Chapter 4

Air Quality

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

During 2001, BNL facilities released a total of 9,814 Ci of airborne radioactive material. Short-lived gaseous oxygen-15 and carbon-11 released from the Brookhaven Linac Isotope Producer accounted for more than 99.9 percent of the site's radiological air emissions.

Continuing a pattern observed in 2000, natural gas prices were higher than residual fuel prices through much of 2001, 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 2001 than in 1999.

4.1 RADIOLOGICAL AIRBORNE EMISSIONS

Federal air quality laws and DOE regulations governing the release of airborne radioactive material include 40 CFR 61 Subpart H (from the National Emission Standards for Hazardous Air Pollutants, or NESHAPs—part of the Clean Air Act), DOE Order 5400.1 (1990), *General Environmental Protection Program,* and DOE Order 5400.5 (1993), *Radiation Protection of the Public and the Environment*. Under NESHAPs Subpart H, facilities with emissions 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. BNL has five facilities that fall into this category. Figure 4-1 indicates the location of each of the monitored facilities, and Table 4-1 presents the airborne releases from each of these facilities during 2001. Facilities with potential emissions that fall below this value require only periodic, confirmatory monitoring. Annual emissions from each facility are discussed in the following sections. 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 (thermal). Air from the interior of the containment building was used to cool the neutron reflector surrounding the core of the

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

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

Facility	Nuclide	Half-life	Ci Released
BMRR			None
HFBR	H-3	12.3 years	3.60E+00
BLIP	O-15	122 seconds	7.40E+03
	C-11	20.4 minutes	2.41E+03
	H-3	12.3 years	2.10E-03
Evaporator Facility			None
Target	As-74	17.8 days	4.47E-04
Processing	Br-77	56 hours	4.17E-03
Laboratory	I-125	60.1 days	8.94E-03
	I-126	13 days	2.38E-04
	In-116m	54.2 minutes	1.73E-02
	Se-75	119.8 days	2.00E-04
	Sn-113	115.1 days	5.48E-03
	Tc-96	4.3 days	2.77E-04
	Tl-202	12.23 days	2.81E-04
Total			9.814 E+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.
No wastewater was processed at the Waste Concentration Facility in 2001.

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 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.

Since the BMRR is no longer operating, the frequency of monitoring was reduced from continuous to semi-annual. January 2001 sampling showed no air emissions at zero power level with building ventilation on and the BMRR core unchanged. Real-time monitoring was used to track argon-41 air emissions, while passive filter media were used to collect and quantify radioiodines and particulate emissions. The monitoring results for the year showed there were no quantifiable emissions of argon-41 or nonargon radionuclides.

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, 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 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). Tritium continues to be released from the HFBR even though the fuel has been removed from the reactor vessel and the heavy water has been drained from the cooling loops; the vessel and associated cooling loops contain residual heavy water. Tritiated water vapor (abbreviated 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 emissions are assessed using an integrating silica gel absorbent. In 2001, 3.6 Ci of airborne HTO were released from the HFBR. Figure 4-2 illustrates the declining trend of tritium emissions from the HFBR since 1992.

4.1.3 Brookhaven Linac Isotope Producer

Protons from the Linear Accelerator are sent via an underground beam tunnel to the Brookhaven Linac Isotope Producer (BLIP), where they strike various target metals. These metals, which become activated by the proton beam, are then transferred to the Target Processing Laboratory (Building 801) for later use in radiopharmaceutical research. During irradiation, the targets are cooled by a continuously recircu-

