4 QUALITY ASSURANCE

4.1 INTRODUCTION

As required by Department of Energy (DOE) Order 458.1, *Radiation Protection of the Public and Environment*, and DOE Order 436.1, *Departmental Sustainability*, Brookhaven National Laboratory (BNL) has established a Quality Assurance (QA)/Quality Control (QC) Program to ensure that the accuracy, precision, and reliability of environmental monitoring data are consistent with the requirements of Title 10 of the Code of Federal Regulations, Part 830 10 CFR 830, Subpart A, *Quality Assurance Requirements* (2020), and DOE Order 414.1D (Chg. 2: LtdChg 2020), *Quality Assurance*. The responsibility for quality at BNL starts with the Laboratory Director, who approves the policies and standards of performance governing work and extends throughout the entire organization. The purpose of the BNL QA Program is to implement QA methodology throughout the various Laboratory management systems and associated processes to do the following:

- Plan and perform BNL operations in a reliable and effective manner to minimize any impact on the health and safety of the public, employees, and the environment;
- Standardize processes and support continual improvement in all aspects of BNL operations;
- Enable the delivery of products and services that meet customers' requirements and expectations;
- Support an environment that facilitates scientific and operational excellence.

For environmental monitoring, QA is deployed as an integrated system of management activities. These activities involve planning, implementation, control, reporting, assessment, and continual improvement. QC activities measure each process or service against the QA standards. QA/QC practices and procedures are documented in manuals, plans, and a comprehensive set of standard operating procedures (SOPs) for environmental monitoring (EM-SOPs). Staff members who must follow these procedures are required to document that they have reviewed and understand them.

4.2 ENVIRONMENTAL SAMPLE ANALYSIS AND QUALIFICATIONS

The Laboratory's environmental QA practices and procedures are documented in manuals and SOPs that govern sample collection, radiation measurements, chain-of-custody (COC) requirements, and analytical chemistry standards. Environmental samples are analyzed through contracts with five off-site analytical laboratories: General Engineering Lab (GEL) and Test America (TA) perform radiological and non-radiological analyses; Pace and Chemtex Lab perform nonradiological analyses; and American Radiation Services (ARS) perform radiological analyses.

Four of the five laboratories are certified by the New York State Department of Health (NYSDOH) for the relevant analytes, where such certification exists, and are periodically audited to ensure that quality standards are maintained. NYSDOH does not currently certify for the specific analytes tested by Chemtex Lab, which has Louisiana National Environmental Laboratory Accreditation Program (NELAP) accreditation.

The labs are required to incorporate QA guidelines into their operations when performing work and participate in several national and/or state performance evaluation (PE) testing programs. Results of the PE tests provide information on the quality of a laboratory's results and allow comparisons to be made between labs. In addition, BNL has established a program of internal and external audits to verify the effectiveness of the environmental sampling, analysis, and database activities. Contractor laboratories are also subject to DOE Consolidated Audit Program (DOECAP)-sponsored audits.

4.3 DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQOs) included in this plan follow the DQO process, a seven-step planning approach to develop sampling designs for data collection activities that support decision making. This process uses systematic planning and statistical hypothesis testing to differentiate between two or more clearly defined alternatives. The DQO process provides the following benefits:

- Promotes understanding of the real purpose of collecting data (i.e., why the data are needed and what questions the data may help answer)
- Provides a convenient way to document activities and decisions
- Facilitates rapid review and approval by regulators and stakeholders
- Fosters communication between interested parties
- Promotes efficient use of limited resources
- Outlines methods of assessing performance and states the consequences of decision errors

4.4 SAMPLE COLLECTION

Trained technicians follow procedures outlined in EM-SOPs, which are developed using information in the media-specific DQOs. Technicians use bound logbooks and media-specific log sheets to document sample collection. COC procedures are followed to ensure that each sample is properly handled and controlled.

4.5 DATA MANAGEMENT

Each environmental sample collected is identified with a unique number and accompanied by a COC. The sampling data are reported in electronic and hard copy formats. All electronic data are maintained in the BNL Environmental Information Management System (EIMS). The EIMS consists of an environmental data management system platform that is linked with a geographic information system (GIS). Analytical data in the EIMS can be retrieved and evaluated using custom applications and paper records are filed for future reference. In September 2017, *EPD-SOP-004 Electronic Data Archiving* (BNL 2017a) was issued. This procedure provides a standardized method to electronically archive environmental sampling laboratory data packages. Environmental samples include drinking water, groundwater, surface water, soil, sediment, flora, fauna, air, and waste matrices. Samples are sent to contractor laboratories for the analysis of radiological and non- radiological parameters. Once the data is reviewed, tabulated, and disseminated, the data packages are archived. Depending on the use and regulatory requirement the data was collected for, the packages remain in archive for between 30 and 75 years.

