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INTERIM GUIDELINES AND SPECIFICATIONS FOR PREPARING QUALITY ASSURANCE PROJECT PLANS

QAMS-005/80

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ABSTRACT

The Agency-wide quality assurance policy stipulates that every monitoring and measurement project must have a written and approved Quality Assurance (QA) Project Plan. A QA Project Plan is a written document, which presents, in specific terms, the policies, organization (where applicable), objectives, functional activities, and specific QA and quality control (QC) activities designed to achieve the data quality goals of a specific project(s) or continuing operation(s). The QA Project Plan is required for each specific project or continuing operation (or group of similar projects or continuing operations). The QA Project Plan will be prepared by the responsible Program Office, Regional Office, Laboratory, contractor, grantee, or other organization.

This document describes the sixteen elements which must be considered for inclusion in all Quality Assurance Project Plans, and establishes criteria for plan preparation, review and approval. All QA Project Plans must describe procedures which will be used to document and report precision, accuracy and completeness of environmental measurements.

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1.0 INTRODUCTION

Environmental Protection Agency (EPA) policy requires participation by all EPA regional offices, program offices, EPA laboratories and States in a centrally-managed quality assurance (QA) program as stated in the Administrator's Memorandum of May 30, 1979. This requirement applies to all environmental monitoring and measurement efforts mandated or supported by EPA through regulations, grants, contracts, or other formalized means not currently covered by regulation. The responsibility for developing, coordinating and directing the implementation of this program has been delegated to the Office of Research and Development (ORD), which has established the Quality Assurance Management Staff (QAMS) for this purpose.

Each office or laboratory generating data has the responsibility to implement minimum procedures which assure that precision, accuracy, completeness, and representativeness of its data are known and documented. In addition, an organization should specify the quality levels which data must meet in order to be acceptable. To ensure that this responsibility is met uniformly across the Agency, each EPA Office or Laboratory must have a written QA Project Plan covering each monitoring or measurement activity within its purview.

2.0 DEFINITION, PURPOSE AND SCOPE

2.1 Definition

QA Project Plans are written documents, one for each specific project or continuing operation (or group of similar projects or continuing operations), to be prepared by the responsible Program Office, Regional Office, Laboratory, Contractor, Grantee, or other organization. The QA Project Plan presents, in specific terms, the policies, organization, objectives, functional activities, and specific QA and quality control (QC) activities designed to achieve the data quality goals of the specific project(s) or continuing operation(s). Other terms useful in understanding this document are defined in Appendix A.

2.2 Purpose

This document (1) presents guidelines and specifications that describe the 16 essential elements of a QA Project Plan, (2) recommends the format to be followed, and (3) specifies how plans will be reviewed and approved.

2.3 Scope

The mandatory QA program covers all environmentally-related measurements. Environmentally-related measurements are defined as all field and laboratory investigations that generate data. These include (1) the measurement of chemical, physical, or biological parameters in

the environment, (2) the determination of the presence or absence of pollutants in waste streams, (3) assessment of health and ecological effect studies, (4) conduct of clinical and epidemiological investigations, (5) performance of engineering and process evaluations, (6) study of laboratory simulation of environmental events, and (7) study or measurement on pollutant transport and fate, including diffusion models. Each project within these activities must have a written and approved QA Project Plan.

3.0 PLAN PREPARATION AND RESPONSIBILITIES

3.1 Document Control

All Quality Assurance Project Plans must be prepared using a document control format consisting of information placed in the upper right-hand corner of each document page:

- Section Number
- Revision Number
- Date (of revision)
- Page

3.2 Elements of QA Project Plan

Each of the sixteen items listed below must be considered for inclusion in each QA Project Plan:

(1) Title page with provision for approval signatures

(2) Table of contents

(3) Project description

(4) Project organization and responsibility

(5) QA objectives for measurement data in terms of precision, accuracy, completeness, representativeness and comparability

(6) Sampling procedures

(7) Sample custody

(8) Calibration procedures and frequency

(9) Analytical procedures

(10) Data reduction, validation and reporting

(11) Internal quality control checks and frequency

(12) Performance and system audits and frequency

(13) Preventive maintenance procedures and schedules

(14) Specific routine procedures to be used to assess data precision, accuracy and completeness of specific measurement parameters involved

(15) Corrective action

(16) Quality assurance reports to management

It is Agency policy that precision and accuracy of data shall be assessed on all monitoring and measurement projects. Therefore, Item 14 must be described in all Quality Assurance Project Plans.

