Air Quality 4

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 2013, BNL facilities released a total of 4,919 curies of short-lived radioactive gases. Oxygen-15 and carbon-11 emitted from the Brookhaven Linac Isotope Producer constituted more than 99.9 percent of the site's radiological air emissions.

Because natural gas prices were comparatively lower than residual fuel prices throughout the year, BNL's Central Steam Facility used natural gas to meet 97.4 percent of the heating and cooling needs of the Laboratory's major facilities in 2013. As a result, annual facility emissions of criteria pollutant emission were slightly higher than 2012 levels, when natural gas use accounted for 99 percent of Laboratory major facilities heating and cooling needs.

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 3, *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). During 2013, periodic monitoring was conducted at one active facility, the Target Processing Laboratory (TPL), and one inactive facility, the High Flux Beam Reactor (HFBR). Figure 4-1 provides the locations of these monitored facilities, and Table 4-1 presents the airborne release data for each of these facilities. Annual emissions from monitored facilities are discussed in the following sections of this chapter. The associated radiation dose estimates are presented in Chapter 8, Table 8-4.

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

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

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

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. 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.

4.1.2 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 2013, BLIP operated over a period of 29 weeks, during which 1,620 Ci of C-11 and 3,300 Ci of O-15 were released. Tritium produced from activation of the target cooling water was also released, but in a much smaller quantity, 2.68 E-4 Ci. Combined emissions of C-11 and O-15 were 4,919 Ci, only slightly higher than the combined emission of 4,910 Ci in 2012.

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

Facility	Nuclide	Half-Life	Ci Released
HFBR	Tritium	12.3 years	5.22E-01
BLIP	Carbon-11	20.4 minutes	1.62E+03
	Oxygen-15	122 seconds	3.30E+03
	Tritium	12.3 years	2.68E-04
Total			**4.92E+03**

Notes:
Ci = 3.7E+10 Bq
BLIP = Brookhaven Linac Isotope Producer
HFBR = High Flux Beam Reactor (operations were terminated in November 1999)

4.1.3 Target Processing Laboratory

As mentioned in Section 4.1.2, 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. Gamma analysis of monthly composite samples was discontinued in 2013. This decision was made during the preparation of BNL's 2013 Environmental Monitoring Plan, and was based on the fact that historical analytical results of TPL particulate filters showed gross alpha/beta levels to be very low and consistent with background concentrations. As a result, there are no reported radionuclide emissions from the TPL in Table 4-1. Should future gross beta analyses of TPL emissions show the potential for other radionuclide emissions, gamma analyses will be conducted.

4.1.4 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 197, 197B, 463, 480 , 490, 490A, 725, 801, 865, and 901, and 815, where research is conducted in the fields of nuclear safety, biology, high energy physics, medicine, medical therapy, photon science, advanced technology, environmental chemistry, and synthetic biology. See Table 8-4 in Chapter 8 for the calculated dose from these facility emissions.

4.1.5 Nonpoint Radiological Emission Sources

Nonpoint radiological emissions from a variety of diffuse sources were evaluated in 2013 for compliance with NESHAPs Subpart H. Diffuse sources evaluated included planned research, planned waste management activities, 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 2013.

4.2 FACILITY MONITORING

Radioactive emissions are monitored at the TPL and BLIP. 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 4-2 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 2013 are reported in Table 4-2. The average gross alpha and beta airborne activity levels for samples collected from the BLIP exhaust stack were 0.0005 and 0.0111 pCi/m^3, respectively. Annual average gross alpha and beta airborne activity levels for samples collected from the TPL were 0.0010 and 0.0110 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 4-2 for locations). There are six blockhouse stations and three pole-mounted, battery-powered silica-gel samplers equipped for collecting samples.

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 2013, silica-gel samples were collected every 2 weeks.

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. Since there are no active nuclear reactors on site and there were no planned radiological remediation projects in 2013, a decision was made to only collect ambient air samples from Stations P2, P4, P7, and P9 around the site perimeter. 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 four monitoring stations were 0.0017 and 0.0140 pCi/m^3, respectively. Annual gross beta activity trends recorded at Station P7 are plotted in Figure 4-3. The results for this location are typical for the site, and show 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. The analytical results 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 0.0011 and 0.0210 pCi/m^3, with an average concentration of 0.0091 pCi/m^3. BNL results ranged from 0.0050 to 0.0222 pCi/m^3, with an average concentration of 0.0128 pCi/m^3.