The EIMS became the sole repository of all environmental data in 2002. Previously, the EIMS held environmental data collected only from environmental restoration activities. Compliance and environmental surveillance data from 1995 to 2002 were housed in the environmental database shared with BNL's on-site Analytical Services Laboratory (ASL). The ASL stopped operations in the first quarter of 2004, and the data was then transferred to EIMS. This transfer involved changing the identification scheme for sampling locations.

Sample location identifications are addressed using EM-SOP-202. This procedure establishes a common Laboratory-wide system for uniquely identifying the locations where environmental samples are taken for BNL environmental sampling projects and programs. The procedure for identifying sampling locations that will be stored in the BNL EIMS is also contained within EM-SOP-202. Identification includes location name (Site ID) and geographic location, as designated by geographic coordinates.

4.6 ELECTRONIC DATA QUALITY ASSURANCE

Data quality assurance steps are detailed in the EIMS Data Management Description and in applicable SOPs. When data are entered into the EIMS, completeness checks are automatically performed to ensure that analyses are provided for all samples, required data fields are not empty, and that certain fields contain only predefined legal values or formats. If any data quality issues are found, the data is checked against the PDF copy of the laboratory report following the data verification process outlined in EM-SOP-203 and EM-SOP-204. Any quality control checks that are not met are qualified and a Data Verification Form is created and stored. The form is then forwarded to the project manager. All analytical results entered into the EIMS are automatically flagged for outlier values. Project managers using the Data Flagging Query Tool are notified in order to expedite evaluation of these data.

4.7 VERIFICATION, VALIDATION AND USABILITY OF ANALYTICAL RESULTS

Environmental monitoring data are subject to data verification, usability and, in certain cases, data validation when the data quality objectives of the project require this step.

Data Verification process involves checking for common errors associated with analytical data such as: holding times missed, incorrect test method, poor recovery, incorrect MDL, invalid COC, instrument failure, preservation requirements not met, contamination of samples, and matrix interference. (BNL 2017 b, d).

Data Validation involves a more extensive process than data verification. Validation includes all the verification checks, as well as checks for less common errors, including instrument calibration that was not conducted as required, internal standard errors, transcription errors, and calculation errors. (BNL 2017 c, h).

Data Usability is the process by which laboratory results are determined to be consistent with project-specific DQOs. This procedure may be applied to data that has been identified by the project manager as outside the range of normal expectations, and may include examination of the verification or validation reports, process knowledge, inspection of raw data, and/or checks of general analytical correctness of data.(BNL 2017 f, g)

Non-radiological data analyzed off site are verified and validated using EPA contract laboratory protocols (EPA 2006, 2012, 2013; BNL 2017 e, h). Radiological packages are verified and validated using both BNL and DOE guidance documents (BNL 2017b, c, DOE order 458.1[2011]).

4.8 DATA QUALITY PROCESS

The goal of the data quality process is to ensure that results are representative and defensible. That data is of the type and quality needed to verify protection of the public, employees, and the environment. The quality system diagram on the following page details the three-stage data quality process: planning, implementation, and assessment. The planning stage can be divided into the DQO process and the QA plans associated with the program. The implementation stage entails the actual collection of samples and analysis in accordance with the SOPs and quality control guidelines. The final stage is data quality assessment which may include data verification and/or data validation, as well as data usability (which includes) review of the decision-making process to ensure that effluents, emissions, and receptor data are adequate to assess impacts to the health of the BNL environment. The outcomes of the quality process are defensible products and decisions.

