APPENDICES

APPENDIX A

GLOSSARY*

*The following glossary is taken from the document
EPA Guidance for Quality Assurance Project Plans EPA *QA/G-5*

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria - Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy - A measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to monitoring and analytical operations; the EPA recommends using the terms *{'precision"* and *{'bias",* rather than "accuracy," to convey the information usually associated with accuracy.

Activity - An all-inclusive term describing a specific set of operations of related tasks to be performed, either serially or in parallel (e.g., research and development, field monitoring, analytical operations, equipment fabrication), that, in total, result in a product or service.

Assessment - The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality)- A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) - A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate - The act of establishing an item as genuine, valid, or authoritative.

Bias - The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank - A sample subjected to the usual analysis or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration - A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift - The deviation in instrument response from a reference value over a period of time before recalibration.

Certification - The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of custody - An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Characteristic - Any property or attribute of a datum, item, process, or service that is distinct, describable, and/or measurable.

Check standard - A standard prepared independently of the calibration standards and analyzed exactly like the samples. Check standard results are used to estimate analytical precision and to indicate the presence of bias due to the calibration of the analytical system.

Collocated samples - Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

Comparability - A measure of the confidence with which one data set or method can be compared to another.

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.

Computer program - A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as "software," or it may be stored permanently on computer chips, referred to as "firmware." Computer programs covered in a QAPP are those used for design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Confidence Interval - The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability.

Confidentiality procedure – A procedure used to protect confidential business information (including proprietary data and personnel records) from unauthorized access.

Configuration - The functional, physical, and procedural characteristics of an item, experiment, or document.

Conformance – An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Consensus standard - A standard established by a group representing a cross section of a particular industry or trade, or a part thereof.

Contractor – Any organization or individual contracting to furnish services or items to perform work.

Corrective action - Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Correlation coefficient – A number between –1 and 1 that indicated the degree of linearity between two variables or sets of numbers. The closer to –1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables. The most common correlation coefficient is the product-moment, a measure of the degree of linear relationship between two variables.

Data of known quality - Data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data Quality Assessment (DQA) - The scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA Process include: 1) reviewing the DQOs and monitoring design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Indicators (DQIs) – The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy (bias is preferred), comparability, completeness, representativeness.

Data Quality Objectives (DQOs) – The qualitative and quantitative statements derived from the DQO Process that clarify study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be uses as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objectives (DQO) Process - A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. The key elements of the DQO process include the following:

- state the problem,
- identify the decision,
- identify the inputs to the decision,
- define the boundaries of the study,
- develop a decision rule,
- specify tolerable limits on decision errors, and
- optimize the design for obtaining data.

DQOs are the qualitative and quantitative outputs from the DQO Process.

Data reduction - The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data usability - The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Deficiency An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Demonstrated capability - The capability to meet a procurement's technical and quality specifications through evidence presented by the supplier to substantiate its claims and in a manner defined by the customer.

Design - The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.
Design change - Any revision or alteration of the technical requirements defined by approved and issued design output documents and approved and issued changes thereto.

Design review - A documented evaluation by a team, including personnel such as the responsible designers, the client for whom the work or product is being designed, and a quality assurance (QA) representative but excluding the original designers, to determine if a proposed design will meet the established design criteria and perform as expected when implemented.

Detection Limit (DL) - A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Distribution - 1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; 2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document - Any written 'or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document control - The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Duplicate samples - Two samples taken from and representative of the same population and carried through all steps of the monitoring and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including monitoring and analysis. See also *collocated sample.*

Environmental conditions -The description of a physical medium (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data - Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Environmental data operations - Any work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental monitoring - The process of measuring or collecting environmental data.

Environmental processes - Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs - An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental technology - An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination

to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Estimate A characteristic from the sample from which inferences on parameters can be made.

Evidentiary records - Any records identified as part of litigation and subject to restricted access, custody, use, and disposal.

Expedited change - An abbreviated method of revising a document at the work location where the document is used when the normal change process would cause unnecessary or intolerable delay in the work.

Field blank - A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the monitoring site, exposed to monitoring conditions, returned to the laboratory, and treated as an environmental sample.

Field (matrix) spike - A sample prepared at the monitoring point (i.e., in the field) by adding a known mass of the target analyte to a specified amount of the sample. Field matrix spikes are used, for example, to determine the effect of the sample preservation, shipment, storage, and preparation on analyte recovery efficiency (the analytical bias).

