Quality Assurance

Brookhaven National Laboratory conducts sampling activities designed to monitor groundwater, air, surface water characteristics, effluent discharges, flora, and fauna throughout the site and the surrounding area. Quality assurance is an integral part of every function at BNL. A program is in place to ensure that all environmental monitoring data meet appropriate quality assurance requirements. Review of the quality assurance measures at BNL presented in this chapter confirms that the analytical data reported in the 1999 Site Environmental Report are reliable.

Brookhaven National Laboratory uses its onsite Analytical Services Laboratory and four offsite contractor laboratories to analyze environmental samples. The oversight of laboratory analyses involves proficiency testing, auditing, and ensuring adherence to a quality assurance program. The New York State certified laboratories that perform analyses are included in this report.

The Analytical Services Laboratory performs approximately 5,000 radiological and nonradiological (chemical) analyses per year on environmental samples, and also supervises contracts with other laboratories. Quality control is maintained through daily instrument calibration, efficiency and background checks, and testing for precision and accuracy.

The two primary laboratories reporting radiological analytical data each scored between 90 and 100 percent satisfactory results in both state and federal performance evaluation programs. For nonradiological performance evaluation testing, the ASL and the three BNL contractor laboratories each scored over 90 percent in the 1999 New York State Environmental Laboratory Approval Program evaluations. Over all, analytical data reported for 1999 are of high quality.

9.1 QUALITY ASSURANCE

This chapter discusses the quality assurance measures at Brookhaven National Laboratory. It is extremely important that environmental data used for reporting and decision making is accurate. A program is in place to ensure that all environmental monitoring data are reliable and meet appropriate quality assurance (QA) requirements.

Environmental samples at BNL are analyzed by an onsite laboratory, the Analytical Services Lab (ASL). BNL also procures and maintains contracts with offsite laboratories: General Engineering Lab (GEL) (Charleston, SC) for radiological and nonradiological analytes; H2M Lab (Melville, NY) for nonradiological analytes; Severn-Trent Lab (STL) (Monroe, CT) and Chemtex Lab (Port Arthur, TX) for select nonradiological analytes. All analytical laboratories are New York State certified and subject to audits. The process of selecting laboratories involves an evaluation of past performance evaluation (PE) testing results, pre-selection bidding, post selection auditing, and adherence to its own quality assurance program (QAP).

The ASL performs approximately 5,000 radiological and nonradiological (chemical) analyses per year on environmental samples. Routine quality control (QC) procedures followed by the ASL include daily instrument calibrations, efficiency and background checks, and standard tests for precision and accuracy.

As in prior years, the ASL and three contractor laboratories participated in several national and state PE testing programs. Results of those PE tests provide information on the quality of a laboratory's results.

Figures 9-1 and 9-2 summarize the overall 1999 scores of the ASL and the three contractor laboratories that participated in the U.S. Department of Energy (DOE) Quality Assessment Program for radiological analytes, Environmental Resources Associates (ERA) performance evaluations, or the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP). All performance evaluation testing results reported by each participating analytical laboratory during 1999 are summarized in Figures 9-1 and 9-2 and presented in detail in Table F-2 through Table F-17 (see Appendix F). The bar graphs of Figures 9-1 and 9-2 show radiological and nonradiological results (as percentage scores) that were acceptable, within warning limits, or unacceptable for each analytical laboratory, and by PE testing program. A 'warning' or 'check for error' is considered satisfactory, being within two and three standard deviations of the target value, and an 'unacceptable' result is greater than three standard deviations of the target value. An 'overall satisfactory' score is the sum of results rated as acceptable and those rated as 'warning,' divided by the total number of results reported.

During 1999, BNL's overall satisfactory radiological scores were comparable to those of its offsite contractor laboratory (GEL), with a 90 to 95 percent rate of satisfactory radiological results. For nonradiological results, the overall rate of satisfactory results ranged from 91 to 99 percent for BNL, H2M, and STL. Performance evaluation testing data are not presented for Chemtex Laboratory because NYSDOH does not provide performance testing for these analytes.

9.2 THE BNL ENVIRONMENTAL MONITORING QUALITY ASSURANCE PROGRAM

Responsibility for quality at BNL starts with the Laboratory Director and extends down through the entire organization. The BNL Quality Assurance Program coordinates and evaluates QA implementation at the Laboratory and provides professional assistance to the departments and divisions. The objectives of BNL's environmental monitoring QA program are to ensure proper planning, organization, direction, control, and support in order to achieve the objectives of the environmental program. Overall performance is reviewed and evaluated using a rigorous assessment process described in the following sections of this chapter. This QA program was developed to ensure compliance with requirements established by the U.S Department of Energy in DOE in Order 414.1 (1998), *Quality Assurance,* and DOE Order 5400.1 (1988), *General Environmental Protection Program*.

