15.0 Assessment and Corrective Action

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. It is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection and surveillance. For the Ambient Air Quality Monitoring Program, the following assessments will be discussed: network reviews, performance evaluations, technical systems audits and data quality assessments.

15.1 Network Reviews

Beginning July 2007, the State, or where applicable, local monitoring organizations shall adopt and submit to the Regional Administrator an annual monitoring network plan which shall provide for the establishment and maintenance of an air quality surveillance system that consists of a network of SLAMS monitoring stations including FRM, FEM, and ARM monitors that are part of SLAMS, NCore stations, STN stations, State speciation stations, SPM stations, and/or, in serious, severe and extreme ozone nonattainment areas, PAMS stations, and SPM stations. The plan shall include a statement of purposes for each monitor and evidence that siting and operation of each monitor meets the requirements of appendices A, C, D, and E of Part 58, where applicable. The annual monitoring network plan must be made available for public inspection for at least 30 days prior to submission to EPA. The AMTIC Website has a page[1] devoted to the progress and adherence to this requirement. This page contains links to State and local ambient air monitoring plans.

In addition to an annual network plan, starting in 2010, the State, or where applicable local, monitoring organization shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR Part 58, Appendix D, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the monitoring organization itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable, local monitoring organization must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator.

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Part 58, Appendices D and E are determined through annual network reviews of the ambient air quality monitoring system. The annual review of the network is used to determine how well the network is achieving its required monitoring objectives and how it should be modified to continue to meet its objectives. Most network reviews are accomplished by the EPA Regional Office, however, the following information can be useful to State and local organizations to prepare for reviews or assess their networks.

In order to maintain consistency in implementing and collecting information from a network review, EPA has developed SLAMS/PAMS Network Review Guidance. The information presented in this section provides some excerpts from this guidance document.

[1] http://www.epa.gov/ttn/amtic/plans.html

15.1.1 Network Selection

Due to the resource-intensive nature of network reviews, it may be necessary to prioritize monitoring organizations and/or pollutants to be reviewed. The following criteria may be used to select networks:

- date of last review;
- areas where attainment/nonattainment designations are taking place or are likely to take place;
- results of special studies, saturation sampling, point source oriented ambient monitoring, etc.; and
- monitoring organizations which have proposed network modifications since the last network review.

In addition, pollutant-specific priorities may be considered (e.g., newly designated ozone nonattainment areas, PM_{10} "problem areas", etc.). Once the monitoring organizations have been selected for review, significant data and information pertaining to the review should be compiled and evaluated. Such information might include the following:

- network files for the selected monitoring organization (including updated site information and site photographs);
- AQS reports (AMP220, 225, 255, 380, 390, 450);
- air quality summaries for the past five years for the monitors in the network;
- emissions trends reports for major metropolitan areas;
- emission information, such as emission density maps for the region in which the monitor is located and emission maps showing the major sources of emissions; and
- National Weather Service summaries for monitoring network area.

Upon receiving the information, it should be checked to ensure it was the latest revision and for consistency. Discrepancies should be noted on the checklist (Appendix H) and resolved with the monitoring organization during the review. Files and/or photographs that need to be updated should also be identified.

15.1.2 Conformance to 40 CFR Part 58 Appendix D- Network Design Requirements

With regard to 40 CFR Part 58 Appendix D requirements, the network reviewer must determine the adequacy of the network in terms of number and location of monitors: specifically, (1) is the monitoring organization meeting the number of monitors required by the design criteria requirements; and (2) are the monitors properly located, based on the monitoring objectives and spatial scales of representativeness?

Number of Monitors

For SLAMS, the minimum number of monitors required is specified in the regulations for ozone, PM_{10}, $PM_{2.5}$, and PAMS. The other criteria pollutants do not have minimum requirements and is determined by the Regional Office and the monitoring organizations on a case-by-case basis to meet the monitoring objectives specified in Appendix D. Adequacy of the network may be determined by using a variety of tools, including the following:

- maps of historical monitoring data;
- maps of emission densities;
- dispersion modeling;
- special studies/saturation sampling;
- best professional judgment;
- SIP requirements; and
- revised monitoring strategies (e.g., lead strategy, reengineering air monitoring network).