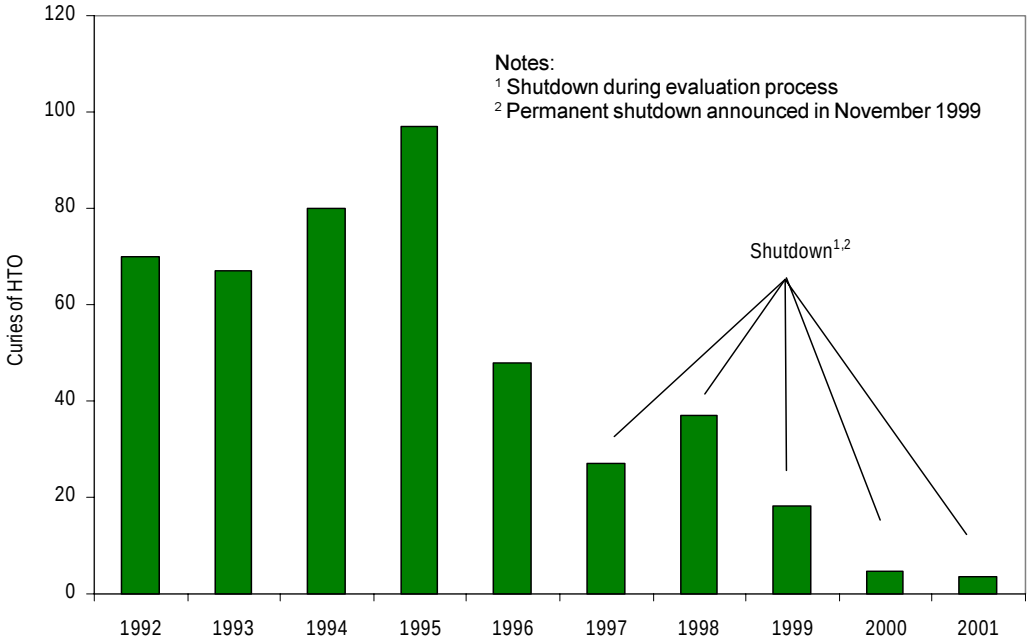

Figure 4-2. High Flux Beam Reactor Tritium Emissions, Ten-Year Trend (1992—2001).

lating water system. Several radioisotopes are produced in the cooling water, the most significant of which are oxygen-15 and carbon-11 (radionuclides with respective short half-lives of 122 seconds and 20.4 minutes). Both of these isotopes are released as gaseous airborne emissions.

In recognition of the fact that carbon-11 was not characterized in prior year samples, collected samples in 2001 were counted for longer intervals to insure the characterization of the carbon-11 fraction in BLIP emissions. In 2001, the BLIP operated over a period of 35 weeks. During this period, 2,410 Ci of carbon-11 and 7,400 Ci of oxygen-15 were released. Tritium produced from activation of the target cooling water was also released, but in a much smaller quantity. The increase in oxygen -15 emissions, compared to 2000 (1,070 Ci) is due partly to an increase in the period of operations (13 weeks in 2000, compared to 35 weeks in 2001) and partly to an increase in the average proton beam intensity (56 microamperes in 2000, compared to 75 microamperes in 2001). See Table 4-1 for a complete listing of the radionuclides released.

4.1.4 Evaporator Facility

The Evaporator Facility (Building 802B) was constructed to reduce the total amount of tritiated water released to the Peconic River from BNL operations through the Sewage Treatment Plant (STP). The Evaporator Facility began processing wastewater in 1995.

Liquid waste generated on site that contains residual radioactivity is accumulated at the Waste Concentration Facility (WCF) in Building 811. At the WCF, suspended solids and a high percentage of radionuclides are removed from the liquid using reverse osmosis. However, because tritium is an isotope of hydrogen (a very small molecule), it cannot be removed from the liquid waste. The tritiated water which remains following waste

Figure 4-3. HFBR and Evaporator Facility Exhaust Stack.

concentration is transferred to the Evaporator Facility in Building 802B, where it is converted to steam and released as an airborne emission. The emissions are directed to the same stack used by the HFBR to exhaust building air (see Figure 4-3). This method is preferable to release via surface water because there is virtually no potential to influence groundwater; the potential for this tritium to contribute to an off-site dose is minimized by atmospheric dispersion.

In 2001, no liquid waste was processed at the WCF. As a result, the Evaporator Facility was not used and there were no emissions of tritiated water vapor.

4.1.5 Target Processing Laboratory

Target metals irradiated at the BLIP facility are transported to the Target Processing Laboratory (Building 801), where the useful 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). Radionuclide quantities released from this facility annually are small, typically in the millicurie range. In 2001, the total release from the Target Processing Laboratory was 0.037 Ci.

4.1.6 Additional Minor Sources

Several research departments within BNL conduct work that involves very small quantities of radioactive materials (in the microcurie to millicurie range) within designated fume hoods. Transferring material between containers, pipetting, and chemical compound labeling are typical of the work conducted within the hoods. 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 318, 463, 490, 490A, 555, 703W, and 830, where research is conducted in the fields of biology, chemistry, medicine, applied science, and advanced technology.