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 2013, NYSDOH reported that airborne gross beta activity at that location varied between 0.0057 and 0.0290 pCi/m^3, and the average concentration was 0.0115 pCi/m^3. All of the sample results measured at BNL 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 (tritiated water) is monitored throughout the BNL site. In addition to the five blockhouses containing tritium samplers, three pole-mounted monitors that may be used for tritium sampling are located at or near the Laboratory's property boundary (see Figure 4-2 for sample locations). Tritium sampling in 2013 was limited to Stations P2, P4, P7, and P9 on the basis that they are adequately located around the site's perimeter to monitor potential impacts from BNL's three tritium sources. Observed concentrations

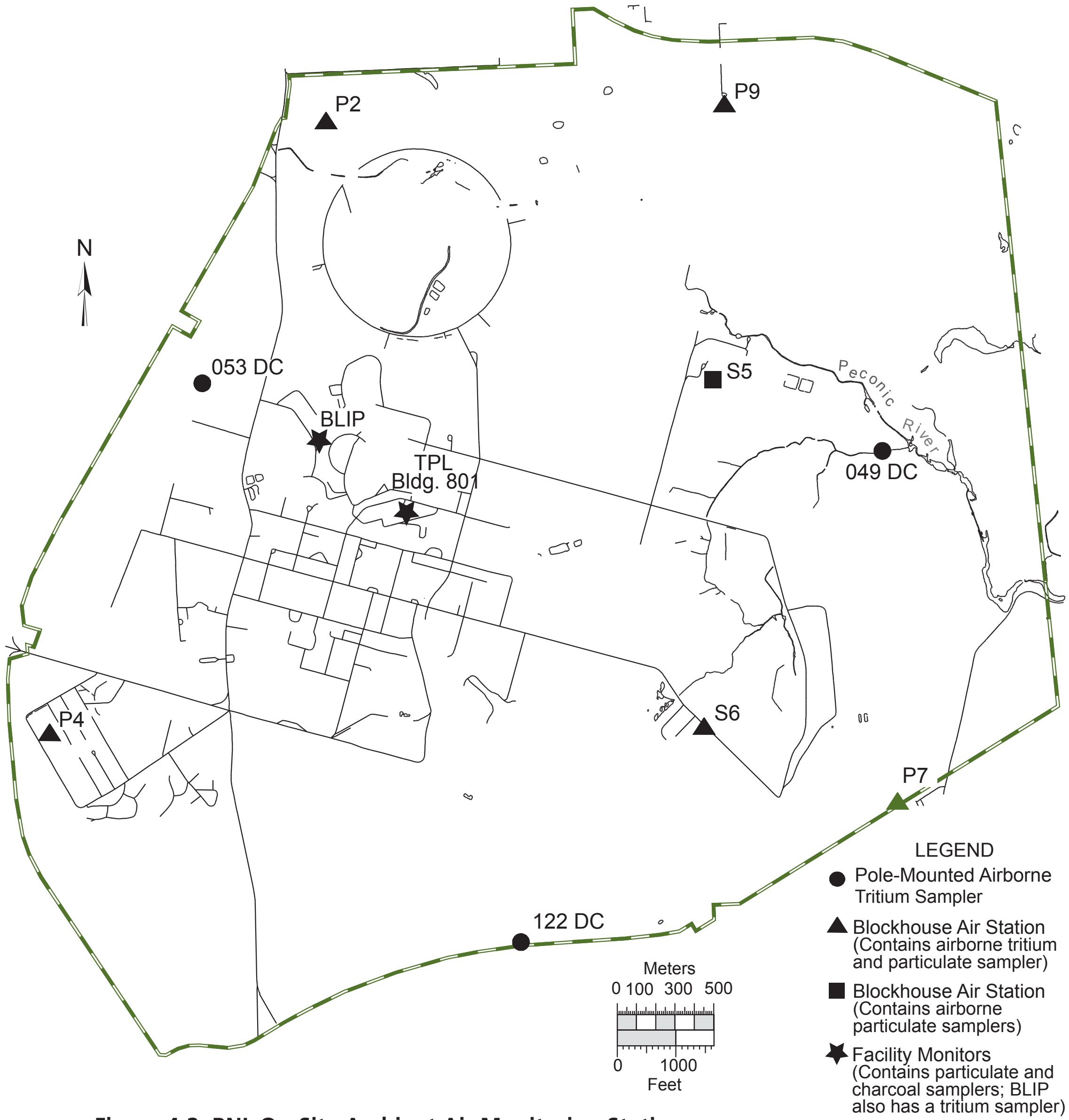


Figure 4-2. BNL On-Site Ambient Air Monitoring Stations.