Field split samples - Two or more representative portions taken from the same sample and submitted for analysis to different laboratories to estimate interlaboratory precision.

Financial assistance - The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding - An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Goodness-of-fit test - The application of the chi square distribution in comparing the frequency distribution of a statistic observed in a sample with the expected frequency distribution based on some theoretical model.

Grade - The category or rank given to entities having the same functional use but different requirements for quality.

Graded approach - The process of basing the level of application of managerial controls applied to an item or work according to the intended use of the results and the degree of confidence needed in the quality of the results. (See also *Data Quality Objectives (DQO) Process.*)

Guidance - A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline - A suggested practice that is not mandatory in programs intended to comply with a standard.

Hazardous waste - Any waste material that satisfies the definition of hazardous waste given in 40 CFR 261, "Identification and Listing of Hazardous Waste."

Holding time - The period of time a sample may be stored prior to its required analysis. While exceeding the holding time does not necessarily negate the veracity of analytical results, it causes the qualifying or "flagging" of any data not meeting all of the specified acceptance criteria.

Identification error - The misidentification of an analyte. In this error type, the contaminant of concern is unidentified and the measured concentration is incorrectly assigned to another contaminant.

Independent assessment - An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection - The examination or measurement of an item or activity to verify conformance to specific requirements.

Internal standard - A standard added to a test portion *of* a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias *of* the applied analytical method.

Item - An all-inclusive term used in place of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, product, structure, subassembly, subsystem, system, unit, documented concepts, or data.

Laboratory split samples - Two or more representative portions taken from the same sample and analyzed by different laboratories to estimate the interlaboratory precision or variability and the data comparability.

Limit of quantitation - The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Management - Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system - A structured, non-technical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR) - The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix spike - A sample prepared by adding a known mass of a target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

May - When used in a sentence, a term denoting permission but not a necessity.

Mean (arithmetic) - The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Mean squared error A statistical term for variance added to the square of the bias.

Measurement and Testing Equipment (M&TE) - Tools, gauges, instruments, monitoring devices, or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Memory effects error - The effect that a relatively high concentration sample has on the measurement of a lower concentration sample of the same analyte when the higher concentration sample precedes the lower concentration sample in the same analytical instrument.

Method - A body of procedures and techniques for performing an activity (e.g., monitoring, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank - A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Mid-range check - A standard used to establish whether the middle of a measurement method's calibrated range is still within specifications.

Mixed waste - A hazardous waste material as defined by 40 CFR 261 Resource Conservation and Recovery Act (RCRA) and mixed with radioactive waste subject to the requirements of the Atomic Energy Act.

Must - When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance - A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; non-fulfillment of a specified requirement.

Objective evidence - Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation - An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization - A company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure - The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Outlier - An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter - A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for "variable," "characteristic," or "property".

Peer review - A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. Conducted by qualified individuals (or an organization) who are independent of those who performed the work but collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. An in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Evaluation (PE) - A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention - An organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Population The totality of items or units of material under consideration or study.

Precision - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation.

Procedure - A specified way to perform an activity.

Process - A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project - An organized set of activities within a program.

Qualified data - Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services - An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality - The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) - An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client

Quality Assurance Program Description/Plan - See *quality management plan.*

Quality Assurance Project Plan (QAPP) - A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and *QA/G-5.*

Quality Control (QC) - The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality control (QC) sample - An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement - A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management - That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) - A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system - A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Radioactive waste - Waste material containing, or contaminated by, radionuclides, subject to the requirements of the Atomic Energy Act.

Readiness review - A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Record (quality) - A document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery - The act of determining whether or not the methodology measures all of the analyte contained in a sample.

Remediation - The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil media to a level that poses an acceptable risk to human health.

Repeatability - The degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

Reporting limit - The lowest concentration or amount of the target analyte required to be reported from a data collection project. Reporting limits are generally greater than detection limits and are usually not associated with a probability level.

Representativeness - A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a monitoring point, a process condition, or an environmental condition.

Reproducibility - The precision, usually expressed as variance that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement - A formal statement of a need and the expected manner in which it is to be met.

Research (applied) - A process, the objective of which is to gain the knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

Research (basic) - A process, the objective of which is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

Research development/demonstration - The systematic use of the knowledge and understanding gained from research and directed toward the production of useful materials, devices, systems, or methods, including prototypes and processes.