9.3 SCOPE OF THE ENVIRONMENTAL MONITORING QUALITY ASSURANCE PROGRAM

BNL has adopted or adapted program elements specified in DOE Order 414.1, as well as the additional environmental QA requirements of DOE Order 5400.1, into sampling, analysis, and data handling activities. QA practices and procedures are documented in manuals and a comprehensive set of detailed,

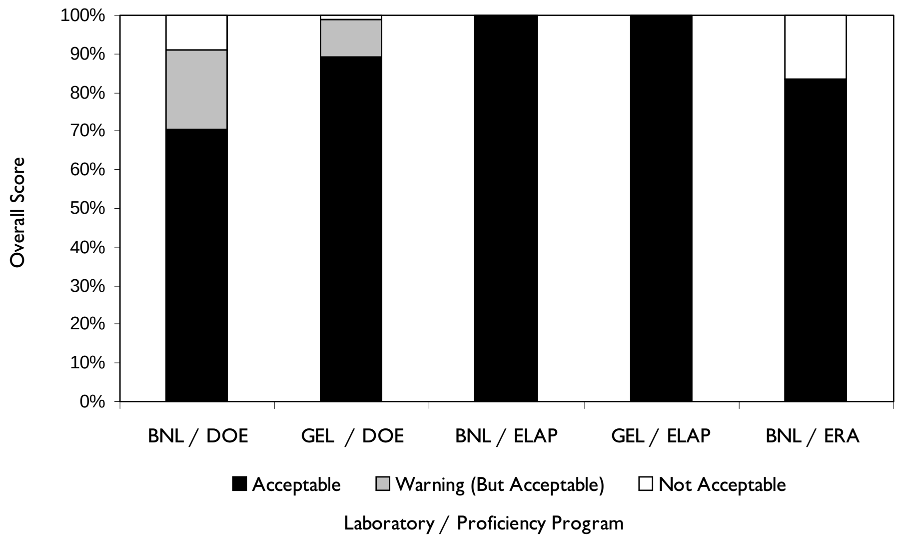

Figure 9-1. Summary of 1999 Performance Evaluation Scores in DOE, NYSDOH ELAP, and ERA Radiological Programs.

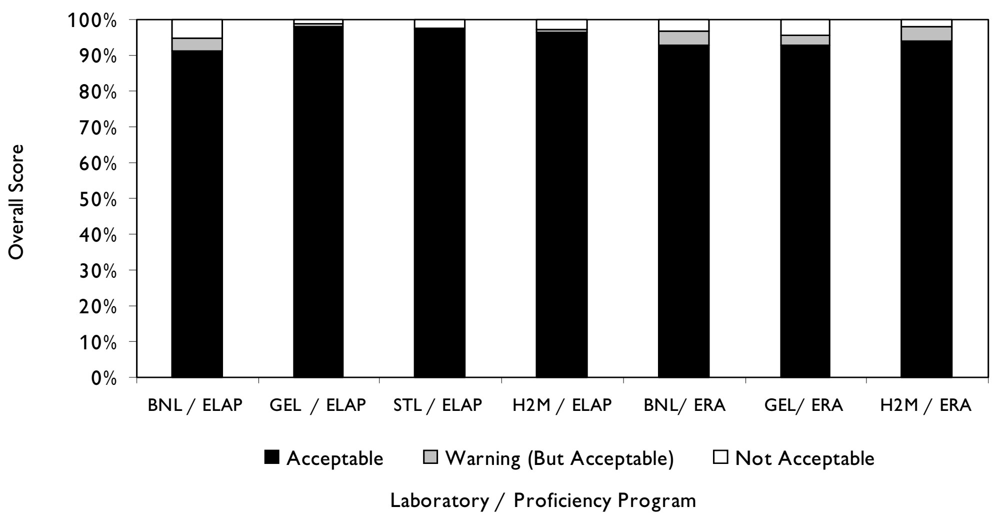

Figure 9-2. Summary of 1999 Performance Evaluation Scores in NYSDOH ELAP and ERA Nonradiological Programs.

internal Environmental Monitoring Standard Operating Procedures (EM-SOPs) (BNL 1999a).

BNL ensures that environmental media are sampled and analyzed in a way that provides representative, defensible data. The QA program supports this activity by incorporating quality assurance elements in environmental monitoring programs such as field sampling designs, documented procedures, chain-of-custody, a calibration/standardization program, acceptance criteria, statistical data analyses, QA software and data processing systems. Whenever discrepancies are found in these elements or when failures in PE testing occur, a nonconformance report is typically generated by the laboratory. Corrective actions are then made when appropriate. The offsite contractor laboratories that perform radiological and chemical analyses for BNL are also required to maintain stringent QA programs.

