

9. Quality Assurance

Setting:

The overall goal of a well-designed and well-implemented sampling and analysis program is to measure accurately what is really there. Environmental decisions are made on the assumption that analytical results are, within known limits of accuracy and precision, representative of site conditions. Many sources of error exist that could affect the analytical results. Factors to consider as sources of error include improper sample collection, handling, preservation, and transport; inadequate personnel training; and poor analytical methods, data reporting, and record keeping. A quality assurance (QA) program is designed to minimize these sources of error and to control all phases of the monitoring process.

Update:

The QA scores for the ORR analytical laboratories, as determined by 10 external QA programs, averaged 96.6% accuracy for 2403 samples tested in 1998 compared to 95.0% for 2253 samples in 1997.

9.1 INTRODUCTION

The application of a quality assurance/quality control (QA/QC) program for environmental monitoring activities at the ORR is essential to generating data of known and defensible quality. Each aspect of the environmental monitoring program, from sample collection to data management, must address and meet applicable quality standards.

Since 1997, QA/QC results for the three sites have been compiled into a summary that represents the performance of the reservation as a whole. Before 1996, the results were reported separately for each of the three site analytical laboratories. In 1995, the three site service laboratories were combined into a single entity, the Analytical Services Organization. The 1998 results are based on data from the Analytical Services Organization, the ORNL Environmental Sciences Division (ESD), the ORNL Industrial Hygiene Department, and the ETTP Midwest Research Institute, Materials Chemistry Laboratory.

9.2 FIELD SAMPLING QUALITY ASSURANCE

Field sampling QA encompasses many practices that minimize error and evaluate sampling

performance. Some key quality practices include the following:

- use of standard operating procedures (SOPs) for sample collection and analysis;
- use of chain-of-custody and sample-identification procedures;
- instrument standardization, calibration, and verification;
- technician and analyst training;
- sample preservation, handling, and decontamination; and
- use of QC samples such as field and trip blanks, duplicates, and equipment rinses.

Because of changing technologies and regulatory protocols, training of field personnel is a continuing process. To ensure that qualified personnel are available for the array of sampling tasks to be accomplished, training programs by the Environmental Protection Agency (EPA) as well as private contractors have been used to supplement internal training. Examples of topics addressed include the following:

- planning, preparation, and record keeping for field sampling;
- well construction and groundwater sampling;
- surface water, leachate, and sediment sampling;
- soil sampling;
- stack sampling;

- decontamination procedures; and
- health and safety considerations.

9.3 ANALYTICAL QUALITY ASSURANCE

The Lockheed Martin analytical laboratories have well-established QA/QC programs, well-trained and highly qualified staff, and excellent equipment and facilities. Current, approved analytical methodologies employing good laboratory and measurement control practices are used routinely to ensure analytical reliability. The analytical laboratories conduct extensive internal QC programs with a high degree of accuracy, participate in several external QA programs, and use statistics to evaluate and to continuously improve performance. Thus, QA and QC are daily responsibilities of all employees.

9.3.1 Internal Quality Control

Analytical activities are supported by the use of standard materials or reference materials (e.g., materials of known composition that are used in the calibration of instruments, methods standardization, spike additions for recovery tests, and other practices). Certified standards from the National Institute of Standards and Technology (NIST), EPA, or other DOE laboratories are used for such work. The laboratories operate under specific QA/QC criteria at each installation. Additionally, separate QA/QC documents relating to analysis of environmental samples associated with regulatory requirements are developed.

QA/QC measurement control programs external to the sample analysis groups have single-blind control samples submitted to the analytical laboratories to monitor performance. The results of such periodic measurement programs are statistically evaluated and reported to the laboratories and their customers. Most reports are issued quarterly, and some laboratories compile annual summary reports. These reports assist in evaluating the adequacy of analytical support programs and procedures. If serious deviations are noted by the QC groups, the operating laboratories are promptly notified so that corrective actions can be initiated and problems can be resolved. QC

data are stored in an easily retrievable manner so that they can be related to the analytical results they support.

9.3.2 External Quality Assurance

In addition to the internal programs, all Lockheed Martin analytical laboratories are directed by DOE and are expected by EPA to participate in external QA programs. The QA programs generate data that are readily recognizable as objective packets of results. The external QA programs typically consist of the Lockheed Martin laboratories analyzing a sample of unknown composition provided by various QA organizations. The organizations know the true composition of the sample and provide the Lockheed Martin laboratories with a data report on their analytical performance. The sources of these programs are laboratories in EPA, DOE, and the commercial sector. Lockheed Martin participates in ten such programs (Table 9.1). The following sections describe the external QA programs in which Lockheed Martin participates.