Round-robin study - A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Ruggedness study - The carefully ordered testing of an analytical method while making slight variations in test conditions (as might be expected in routine use) to determine how such variations affect test results. If a variation affects the results significantly, the method restrictions are tightened to minimize this variability.

Scientific method - The principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis formulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Self-assessment - The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity - the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

Service - The result generated by activities at the interface between the supplier and the customer, and the supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, and installation.

Shall - A term denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should - A term denoting a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition - Any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Software life cycle - The period of time that starts when a software product is conceived and ends when the software product is no longer available for routine use. The software life cycle typically includes a requirement phase, a design phase, an implementation phase, a test phase, an installation and check-out phase, an operation and maintenance phase, and sometimes a retirement phase.

Source reduction - Any practice that reduces the quantity of hazardous substances, contaminants, or pollutants.

Span check - A standard used to establish that a measurement method is not deviating from its calibrated range.

Specification - A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike - A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split samples - Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control CQC) samples that are used to assess analytical variability and comparability.

Standard deviation - A measure of the dispersion or imprecision of a sample or population distribution expressed as the positive square root of the variance and has the same unit of measurement as the mean.

Standard Operating Procedure (SOP) - A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Supplier - Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement An all-inclusive term

used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte - A pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them to establish that the analytical method has been performed properly.

Surveillance (quality) - Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled

Technical review - A documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements have been satisfied.

Technical Systems Audit (TSA) - A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, recordkeeping, data validation, data management, and reporting aspects of a system.

Traceability - The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Trip blank - A clean sample of a matrix that is taken to the monitoring site and transported to the laboratory for analysis without having been exposed to monitoring procedures.

Validation - Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled. In design and development, validation concerns the process of examining a product or result to determine conformance to user needs.

Variance (statistical) - A measure or dispersion of a sample or population distribution. Population variance is the sum of squares of deviation from the mean divided by the population size (number of elements). Sample variance is the sum of squares of deviations from the mean divided by the degrees of freedom (number of observations minus one).

Verification - Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

APPENDIX B

MEASUREMENT QUALITY OBJECTIVES FOR CARBON MONOXIDE

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA-CO			
One Point QC Check Single analyzer	1/ 2 weeks	≤ ±10% (percent difference)	1 - 10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift ≤ ± 2% of full scale Span drift ≤ ± 10 %	
OPERATIONAL CRITERIA-CO			
Shelter Temperature			
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours	
Temperature Device Check	2/year	± 2°C of standard	
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV ≤ 10%	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL ≤ ± 10%	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level ≤ 15%	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference ≤ 15%	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within ± 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1
Zero Air/Zero Air Check	1/year	Concentrations below LDL	

Requirement	Frequency	Acceptance Criteria	Information /Action
Gas Dilution Systems	1/3 months	Accuracy ± 2 %	
Detection			
Noise	NA	0.50 ppm	40 CFR Part 53.20
Lower detectable level	1/year	1.0 ppm	40 CFR Part 53.20
SYSTEMATIC CRITERIA-CO			
Standard Reporting Units	All data	ppm (final units in AQS)	
Completeness (seasonal)	Hourly	75% of hourly averages for the 8-hour period	8-Hour average
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E

APPENDIX C

GASEOUS POLLUTANT MONITORING MEASUREMENT-RELATED QUALITY CONTROL CRITERIA

Gaseous Pollutant Monitoring Program Measurement-Related Quality Control Criteria

Category	Criteria	Parameter	Acceptance Range	Frequency
Critical Criteria	Zero/span check of gas analyzers	O3 SO2 CO	Zero drift =±1% of full scale Span drift =±15% (at 80% of full scale)	2/week
		NOx	Note that SO2,CO, and NOx ranges may be different for specific research applications	
	Precision of gas analyzers	O3 SO2 CO	Precision =± 10% of value	1/ 2 weeks
		NOx	Note that SO2, CO, and NOx ranges may be different for specific research applications	
Operations	Shelter temperature	Range	20° to 30°C (hourly average) or within EPA designation specifications	Hourly values
		Control	=±4°C standard deviation over 24 hours	Daily from hourly values
	Internal performance audit - monitors	Ambient gases	(See QAPP Chapter 14)	Every 6 months at each site
	Independent performance audit monitors	Ambient gases	Same as internal performance audit except as otherwise defined by audit agency	Performed by cooperating state agencies on their schedules. Most NPS sites with ozone levels at or near NAAQS are audited at least 1/year. Some network sites do not receive independent audits.