3.3 Responsibilities

Intramural Projects - Each Project Officer working in close coordination with the QA Officer is responsible for the preparation of a written QA Project Plan for each intramural project that involves environmental measurements. This written plan must be separate from any general plan normally prepared for the project (see caveat presented in Section 6). The Project Officer and the QA Officer must ensure that each intramural project plan contains procedures to document and report precision, accuracy and completeness of all data generated.

Extramural Projects - Each Project Officer working in close coordination with the QA Officer has the responsibility to see that a written QA Project Plan is prepared by the extramural organization for each project involving environmental measurements. The elements of the QA Project Plan must be separately identified from any general plan normally prepared for the project (see caveat presented in Section 6). The Project Officer and the QA Officer must ensure that each extramural project plan contains procedures to document and report precision, accuracy and completeness of all data generated.

4.0 PLAN REVIEW, APPROVAL AND DISTRIBUTION

Intramural Projects - Each QA Project Plan must be approved by the Project officer's immediate supervisor and the QA Officer. Completion of reviews and approvals is shown by signatures on the title page of the plan. Environmental measurements may not be initiated until the QA Project Plan has received the necessary approvals, unless emergency response is necessary. A copy of the approved QA Project Plan will be distributed by the Project Officer to each person who has a major responsibility for the quality of measurement data.

Extramural Projects - Each QA Project Plan must be approved by the funding organization's Project Officer and the QA Officer. In addition, the extramural organization's Project Manager and responsible QA official must review and approve the QA Project Plan. Completion of reviews and approvals is shown by signatures on the title page of the plan. Environmental measurements may not be initiated until the QA Project Plan has received the necessary approvals. A copy of the approved QA Project Plan will be distributed by the extramural organization's Project Director to each person who has a major responsiblity for the quality of the measurement data.

5.0 PLAN CONTENT REQUIREMENTS

The sixteen (16) essential elements described in this section must be considered and addressed in each QA Project Plan. If a particular element is not relevant to the project under consideration, a brief explanation of why the element is not relevant must be included. EPA-approved reference, equivalent or alternative methods must be used and their corresponding Agency-approved guidelines must be applied wherever they are available and applicable.

It is Agency policy that precision and accuracy of data shall be assessed routinely and reported on all environmental monitoring and measurement data. Therefore, specific procedures to assess precision and accuracy on a routine basis during the project must be described in each QA Project Plan. Procedures to assess data quality are being developed by QAMS and the Environmental Monitoring Systems Support Laboratories. Additional guidance can be obtained from QA handbooks for air, water biological, and radiation measurements (References 1, 2, 3, 12, 17, and 18).

The following subsections provide specific guidance pertinent to each of the 16 components which must be considered for inclusion in every QA Project Plan.

5.1 Title page

At the bottom of the title page, provisions must be made for the signatures of approving personnel. As a minimum, the QA Project Plan must be approved by the following:

A. For intramural projects
   1. Project Officer's immediate supervisor
   2. QA Officer

B. For extramural projects
   1. Organization's Project Manager
   2. Organization's responsible QA Official
   3. Funding organization's Project Officer
   4. Funding organization's QA Officer

5.2 Table of Contents

The QA Project Plan Table of Contents will address each of the following items:

- Introduction.
- A serial listing of each of the 16 quality assurance project plan components.
- A listing of any appendices which are required to augment the Quality Assurance Project Plan as presented (i.e., standard operating procedures, etc.).

At the end of the Table of Contents, list the QAO and all other individuals receiving official copies of the QA Project Plan and any subsequent revisions.

5.3 Project Description

Provide a general description of the project, including the experimental design. This description may be brief but must have sufficient detail to allow those individuals responsible for review and approval of the QA Project Plan to perform their task. Where appropriate, include the following:

- Flow diagrams, tables and charts.
- Dates anticipated for start and completion.
- Intended end use of acquired data.

5.4 Project Organization and Responsibility

Include a table or chart showing the project organization and line authority. List the key individuals, including the QAO, who are responsible for ensuring the collection of valid measurement data and the routine assessment of measurement systems for precision and accuracy.