In addition, BNL conducts a program of internal and external audits to verify the effectiveness of the environmental sampling, analysis, and database activities. Contractor laboratories are subject to audits by BNL personnel at the time of contract renewal. The BNL Quality Management Office, DOE Brookhaven Group, DOE Chicago Operations, regulatory agencies, and other independent parties periodically audit the environmental programs.

For sampling, SOPs have been established to calibrate field equipment, collect samples, and maintain chain-of-custody of all environmental samples. These SOPs ensure consistency between samples, whether they were collected by BNL employees or outside contractors. Quality control checks of sampling include the collection of field duplicates, matrix spike samples, field blanks, trip blanks, and equipment blanks. In addition, specific sampling methodologies (e.g., the low flow sampling technique) include quality control checks such as field analysis of stability parameters to ensure proper purging of monitoring wells.

For in-house analyses, SOPs have been established to calibrate instruments, analyze samples, and assess quality control. These procedures are consistent with U.S. Environmental Protection Agency (EPA) methodology and are described in Appendix D. Quality control checks are performed and include analysis of blanks or background concentrations; use of Amersham or National Institute for Standards and Technology (NIST) traceable standards; and analysis of reference standards, spiked samples, and duplicate samples. The ASL Supervisor, Quality Assurance Officer, or Group Leader review all analytical and quality control results before the data are reported.

9.4 QUALITY ASSURANCE PROGRAM FOR GROUNDWATER MONITORING ACTIVITIES

This section describes the QA requirements for activities that were conducted as part of the 1999 BNL groundwater monitoring program. Sample analyses for environmental restoration sample data were performed by General Engineering Lab, under contract to BNL. Environmental surveillance groundwater data were analyzed by the ASL with two exceptions: the Major Petroleum Facility and the Motor Pool monitoring programs were sampled under NYSDEC permit requirements. The ASL is not certified by New York State for analysis of semivolatile organic compounds; therefore, samples are sent offsite to H2M Labs, Inc. The *BNL Groundwater Monitoring Program Quality Assurance Project Plan* (QAPP) (BNL 1999b) describes the QA program and QC requirements followed. The QAPP documents organizational structure, documentation requirements, sampling requirements, field QA/QC sample collection, acceptance criteria, sample custody requirements, data validation procedures, and general data handling procedures (database procedures).

9.4.1 SAMPLE COLLECTION PROCEDURES

The primary objectives of environmental groundwater sampling are to monitor groundwater quality, to identify the extent of contamination, and to identify potential receptors at risk. BNL has developed SOPs for all phases of sampling activities including field equipment calibration, chain-of-custody, sampling of monitoring wells, and waste handling requirements.

9.4.1.1 GROUNDWATER SAMPLING PROCEDURES

EM-SOP-302, *Low Purge Sampling of Monitoring Wells Using Dedicated Pumps*, was followed by field personnel collecting groundwater samples. Most of the wells in the monitoring program were equipped with dedicated pumps designed to collect water samples using a low flow process. When a well was designated to be sampled using the low flow process but a dedicated pump was not associated with the well, the procedures outlined in EM-SOP-307, *Low Purge Sampling of Monitoring Wells using Non-dedicated Pumps*, was used. The only exception was for the AOC29 High Flux Beam Reactor Program where procedures outlined in the *Natural Attenuation Monitoring Work Plan for the HFBR Tritium Plume* (BNL 1998) were followed.

9.4.2 FIELD QUALITY CONTROL SAMPLES

Field QC samples collected for the environmental monitoring program included trip blanks, field blanks, field duplicate samples, matrix spike/matrix spike duplicates, and equipment blanks.

The rationale for selection of specific field QC samples and minimum requirements for use in the environmental monitoring and surveillance programs are provided below and in EM-SOP-200, *Collection and Frequency of Field Quality Control Samples.*

Trip blanks consist of an aliquot of distilled water that is sealed in a sample bottle either by the analytical laboratory prior to shipping the sample bottles to BNL or prepared by the field sampling personnel. The trip blank is used to determine if any cross-contamination occurs between aqueous samples during shipment. Trip blanks are analyzed for volatile organic compounds only. The trip blanks were shipped to the analytical laboratory each day that field sampling for aqueous volatiles was conducted. They were collected in accordance with the procedure described in EM-SOP-200.

Field blanks were collected to evaluate potential cross-contamination of samples caused by sampling equipment. The frequency of collection was one field blank for every twenty samples shipped to the analytical laboratory or one per sampling round per project, whichever was more frequent. On any given day, the field blanks were analyzed for the same parameters as groundwater samples.

Field duplicate samples were analyzed to check reproducibility of the sampling and analytical results. EM-SOP-200 specifies the frequency of duplicate collection. Generally, groundwater duplicates were collected for five percent (one out of every 20 samples) of the total number of collected samples. Table F-1 (see Appendix F) summarizes the number of field duplicate samples collected. Field duplicate acceptability is based on EPA Region II guidelines. The relative percent difference for concentrations above the contract-required detection limit, or five times the reporting limit (depending on the reporting limit and analyte), must be below 20 percent for the duplicate to be acceptable.