of tritium at the sampling stations in 2013 were similar to concentrations observed in 2012. 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 supersaturated silica gel, insufficient sample volumes, or the loss of sample during preparation at the contract analytical laboratory). Airborne tritium samples were collected every two weeks from each sampling station during 2013; however, the contract analytical laboratory rejected 20 samples 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 limits (MDLs), which ranged from 3.5 to 10.0 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

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

Facility Monitor		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
BLIP	N	49	49
	Max.	0.0022 ± 0.0009	0.0696 ± 0.0034
	Avg.	0.0005 ± 0.0005	0.0111 ± 0.0013
	MDL	0.0007*	0.0010*
TPL-Bldg. 801	N	53	53
	Max.	0.0052 ± 0.0013	0.0458 ± 0.0019
	Avg.	0.0010 ± 0.0004	0.0110 ± 0.0010
	MDL	0.0004*	0.0006*

Notes:
See Figure 4-2 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.

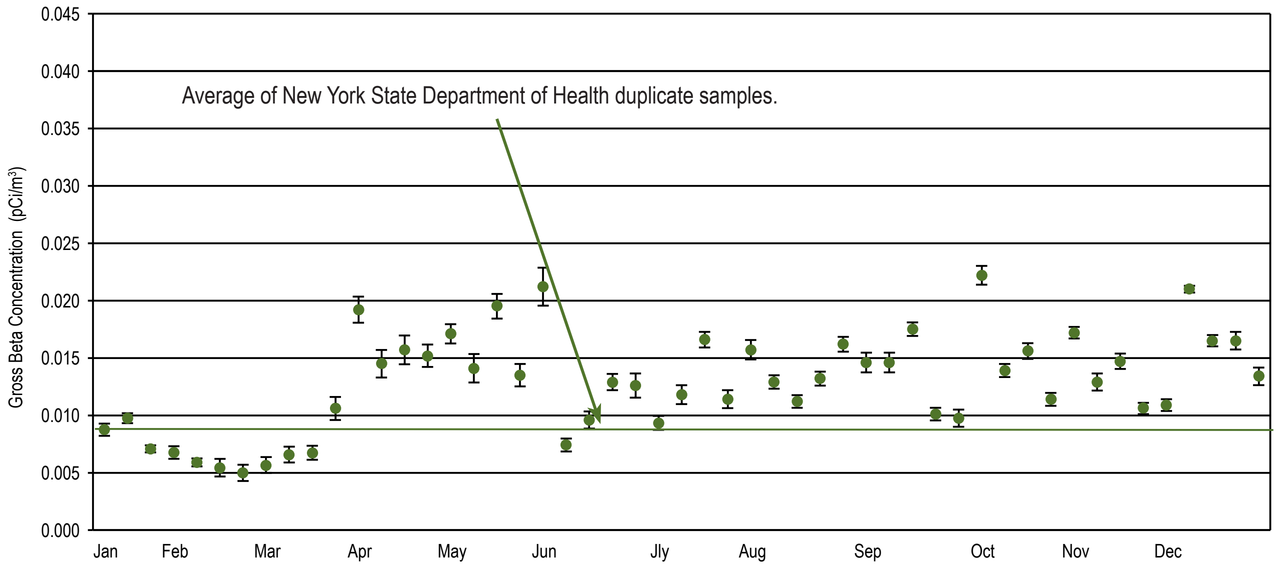
Sample Station		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
P2	N	47	47
	Max	0.0038 ± 0.0011	0.0250 ± 0.0016
	Avg.	0.0017 ± 0.0006	0.0150 ± 0.0013
	MDL	0.0006*	0.0008*
P4	N	49	49
	Max	0.0036 ± 0.0003	0.0268 ± 0.0017
	Avg.	0.0017 ± 0.0006	0.0148 ± 0.0012
	MDL	0.0005*	0.0007*
P7	N	50	50
	Max	0.0030 ± 0.0003	0.0222 ± 0.0016
	Avg.	0.0016 ± 0.0006	0.0128 ± 0.0012
	MDL	0.0006*	0.0007*
P9	N	47	47
	Max	0.0040 ± 0.0003	0.0275 ± 0.0017
	Avg.	0.0017 ± 0.0006	0.0135 ± 0.0011
	MDL	0.0005*	0.0007*
Grand Average		**0.0017 ± 0.0006**	**0.0140 ± 0.0012**

Notes:
See Figure 4-2 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

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



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

Figure 4-3. Airborne Gross Beta Concentration Trend Recorded at Station P7.