4.1.7 Uncharacterized Radiological Emission Sources Evaluated in 2001

Within NESHAPs Subpart H, there are established procedures to evaluate the potential impacts to the public of activities that emit or have the potential to release radiological emissions to the atmosphere. Using these procedures and the EPA-approved CAP88-PC dose modeling program, several planned environmental restoration and waste management activities were evaluated in 2001. These evaluations determined whether NESHAPs permitting and continuous monitoring requirements would be applicable or whether periodic confirmatory sampling would be needed to ensure compliance with Subpart H standards for radionuclide emissions. Chapter 8 discusses the NESHAPs evaluations of the various environmental restoration and waste management activities that were expected to commence in 2001.

One of the environmental restoration activities found to have a significant potential impact was the removal of the pad area that surrounded the canal and water treatment house of the Brookhaven Graphite Research Reactor (a reactor that produced neutrons for scientific research from 1950 to 1969 and is now being decommissioned). Results using the CAP 88-PC computer model conservatively estimated an effective dose equivalent of 1.7 mrem/year (17 μSv/yr) to the maximally exposed individual assumed to be living at the site boundary. This value exceeded the 0.1 mrem/year (1 μSv/yr) threshold that triggers the NESHAPs Subpart H requirements for continuous monitoring. Chapter 8 discusses in detail the continuous monitoring that took place while this project was underway from March to July of 2001.

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 Target Processing Laboratory (Building 801), and the BLIP. Since the BMRR and HFBR are permanently shut down and the

Evaporator Facility did not process any liquid wastes in 2001, no particulate sampling was conducted at these facilities.

The samplers in the exhaust duct for the Target Processing Laboratory and the exhaust stack for the BLIP are equipped with glass-fiber filter paper designed to capture airborne particulate matter generated at these facilities (see Figure 4-4 for locations). The filter paper is collected and analyzed on a weekly basis 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 Target Processing Laboratory were –0.0066 pCi/m^3 and –0.1130 pCi/m^3, respectively. The annual average gross alpha and beta airborne activity levels for samples collected from the BLIP exhaust stack were –0.0049 pCi/m^3 and –0.6640 pCi/m^3, respectively. (For a discussion of negative values associated with radioactivity monitoring, see Appendix B.)