5.5 QA Objectives for Measurement Data in Terms of Precision, Accuracy, Completeness, Representativeness, and Comparability

For each major measurement parameter, including all pollutant measurement systems, list the QA objectives for precision, accuracy and completeness. These QA objectives will be summarized in a table. (See Table 1 for example of format.)

All measurements must be made so that results are representative of the media (air, water, biota, etc.) and conditions being measured. Unless otherwise specified, all data must be calculated and reported in units consistent with other organizations reporting similar data to allow comparability of data bases among organizations. Definitions for precision, accuracy and completeness are provided in Appendix A.

Data quality objectives for accuracy and precision established for each measurement parameter will be based on prior knowledge of the measurement system employed and method validation studies using replicates, spikes, standards, calibrations, recovery studies, etc, and the requirements of the specific project.

5.6 Sampling Procedures

For each major measurement parameter(s), including all pollutant measurement systems, provide a description of the sampling procedures to be used. Where applicable, include the following:

Table 1

EXAMPLE OF FORMAT TO SUMMARIZE PRECISION, ACCURACY AND COMPLETENESS OBJECTIVES

Measurement Parameter (Method)	Reference	Experimental Conditions	Precision, Std. Dev.	Accuracy	Completeness
NO_2 (Chemiluminescent)	EPA 650/4-75-011 February 1975	Atmospheric samples spiked with NO_2 as needed	<±10%	±5%	90%
SO_2 (24 hr) (Pararosaniline)	EPA 650/4-74-027 December 1973	Synthetic atmosphere	<±20%	±15%	90%
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

- Description of techniques or guidelines used to select sampling sites.
- Inclusion of specific sampling procedures to be used (by reference in the case of standard procedures and by actual description of the entire procedure in the case of nonstandard procedures).
- Charts, flow diagrams or tables delineating sampling program operations.
- A description of containers, procedures, reagents, etc., used for sample collection, preservation, transport, and storage.
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination (e.g., containers for organics should be solvent-rinsed; containers for trace metals should be acid-rinsed).
- Sample preservation methods and holding times.
- Time considerations for shipping samples promptly to the laboratory.
- Sample custody or chain-of-custody procedures (to be described later in this document).
- Forms, notebooks and procedures to be used to record sample history, sampling conditions and analyses to be performed.

5.7 Sample Custody

Sample custody is a part of any good laboratory or field operation. Where samples may be needed for legal purposes, "chain-of-custody" procedures, as defined by the Office of Enforcement, will be used. However, as a minimum, the following sample custody procedures will be addressed in the QA Project Plans:

A. Field Sampling Operations:

- Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters, and absorbing reagents).

- Procedures and forms for recording the exact location and specific considerations associated with sample acquisition.

- Documentation of specific sample preservation method.

- Pre-prepared sample labels containing all information necessary for effective sample tracking. Figure 1 illustrates a typical sample label applicable to this purpose.

- Standardized field tracking reporting forms to establish sample custody in the field prior to shipment. Figure 2 presents a typical sample of a field tracking report form.

B. Laboratory Operations:

- Identification of responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment (e.g., bill of lading number or mail receipt), and verify the data entered onto the sample custody records.

- Provision for a laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets. A typical sample of a standardized lab-tracking report form is shown in Figure 3.

(NAME OF SAMPLING ORGANIZATION)

SAMPLE DESCRIPTION _____

_____

PLANT: _____ LOCATION: _____

DATE: _____ _____

TIME: _____ _____

MEDIA: _____ STATION: _____

SAMPLE TYPE: _____ PRESERVATIVE: _____

SAMPLED BY: _____

SAMPLE ID NO.: _____ - _____ - _____ - _____

LAB NO. _____

REMARKS

Figure 1. Example of General Sample Label

W/O No. _____ Page____

FIELD TRACKING REPORT: _____-_____
(LOC-SN)

FIELD SAMPLE CODE (FSC)	BRIEF DESCRIPTION	DATE	TIME(s)	SAMPLER

Figure 2. Sample of Field Tracking Report Form

W/O No. _____ Page____

LAB TRACKING REPORT: ____ - ____ - ____
(LOC-SN-FSC)

FRACTION CODE	X	PREP/ANAL REQUIRED	RESPONSIBLE INDIVIDUAL	DATE DELIVERED	DATE COMPLETED

Figure 3. Sample of Lab-Tracking Report Form

- Specification of laboratory sample custody procedures for sample handling, storage and dispersement for analysis.