Matrix spike/matrix spike duplicates for organic analysis were performed in order to determine if the sample matrix adversely affected the analysis. They were performed at a rate of approximately one per twenty samples collected.

Equipment blank samples were collected as needed to verify the effectiveness of the decontamination process for non-dedicated or reusable sampling equipment. Equipment rinsates were collected from the final rinse water generated using a laboratory-grade water source. When equipment rinsate collections are needed, these QC samples are collected at the frequency specified in EM-SOP-200.

9.4.3 FIELD SAMPLE HANDLING AND CUSTODY

In order to ensure the integrity of samples, a chain-of-custody is maintained and documented for all samples collected. A sample or evidence file is considered to be in the custody of a person if any of the following rules of custody are met: (a) the person has physical possession of the sample or file; (b) the sample or file is in view of the person after being in possession; (c) the sample or file is placed in a secure location by the custody holder; or (d) the sample or file is in a designated secure area.

9.4.3.1 FIELD SAMPLE CUSTODY REQUIREMENTS

The sampling team leader was responsible for the care and custody of the samples collected until they were transferred to a sample receiving group or an analytical laboratory. The sampling team member who maintained custody of the samples signed the chain-of-custody form when the samples were transferred to a sample receiving group or analytical laboratory. The appropriate sample relinquishment signatures and sample receipt signatures were documented on the chain-of-custody form. Field requirements were as follows:

(a) The chain-of-custody was generated at the point of sample generation.
(b) Samples were collected as specified in the QAPP or project-specific work plan.
(c) The information concerning the sample collection was recorded in a field log.
(d) Samples requiring refrigeration were placed immediately into a refrigerator and/or into a cooler with cooling media, and kept under the rules of custody.

9.4.3.2 SAMPLE TRACKING

Samples and results are tracked within the Environmental Information Management System (EIMS). Tracking was initiated when a sample was recorded on a chain-of-custody form. Copies of the chain-of-custody and supplemental forms were provided at least weekly to the project manager or his designee (sample coordinator) and forwarded to the data coordinator for entry into the EIMS.

9.4.3.3 SAMPLE DOCUMENTATION

The sample team is required to keep a field notebook. The field notebook is a bound, weatherproof logbook that was filled out at the location of sample collection. It contains sample designation, sample collection time, sample description, sample collection method, daily weather, field measurements, and other site-specific observations, as appropriate. The sample team also completes a sample collection log for every sample that is collected.

9.4.3.4 SAMPLE PRESERVATION, SAMPLE SHIPMENT, AND RECEIPT

Samples shipped to offsite laboratories were managed as follows. Prior to sample collection, the sampling team prepared all bottle labels and affixed them to the appropriate container type as defined in the QAPP. Appropriate preservatives are added to containers prior to sample collection or immediately after collection.

After sample collection by BNL or contractor personnel, the samples are preserved and maintained as required throughout shipment. If samples are sent via commercial carrier, a bill-of-lading (waybill) was used. Receipts for bills-of-lading and all other documentation of shipment were maintained as part of permanent custody documentation. Commercial carriers are not required to sign the chain-of-custody form.

9.4.4 DATA MANAGEMENT PROCEDURES

Data management procedures govern the tracking, validation, verification, and distribution of the analytical data. When samples are shipped to the laboratory, chain-of-custody information is entered into the EIMS. Following sample analysis, the laboratory provides the results to the project manager or their designee, and (when applicable) the validation subcontractor in accordance with its contract with BNL. Upon receipt of the hard copy analytical results from the laboratory, the sample coordinator/radiochemist verifies that the results were complete. The verification process includes a check for data package completeness as well as an evaluation of holding times and blank contamination. The Environmental Restoration program sends out approximately 20% of the samples collected for independent validation. The validation contractors used for this work were IT Corp., Inc. (Summerset, NJ) for nonradiological analyses and MJW (Williamsville, NY) for radiological analyses. ES Program samples are not subjected to the validation process.

9.4.4.1 VALIDATOR RESPONSIBILITIES

When a set of analytical results is validated by a validation subcontractor, the validator is responsible for the following data deliverables: (a) hard copy results to the project manager and (b) electronic data deliverables to the data coordinator.

9.5 ANALYSES PERFORMED OFFSITE

Samples collected for regulatory compliance purposes are analyzed by offsite contractor laboratories. Samples requiring semi-volatile organic analyses and toxicity characteristic leachate procedure (TCLP) samples are sent offsite. In addition, when demand exceeds ASL capacity, some strontium-90, metals, and polychlorinated biphenyls (PCBs) are sent to a contractor laboratory.