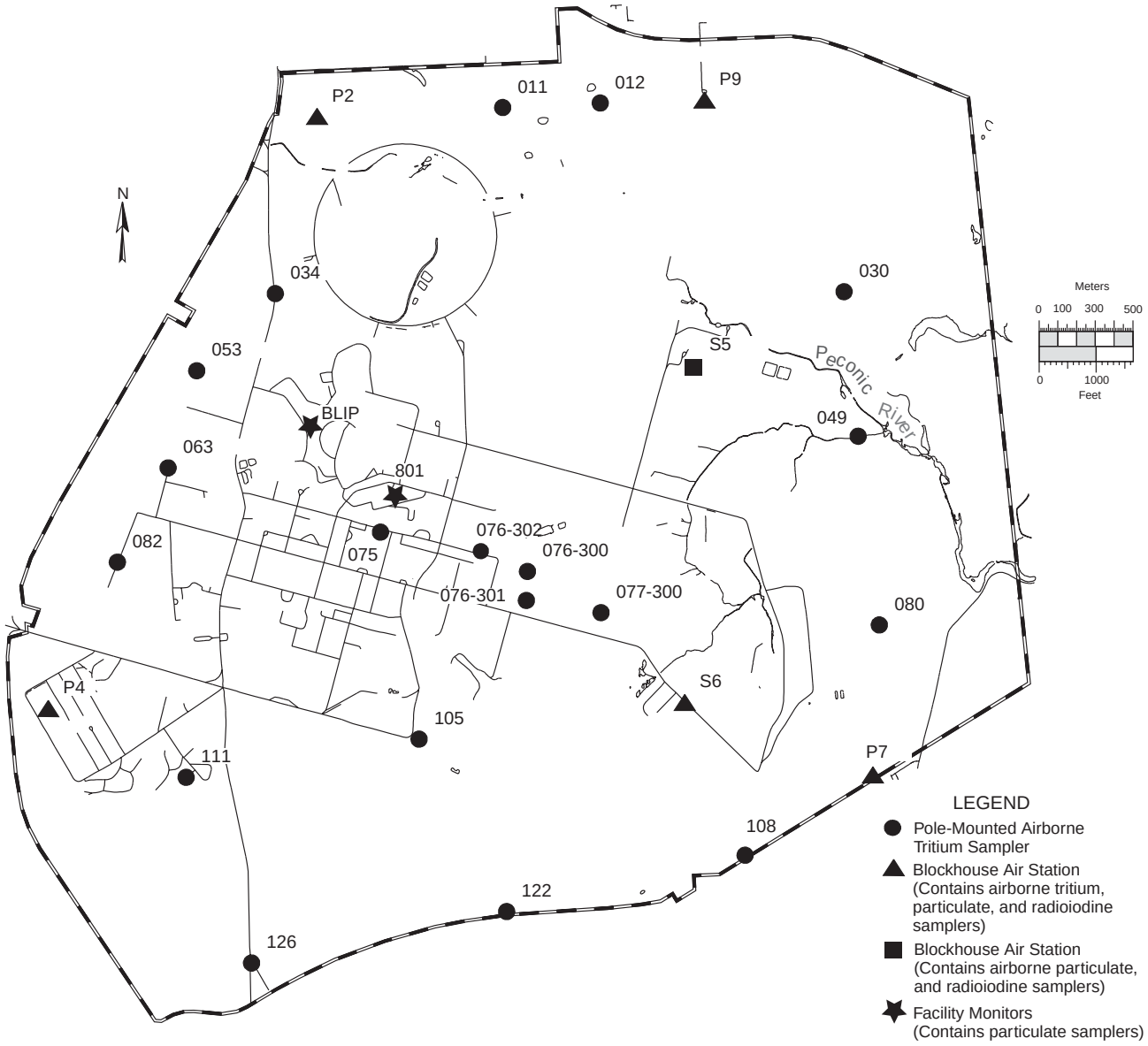

Figure 4-4. On-site Ambient Air Monitoring Stations.

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

Facility Monitor		Gross Alpha (pCi/m^3)	Gross Beta (pCi/m^3)
801	N	51	50
	Max.	0.0224 ± 0.0166	0.2080 ± 0.0848
	Avg.	-0.0066 ± 0.0035	-0.1130 ± 0.0051
	MDL	0.0621	0.1430
BLIP	N	51	51
	Max.	0.1780 ± 0.1590	0.4370 ± 0.4210
	Avg.	-0.0049 ± 0.0172	-0.6440 ± 0.0260
	MDL	0.2430	0.7560

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

4. 3 AMBIENT AIR MONITORING

As part of the Environmental Monitoring Program, an array of monitoring stations is in place around the BNL site to collect air samples for determining possible radionuclides in the air. Samplers are housed within six blockhouse stations (see Figure 4-4 for locations). The blockhouses are fenced to control access and to protect costly sampling equipment. In addition to the blockhouses, 19 pole-mounted, battery-powered silica-gel samplers (used for tritium analysis) are located throughout the site, primarily along the site boundary.

At each blockhouse, glass-fiber filter paper captures airborne particulate matter, charcoal cartridges collect any potential radioiodines, and silica-gel absorbent collects water vapor for tritium analysis. (Note that Station S5 does not contain a tritium sampler.) Filter paper is collected weekly and analyzed for gross alpha and beta activity using a gas-flow proportional counter. Charcoal cartridges are collected monthly and analyzed by gamma spectroscopy. Silica-gel samples are collected one week a 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/m^3 and 0.0118 pCi/m^3, respectively. Annual gross beta activity trends recorded at Station P7 are plotted in Figure 4-5. 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, located at the southeast site boundary. These samples were

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

Sample Station		Gross Alpha (pCi/m^3)	Gross Beta (pCi/m^3)
P2	N	52	52
	Max.	0.0030 ± 0.0059	0.0737 ± 0.0181
	Avg.	0.0006 ± 0.0002	0.0120 ± 0.0008
	MDL	0.0010	0.0031
P4	N	52	52
	Max.	0.0028 ± 0.0056	0.0907 ± 0.0018
	Avg.	0.0007 ± 0.0002	0.0138 ± 0.0006
	MDL	0.0010	0.0032
P7	N	51	51
	Max.	0.0029 ± 0.0041	0.0424 ± 0.0189
	Avg.	0.0006 ± 0.0002	0.0102 ± 0.0007
	MDL	0.0009	0.0030
P9	N	52	52
	Max.	0.0020 ± 0.0008	0.0424 ± 0.0024
	Avg.	0.0007 ± 0.0001	0.0102 ± 0.0002
	MDL	0.0008	0.0026
S5	N	52	52
	Max.	0.0016 ± 0.0007	0.0256 ± 0.0025
	Avg.	0.0007 ± 0.0001	0.0129 ± 0.0003
	MDL	0.0010	0.0031
S6	N	52	52
	Max.	0.0024 ± 0.0008	0.0222 ± 0.0023
	Avg.	0.0006 ± 0.0001	0.0117 ± 0.0002
	MDL	0.0009	0.0029
Grand Average		0.0007 ± 0.0001	0.0118 ± 0.0008