Additional guidelines useful in establishing a sample custody procedure are given in Section 2.0.6 of Reference 2, and Section 3.0.3 of Reference 3, and References 13 and 14.

5.8 Calibration Procedures and Frequency

Include calibration procedures and information:

- For each major measurement parameter, including all pollutant measurement systems, reference the applicable standard operating procedure (SOP) or provide a written description of the calibration procedure(s) to be used.
- List the frequency planned for recalibration.
- List the calibration standards to be used and their sources(s), including traceability procedures.

5.9 Analytical Procedures

For each measurement parameter, including all pollutant measurement systems, reference the applicable standard operating procedure (SOP) or provide a written description of the analytical procedure(s) to be used. Officially approved EPA procedures will be used when available. For convenience in preparing the QA Project Plan, Elements 6, 8 and 9 may be combined (e.g., Sections 5.6, 5.8 and 5.9).

5.10 Data Reduction, Validation and Reporting - For each major measurement parameter, including all pollutant measurement systems, briefly describe the following:

- The data reduction scheme planned on collected data, including all equations used to calculate the concentration or value of the measured parameter and reporting units.
- The principal criteria that will be used to validate data integrity during collection and reporting of data.
- The methods used to identify and treat outliers.
- The data flow or reporting scheme from collection of raw data through storage of validated concentrations. A flowchart will usually be needed.
- Key individuals who will handle the data in this reporting scheme (if this has already been described under project organization and responsibilities, it need not be repeated here).

5.11 Internal Quality Control Checks

Describe and/or reference all specific internal quality control ("internal" refers to both laboratory and field activities) methods to be followed. Examples of items to be considered include:

- Replicates
- Spiked samples
- Split samples
- Control charts

- Blanks
- Internal standards
- Zero and span gases
- Quality control samples
- Surrogate samples
- Calibration standards and devices
- Reagent checks

Additional information and specific guidance can be found in References 17 and 18.

5.12 Performance and System Audits

Each project plan must describe the internal and external performance and systems audits which will be required to monitor the capability and performance of the total measurement system(s).

The systems audit consists of evaluation of all components of the measurement systems to determine their proper selection and use. This audit includes a careful evaluation of both field and laboratory quality control procedures. Systems audits are normally performed prior to or shortly after systems are operational; however, such audits should be performed on a regularly scheduled basis during the lifetime of the project or continuing operation. The on-site systems

audit may be a requirement for formal laboratory certification programs such as laboratories analyzing public drinking water systems. Specific references pertinent to systems audits for formal laboratory certification programs can be found in References 19 and 20.

After systems are operational and generating data, performance audits are conducted periodically to determine the accuracy of the total measurement system(s) or component parts thereof. The plan should include a schedule for conducting performance audits for each measurement parameter, including a performance audit for all measurement systems. As part of the performance audit process, laboratories may be required to participate in analysis of performance evaluation samples related to specific projects. Project plans should also indicate, where applicable, scheduled participation in all other inter-laboratory performance evaluation studies.

In support of performance audits, the Environmental Monitoring Systems/Support Laboratories provide necessary audit materials and devices and technical assistance. Also, these laboratories conduct regularly scheduled inter-laboratory performance tests and provide guidance and assistance in the conduct of systems audits. To make arrangements for assistance in the above areas, these laboratories should be contacted directly:

Environmental Monitoring Systems Laboratory
Research Triangle Park, NC 27711
Attention: Dr. Thomas R. Hauser, Director

Environmental Monitoring and Support Laboratory
26 W. St. Clair Street
Cincinnati, OH 45268
Attention: Mr. Robert L. Booth, Director

Environmental Monitoring Systems Laboratory
P.O. Box 15027
Las Vegas, NV 89114
Attention: Mr. Glen Schwitzer, Director

5.13 Preventive Maintenance

The following types of preventive maintenance items should be considered and addressed in the QA Project Plan:

- A schedule of important preventive maintenance tasks that must be carried out to minimize downtime of the measurement systems.
- A list of any critical spare parts that should be on hand to minimize downtime.

5.14 Specific Routine Procedures Used to Assess Data Precision, Accuracy and Completeness

It is Agency policy that precision and accuracy of data must be routinely assessed for all environmental monitoring and measurement data. Therefore, specific procedures to assess precision and accuracy on a routine basis on the project must be described in each QA Project Plan.