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 2013, there were no measured exceedances of the NO_x emission standards for either boiler.

In 2013, the one excess opacity measurement recorded by Boiler 6 during routine operations on August 5 was due to a localized short-term power outage caused by electrical maintenance work at the CSF. During quarterly quality assurance tests of the opacity monitors for Boilers 6 and 7 multiple 6-minute periods greater than 20 percent opacity were recorded. These excursions were documented in quarterly Site-Wide Air Emissions and Monitoring Systems Performance Reports submitted to NYSDEC. 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 demonstrate periodic compliance with applicable total suspended particulate and NO_x emission standards, emission tests of all four boilers must be conducted once during the term of BNL's Title V operating permit. All of the tests were scheduled to be completed in December 2012, however unseasonably warm weather made it impractical to run Boilers 5, 6, and 7 near peak loads for the required particulate tests and subsequent operational issues caused their testing to be rescheduled to March, July, and June, respectively.

Test results showed that Boilers 1A, 5, 6, and 7 met the total suspended particulate emissions standard of 0.1 lbs/MMBtu while burning No. 6 oil near peak steam load conditions, with average emission rates of 0.035, 0.032, 0.023 and 0.032 lbs/MMBtu, respectively. NO_x emission testing of Boilers 1A and 5 demonstrated that both boilers meet current Part 227-3 NO_x emission limits of 0.3 lbs/MMBtu while burning No. 6 oil or natural gas (Boiler 5). The results also provide valuable insight that will help CSF personnel to operate the facility effectively and to comply with the new lower Part 227-3 NO_x emission standards that go into effect on July 1, 2014. Under the new standards, average NO_x emissions from midsize boilers with maximum heat input capacities between 25 and 100 MMBtu/hr

Table 4-4. Ambient Airborne Tritium Measurements in 2013.

Sample Station	Wind Sector	Validated Samples	Maximum (pCi/m^3)	Average (pCi/m^3)
P2	NNW	24	24.8 ± 6.1	3.3 ± 4.2
P4	WSW	25	36.2 ± 4.5	2.7 ± 3.4
P7	ESE	7	4.0 ± 2.8	1.3 ± 2.3
P9	NE	23	20.5 ± 3.6	2.7 ± 3.5
Grand Average				**2.8 ± 3.6**

Notes:
See Figure 4-2 for station locations.
Wind sector is the downwind direction of the sample station from the High Flux Beam Reactor (HFBR) stack.
All values reported with a 95% confidence interval.
Typical minimum detection limit for tritium is between 2.0 and 10.0 pCi/m^3.
DOE Order 5400.5 Air Derived Concentration Guide is 100,000 pCi/m^3.

(i.e. Boiler 1A) must be no greater than 0.20 lbs/MMBtu when combusting oil or natural gas, while average NO_x emissions from large boilers with maximum heat inputs greater than 100 and less than 250 MMBtu/hr (Boilers 5, 6, and 7) must be less than or equal to 0.15 lbs/MMBtu when combusting oil or natural gas.

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 2013. 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 2013, residual fuel prices exceeded those of natural gas for most of the year. As a result, natural gas was used to supply more than 97.4 percent of the heating and cooling needs of BNL's major facilities. By comparison, in 2005, residual fuel satisfied 99.9 percent of the major facility heating and cooling needs. Consequently, 2013 emissions of particulates, NO_x, and sulfur dioxide (SO_2) were 12.3, 49.7, and 90.2 tons less than the respective totals for 2005, when No. 6 oil was the predominant fuel. 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 2004.

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 includes these same goals in its annual Site Sustainability Plan (SSP), which is submitted to DOE in December of each year. Due to planned programmatic growth with the addition of the Laboratory's National Synchrotron Light Source II (NSLS-II) and other programs, Scope 1 and 2 emissions are projected to increase to 289,000 metric tons carbon dioxide equivalent ($MtCO_2e$) by 2020, a 95 percent increase from the FY 2008 baseline of 205,542 $MtCO_2e$. Due to the projected increase, meeting the Scope 1 and 2 reduction goal will be 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 at the BNL site began producing solar power. Annually, the LISF is expected to deliver 44 million kilowatt-hours of solar energy into the local utility grid. 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. In 2013, BNL consumed 118, 856 megawatts of hy-dropower, providinga net GHG reduction of 72,502 $MtCO_2e$.