9.5.1 THE CONTRACT PROCESS

During 1999 BNL had four contracts with offsite laboratories. The contracts specify the analytes, methods, required detection limits, and deliverables (which include standard batch QA/QC performance checks). Successful bidders must also provide BNL with a copy of their QA/QC manual as well as their QAPP.

A contract for nonradiological sample analyses was established with H2M Laboratories, Inc., with an option for second and third year renewals. A second contract for nonradiological sample analyses was established with Chemtex Laboratory in order to provide special analytical services required to meet BNL discharge permit requirements for four analytes (these samples are wastewater samples collected from various recharge basins and one cooling tower).

Contracts for radiological and nonradiological analyses were established GEL and STL with an option for a second and third year renewals. Samples sent offsite for radiological analyses were those requiring either EPA methods or DOE standard methods that the ASL did not perform. Examples are strontium-90 and actinide analyses in soil, vegetation, animal tissue, and water.

The contractor laboratories were audited periodically by the ASL and/or Environmental Restoration program staff to verify competence in analytical methodology and implementation of a comprehensive QA program. During 1999, the ASL began contract renewal and bid processes for both GEL and H2M. The audits of these two laboratories, as well as for Chemtex, are planned for early 2000.

9.5.2 QA/QC VERIFICATION PERFORMED AT BNL

9.5.2.1 CONTRACTOR ANALYSES RESULTS VERIFICATION

Data packages for onsite samples sent out to a contractor laboratory were reviewed at BNL upon return by subject matter experts in either radiological analyses or analytical chemistry to ensure they complied with the contract specifications before the data was accepted and reported. In addition, data packages were examined to determine if samples exceeded holding times, if there were poor recoveries, if the proper method was used, and if field blanks were less than the method minimum detectable limit (MDL). Nonradiological data analyzed offsite were verified and validated using EPA Contract Laboratory Program guidelines (EPA 1990, 1996). Radiological packages were verified and validated using both BNL and DOE guidance documents (BNL 1997 and DOE 1994). Data packages, which were not validated, underwent data verification by the Environmental Restoration Division as per BNL SOPs. Results of the verifications were added to the EIMS.

9.5.2.2 IN-HOUSE ANALYSES RESULTS VALIDATION

The function of the ASL's QA Officer is to verify that all analytical batches fulfill internal QA/QC acceptance criteria. The criteria include: (a) precision, (b) accuracy, (c) recovery, (d) instrument background checks, and (e) stable instrument efficiency performance. All QA/QC data were reviewed before the results were reported. These criteria are fully described in the ASL's QAPP issued in May 1999 (BNL 1999c). The QA Officer and technical staff maintained the detailed QA/QC trend-charts included in this chapter.

9.6 ANALYSES PERFORMED ONSITE

The ASL performs radiological and nonradiological analyses in support of both environmental monitoring and facility operations. The ASL is certified by the New York State Department of Health (NYSDOH) for tritium, gross alpha/beta and gamma in potable and non-potable water analyses in several matrices, all of which are approved EPA methods.

ASL's nonradiological chemical group is certified by the NYSDOH ELAP to perform analyses utilizing EPA Methods 524 and 624 for volatile organic analytes, in potable and wastewaters, respectively. Thirty-seven volatile organic compounds (VOCs) are currently available for analysis with Method 624 (for ground and wastewaters), an addition of 26 over 1998. EPA Method 524 (for potable water) includes 63 organic analytes and was a new addition to the ASL's capabilities. Metals are analyzed utilizing both atomic absorption spectroscopy and inductively coupled plasma/mass spectroscopy EPA Methods. The number of certified metals in potable water doubled from 10 to 21 in 1999. In addition, the ASL is now certified for analyses of 17 metals (the entire ELAP list) in potable water, as well as 21 metals in wastewater.

Certification for three anions has been established for potable and wastewaters, using EPA Method 300. All analytical methods performed by the ASL are described in detail in Appendix D. The abbreviations used for purgeable organics that follow in Appendix F figures are: benzene (benz) , toluene (tol), xylene (xyl), ethylbenzene (E-benz), chloroform (Chlor), chlorobenzene (Cl-benz), methyl chloride (methly-Cl), 1,1-dichloroethylene (DCE), 1,1-dichloroethane (DCA), 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), tetrachloroethylene (PCE) and carbon tetrachloride (CCl_4).

9.7 ASL'S INTERNAL QUALITY ASSURANCE PROGRAM

In May 1999, the ASL issued its QAPP (BNL 1999c) following EPA Region-V guidelines (EPA 1998). SOPs maintained by the ASL were also revised. The QA procedures followed at ASL include daily instrument calibrations, efficiency and background checks, and routine tests for precision and accuracy. A brief summary of the methods and results of these procedures follows.