Location of Monitors

For the ozone, PM_{10}, and $PM_{2.5}$ SLAMS sites, Appendix D does provide general locations of sites in regards to NAAQS related concentrations. For other criteria pollutants the location of monitors is not specified in the regulations, but is determined by the Regional Office and State monitoring organizations on a case-by-case basis to meet the monitoring objectives specified in Appendix D. Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information can be extremely helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitor locations are especially useful.

For PAMS, there is considerable flexibility when locating each PAMS within a nonattainment area or transport region. The three fundamental criteria which need to be considered when locating a final PAMS site are: (1) sector analysis - the site needs to be located in the appropriate downwind (or upwind) sector (approximately 45^{o}) using appropriate wind directions; (2) distance - the sites should be located at distances appropriate to obtain a representative sample of the areas precursor emissions and represent the appropriate monitoring scale; and (3) proximate sources.

15.1.3 Conformance to 40 CFR Part 58, Appendix E - Probe Siting Requirements

Applicable siting criteria for SLAMS, and PAMS are specified in 40 CFR Part 58, Appendix E. The on-site visit itself consists of the physical measurements and observations needed to determine compliance with the Appendix E requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc. Prior to the site visit, the reviewer should obtain and review the following:

- most recent hard copy of site description (including any photographs)
- data on the seasons with the greatest potential for high concentrations for specified pollutants
- predominant wind direction by season

The checklist provided in Appendix H of this Handbook is also intended to assist the reviewer in determining conformance with Appendix E. In addition to the items on the checklist, the reviewer should also do the following:

- ensure that the manifold and inlet probes are clean
- estimate probe and manifold inside diameters and lengths
- inspect the shelter for weather leaks, safety, and security
- check equipment for missing parts, frayed cords, etc.
- check that monitor exhausts are not likely to be introduced back to the inlet
- record findings in field notebook and/or checklist
- take photographs/videotape in the 8 directions
- document site conditions, with additional photographs/videotape

15.1.4 Checklists and Other Discussion Topics

Checklists are provided in Appendix H to assist network reviewers (SLAMS and PAMS) in conducting the review. In addition to the items included in the checklists, other subjects for possible discussion as part of the network review and overall adequacy of the monitoring program include:

- installation of new monitors;
- relocation of existing monitors;
- siting criteria problems and suggested solutions;
- problems with data submittals and data completeness;
- maintenance and replacement of existing monitors and related equipment;
- quality assurance problems;
- air quality studies and special monitoring programs; and
- other issues (proposed regulations/funding).

15.1.5 Summary of Findings

Upon completion of the network review, a written network evaluation should be prepared. The evaluation should include any deficiencies identified in the review, corrective actions needed to address the deficiencies, and a schedule for implementing the corrective actions. The kinds of discrepancies/deficiencies to be identified in the evaluation include discrepancies between the monitoring organization network description and the AQS network description; and deficiencies in the number, location, and/or type of monitors.

NPAP through the probe audit

PEP Audit

15.2 Performance Evaluations

Performance evaluations (PEs) are 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 a laboratory[2]. The National Performance Evaluation Programs:

- Allow one to determine data comparability and usability across sites, monitoring networks (Tribes, States, and geographic regions), instruments and laboratories.
- Provide a level of confidence that monitoring systems are operating within an acceptable level of data quality so data users can make decisions with acceptable levels of certainty.
- Help verify the precision and bias estimates performed by monitoring organizations.
- Identify where improvements (technology/training) are needed.
- Assure the public of non-biased assessments of data quality.

[2] American National Standard-Quality Systems for Environmental Data and Technology Programs-Requirements with Guidance for Use (ANSI/ASQC E4-2004)

- