4 Air Quality

Brookhaven National Laboratory monitors both radioactive and nonradioactive emissions at several facilities to ensure compliance with the requirements of the Clean Air Act. In addition to a facility emissions monitoring program, ambient air monitoring is conducted to verify local air quality and to assess environmental impacts from the Laboratory's operations.

During 2002, BNL facilities released a total of 5,682 curies of short-lived radioactive gases. Oxygen-15 (half-life: 122 seconds) and carbon-11 (half-life: 20.48 minutes) released from the Brookhaven Linac Isotope Producer constituted more than 99.9 percent of the site's radiological air emissions.

Continuing a pattern observed in 2000 and 2001, natural gas prices were higher than residual fuel prices through much of 2002, causing the Central Steam Facility to rely more on residual fuel to meet the heating and cooling needs of BNL's major facilities than in 1999. As a result, annual facility emissions of particulate matter, nitrogen oxides, and sulfur dioxide were considerably higher in 2002 than in 1999, when natural gas was the predominant fuel used at the Central Steam Facility. Compared to 2001, however, when natural gas prices spiked, residual fuel use and emissions declined significantly in 2002.

4.1 RADIOLOGICAL EMISSIONS

Federal air quality laws and DOE regulations governing the release of airborne radioactive material include 40 CFR 61 Subpart H, the *National Emission Standards for Hazardous Air Pollutants* (NESHAPs)—part of the Clean Air Act, and DOE Order 5400.5 (1993), *Radiation Protection of the Public and the Environment*. Under NESHAPs Subpart H, facilities that have the potential to deliver a radiation dose of greater than 0.1 mrem/year (1 µSv/year) to a member of the public must be continuously monitored for emissions. Also, facilities capable of delivering a radiation dose below 0.1 mrem/year (1 µSv/year) require periodic, confirmatory monitoring. BNL has one facility that requires continuous monitoring, the Brookhaven Linac Isotope Producer (BLIP), and three active facilities where periodic monitoring is conducted. Figure 4-1 indicates the locations of the monitored facilities, and Table 4-1 presents the airborne release data from each of these facilities during 2002. Annual emissions from monitored facilities are discussed in the following sections. A fourth inactive facility, the Evaporator facility, which was periodically monitored in past years, is also discussed. The associated radiation dose calculations are presented in Chapter 8.

4.1.1 Brookhaven Medical Research Reactor

In August 2000, DOE announced that the Brookhaven Medical Research Reactor (BMRR) would be permanently shut down. Until it stopped operating in late December 2000, the BMRR was fueled with enriched uranium, moderated and cooled by light water, and was operated intermittently at power levels up to 3 megawatts (ther-

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

mal). Air from the interior of the containment building was used to cool the neutron reflector surrounding the core of the reactor vessel. As air was drawn through the reflector it was exposed to a neutron field, resulting in activation of the argon fraction of the air and producing argon-41, an inert, radioactive gas with a short half-life of 1.8 hours. After passage through the reflector, the air was routed through a roughing filter and a high efficiency particulate air (HEPA) filter to remove any particulate matter. Charcoal filters were also used to remove radioiodines produced during the fission process. Following filtration, the air was exhausted to the atmosphere through a 150-foot stack adjacent to the reactor containment building.

After the BMRR stopped operating, continuous monitoring to track argon-41 air emissions was reduced to periodic semi-annual monitoring, because the emissions were very low. January and September 2002 sampling showed there were no quantifiable emissions of argon-41 or nonargon radionuclides at zero power level with building ventilation on and the BMRR core unchanged.

4.1.2 High Flux Beam Reactor

Following the discovery of an underground plume of tritiated groundwater emanating from a leak in the spent fuel storage pool, the High Flux Beam Reactor (HFBR) was kept in a standby mode from January 1997 until November 1999,

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

Facility	Nuclide	Half-life	Ci Released
BMRR	Argon-41	1.8 hours	None
HFBR	Tritium	12.3 years	1.93E + 00
BLIP	Carbon-11	20.5 minutes	1.41E + 03
	Germanium-69	1.6 days	9.20E - 05
	Oxygen-15	122 seconds	4.27E + 03
	Rubidium-86	18.7 days	4.99E - 05
	Tritium	12.3 years	1.80E - 01
Target Processing Laboratory	Arsenic-74	17.8 days	1.85E - 06
	Bromine-77	56 hours	6.94E - 05
	Cesium-137	30 years	6.19E - 07
	Rubidium-86	18.7 days	2.78E - 05
	Selenium-75	119.8 days	9.77E - 09
	Thallium-202	12.2 days	6.37E - 07
	Tin-113	115.1 days	3.59E - 05
	Zirconium-88	83.4 days	8.63E - 07
Total			5.682E + 03

Notes:
Ci = 3.7E + 10 Bq.
BMRR = Brookhaven Medical Research Reactor
HFBR = High Flux Beam Reactor
BLIP = Brookhaven Linac Isotope Producer
The BMRR stopped operating in December 2000.

when DOE announced that it would be permanently shut down. The storage pool was drained in December 1997 to prevent additional leakage as well as to facilitate repairs and double lining of the pool to conform to Suffolk County Article 12. When the HFBR operated, it used heavy water as a neutron moderator and fuel coolant. Heavy water, or D_2O, is water composed of a nonradioactive isotope of hydrogen known as deuterium. When exposed to the neutron fields generated inside the reactor vessel, the deuterium became activated, producing radioactive tritium (half-life = 12.3 years). Although heavy water has been removed from the vessel, residual tritium still remains in the vessel and cooling loops. Tritiated water vapor (HTO) is released from the vessel and associated piping systems (via diffusion at valve seals and other system penetrations) to building air, where it is routed to the facility's 328-foot stack. Concentrations of HTO in air are assessed using a silica gel absorbent material. In 2002, 1.93 curies (Ci) of airborne HTO were released from the HFBR. Figure 4-2 illustrates the declining trend of tritium emissions from the HFBR since 1993. In 2002, sampling was reduced to one week per month.

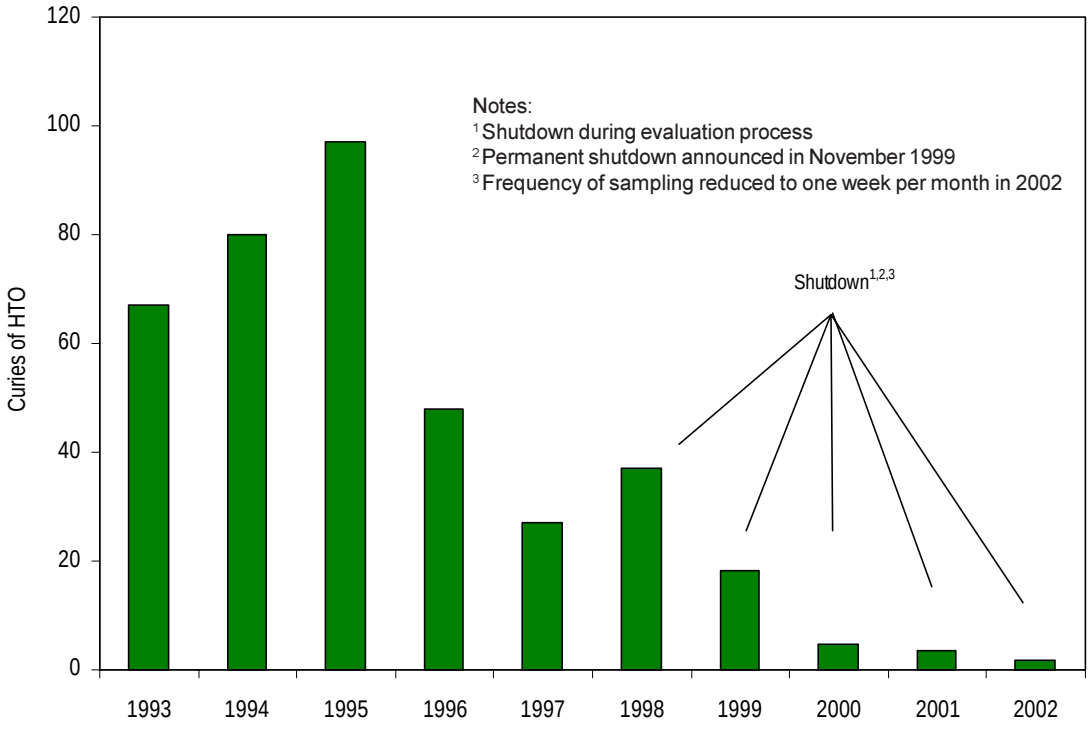

Figure 4-2. High Flux Beam Reactor Tritium Emissions, Ten-Year Trend (1993–2002).

4.1.3 Brookhaven Linac Isotope Producer

Protons from the Linear Accelerator are sent via an underground beam tunnel to the BLIP, where they strike various metal targets. The proton beam activates these metal targets to produce new radionuclides for diagnostic use. The activated metal targets are transferred to the Target Processing Laboratory (TPL), Building 801, for separation and are later shipped 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 are oxygen-15 and carbon-11 (radionuclides with short half-lives of 122 seconds and 20.48 minutes, respectively). Both of these isotopes are released as gaseous, airborne emissions through the facility's 33-foot stack.

In 2002, the BLIP operated over a period of 21 weeks; during this period, 1,410 Ci of carbon-11 and 4,270 Ci of oxygen-15 were released. Tritium produced from activation of the target cooling water was also released, but in a much smaller quantity. Emissions of carbon-11 and oxygen-15 declined by more than 40 percent from 2001, primarily due to a decreased period of operations (35 weeks in 2001 compared to 21 weeks in 2002). See Table 4-1 for a complete listing of the radionuclides released from the BLIP facility during 2002.

4.1.4 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 the WCF, suspended solids and a high percentage of radionuclides were removed from the liquid, using reverse osmosis. However, because tritium is an isotope of hydrogen, it could not be removed from aqueous wastes. The tritiated water that remained following waste concentration 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. Emissions were directed to the same stack used by the HFBR to exhaust building air. This method was preferable to release via surface water because there was virtually no potential for the airborne emissions to influence groundwater (the primary drinking water source on Long Island), and the potential for the released tritium to contribute to an off-site dose was minimized by atmospheric dispersion.

Since no aqueous waste was processed at the WCF in 2002, there were no emissions of tritiated water vapor from the Evaporator Facility. Because generation rates of aqueous wastes containing residual radioactivity are expected to remain low, it is no longer economical to process the waste in the same manner. As a result, plans are to decommission the WCF reverse osmosis process and the Evaporator Facility.

4.1.5 Target Processing Laboratory

As mentioned in Section 4.1.3, the metal targets irradiated at the BLIP facility 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 HFBR stack (see Table 4-1 for isotopes and quantities). The types of radionuclides that are released depends on the isotopes that are chemically extracted from the irradiated metal targets, which can change from year to year. Annual radionuclide quantities released from this facility are very small, typically in the millicurie (mCi) range. In 2002, the total release from the TPL was 0.14 mCi.

4.1.6 Additional Minor Sources

Several research departments at BNL use designated fume hoods for work that involves very small quantities of radioactive materials (in the microcurie to millicurie range). The work done using fume hoods typically involves transferring material between containers, using pipettes, and labeling chemical compounds. Due to the use of HEPA 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, 490, 490A, 510, 555, 725, and 801, where research is conducted in the fields of biology, medicine, high energy physics, chemistry, applied and materials science, and advanced technology. See Table 8-4 for the calculated dose from the emissions from these facilities.

4.1.7 Uncharacterized Radiological Emission Sources Evaluated in 2002

Uncharacterized radiological emissions (diffuse or area sources) were evaluated for compliance with NESHAPs, Subpart H. The EPA-approved CAP88-PC dose modeling program (see Chapter 8 for more details) was used to calculate the dose to members of the public from planned research, environmental restoration, and waste management activities. These evaluations determined whether NESHAPs permitting and continuous monitoring requirements are applicable or whether periodic confirmatory sampling is needed to ensure compliance with Subpart H standards for radionuclide emissions. Chapter 8 discusses the NESHAPs evaluations of the research, environmental restoration, and waste management activities that occurred in 2002.

One of the projects evaluated as a diffuse source was the Chemistry Department's use of radiotracers for neuroimaging research in Building 901. The radiotracers are fabricated in the form of ^{11}C (half-life: 20.48 minutes) labeled compounds. The procedure is initiated by trapping the $^{11}CO_2$ in a molecular sieve and reacting it with hydrogen to convert it into $^{11}CH_4$. The $^{11}CH_4$ is converted to ^{11}CN by reacting it with NH_3. The complete procedure is performed under a laboratory hood and the waste gases are collected in an 8-foot weather balloon encased in a secondary polyethylene bag. The ^{11}C collected in the weather balloon is decayed for ten half-lives and then vented to the outside. Another tracer the Chemistry Department uses is fluorine-18 (half-life: 109.77 minutes), which is produced by irradiating ^{18}O water. The potential emissions from this operation, ^{11}C and ^{18}F, were evaluated for NESHAPs compliance. By decaying the emission gases for ten half-lives before discharging them to the environment, the effective dose to members of the public and impacts to the environment are minimized in accordance with BNL's commitment to the ALARA (as low as reasonably achievable) policy.

The CAPP88-PC model conservatively overestimated an effective dose equivalent of 1.33E-02 mrem/annual to the maximally exposed individual with a worst-case scenario, 100 percent release of the source term to the environment. This value is well under the annual 0.1 mrem threshold that triggers the NESHAPs Subpart H requirements for continuous monitoring. Chapter 8 discusses in greater detail this and other activities that were evaluated.

4.2 FACILITY MONITORING

In the past, potential sources of radioactive particulate emissions that have been monitored included the BMRR, the HFBR, the Evaporator Facility, the TPL (Building 801), and the BLIP. Since the BMRR and HFBR are permanently shut down and the Evaporator Facility did not process any aqueous wastes in 2002, no particulate sampling was conducted at these facilities.

The samplers in the exhaust duct for the TPL and the exhaust stack for the 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 are reported in Table 4-2. Annual average gross alpha and beta airborne activity levels for samples collected from the TPL were 0.036 pCi/m^3 and 0.219 pCi/m^3, respectively. The annual average gross alpha and beta airborne activity levels for samples collected from the BLIP exhaust stack were -0.043 pCi/m^3 and -0.460 pCi/m^3, respectively. (For a discussion of negative values associated with radioactivity monitoring, see Appendix B.)