For each major measurement parameter, including all pollutant measurement systems, the QA Project Plan must describe the routine procedures used to assess the precision, accuracy and completeness of the measurement data. These procedures should include the equations to calculate precision, accuracy and completeness, and the methods used to gather data for the precision and accuracy calculations.

Statistical procedures applicable to environmental projects are found in References 1, 2, 3, 12, 17, and 18. Examples of these procedures include:

- Central tendency and dispersion
  - Arithmetic mean
  - Range
  - Standard deviation
  - Relative standard deviation
  - Pooled standard deviation
  - Geometric mean
- Measures of variability
  - Accuracy
  - Bias
  - Precision; within laboratory and between laboratories
- Significance test
  - u-test
  - t-test
  - F-test
  - Chi-square test

- Confidence limits
- Testing for outliers

Recommended guidelines and procedures to assess data precision, accuracy and completeness are being developed.

5.15 Corrective Action

Corrective action procedures must be described for each project which include the following elements:

- The predetermined limits for data acceptability beyond which corrective action is required.
- Procedures for corrective action.
- For each measurement system, identify the responsible individual for initiating the corrective action and also the individual responsible for approving the corrective action, if necessary.

Corrective actions may also be initiated as a result of other QA activities, including:

(1) Performance audits

(2) Systems audits

(3) Laboratory/interfield comparison studies

(4) QA Program audits conducted by QAMS

A formal corrective action program is more difficult to define for these QA activities in advance and may be defined as the need arises.

5.16 Quality Assurance Reports to Management

QA Project Plans should provide a mechanism for periodic reporting to management on the performance of measurement systems and data quality. As a minimum, these reports should include:

- Periodic assessment of measurement data accuracy, precision and completeness.
- Results of performance audits.
- Results of system audits.
- Significant QA problems and recommended solutions.

The individual(s) responsible for preparing the periodic reports should be identified. The final report for each project must include a separate QA section which summarizes data quality information contained in the periodic reports.

6.0 QUALITY ASSURANCE PROJECT PLANS VERSUS PROJECT WORK PLANS

This document provides guidance for the preparation of QA Project Plans and describes 16 components which must be included. Historically, most project managers have routinely included the majority of these 16 elements in their project work plans. In practice, it is frequently difficult to separate important quality assurance and quality control functions and to isolate these functions from technical performance activities. For those projects where this is the case, it is not deemed necessary to replicate the narrative in the Quality Assurance Project Plan section.

In instances where specific QA/QC protocols are addressed as an integral part of the technical work plan, it is only necessary to cite the page number and location in the work plan in the specific subsection designated for this purpose.

It must be stressed, however, that whenever this approach is used a "QA Project Plan locator page" must be inserted into the project work plan immediately following the table of contents. This locator page must list each of the items required for the QA Project Plan and state the section and pages in the project plan where the item is described. If a QA Project Plan item is not applicable to the work plan in question, the words "not applicable" should be inserted next to the appropriate component on the locator page and the reason why this component is not applicable should be briefly stated in the appropriate subsection in the QA Project Plan proper.

7.0 STANDARD OPERATING PROCEDURES

A large number of laboratory and field operations can be standardized and written as Standard Operating Procedures (SOP). When such procedures are applicable and available, they may be incorporated into the QA Project Plan by reference.

QA Project Plans should provide for the review of all activities which could directly or indirectly influence data quality and the determination of those operations which must be covered by SOP's. Examples are:

- General network design
- Specific sampling site selection
- Sampling and analytical methodology
- Probes, collection devices, storage containers, and sample additives or preservatives
- Special precautions, such as heat, light, reactivity, combustability, and holding times
- Federal reference, equivalent or alternative test procedures
- Instrumentation selection and use
- Calibration and standardization
- Preventive and remedial maintenance
- Replicate sampling
- Blind and spiked samples

- Colocated samplers
- QC procedures such as intralaboratory and intrafield activities, and interlaboratory and interfield activities
- Documentation
- Sample custody
- Transportation
- Safety
- Data handling procedures
- Service contracts
- Measurement of precision, accuracy, completeness, representativeness, and comparability
- Document control

8.0 SUMMARY

Each intramural and extramural project that involves environmental measurements must have a written and approved QA Project Plan. All 16 items described previously must be considered and addressed. Where an item is not relevant, a brief explanation of why it is not relevant must be included. It is Agency policy that precision and accuracy of data must be routinely assessed and reported on all environmental monitoring and measurement data. Therefore, specific procedures to assess precision and accuracy on a routine basis during the project must be described in each QA Project Plan.