9.7.1 ASL INSTRUMENT CALIBRATIONS

Figures F-1 through F-4 (see Appendix F) summarize the internal quality control checks for the ASL's radiological instruments. Figure F-1 shows the annual mean efficiencies, with a 99 percent confidence interval, for the ASL's alpha, beta, tritium, and strontium-90 analyzers. Efficiency is the measure by which radiological decaying events are converted into observable counts (counts per minute). Instrument efficiencies were determined daily, using a calibration standard, and averaged for the calendar year. The data points show the annual mean and one standard deviation for each analyzer. All analyzers exhibited stable behavior and there were no unusual occurrences with existing instrumentation.

Figure F-2 summarizes the variability in background counts experienced by each analyzer in 1999. Instrument background is used to determine the MDL of a radiological analyte. In

1999, there were no unusual drift and/or variability in instrument background for each type of analyzer, based on the mean background count-rates and one standard deviation.

Figure F-3 shows the mean, with 99 percent confidence intervals, for eight high-purity germanium gamma detectors. Each detector was calibrated for energy and instrument efficiency daily using a NIST traceable cesium-137 standard. Geometry efficiency calibrations are performed quarterly. Cesium-137 detection efficiencies for the eight detectors is illustrated on the graph, with the EPA acceptance limit of 1 keV shown as the upper and lower lines. The data showed that all eight gamma detectors performed well within the EPA acceptance limit during 1999.

Figure F-4 compares the mean, with a 99 percent confidence interval, for each strontium-90 detector. The plot shows that the mean detector efficiencies, using calibration standards, were within two percent of each other. Each of the weekly efficiency checks performed were within the five percent EPA acceptance limit. The graph is the summary of six months data because the unit was taken out of service and replaced with a new instrument in November 1999.

9.7.2 PRECISION AND ACCURACY

Precision is the percent difference between two measured values, whereas accuracy is the percent difference between a measured value and its known (expected) value. The relative percent difference (RPD) statistic is the measure of batch precision and is defined as the absolute difference between two results, divided by the average of both results, multiplied by 100. Typically, a radioactive tracer solution (i.e., spike) is added to either a routine sample or tap water sample as a means of determining both precision and accuracy. In the case of nonradiological analyses, a known amount of a given analyte is added to a sample, and the percent recovery is the measure of accuracy. The percent recovery is the ratio of the measured amount divided by the known (spiked) amount multiplied by 100.

9.7.2.1 NONRADIOLOGICAL: ORGANIC AND INORGANIC ANALYSES

Figure F-5 summarizes the internal quality control program for the ion chromatography and atomic absorption methods used for inorganic analyses. Figure F-5 presents the annual means and 99 percent confidence intervals for reference checks and continuing calibration check recoveries. There were 147 checks performed in 1999 for the 21 metals and three anions shown.

Figures F-6 shows the 1999 results of the ASL's internal quality control program for the gas chromatography/mass spectroscopy method used in the organic analyses. It summarizes the reference check recoveries for 14 primary VOCs. The recoveries are presented as the annual means, with 99 percent confidence intervals, for each of the VOCs. Mean recoveries and 99 percent confidence intervals for all 14 analytes were within their target ranges, that is, ± 20 percent.

Figure F-7 presents the means, with 99 percent confidence intervals, of surrogate recoveries for samples analyzed in 1999. The recovery range for 4-bromofluorobenzene (BFB) was 72 - 115 percent. The recovery ranges for toluene-d8 and dibromofluoromethane (DBFM) were 84 - 111 percent and 80 - 113 percent, respectively.

Figure F-8 shows the method precision for organic compounds processed by the ASL in 1999. The data are averages for about 20 batches, where precision was determined by analyzing samples in duplicate. The results for 11 compounds represent the average RPD and two standard deviations. All 11 analytes had relative percent difference within the ASL's internal acceptance limit of ± 20 percent. The two sigma uncertainties were all within the EPA acceptance criteria of ±20 percent.

9.7.2.2 RADIOLOGICAL: GROSS ALPHA/BETA AND TRITIUM

Figure F-9 summarizes the ASL's gross alpha and beta (GAB) precision for 270 batches processed in 1999. The figure shows the RPD statistics for each batch of GAB analyses performed. Tap water was spiked with known amounts of americium-241 (for alpha) and strontium/yttrium-90 (for beta) in order to determine batch precision. The acceptance criteria for batch precision is an RPD statistic less than 20 percent (for activity concentrations that are five times greater than the method MDL). During 1999, GAB batch precision was consistently within the acceptable range, except for one instance. In that instance, analytical results were rejected and the entire batch reanalyzed with no lost data. The rejection rate for GAB analyses performed in 1999 was 0.4 percent.

Figure F-10 summarizes the ASL's tritium precision for 307 batches processed in 1999. There were four rejected batches of tritium in 1999 representing a rejection rate of 1.3 percent. Each rejected batch was reprocessed and then passed quality control with no loss of data.