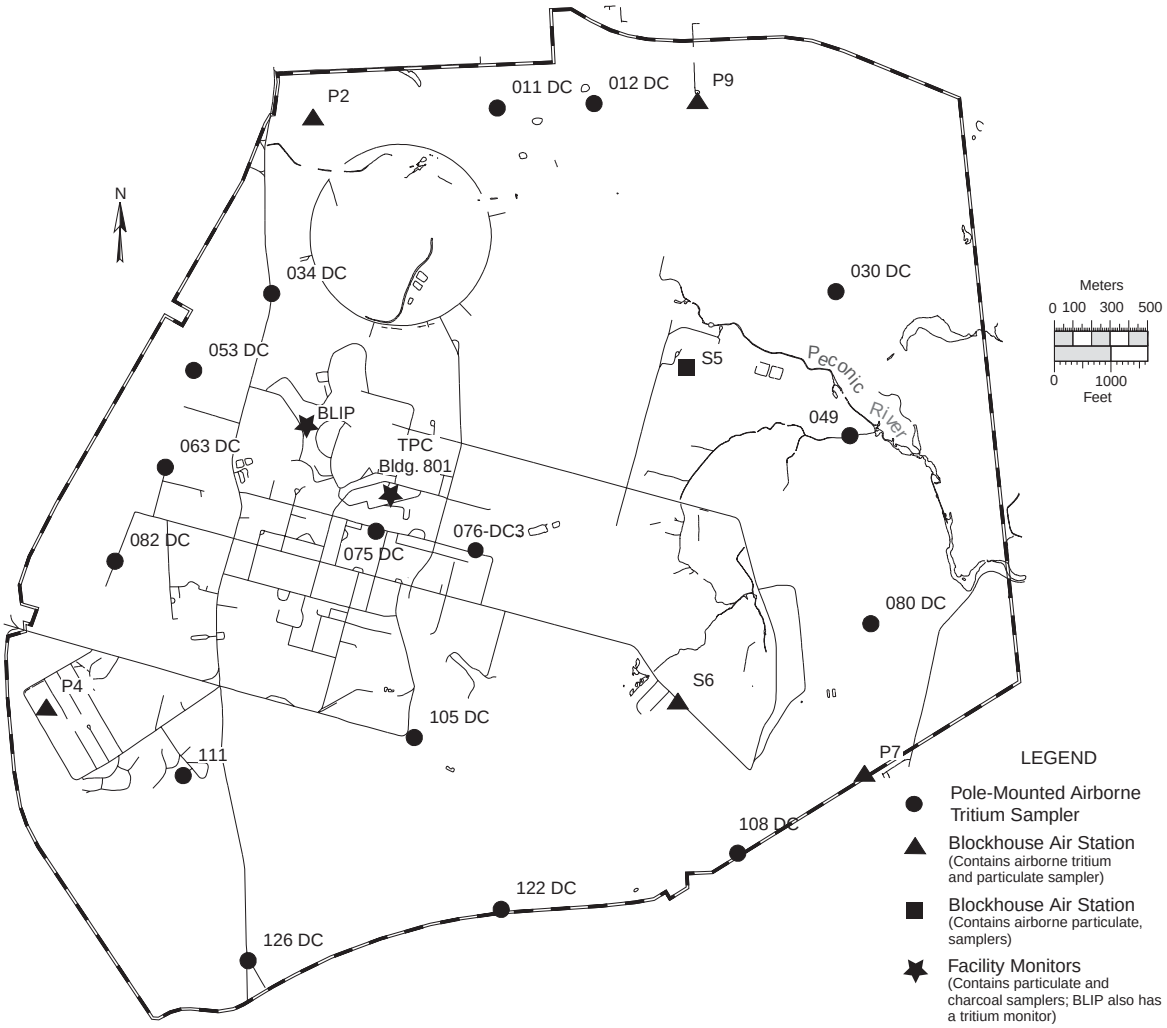

Figure 4-3. On-Site Ambient Air Monitoring Stations.

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

Facility Monitor		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
TPL - Bldg. 801	N	51	51
	Max.	2.200 ± 3.740	14.400 ± 12.200
	Avg.	0.036 ± 0.143	0.219 ± 0.466
	MDL	0.168	0.510
BLIP	N	51	51
	Max.	0.120 ± 0.101	0.660 ± 0.332
	Avg.	-0.043 ± 0.023	-0.460 ± 0.054
	MDL	0.231	0.667

Notes:
See Figure 4-3 for sample station locations.
All values shown with a 95% confidence interval.
Negative values occur when the measured value is less than background.
BLIP = Brookhaven Linac Isotope Producer
N = Number of samples collected
MDL = Average Minimum Detection Limit
TPL = Target Processing Laboratory

4. 3 AMBIENT AIR MONITORING

As part of the Environmental Monitoring Program, an array of air monitoring stations is in place around the perimeter of the BNL site. Samplers are housed within six blockhouse stations (see Figure 4-3 for locations). The blockhouses are fenced to control access and protect costly sampling equipment. In addition to the blockhouses, 16 pole-mounted, battery-powered silica-gel samplers (used for tritium monitoring) are located throughout the site, primarily near the site boundary.

At each blockhouse, particulate matter is captured on a glass-fiber filter and water vapor for tritium analysis is collected on silica-gel absorbent material. (Note that Station S5 does