REFERENCES

1. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume I - Principles. EPA-600/9-76-005, March 1976.

2. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II - Ambient Air Specific Methods. EPA-600/4-77-027a, May 1977.

3. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III - Stationary Source Specific Methods. EPA-600/4-77-027b, August 1977.

4. Systems Audit Criteria and Procedures for Ambient Air Monitoring Programs. Currently under development and available from address shown in Reference 1 after July 1, 1980.

5. Techniques to Evaluate Laboratory Capability to Conduct Stack Testing.

6. Performance Audit Procedures for Ambient Air Monitoring Programs. Currently under development.

7. Appendix A - Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS). Federal Register, Vol. 44, No. 92, pp. 27574-81, May 10, 1979.

8. Appendix B - Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring, Federal Register. Vol. 44, No. 92, pp. 27582-84, May 10, 1979.

9. Appendix E - Quality Assurance Requirements for Continuous Emission Monitoring Systems (CEMS). To be submitted as a proposed regulation to amend 40 CFR 60.

10. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. EPA SW-846, 1980.

11. Quality Assurance Guidelines for IERL-CI Project Officers. EPA-600/9-79-046. December 1979.

12. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019, March 1979.

13. NEIC Policies and Procedures Manual. Office of Enforcement, EPA-330-9-78-001, May 1978.

14. NPDES Compliance, Sampling and Inspection Manual. Office of Water Enforcement, Compliance Branch, June 1977.

15. Juran, J. M. (ed), Quality Control Handbook. Second Edition, McGraw Hill, New York, 1962.

16. Juran, J. M. and F. M. Gryna, Quality Planning and Analysis. McGraw Hill, New York, 1970.

17. Handbook for Analytical Quality Control and Radioactivity Analytical Laboratories. EPA-600/7-77-088, August 1977.

18. Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples. EPA-600/1-79-008, January 1979.

19. Procedure for the Evaluation of Environmental Monitoring Laboratories. EPA 600/4-78-017, March 1978.

20. Manual for the Interim Certification of Laboratories Involved in Analyzing Public Drinking Water Supplies - Criteria and Procedures. EPA 600/8-78-008, August 1978.

APPENDIX A

GLOSSARY OF TERMS

AUDIT:

A systematic check to determine the quality of operation of some functon or activity. Audits may be of two basic types: (1) performance audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system, or (2) system audits of a qualitative nature that consist of an on-site review of a laboratory's quality assurance system and physical facilities for sampling, calibration, and measurement.

DATA QUALITY:

The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability. These characteristics are defined as follows:

- Accuracy - the degree of agreement of a measurement (or an average of measurements of the same thing), X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

- Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."

- Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

- Representativeness - expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

- Comparability - expresses the confidence with which one data set can be compared to another.

DATA VALIDATION

A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification, and review.

ENVIRONMENTALLY RELATED MEASUREMENTS:

A term used to describe essentially all field and laboratory investigations that generate data involving (1) the measurement of chemical, physical, or biological parameters in the environment, (2) the determination of the presence or absence of criteria or priority pollutants in waste streams, (3) assessment of health and ecological effect studies, (4) conduct of clinical and epidemiological investigations, (5) performance of engineering and process evaluations, (6) study of laboratory simulation of environmental events, and (7) study or measurement on pollutant transport and fate, including diffusion models.

PERFORMANCE AUDITS:

Procedures used to determine quantitatively the accuracy of the total measurement system or component parts thereof.

QUALITY ASSURANCE:

The total integrated program for assuring the reliability of monitoring and measurement data. A system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

QUALITY ASSURANCE PROGRAM PLAN:

An orderly assemblage of management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.

QUALITY ASSURANCE PROJECT PLAN:

An orderly assembly of detailed and specific procedures which delineates how data of known and accepted quality data is produced for a specific project. (A given agency or laboratory would have only one quality assurance program plan, but would have a quality assurance project plan for each of its projects.)

QUALITY CONTROL:

The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

STANDARD OPERATING PROCEDURE (SOP):

A written document which details an operation, analysis or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.