9.3.2.1 EPA Contract Laboratory Program

The Contract Laboratory Program (CLP) is an EPA-administered QA element used to evaluate laboratory analytical proficiency in comparison with an analyte and the current state of work. The program operates from the EPA Contract Laboratory Analytical Services Support office at Alexandria, Virginia, in cooperation with the EPA regional offices. This program evaluates laboratories for the determination of organic and inorganic contaminants in aqueous and solid hazardous waste materials and enforces stringent QA/QC requirements to ensure comparable data. This program scores on additional criteria other than an “acceptable-unacceptable” evaluation of the measurement result. By the CLP scoring algorithm, performance of 75% or better indicates acceptable performance. Values below this score indicate that deficiencies exist and that the participant has failed to demonstrate the capability to meet the contract requirements.

Table 9.1. QA/QC results for the Oak Ridge Reservation, 1998

Program	Total number of analytes	Acceptable	
		Total	Percentage
EPA Contract Laboratory Program (CLP) ^{a,b}			94.07
EPA Water Supply Laboratory Performance Quality Control Program (Water Supply)	273	262	95.97
EPA Water Pollution Performance Evaluation Quality Control Program (Water Pollution) ^c and Discharge Monitoring Quality Assurance Study ^c	278	275	98.92
AIHA Proficiency Analytical Testing Program ^d	248	247	99.60
EPA National Exposure Research Laboratory Intercomparison Radionuclide Control Program	80	70	87.50
AIHA Environmental Lead Proficiency Analytical Testing Program (ELPAT)	48	48	100
DOE Mixed Analyte Performance Evaluation Program (MAPEP)	132	131	99.24
DOE Environmental Measurements Laboratory (EML) Quality Assessment Program	131	126	96.18
Proficiency Environmental Testing Program (PET)	1251	1229	98.24

^aThe CLP scores its results on other factors besides quantitation. An average score was determined by averaging each site's average score from the CLP.

^bNot all data available.

^cIncludes toxicology data from the ORNL Environmental Sciences Division in addition to the Analytical Services Organization.

^dIncludes organics and asbestos data from the ORNL Industrial Hygiene Department, asbestos data from the ETPP, Midwest Research Institute, Materials Chemistry Laboratory, as well as data from the Analytical Services Organization.

9.3.2.2 EPA Water Supply Laboratory Performance Quality Control Program

This program is administered by EPA and is used by the state of Tennessee to certify laboratories for drinking water analysis. To maintain a certification, a laboratory must meet a specified set of criteria relating to technical personnel, equipment, work areas, QA/QC operating procedures, and successful analysis of QA samples. In addition, inclusion on the state of Tennessee's underground storage tank (UST) approved listing may be granted as a result of successful participation in this program. This program is also used by other states as part of their certification programs.

9.3.2.3 Combined EPA Water Pollution Performance Evaluation Quality Control Program and EPA Discharge Monitoring Report Quality Assurance Study

During 1996, the EPA Water Pollution Performance Evaluation Quality Control Program was combined with the EPA Discharge Monitoring Report Quality Assurance Study, although they are two separate and distinct programs.

The Water Pollution Performance Evaluation Quality Control Program is used by EPA to evaluate laboratories engaged in analysis of polluted water samples. It is administered by the EPA laboratory in Cincinnati, Ohio, (Region 5) and is

used by some states as part of their laboratory certification process.

EPA conducts the national Discharge Monitoring Report Quality Assurance Study in support of the National Pollutant Discharge Elimination System (NPDES) permits. Use of the program is mandatory for major permit holders. EPA supplies the QA samples and furnishes the evaluated results to the permittee, who is required to report the results and any necessary corrective actions to the state or regional coordinator.

9.3.2.4 American Industrial Hygiene Association Proficiency Analytical Testing Program

The American Industrial Hygiene Association (AIHA) administers the Proficiency Analytical Testing Program as part of its AIHA accreditation process for laboratories performing analyses of industrial hygiene air samples.

9.3.2.5 EPA Intercomparison Radionuclide Control Program

The EPA Intercomparison Radionuclide Control Program is administered by the National Exposure Research Laboratory at Las Vegas (NERL-LV). Samples are composed of a water matrix. The state of Tennessee requires participation for drinking water certification of radionuclide analysis. This program is also used by other states as part of their laboratory certification process. The NERL-LV program calculates a normalized standard deviation for each laboratory based on all reported results. By its criteria, any reported value above three standard deviations is considered unacceptable.