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

Sample Station		Gross Alpha (pCi/m³)	Gross Beta (pCi/m³)
P2	N	52	52
	Max	0.0038 ± 0.0008	0.0201 ± 0.0019
	Avg.	0.0007 ± 0.0001	0.0111 ± 0.0002
	MDL	0.0008	0.0024
P4	N	52	52
	Max	0.0054 ± 0.0010	0.0189 ± 0.0026
	Avg.	0.0006 ± 0.0002	0.0104 ± 0.0005
	MDL	0.0008	0.0025
P7	N	52	52
	Max	0.0048 ± 0.0009	0.0178 ± 0.0017
	Avg.	0.0006 ± 0.0001	0.0082 ± 0.0004
	MDL	0.0006	0.0019
P9	N	52	52
	Max	0.0056 ± 0.0010	0.0186 ± 0.0024
	Avg.	0.0009 ± 0.0001	0.0107 ± 0.0003
	MDL	0.0008	0.0025
S5	N	52	52
	Max	0.0039 ± 0.0008	0.0238 ± 0.0029
	Avg.	0.0008 ± 0.0001	0.0125 ± 0.0002
	MDL	0.0009	0.0027
S6	N	52	52
	Max	0.0056 ± 0.0010	0.0201 ± 0.0027
	Avg.	0.0008 ± 0.0001	0.0124 ± 0.0003
	MDL	0.0009	0.0027
Grand Average		0.0007 ± 0.0001	0.0109 ± 0.0005

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

not contain a tritium sampler.) Particulate filters are collected weekly and are analyzed for gross alpha and beta activity using a gas-flow proportional counter. Silica-gel samples are collected for one week per month for processing by liquid scintillation analysis. Before April 1999, silica-gel samples were collected weekly, but multiple years' worth of results below the minimum detection limit (MDL) were the basis for reducing the sampling frequency.

4.3.1 Gross Alpha and Beta Activity

Particulate filter analytical results for gross alpha and beta activity are reported in Table 4-3. The annual average gross alpha and beta airborne activity levels for the six monitoring stations were 0.0007 pCi/m³ and 0.0109 pCi/m³, respectively. Annual gross beta activity trends recorded at Station P7 are plotted in Figure 4-4. The results at 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 gross alpha activity is not plotted because the vast majority of results were below the MDL.

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

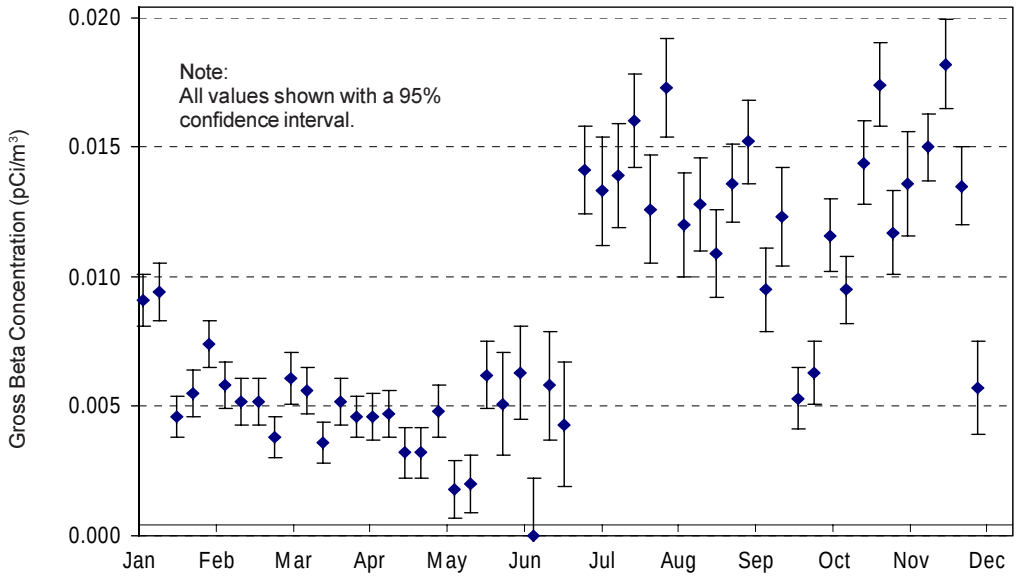

Figure 4-4. Airborne Gross Beta Concentration Trend Recorded at Station P7.

and analyzed by the NYSDOH laboratory for gross beta activity. The analytical results received were comparable to the Station P7 samples analyzed by the BNL Analytical Services Laboratory. Analytical results for gross beta activity reported by the NYSDOH laboratory were between 0.010 and 0.027 pCi/m^3, with an average concentration of 0.016 pCi/m^3, whereas the BNL results ranged from - 0.001 to 0.062 pCi/m^3 with an average concentration of 0.011 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. NYSDOH reported in 2002 that airborne gross beta activity at that location varied between 0.00003 and 0.037 pCi/m^3. The average concentration at this control location was 0.015 pCi/m^3. Sample results measured at BNL generally fall within this range, demonstrating that on-site radiological air quality is 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, fourteen pole-mounted monitors are located at or near the property boundary (see Figure 4-3 for locations). Two additional pole-mounted monitors are centrally located on site. Airborne tritium is collected by using a pump to draw air through a column of silica gel, a water-absorbent medium. The absorbed HTO is recovered by distillation and analyzed using liquid scintillation counting techniques.