In October 2013, BHSO on behalf of BNL was awarded a Utility Energy Service Contract. This project allows for the implementation of energy savings measures and is scheduled for completion by late 2015. In addition to energy savings, it will reduce Scope 1/2 GHG levels by

Table 4-5. Central Steam Facility Fuel Use and Emissions (2004 – 2013).

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)
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
2012	43.44	6,519	0.00	0	613.44	630,616	2.5	29.1	1.2	1.7
2013	117.21	17,590	0.00	0	631.95	649,645	2.9	30.7	2.9	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

approximately 7,000 $MtCO_2e$. Some of the Phase I energy conservation measures that will be employed in 2014 include:

- Improvements that will increase that efficiency in supplying chilled water
- Upgraded lighting throughout the site
- Building control additions to provide for heating, ventilation, and air conditioning setbacks

Other planned energy savings initiatives include improvements at the Central Steam Facility and in the steam distribution system, and the construction of a combined heat and power plant.

To meet the 2020 Scope 3 GHG emissions reduction goal, Scope 3 emissions must be lowered by nearly 2,600 $MtCO_2e$ 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 business travel by 12 percent from the FY 2008 baseline or 1,065 $MtCO_2e$. Overall, Scope 3 GHG emissions have dropped by 2,706 $MtCO_2e$ or 13 percent from FY 2008 to FY 2012, despite a 113 $MtCO_2e$ or 1.0 percent increase in employee business travel GHG emissions over the same period. This reduction was a direct result of the purchase and use of 118, 856 megawatt-hours of hydropower from the New York Power Authority in 2013. Hydropower purchased in 2013 accounted for 43.9 percent of all BNL power purchases. As a result, GHG emissions from transmission and distribution losses dropped 3,399 $MtCO_2e$, or 30.5 percent.

To achieve the employee travel reduction goal, BNL must reduce its employee travel GHGs by 1,040 $MtCO_2e$. Reaching this goal is complicated by a growing employee population that rose 12.6 percent from 2,669 full-time employees at the end of FY 2008 to 3,004 as of end of March in 2013. Further increases are projected due to programmatic growth. Actions taken in 2013 that will help BNL move forward in meeting the employee business travel GHG reduction goals included:

- BNL staff continued to work with administrators of MetroPool, the New York State Department of Transportation regional commuting services contractor, on developing a rideshare portal customized to meet the needs of employees interested in ridesharing. Some issues with securing personally identifiable information used in ridematch search applications must be addressed before the portal development can continue. The proposed portal would include ride-match maps, displaying the location of other employee homes within a defined radius of the person seeking partners, or home locations of other employees near the route traveled by the employee. The portal will include other features, such as the location of park & ride lots, a commute cost calculator, Guaranteed Ride Service Information, and a live link to traffic conditions on major arteries.

- A working group led by BNL Human Resources developed two new procedures that will be added to the BNL Standards-Based Management System (SBMS) Flexible Work Arrangements Subject Area. These new procedures expand flexible workweek and compressed workweek schedules for non-bargaining non-exempt employees and non-bargaining employees, respectively.
- BNL's Badging Office amended forms used to register employee vehicles and provide stickers for site entrance purposes. The form now includes the vehicle model, in addition to the model year and make that was previously recorded. These records will serve as an improved metric for estimating the average mileage of vehicles used in vehicle commuting and for measuring reductions in commuter GHGs over time as employees replace older less fuel efficient models with vehicles meeting the progressively higher corporate average fuel economy standards that became effective with 2011 model year light duty vehicles.

Future actions that should help to reduce business travel GHS include plans to deploy greatly enhanced Unified Communications technologies in FY 2014 and FY 2015 as part of BNL's site-wide telephone replacement project. In addition to providing users with the ability to rapidly schedule and conduct ad-hoc audio teleconferences, the new technologies will enable users to integrate desktop video teleconferencing capabilities with larger room-based sessions and mobile devices. This allows teleconferencing sessions to be scheduled by any individual user, and spans the use of previously disparate technologies. As such, the need to travel for traditional face-to-face meetings is expected to decrease.

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