9.3.2.6 AIHA Environmental Lead Proficiency Analytical Testing Program

The Environmental Lead Proficiency Analytical Testing Program (ELPAT) is administered by AIHA. It was established by AIHA in 1992 to evaluate analysis of environmental lead samples in different matrices. The matrices evaluated are paint, soil, and dust wipes. The participating

laboratory can analyze each matrix at four levels. In addition, a laboratory may request to become accredited for lead analysis in this program.

9.3.2.7 DOE Mixed Analyte Performance Evaluation Program

The Mixed Analyte Performance Evaluation Program (MAPEP) is a program set up by the DOE Radiological and Environmental Sciences Laboratory in conjunction with the Laboratory Management Division of the Office of Technology Development to evaluate analysis of mixed-waste samples. MAPEP is evaluated by Argonne National Laboratory. Participation is required by DOE for laboratories that perform environmental analytical measurements in support of Environmental Management (EM) activities.

9.3.2.8 DOE Environmental Measurements Laboratory Quality Assessment Program

Participation in the radionuclide Quality Assessment Program, administered by the DOE Environmental Measurements Laboratory (EML) in New York, is required by a DOE memorandum. Various matrices, such as soil, water, air filters, and vegetation, are submitted semiannually for analysis of a variety of radioactive isotopes. All matrices, except air filters, are actual materials obtained from the environment at a DOE facility. A statistical report is submitted to the sites by EML for each study.

9.3.2.9 Proficiency Environmental Testing Program

The Proficiency Environmental Testing Program is a service purchased from an outside vendor and is used by the Lockheed Martin analytical laboratory to meet the need for a QA program for environmental analyses. The samples are supplied by the commercial company at two concentration levels (high and low). All data from the laboratory are reported to the supplier. The commercial supplier provides a report on the evaluated data to the laboratory. The report includes a percentage recovery of the referenced

value, deviation from the mean of all reported data, specific problems in a laboratory, and other statistical information.

9.3.3 Quality Assessment Program for Subcontracted Laboratories

A buy/make assessment has been established for each project that requires analytical work. Based on the results of this assessment, work is managed in-house or is placed with a subcontracted laboratory through the DOE Sample Management Office (SMO). A competitive award system has been established to place analytical work. The SMO provides single-source sample management for the reservation by supporting Bechtel Jacobs Company LLC and Lockheed Martin Energy Systems. The SMO anticipates placing work with 13 commercial laboratories on a yearly basis. Laboratories approved by the SMO are required to comply with the requirements set forth in the Analytical Support Agreement terms and conditions. Oversight of subcontracted commercial laboratories is performed by DOE, which is supported by the SMO. DOE, SMO, and subcontractors conduct on-site laboratory reviews and monitor the performance of all subcontracted laboratories.

Bechtel Jacobs Company LLC manages the Integrated Performance Indicator Program (IPIP) to report quality indicators that will assess trends for the commercial and Government-Owned Contractor-Operated (GOCO) analytical laboratories used to support the DOE ORO programs. The objective of the IPIP is to evaluate all analytical laboratories based upon a set of standardized performance criteria that can then be quantitatively tracked and trended. The Bechtel Jacobs Company management uses performance summary reports generated by this system to monitor and evaluate laboratories utilized by the Oak Ridge SMO. These reports are issued quarterly and highlight areas of good performance and areas that need improvement, and can serve as a basis for assessing penalties for poor performance.

9.3.3.1 IPIP Work Performance Indicators

Laboratories approved to participate in the Analytical Support Agreement are evaluated on their ability to perform in several different performance areas. The Work Performance indicators consist of the following: holding times, turn-around times, sample disposition, and contract compliance verification. Each of these areas are scored, and the work performance average is tracked to show the progress of each laboratory. A laboratory must maintain a score of $\geq 80\%$ to remain in good standing. A score of 64–79% would result in a laboratory being placed on probation.

9.3.3.2 Single Blind PE Program

If applicable, laboratories must participate in several external Single Blind Performance Evaluation (PE) Programs required by the Analytical Support Agreement. All results that are officially reported by the responsible agency (EPA or DOE) during the period of evaluation are used in computing the Single Blind PE score. Single Blind PE Program results are categorized into radiochemistry, organic, and inorganic methodology areas.