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, or the loss of sample during laboratory preparation). Airborne tritium samples were collected from each sampling station over a one-week period during each calendar month. While one location (S6) showed the maximum and average values to be above the typical MDL range of 1 to 6 pCi/m^3, the remaining sample results were below the MDL. The collected data demonstrate that there were no significant differences in ambient tritium concentrations on site or at the site boundary. All annual average concentrations were below the MDL, except at Station S6, which is adjacent to the Former Waste Management Facility (FWMF). The maximum concentration recorded at Station S6 was 97 pCi/m^3 ± 4.9. BNL intends to investigate the FWMF and the Current Landfill as potential contributing sources for the elevated tritium concentrations at Station S6. To put Station S6's maximum value of 97 pCi/m^3 into perspective, the concentration guide for tritium in

Table 4-4. Ambient Airborne Tritium Measurements in 2002.

Sample Station	Wind Sector	Validated Samples	Maximum (pCi/m^3)	Average (pCi/m^3)
P9	NE	12	3.6 ± 1.8	0.6 ± 1.0
011	NNE	12	2.4 ± 1.7	0.7 ± 0.6
012	NNE	11	< 6.3	0.7 ± 0.7
P2	NNW	12	<2.8	0.7 ± 0.8
030	ENE	12	<4.5	0.8 ± 0.8
034	NNW	12	<21.1	1.5 ± 1.3
049	E	12	8.2 ± 4.3	0.6 ± 0.8
053	NW	12	< 4.1	0.5 ± 0.6
063	W	12	<4.6	0.5 ± 0.7
075	SW	12	<5.2	1.0 ± 0.7
076-302	ESE	11	<3.5	-1.5 ± 3.4
080	ESE	12	<5.0	0.8 ± 0.
082	W	12	<5.1	-0.2 ± 1.0
S6	SE	12	97.0 ± 4.9	45.6 ±19.3
P7	ESE	12	<2.5	0.3 ± 0.7
105	S	12	<7.2	0.9 ± 0.9
108	SE	12	<4.9	0.1 ± 1.3
P4	WSW	12	4.5 ± 2.5	0.4 ± 1.0
111	SW	12	< 6.8	1.1 ± 0.8
122	SSE	12	< 3.8	0.2 ± 0.7
126	SSW	12	< 4.4	-0.2 ± 1.1
Grand Average				2.6 ± 1.5

Notes:
See Figure 4-3 for station locations.
Wind sector is the downwind direction of the sample station from the BNL facilities noted in Section 4.1 that are subject to NESHAPs Subpart H monitoring requirements.
All values reported with a 95% confidence interval.
Typical minimum detection limit for tritium is between 1 and 6 pCi/m^3.
DOE Order 5400.5 Air Derived Concentration Guide is 100,000 pCi/m^3.

air is 100,000 pCi/m^3 (DOE Order 5400.5). This is the amount of an airborne radionuclide, which, if inhaled at that concentration for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to the maximally exposed individual. Therefore, all BNL station measurements of ambient tritium are less than 0.1 percent of the DOE-derived concentration guide value. Observed concentrations of tritium at the sampling stations in 2002 were comparable to concentrations observed in 2001, but were considerably lower than measured station concentrations in 1996, when the HFBR was last operational and released 48 Ci of HTO to the atmosphere.

The three pole-mounted air samplers located near the Removal Action V Recharge Basin that were used to monitor ambient tritium concentrations in prior years have been dismantled because the potential source of emissions, the tritiated groundwater pump and recharge system, is no longer operational.