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

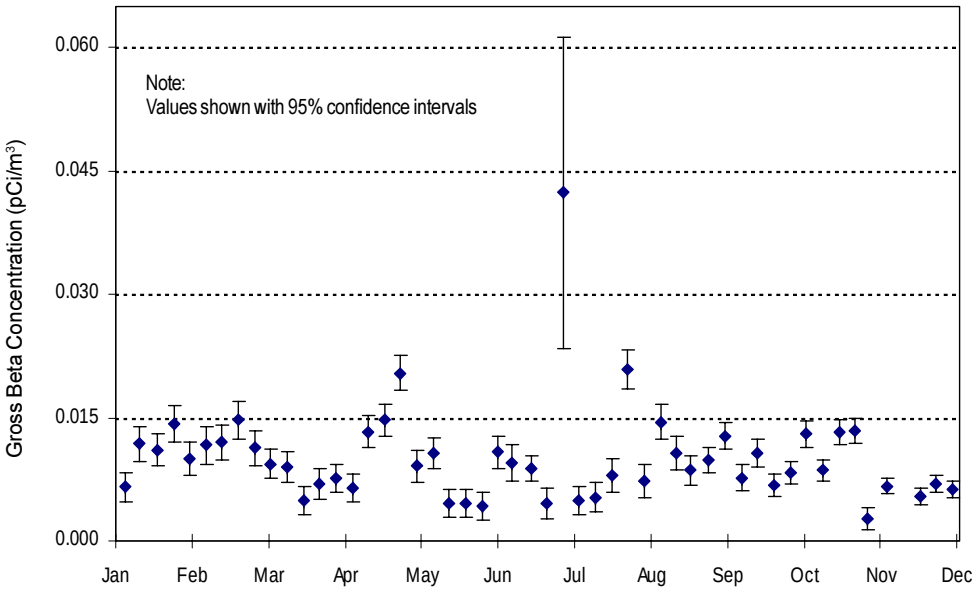

Figure 4-5. Airborne Gross Beta Concentration Trend Recorded at Station P7.

collected weekly 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 0.003 and 0.028 pCi/m^3, whereas the BNL results ranged from 0.003 to 0.042 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 2001 that airborne gross beta activity at that location varied between 0.00589 and 0.027 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, 16 pole-mounted monitors (not including those which monitor the Removal Action V Recharge Basin (see Section 4.3.2.1) are located at or near the property boundary (see Figure 4-4 for locations). Two additional pole-mounted monitors are centrally located on site. Airborne tritium is collected using a pump that draws 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 minimum detection limit range from 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 Hazardous Waste

Management Facility. The maximum concentration recorded at Station S6 was 40.0 pCi/m^3. The values observed at this station are most likely due to continuing emissions during remediation and decommissioning work at the former Hazardous Waste Management Facility.

To put Station S6's maximum value of 40 pCi/m^3 into perspective, the concentration guide for tritium in air is 100,000 pCi/m^3 (DOE Order 5400.5). This is the amount of an airborne radionuclide which, if inhaled at that level 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 2001 are comparable to concentrations observed in 2000, and are considerably lower than measured station concentrations in 1996, when the HFBR released 48 Ci of HTO to the atmosphere.

Table 4-4. Ambient Airborne Tritium Measurements.

Sample Station	Wind Sector	Validated Samples	Maximum (pCi/m^3)	Average (pCi/m^3)
P9	NE	12	<3.4	0.8 ± 0.7
011	NNE	11	< 6.5	1.0 ± 1.0
012	NNE	12	< 6.8	0.7 ± 0.6
P2	NNW	12	7.7 ± 4.2	1.3 ± 1.2
030	ENE	12	< 5.6	0.9 ± 0.9
034	NNW	12	< 5.8	0.5 ± 1.0
049	E	11	8.2 ± 4.3	1.7 ± 1.4
053	NW	11	<4.0	0.4 ± 0.9
063	W	11	5.4 ± 4.0	1.4 ± 1.1
075	SW	11	< 4.3	0.7 ± 0.5
076-302	ESE	11	1.5 ± 1.0	1.0 ± 0.9
080	ESE	7	4.3 ± 2.2	1.4 ± 1.3
082	W	11	< 6.5	0.4 ± 0.8
S6	SE	12	40.0 ± 2.4	16.2 ± 8.5
P7	ESE	12	4.1 ± 2.1	0.7 ± 0.7
105	S	12	2.8 ± 1.1	0.7 ± 0.7
108	SE	10	< 6.4	0.3 ± 1.1
P4	WSW	12	< 4.9	0.9 ± 0.7
111	SW	9	< 6.7	0.3 ± 1.4
122	SSE	9	< 6.5	0.4 ± 0.9
126	SSW	9	< 6.1	0.3 ± 0.8
Grand Average				1.6 ± 0.7