9.3.3.3 Double Blind PE Program

Bechtel Jacobs Company LLC manages a double blind PE program to quantitatively evaluate the total laboratory process. Laboratories receive PE samples from the Bechtel Jacobs Company LLC PE Sample Laboratory. Performance samples are unknown to the laboratory receiving them, and are placed within a set of samples going to that laboratory. Once the project data have been received, the PE results are evaluated and scored. Double blind PE program results are categorized into radiological, organic and inorganic methodology areas.

Single and double blind PE scores are combined to result in total IPIP PE score. A laboratory must score $\geq 80\%$ to remain in good standing. A score of 64–79% would result in a laboratory being placed on probation.

9.3.3.3 Audit Findings

Audit findings are categorized as Priority I, II, and III findings. Only Priority I and II findings are electronically tracked through closure and are used in determining the IPIP results for the percent of audit findings closed. DOE is responsible for tracking the closure of audit findings and transmitting the metrics to Bechtel Jacobs Company LLC. Each laboratory must close out at least 70% of their audit findings on time to remain in good standing. If a laboratory has >30% but <51% of their findings still open after their scheduled closure date, that laboratory will be placed on probation.

9.4 DATA MANAGEMENT, VERIFICATION, AND VALIDATION

Verification and validation of environmental data are performed as components of the data collection process, which includes planning, sampling, analysis, and data review. Verification and validation of field and analytical data collected for environmental monitoring and restoration programs are necessary to ensure that data conform with applicable regulatory and contractual requirements. Validation of field and analytical data is a technical review performed to compare data with established quality criteria to ensure that data are adequate for the intended use. The extent of project data verification and validation activities is based on project-specific requirements.

Over the years, the environmental data verification and data validation processes used by ORR environmental programs have evolved to meet continuing regulatory changes and monitoring objectives. For routine environmental effluent monitoring and surveillance monitoring, data verification activities may include processes of checking whether (1) data have been accurately transcribed and recorded, (2) appropriate procedures have been followed, (3) electronic and hard-copy data show one-to-one correspondence, and (4) data are consistent with expected trends. For example, the requirements for self-monitoring of surface-water and wastewater effluents under

the terms of an NPDES permit require the permittee to conduct the analyses as defined in 40 CFR 136 and to certify that the data reported in the monthly discharge monitoring report are true and accurate.

Typically, routine data verification actions alone are sufficient to document the truthfulness and accuracy of the discharge monitoring report. For restoration projects, routine verification activities are more contractually oriented and include checks for data completeness, consistency, and compliance against a predetermined standard or contract.

Certain projects may perform a more thorough technical validation of the data as mandated by the project's data quality objectives. For example, sampling and analyses conducted as part of a remedial investigation to support the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process may generate data that are needed to evaluate risk to human health and the environment, to document that no further remediation is necessary, or to support a multimillion-dollar construction activity and treatment alternative. In that case, the data quality objectives of the project may mandate a more thorough technical evaluation of the data against predetermined criteria. For example, EPA has established functional guidelines for validation of organic and inorganic data collected under the protocol of the EPA's CLP. These guidelines are used to offer assistance to the data user in evaluating and interpreting the data generated from monitoring activities that require CLP performance.

The validation process may result in identifying data that do not meet predetermined QC criteria (in flagging quantitative data that must be considered qualitative only) or in the ultimate rejection of data from its intended use. Typical criteria evaluated in the validation of CLP data include the percentage of surrogate recoveries, spike recoveries, method blanks, instrument tuning, instrument calibration, continuing calibration verifications, internal standard response, comparison of duplicate samples, and sample holding times.

Integration of compliance-monitoring data for the ORR with sampling and analysis results from remedial investigations is a function of the Oak Ridge Environmental Information System

(OREIS). OREIS is necessary to fulfill requirements prescribed in both the Federal Facility Agreement (FFA) and the Tennessee Oversight Agreement (TOA) and to support data management activities for DOE. The FFA, a tripartite agreement between DOE, EPA Region 4, and the state of Tennessee, requires DOE to maintain one consolidated database for environmental data generated at DOE facilities on the ORR. According to the FFA, the consolidated database is to include data generated pursuant to the FFA as well as data generated under federal and state environmental permits. The TOA further defines

DOE staff obligations to develop a quality assured, consolidated database of monitoring information that will be shared electronically on a near-real-time basis with the state staff.

OREIS is the primary component of the data management program for restoration projects, providing consolidated, consistent, and well-documented environmental data and data products to support planning, decision making, and reporting activities. OREIS provides a direct electronic link of ORR monitoring and remedial investigation results to EPA Region 4 and TDEC/DOE-ORO.