4.4 NONRADIOLOGICAL AIRBORNE EMISSIONS

Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emissions monitoring to demonstrate compliance with emission limits. The Central Steam Facility (CSF) is the only BNL facility that is required to monitor nonradiological emissions. BNL has several other emission sources subject to state and federal regulatory requirements that do not require emissions monitoring (see Chapter 3 for more details). The CSF supplies steam for heating and cooling to BNL major 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 MMBtu/hr). 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, respectively. Each of these boilers has a heat input of 42.6 MW (147 MMBtu/hr). For perspective, Keyspan's Northport, New York power station has four utility-sized turbine/generator boilers, each with a nominal heat input of 385 MW (1,330 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. As such, these boilers are equipped with continuous emission monitors for nitrogen oxides (NO_x). Boiler 7 emissions are also continuously monitored for opacity. To measure combustion efficiency, both boilers are also monitored for carbon dioxide (CO_2). Continuous emissions monitoring results from the two boilers are reported on a quarterly basis to EPA and NYSDEC.

From May 1 to September 15 (the peak ozone period), compliance with the 0.30 lbs/MMBtu (129 ng/J) NO_x emissions standard is demonstrated by calculating the 24-hour average emission rate from continuous emission monitoring system readings and comparing the value to the emission standard. The remainder of the year, the calculated 30-day rolling average emission rate is used to establish compliance. Boiler 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 2002, there were no measured exceedances of the NO_x emission standard for either boiler. Boiler 7 opacity measurements (recorded in the first, third, and fourth quarters) that exceeded the limit occurred during opacity monitoring system calibrations, boiler start-ups, or during routine boiler tube soot blowing operations. While there are no regulatory requirements for continuous monitoring of opacity for Boilers 1A, 5, and 6, surveillance monitoring of visible stack emissions is conducted daily by CSF on-duty personnel. Daily observations of stack gases recorded throughout the year in accordance with conditions of BNL's Title V operating permit showed no visible emissions with opacity levels exceeding regulatory limits established for these boilers.

In the spring of 1997, the Long Island Lighting Company completed work extending a natural gas main into the CSF. To accommodate the combustion of natural gas, new gas rings were added to the burners of Boiler 5, and

Table 4-5. Central Steam Facility Fuel Use and Emissions (1996 – 2002).

	Annual Fuel Use and Fuel Heating Values						Emissions			
Year	# 6 Oil (10^3 gals)	Heating Value (MMBtu)	# 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)
1996	4,782.55	703,991	52.77	7,388	0.00	0	14.0	104.9	109.0	0.7
1997	3,303.43	484,613	10.23	1,432	190.65	26,691	13.7	83.5	75.1	1.0
1998	354.28	52,283	9.44	1,322	596.17	608,093	2.7	75.1	8.9	1.7
1999	682.76	78,335	2.77	388	614.98	627,280	5.1	53.5	16.7	1.8
2000	2,097.32	309,317	0.82	115	342.40	349,248	9.5	81.6	45.0	1.2
2001	3,645.10	538,847	3.40	476	103.96	106,039	17.5	80.4	77.8	0
2002	2,785.04	407,518	0.29	41	220.62	225,030	15.4	62.4	53.8	1.0

Notes:
TSP = Total Suspended Particulates

natural gas trains were installed to connect the gas main to Boilers 5 and 7. In 1998, existing steam-atomized oil burners on Boiler No. 6 were replaced with two dual-fuel low NO_x burners, and a natural gas train was added to connect the boiler to the gas main.

Through much of 2002, natural gas prices exceeded those for residual fuel (No. 6 oil). During these periods of higher natural gas prices, the CSF burned residual fuel. As a result, residual fuel supplied approximately 64 percent of the heating and cooling needs of BNL's major facilities in 2002 (see Table 4-5). By comparison, in 1999 natural gas satisfied more than 88 percent of the major facility heating and cooling needs but only 16 percent of these heating and cooling needs in 2001. Consequently, annual emissions of particulates NO_x, and SO_2 were 10.3 tons, 8.9 tons, and 37.1 tons higher than the respective totals for 1999 but were 2.1 tons, 18 tons, and 24 tons lower than the respective emission totals for 2001.

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