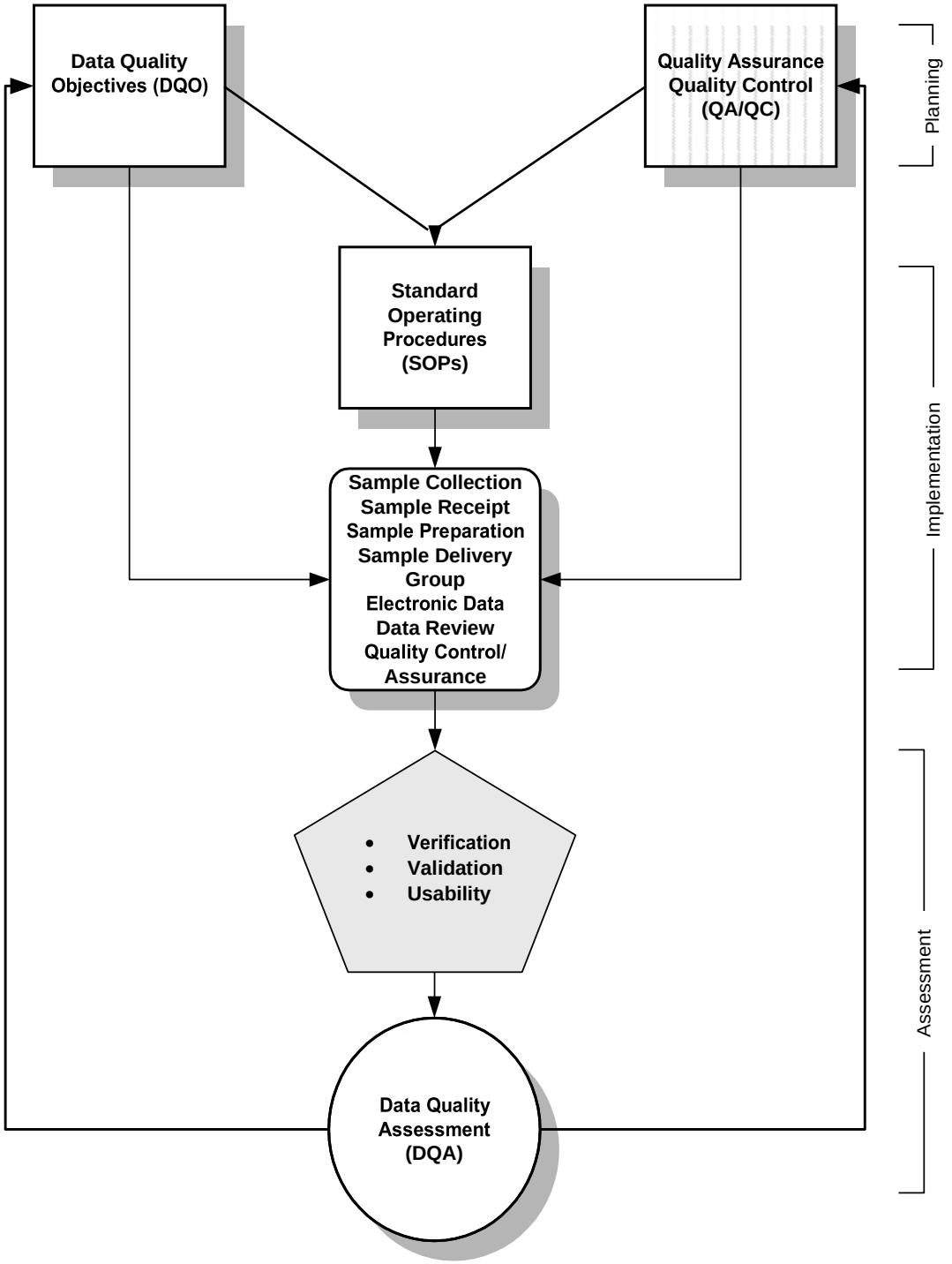

Figure 4.1. Data Quality Flowchart

REFERENCES

10 CFR 830 Subpart A. *U.S. Department of Energy. Quality Assurance Requirements*. U.S. Code of Federal Regulations. 2020.

BNL. 2017a. EPD-SOP 004. *Electronic Data Archiving*. Brookhaven National Laboratory, Upton, NY.

BNL. 2017b. EM-SOP 204. *Radiochemical Data Verification*. Brookhaven National Laboratory, Upton, NY.

BNL. 2017c. EM-SOP 209. *Radiochemical Data Validation*. Brookhaven National Laboratory, Upton, NY.

BNL. 2017d. EM-SOP-202. Sample Location Identification. Brookhaven National Laboratory, Upton, NY.

BNL. 2017e. EM-SOP-203. Chemical Data Verification. Brookhaven National Laboratory, Upton, NY.

BNL. 2017f. EM-SOP-210. Radiochemical Data Usability. Brookhaven National Laboratory, Upton, NY.

BNL. 2017g. EM-SOP-211. Chemical Data Usability. Brookhaven National Laboratory, Upton, NY.

BNL. 2017h. EM-SOP-212. Chemical Data Validation. Brookhaven National Laboratory, Upton, NY.

DOE Order 414.1D. *Quality Assurance. U.S. Department of Energy*. Washington, DC. 2020.

DOE Order 458.1. *Radiation Protection of the Public and Environment*. U.S. Department of Energy, Washington, DC. Admin Chg. 4 2020.

EPA 2006. *Guidance on Systematic Planning Using Data Quality Objectives Process (QA/G-4)*. U.S. Environmental Protection Agency, Washington, DC.

EPA 2015a. *ICP-AES Data Validation*. EPA Region-II SOP HW-3a. Rev. 0 U.S. Environmental Protection Agency, Washington, DC. July 2015.

EPA 2015b. *Low/Medium Volatile Data Validation*. EPA Region-II SOP HW-33. U.S. Environmental Protection Agency, Washington, DC. Revision 0, July 2015.

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