-- continued -

Gaseous Pollutant Monitoring Program Measurement-Related Quality Control Criteria (continued)

Category	Criteria	Parameter	Acceptance Range	Frequency
Operations (continued)	Calibrations (including acceptance tests of new instruments)	Multipoint calibration of ambient gas analyzers (O3, SO2, CO, and NOx) (0 and 5 upscale points)	QAPP Chapter 16	Once per quarter or as acceptance test of new instrument.
		Data acquisition system		During Calibration or as acceptance test of new instrument
	Primary standards verification and transfer standards certification	Ambient gases	QAPP Chapter 16	1/year or as needed
Systematic Criteria	Data quality objectives	All parameters	QAPP Chapter 16	N/A
	Network performance criteria	All parameters	QAPP Chapter 16	As noted
	Sample probe configuration	All gas analyzers	Teflon inlet tube, ¼" OD. Inlet shielded by rain cover. Savillex filter located at instrument	Filter changed every 2 weeks; Tubing cleaned with methanol, soap and water. Tubing replaced at least every 2 years
	Sample probe	Ambient gases	Between 3 and 15 meters.	N/A

APPENDIX D

CALIBRATION METHODS FOR THE MONITORED PARAMETERS IN THE GASEOUS POLLUTANT MONITORING PROGRAM

Calibration Methods for the Parameters in Gaseous Pollutant Monitoring

Measurement Variable	Calibration Method
Ozone (O3)	Multipoint by UV photometer transfer standard (traceable to a NIST-certified primary standard)
Sulfur Dioxide (SO2)	Multipoint mass flow dilution of EPA Protocol gas
Carbon Monoxide (CO)	Multipoint use of EPA Protocol gas/mass flow dilution
Nitrogen Dioxide (NO2)	Multipoint mass flow dilution of EPA Protocol gas and gas phase titration of ozone and NO for NO2 converter check
DAS Time	Compare with NIST time
Barometric Pressure	Traceable to US Signal Corps Type Barometer

Note: See Appendix C for the acceptance criteria and certification/verification frequencies of all NIST-traceable calibration standards.

APPENDIX E

CALIBRATION ACCEPTANCE CRITERIA IN THE GASEOUS POLLUTANT MONITORING PROGRAM

Calibration Acceptance Criteria in Gaseous Pollutant Monitoring

Parameter	Calibration Method	Criteria	Calibration Acceptance Criteria
Gas Max difference	Gas primary or transfer standard	Max error	= ±5.0% at any designated point
Gas Max difference	Gas primary or transfer standard	Average error	= ±5.0% average of all points
Gas Slope (m)	Gas primary or transfer standard	Actual	0.950 = m = 1.050
Gas Intercept (b)	Gas primary or transfer standard	Actual	= ± 3.0 ppb for O3, NOX and SO2 =± 0.3 ppm for CO
Gas Correlation (r)	Gas primary or transfer standard	Actual	r > 0.9950
Data Acquisition System Time	Compare with NIST time	Max error	= ±5 minutes
Data Acquisition System Voltage	Known voltage inputs	Max error	= ±0.01% VDC
Barometric Pressure	Compare to standard	Max error	= ±10 mmHg

APPENDIX F

TRAINING CERTIFICATION EVALUATION FORMS

Training Certification Evaluation Forms

Training certification evaluation forms will be used by the DEQ to certify that personnel involved in the various aspects of carbon monoxide operations have performed at a satisfactory level. These forms currently are under development and will be added to the QAPP upon completion. An outline of the operational areas for forms development is included in this QAPP.

TRAINING CERTIFICATION EVALUATION FORM

AREAS UNDER DEVELOPMENT

I. Field Monitoring Procedures

A. Premonitoring filter operations

1. Filter preparation

B. Monitor operations

1. Filter sample removal
2. Clean sample removal
3. Data QA and documentation

C. Monitor Calibrations

1. Multipoint calibrations
2. Flow checks
3. Temperature calibrations
4. Barometric pressure calibrations

D. Performance audits

E. Monitor maintenance

1. Preventive maintenance
2. Major maintenance

II. Laboratory Procedures

A. Clean filter preparation

B. Filter weighing

C. Data documentation and QA

APPENDIX G

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURES

The following listing provides an example of the types of standard operating procedures that are currently under development or have been developed for the continuous air monitoring program. All procedures are available for EPA review and approval. These SOPs are available to all personnel as previously identified in this QAPP through VA DEQ's intranet.