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

4.3.2.1 Removal Action V Recharge Basin

As described in the *BNL Site Environmental Report for Calendar Year 1997* (BNL 1999), an interim pump-and-recharge system was constructed to control the leading edge of the plume of tritiated groundwater associated with the leaking spent-fuel storage pool at the HFBR. Discharge from this system was directed to the Removal Action (RA) V Recharge Basin that had already been established in the center of the site. This was done to allow natural decay of the tritium to levels below the drinking water standard of 20,000 pCi/L before the groundwater migrated off site.

The pump-and recharge system used three extraction wells to pump groundwater containing both tritium and volatile organic compounds from approximately 150 feet below ground surface to carbon filtration units, and ultimately to the RA V Recharge Basin, located 3,000 feet to the north of the plume edge. (The volatile organic compounds being treated by this system were from sources unrelated to the HFBR.)

Using assumptions that later proved to be very conservative, the recharge basin was evaluated, prior to the start of pumping operations, as a potential air emission source for NESHAPs compliance. In addition, three pole-mounted air samplers were located near the recharge basin to monitor ambient tritium concentrations. Two monitors were installed immediately adjacent to the basin at the northeast and southeast corners (Stations 076-300 and 076-301 on Figure 4-4*),* downwind of the predominant winds on site (see BNL wind rose in Chapter 1, Figure 1-10). The third monitoring station was located near the National Weather Service building (Station 077-300), approximately 0.2 mile east of the basin.

In September 2000, the pump-and-recharge system was placed on standby status after no detectable levels of tritium were found in nearby groundwater monitoring wells located southeast of the system. However, airborne HTO monitor-

Table 4-5. Ambient Tritium Monitoring Results at RA V Recharge Basin.

Location	Validated Samples	Detections	Maximum (pCi/m^3)	Average (pCi/m^3)
Northeast corner of basin (076-300)	9	2	5.1 ± 3.4	2.0 ± 1.2
Southeast corner of basin (076-301)	8	0	< 3.9	0.9 ± 0.7
National Weather Service Building (077-300)	9	0	< 3.7	0.8 ± 0.9

Notes:
See Figure 4-4 for sample station locations.
Typical minimum detection limit for tritium is between 1 and 6 pCi/m^3.
Sampling ended in October 2001 due to the shutdown of the tritium pump and recharge remediation system.

ing in the vicinity of the RA V Recharge Basin continued through October 2001. During 2001, two of the 26 validated samples were detectable (see Table 4-5). These results are consistent with prior findings, which show that the majority of tritium samples collected since the tritium surveillance began in 1997 have been below the MDL.

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. BNL has several emission sources subject to state and federal regulatory requirements that do not require emissions monitoring (see Chapter 3 for more details). The Central Steam Facility (CSF) is the only BNL emission source that is required to monitor nonradiological emissions.

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 56.7 MMBtu/hr. Boiler 5 was installed in 1965 and has a heat input of 225 MMBtu/hr. The newest units, Boilers 6 and 7, were installed in 1984 and 1996. Each of these boilers has a heat input of 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 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 the New York State Department of Environmental Conservation.

From May 1 to September 15 (the peak ozone period), compliance with the 0.30 lbs/MMBtu/hr 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 2001, there were no measured exceedances of the NO_x emission standard for either boiler, or excess opacity measurements on Boiler 7.

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 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.

Table 4-6. Central Steam Facility Fuel Use and Emissions (1996—2001).

	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	0.8

Notes:
TSP = Total Suspended Particulates
VOCs = Volatile Organic Compounds

Through much of 2001, 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 more than 83 percent of the heating and cooling needs of BNL's major facilities in 2001 (see Table 4-6). By comparison, in 1999, natural gas satisfied more than 88 percent of the major facility heating and cooling needs. Consequently, annual emissions of particulates, NO_x, and SO_2,were 12.1 tons, 26.9 tons, and 61.1 tons higher than the respective totals for 1999.

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