Figures F-11 and F-12 summarize the ASL's accuracy for GAB and tritium, respectively during 1999. Overall the ASL's rejection rate for approximately 577 analytical batches processed for both GAB and tritium was 1.3 percent.

Figure F-11 shows five of 270 cases where GAB accuracy failed the EPA's acceptance criteria of ± 25 percent for percent recovery. In those cases, results of the analytical batch were rejected and the batch reanalyzed. In no case was there a loss of analytical data. Figure F-12 shows the four of 307 cases where tritium batches were rejected because the percent recovery exceeded ± 25 percent. As with GAB, those tritium batches were reanalyzed with no loss of analytical data.

9.7.3 RADIOLOGICAL LABORATORY SWIPE TESTING

During 1999, contamination surveys were performed in all radiological labs of the ASL in order to monitor possible sample contamination by analytical equipment. A BNL radiological control technician performed the contamination surveys. Monthly surveys consisted of swipe-tests of all radiological laboratories as well as the ASL counting room. Weekly surveys, swipe-tests, and instrument surveillance were also performed on the ASL's "Controlled Area" hood and all pipettes used to dispense samples and reagents. On a quarterly basis, the BNL radiological control technician performed a Dose-Report Review. No measurable contamination was found during either monthly or weekly ASL surveys.

9.8 RESULTS OF PERFORMANCE EVALUATION TESTS

Effective December 21, 1998, the EPA's performance evaluation programs for both radiological and nonradiological analytes was terminated. Environmental Resources Associates (ERA), a private independent performance evaluation program, was chosen by the ASL as a replacement for the EPA's radiological and nonradiological Performance Evaluation Program. During 1999, the ASL, GEL, STL, and H2M participated in either the NYSDOH Environmental Laboratory Approval Program (ELAP) (for radiological and nonradiological proficiency evaluation testing) or the DOE Environment Measurements Laboratory (EML) Quality Assessment Program (radiological only).

9.8.1 RADIOLOGICAL ASSESSMENTS

Both the ASL and GEL participated in the DOE's EML Quality Assessment Program and the NYSDOH ELAP. The summaries that follow present the results of each analytical laboratory and their respective PE program.

Overall, the ASL's performance in the DOE EML performance evaluation program was satisfactory in 90.9 percent of the analyses performed on four matrices (air, vegetation, water, and soil), as shown in Table F-2 of Appendix F. Thirty-one of 44 analyses (70.4 percent) were within established EML limits showing acceptable agreement with the known value; nine results (20.4 percent) were within warning limits, demonstrating satisfactory agreement; four analyses (9.1 percent) fell outside the acceptance limits. Three of the four results that were not acceptable occurred in the March round of gamma testing in air filters. In late 1998 the DOE EML changed the filter size of their performance evaluation test samples. The ASL began to correct for the geometry change in the September 1999 round of testing. In 1999, the ASL also switched over to a four liter Maranelli™ configuration for gamma counting of water. After the changes in both air filter and gamma-in-water counting geometries, there was a significant reduction in the number of warning and unacceptable ASL results as compared to the 1998 SER.

On occasion, the ASL sent samples to GEL, an offsite contractor laboratory, for radiological analyses. GEL's performance in DOE's EML performance evaluation program is presented in Table F-3. GEL's performance in the DOE EML intercomparison study was acceptable or within warning limits in 99 percent of the analyses performed on the four matrices (air, vegetation, water, and soil). Eighty-four of 94 analyses (89.4 percent) were within EML's acceptance limit; nine of 94 analyses (9.6 percent) were within upper and lower warning limits, demonstrating satisfactory agreement; one analyses for uranium (1.1 percent) fell outside the acceptance limits.

The ASL's radiological results for the ELAP performance evaluation program were in 100 percent agreement for the four analyses shown in Table F-4. For the same performance evaluation program, GEL also scored 100 percent on the eight analytes shown in Table F-5.

The ASL also participated in several ERA radiological PE studies shown in Table F-6. The overall score on the six results performed in 1999 was 83.3 percent with one tritium unacceptable result. A review of internal QC checks suggested no apparent reason for the failure. However, the ASL had performed successfully in both March and September rounds of the DOE's EML intercomparison, as shown in Table F-2.

9.8.2 NONRADIOLOGICAL ASSESSMENTS

The ASL, GEL, STL, and H2M participated in the NYSDOH ELAP during 1999. The NYSDOH certifies laboratories for non-potable water and potable water. These results are summarized in Tables F-7 to F-16. Although not required for certification, H2M, GEL, and the ASL participated in the ERA water supply and water pollution studies. Only the ASL's performance evaluation data in the ERA program are presented in Appendix F. Summary results for ERA are included for GEL and H2M in Figure 9-2.