Gaseous Instrumentation

- **Thermo 42C NO-NO2-NOx Analyzer**
- **Thermo 42C NO-NO2-NOx Trace Level Analyzer (NOy)**
- **Thermo 42i NO-NO2-NOx Analyzer**
- **Thermo 43C SO2 Analyzer**
- **Thermo 43i SO2 Analyzer**
- **Thermo 48i CO Analyzer**
- **Thermo 49C O3 Analyzer**
- **Thermo 49C Primary Standard Calibrator**

Thermo 49i Primary Standard Calibrator

- **Thermo 146C Calibrator**
- **Thermo iPort Software Manual**

APPENDIX H

DATA QUALIFIERS/FLAGS

DATA QUALIFIERS/FLAGS

A data qualifier consists of one or more alphanumeric characters that indicate that the subject analysis either (a) did not produce a numeric result; (b) produced a numeric result that is qualified in some respect relating to its type or validity; or (c) produced a numeric result that should not be used when determining compliance with national ambient air quality standards (NAAQS). Table H-1 provides a list of qualifiers automatically attached to the raw data by monitoring instrumentation:

Table H-1

Code	Definition
<	Less than % required for valid average
P	Power failure
D	Channel disabled (marked offline)
B	Bad status detected
C	Calibration
M	Maintenance
O	Analog over range
U	Analog under range
+	Maximum exceeded
-	Minimum exceeded
R	Rate of change limit exceeded
H	High-high alarm limit exceeded
L	Low-low alarm limit exceeded
J	High rate of change alarm limit exceeded
J	Low rate of change alarm limit exceeded
F	Floor limit exceeded

Table H-2 provides a list of qualifiers used when reporting raw data in AQS. Qualifier type EX denotes an exceptional event, and type NULL denotes invalid data:

Table H-2

Code	Description	Qualifier Type
A	High winds	EX
B	Stratospheric ozone intrusion	EX
C	Volcanic eruptions	EX
D	Sandblasting	EX
E	Forest fire	EX
F	Structural fire	EX
G	High pollen count	EX
H	Chemical spills and industrial accidents	EX
I	Unusual traffic congestion	EX
J	Construction/demolition	EX
K	Agricultural tilling	EX
L	Highway construction	EX
M	Rerouting of traffic	EX
N	Sanding/salting of streets	EX
O	Infrequent large gatherings	EX
P	Roofing operations	EX
Q	Prescribed burning	EX
R	Clean up after a major disaster	EX
S	Seismic activity	EX
U	Sahara dust	EX
AA	Sample pressure out of limits	NULL
AB	Technician unavailable	NULL
AC	Construction/repairs in area	NULL
AD	Shelter storm damage	NULL
AE	Shelter temperature outside limits	NULL
AF	Scheduled but not collected	NULL
AG	Sample time out of limits	NULL
AH	Sample flow rate out of limits	NULL
AI	Insufficient data (cannot calculate)	NULL
AJ	Filter damage	NULL
AK	Filter leak	NULL
AL	Voided by operator	NULL
AM	Miscellaneous void	NULL
AN	Machine malfunction	NULL
AO	Bad weather	NULL
AP	Vandalism	NULL
AQ	Collection error	NULL
AR	Lab error	NULL

Table H-2		
Code	**Description**	**Qualifier Type**
AS	Poor quality assurance results	NULL
AT	Calibration	NULL
AU	Monitoring waived	NULL
AV	Power failure	NULL
AW	Wildlife damage	NULL
AX	Precision check	NULL
AY	QC Control points (zero/span)	NULL
AZ	QC Audit	NULL
BA	Maintenance/routine repairs	NULL
BB	Unable to reach site	NULL
BC	Multi-point calibration	NULL
BD	Auto calibration	NULL
BE	Building/site repair	NULL
BF	Precision/zero/span	NULL
BG	Missing ozone data not likely to exceed level of standard	NULL
BH	Interference/co-elution	NULL
BI	Lost or damaged in transit	NULL
BJ	Operator error	NULL

EPA will exclude data showing violations of the NAAQS provided the state submit documentation to the EPA regional office showing direct causal relationship between the event and the measured violation. Flags placed on data as being due to an exceptional event, together with an initial description of the event, shall be submitted to EPA not later than July 1st of the calendar year following the year in which the flagged measurement occurred.

Flags may be placed on data for informational purposes only, and data flagged for this purpose do not require the documentation necessary for exclusion.