1 INTRODUCTION

1.1 PURPOSE OF THE ENVIRONMENTAL MONITORING PLAN

Established in 1947, Brookhaven National Laboratory (BNL) is a multi-program national laboratory managed for the U.S. Department of Energy (DOE) by Brookhaven Science Associates (BSA), a partnership formed by Stony Brook University and Battelle Memorial Institute. BNL conducts research in nuclear and high-energy physics, the physics and chemistry of materials, nanocience, energy and environmental research, national security and nonproliferation, neurosciences and medical imaging, structural biology, and computational sciences.

DOE Order 436.1 (2011), *Departmental Sustainability*, requires DOE sites to maintain an Environmental Management System (EMS). BNL's EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, of site operations. DOE Order 458.1 (2011), *Radiation Protection of the Public and Environment*, requires DOE sites to maintain surveillance monitoring for determining radiological impacts to the public and environment. BNL's EMS was designed to meet the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001 Environmental Management Standard, with emphasis on compliance, pollution prevention, and community involvement. An extensive environmental monitoring program is one component of the Laboratory's EMS. BNL's Environmental Monitoring Plan (EMP) was developed by the Environmental Protection Division and describes this program in detail.

A full review of the Laboratory's EMP is performed triennially. In addition, an annual review is performed to ensure that any changes in permit requirements, facility-specific monitoring activities, trends in analytical data, or responses to stakeholder concerns are addressed. The plan is structured to provide people familiar with environmental requirements and monitoring at DOE facilities with an understanding of how BNL fulfills its monitoring requirements.

Using the Data Quality Objective (DQO) process developed by the U.S. Environmental Protection Agency (EPA), BNL's EMP describes the Laboratory's environmental monitoring matrices, sampling methods, locations, frequencies, and measured parameters, as well as methods and procedures for data collection, analysis, maintenance, reporting, and archiving. It also addresses quality assurance and quality control of data monitoring.

The Laboratory's EMP is supplemented with standard operating procedures, as well as other technical documents, that provide detailed monitoring instructions. Monitoring results are summarized annually in the BNL Site Environmental Report.

1.2 ORGANIZATION OF THE ENVIRONMENTAL MONITORING PLAN

The EMP is organized into two parts, and supplementary information is provided in Appendices A through D.

Part I (Chapters 1 through 4)

- Chapter 1 describes the purpose and organization of the EMP.
- Chapter 2 describes the Laboratory's physical setting and the surrounding environment.

- Chapter 3 describes the major facility sources, characterizes their principal effluents and/or emissions, and describes the possible pathways for exposure to radiological and nonradiological contaminants.
- Chapter 4 describes BNL's Quality Assurance/Quality Control Program (QA/QC) Program.

Part II (Chapters 5 through 13)

- Chapters 5 through 13 include the DQOs for the various environmental media (air, surface water, potable water, groundwater, precipitation, flora, fauna, and soil/sediment) and direct radiation measurements. Each DQO summarizes the proposed changes for the calendar year, provides a description and technical basis, the drivers for the program, and completes the seven steps of the DQO process.
- Appendix A provides a glossary of terms and acronyms used throughout the plan.
- Appendix B provides a table that combines a list of measured parameters by media.
- Appendix C provides a description of the analytical methods used for on-site analysis.

1.3 ENVIRONMENTAL MONITORING AT BNL

BNL monitors radiological and nonradiological aspects of ambient air quality, emissions from point sources, wastewater discharges, surface water quality, groundwater quality, precipitation, soil, flora, and fauna.

Radiological monitoring:

- Assessment of airborne emission impacts through National Emission Standards for Hazardous Air Pollutants (NESHAPs) reviews of facilities that are known to utilize radioactive materials while performing experimental research
- Continuous monitoring of facilities, such as medical isotope production areas and accelerators that use large quantities of or generate radioactive materials
- Liquid effluent monitoring for radiological materials discharged from facilities before release to the environment for compliance with DOE Orders
- Environmental surveillance of soil, vegetation, and fauna (including aquatic biota)
- Monitoring of potable water for compliance with the U.S. Safe Drinking Water Act (SDWA)
- Determination of external exposure component of dose through the use of thermoluminescent dosimeters (TLDs)
- Groundwater monitoring for radiological constituents to evaluate the impact of BNL operations on its EPA-designated sole source aquifer, which lies beneath the site

Nonradiological monitoring:

- Monitoring of effluents for parameters listed in BNL's State Pollutant Discharge Elimination System (SPDES) permit
- Monitoring of fuel oils used by the Laboratory's Central Steam Facility (CSF) for potential polychlorinated biphenyl (PCB) contamination, as needed
- Monitoring of air emissions from the BNL CSF
- Monitoring of potable water for parameters regulated by the SDWA and the New York State Department of Health (NYSDOH)
- Environmental surveillance of soil, surface water, and groundwater for nonradiological parameters to assess the impact of BNL operations on the environment

BNL environmental monitoring programs consist of:

- Compliance monitoring, to ensure adherence to regulatory and permit limits
- Restoration monitoring, to measure the impact of past operations and assess the effectiveness of remedial measures
- Surveillance monitoring, to evaluate what impact, if any, current operations have on environmental and public health

1.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater monitoring data comply with regulatory and permit limits issued under the federal Clean Air Act (CAA), Clean Water Act (CWA), Oil Pollution Act, SDWA, and the New York State equivalents. Included in compliance monitoring are air emissions monitoring, wastewater discharge monitoring, and groundwater monitoring.