The ASL results for the NYSDOH ELAP for non-potable water are shown in Tables F-7. There were a total of 57 results reported with three unacceptable (5.3 percent), two marginal (3.5 percent), and 52 acceptable results (91.2 percent). The overall satisfactory score for the ASL in the ELAP non-potable water category was 94.7 percent.

GEL reported results for 370 analytes shown in Table F-8. For the NYSDOH ELAP non-potable water studies, there were six unacceptable (1.6 percent), three marginal (0.8 percent), and 361 acceptable (97.9 percent) results. This corresponds to an overall satisfactory score of 98.7 percent .

Table F-9 shows H2M's performance in the NYSDOH ELAP non-potable water studies for January and July 1999. There were 390 results reported with ten unacceptable (2.5 percent), six marginal (1.5 percent), and 374 acceptable (95.9 percent). The overall satisfactory score for H2M laboratory was 97.5 percent.

Table F-10 shows STL's s performance in the NYSDOH ELAP non-potable water studies for January and July 1999. There were 383 results reported with six unacceptable (1.6 percent), one marginal (0.3 percent). The overall satisfactory score for H2M laboratory was 98.2 percent.

In the potable water category of the NYSDOH ELAP, the ASL reported 146 results, shown in Table F-11. There were 142 acceptable (97.3 percent) and four unacceptable results, corresponding to an overall satisfactory score of 97.3 percent. GEL reported 170 results shown in Table F-12. There were 169 acceptable (99.4 percent), and one unacceptable result, corresponding to an overall satisfactory score of 99.4 percent. H2M reported 246 results shown in Table F-13. There were 239 acceptable and five warning results, corresponding to an overall satisfactory score of 97.2 percent.

Table F-14 shows STL's results for the NYSDOH ELAP potable water study. There were 111 acceptable (94.1 percent), one marginal (0.8 percent) and six unacceptable (5.1 percent) results, corresponding to an overall satisfactory score of 94.9 percent.

The ASL also participated in ERA's water pollution and water supply PE studies, as shown in Tables F-15 and F-16, respectively. The total number of results reported in both Tables F-15 and F-16 was 156. There were 145 acceptable (92.9 percent), six 'check for errors' (3.9 percent), and five not acceptable (3.2 percent) results. The overall satisfactory score for the ASL in ERA's water supply and water pollution studies was 96.9 percent.

No PE testing data are presented for Chemtex Laboratory. They only perform chemical analyses on the following analytes: dibromo-nitrilo-propionamide (DBNPA), tolytriazole (TTA), polypropylene-glycol-monobutyl-ether (PGME), and 1,1-hydroxyethylidene-diphosphonic acid (HEDP). Currently, no NYSDOH PE testing program includes these four analytes in its studies.

9.9 NEW INSTRUMENTATION AND NEW ANALYTICAL METHODS

In late November of 1999, the ASL took its Tennelec™ LB770 low-level beta counter out of service and replaced it with a state-of-the-art Tennelec™ 4110 system. This new detector is intended for low-level strontium and technetium measurements in environmental samples. The Tennelec™ 4110 underwent testing during the last two months of 1999 until it passed all QC tests. No environmental samples were impacted by this transition.

In January of 1999, the ASL applied to NYSDOH ELAP for "Broad Approval" certification of strontium-90 in water using a new crown-ether separation technology. Approval is pending. The ASL had conducted an intensive intercomparison study of this new method that was published in the June 1999 issue of *Health Physics Journal* (Scarpitta *et. al.* 1999). This radiochemical separation technique was also used in two program pilot projects, where BNL wastewaters contaminated with strontium-90 were remediated to near environmental levels using filter cartridges impregnated with this strontium-specific crown-ether material.

As was mentioned in section 9.6, the ASL more than doubled the number of nonradiological analytes that it is now certified for. These include the entire NYSDOH ELAP list for metals. Appendix D, Table D-1 lists the 74 analytes that the ASL is now certified for, and Table D-2 lists the 24 metals and anions that the ASL holds certification.

9.10 SUMMARY

Quality control data for BNL's ASL were presented in figures for instrument calibration, efficiency and background checks, and testing for precision and accuracy. Additional quality control data were presented for nonradiological analyses performed by the ASL. Overall, quality control checks were consistently within the EPA guidelines of ± 20 percent.

Detailed data on performance evaluation testing were also presented as tables that were summarized in this chapter. The two laboratories reporting radiological analytical data in the *1999 Site Environmental Report* (ASL and GEL) each scored between 90 and 100 percent satisfactory results in both state and federal performance evaluation programs. For nonradiological performance evaluation testing, the ASL and the three BNL contractor laboratories (H2M, GEL, and STL) each scored over 90 percent in the New York State Environmental Laboratory Approval Program evaluations.

Over all, analytical data reported for the *1999 Site Environmental Report* are of high quality.

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