNL can count on as GHG offsets or reductions. In March 2011, BNL began receiving 15 megawatts per hour of hydropower from the New York Power Authority. Each year, BNL expects to consume 115,600 megawatts of hydropower that will provide a net GHG reduction of 75,000 $MtCO_2e$ annually. Further analysis of current and projected thermal loads from projects under construction suggest that a 5 megawatt combined heat and power plant would meet thermal needs and produce 39,000 megawatt-hours of power annually. A plant of this size would provide GHG emission offsets of 18,000 $MtCO_2e$ per year. A conceptual design for a 5 megawatt plant is expected to be submitted to the Laboratory for review in FY 2013.

To meet the 2020 Scope 3 GHG emissions reduction goal, Scope 3 emissions must be lowered by nearly 1,450 $MtCO_2e$ from the FY 2008 baseline of 20,000 $MtCO_2e$. A secondary Scope 3 goal set by DOE is to reduce GHG emissions from employee travel by 12 percent from the FY 2008 baseline. To achieve the employee travel reduction goal, BNL must reduce its employee travel GHGs by 1,040 $MtCO_2e$. The Laboratory will focus its efforts on reducing employee airline travel as the primary means to surpass this GHG reduction target. In November 2011, BNL presented three proposals to the Laboratory's Policy Council to establish an annual airline mileage reduction goal applicable to all organizations. The first proposal would require each organization to reduce its annual airline mileage 2 percent per year, each year from FY 2012 to FY 2020, using airline miles traveled in FY 2008 as the baseline. The second proposal would require each organization to reduce annual airline mileage 3 percent per year, each year from FY 2012 to FY 2020 using airline miles traveled in FY 2010 as the baseline. The third proposal would require organizations to reduce annual airline mileage 6 percent per year from FY 2012 to FY 2020 using airline miles traveled in FY 2011 as the baseline. Further analysis of the impacts of

Table 4-5. Central Steam Facility Fuel Use and Emissions (2002 – 2011).

Annual Fuel Use and Fuel Heating Values							Emissions			
Year	No. 6 Oil (10^3 gals)	Heating Value (MMBtu)	No. 2 Oil (10^3 gals)	Heating Value (MMBtu)	Natural Gas (10^6 ft^3)	Heating Value (MMBtu)	TSP (tons)	NO_x (tons)	SO_2 (tons)	VOCs (tons)
2002	2,785.04	407,518	0.29	41	220.62	225,030	15.4	62.4	53.8	1.0
2003	4,290.95	628,765	402.06	56,288	0.98	1,000	22.8	75.3	107.1	0.6
2004	4,288.76	628,063	2.45	343	0.11	109	16.4	81.9	104.7	2.4
2005	4,206.12	618,590	0.87	122	0.00	0	15.2	80.4	93.1	2.4
2006	2,933.00	432,430	0.22	30	191.35	195,177	11.8	66.9	66.3	2.2
2007	2,542.85	374,432	0.00	0	263.04	268,301	9.7	77.3	59.3	2.2
2008	1,007.49	148,939	0.10	14	496.48	506,406	5.7	46.7	23.0	1.9
2009	1,904.32	283,734	0.00	0	375.03	382,529	9.0	53.4	44.9	2.1
2010	447.47	66,591	0.00	0	561.42	568,939	3.4	41.5	10.0	1.8
2011	31.49	4,726	0.01	2	657.06	668,564	2.6	30.4	0.9	1.8
Permit Limit (in tons)							113.3	159.0	445.0	39.7

Notes:
NO_x = Oxides of Nitrogen
SO_2 = Sulfur Dioxide
TSP = Total Suspended Particulates
VOCs = Volatile Organic Compounds

each of the proposals on organizations will be provided to the Policy Council in FY 2012.

To support the selected proposal, guidelines will be developed and linked to BNL's Standards-Based Management System Domestic Travel, Foreign Travel, and Conference Management subject areas to consider using rail, personal car, or rental cars as options to airline trips to destinations less than 300 miles from the Laboratory for domestic trips, and for trip legs less than 300 miles during foreign travel. Criteria for options will include cost of trips, travel time, and GHG reductions. A table will be included in the guidelines that will provide comparative travel times, costs, and GHG emissions for rail, auto, and air travel to frequently traveled domestic destinations and foreign departure/destinations separated by less than 300 miles. The guidelines will also encourage employees to reduce business travel trips entirely by taking advantage of teleconferencing options, when available.

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