1.3.1.1 Air Emissions Monitoring

To protect BNL workers, members of the public, and the environment, radiological and nonradiological air emissions monitoring is conducted in compliance with the CAA. Facilities that have the potential to exceed the NESHAPs dose limit of 0.1 mrem (1.0 μSv) annually to a member of the public must be continuously monitored for emissions. The Laboratory has one facility that is continuously monitored, the Brookhaven Linac Isotope Producer (BLIP). Facilities capable of delivering radiation doses below that limit require periodic, confirmatory monitoring; these include one active facility, the Target Processing Laboratory (TPL), and one inactive facility, the High Flux Beam Reactor (HFBR). Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emission monitoring to demonstrate compliance with emission limits. The CSF is the only BNL facility that requires monitoring for nonradiological emissions and is monitored with real-time, continuous monitoring equipment. The Laboratory has several other emission sources subject to state and federal regulatory requirements that do not require emission monitoring.

1.3.1.2 Wastewater Discharge Monitoring

Wastewater discharges are regulated under the CWA, as implemented by the New York State Department of Environmental Conservation (NYSDEC) and under DOE Order 458.1, Radiation Protection of the Public and the Environment. Monitoring is performed at the point of the wastewater discharge and is conducted to ensure that the effluent complies with release limits in BNL's SPDES permits. Twenty-four point-source discharges are permitted at the Laboratory--12 under the Long-term Surveillance and Maintenance program managed by the Groundwater Protection Group and 12 under the SPDES permit program. Samples are collected daily, weekly, monthly, or quarterly, and monitored for organic, inorganic, and radiological parameters. Monthly Discharge Monitoring Reports provide analytical results and an assessment of compliance for that reporting period and are filed with the permitting agency.

1.3.1.3 Groundwater Monitoring

Some groundwater monitoring is performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under BNL's Major Petroleum Facility (MPF) License for the CSF and the Resource Conservation and Recovery Act (RCRA) permit for the Laboratory's Waste Management Facility (WMF). Extensive groundwater monitoring is also conducted under

BNL's Groundwater Protection Group, as required under the Record of Decision (ROD) for Operable Units (OUs) or Areas of Concern (AOC). To ensure that the Laboratory maintains a viable potable water supply, potable water supply wells and the distribution system are monitored, as required by SCDHS.

1.3.2 Restoration Monitoring

Monitoring is conducted to determine the overall impact of past operations, to delineate the real extent of contamination, and to ensure that Removel Actions are effective and remedial systems are performing as designed under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and RCRA. This program involves collecting soil and groundwater samples to determine the lateral and vertical extent of a contaminated area. Samples are analyzed for organic, inorganic, and radiological contaminants, and the analytical results are compared with guidance, standards, cleanup goals, or background concentrations. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated to mitigate continuing impacts. Followup monitoring of groundwater is conducted in accordance with a ROD with regulatory agencies.

1.3.3 Surveillance Monitoring

Surveillance monitoring is performed in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The BNL Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation. Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using TLDs strategically positioned on and off site are routinely reviewed under this program. Control samples (also called background or reference samples) are also collected on and off the site to compare BNL results to areas that could not have been affected by Laboratory operations.

1.4 ENVIRONMENTAL DATA REVIEW

The EMP provides the scope, rationale, and justification for the collection and analysis of environmental samples. Samples are collected by trained BNL staff according to approved sample collection procedures and submitted under strict Chain-of-Custody (COC) procedures to a contract analytical laboratory for the analyses specified under this plan. Within the contract analytical laboratory, the samples are tracked by a laboratory-assigned sample identification number until analyses are completed and reported.

Analytical results are reviewed to ensure the data are of high quality. Various personnel assess BNL’s compliance with regulatory requirements and compare the data with permit limits and background levels to evaluate the Laboratory’s impact on the environment. BNL has established a Standard Operating Procedure (SOP) and a Standards-Based Management System (SBMS) subject area for addressing data that exceed permit limits, diverge from “typical” levels, or exceed regulatory standards. The Laboratory's Groundwater Contingency Plan Procedure and the Events/Issues Management subject area provide a framework for responding to an environmental event in order to facilitate protection of environmental quality, compliance with applicable requirements and regulations, and to ensure timely notification to BNL stakeholders. The primary goal is to assure that appropriate, timely, and coordinated actions are taken and communicated.

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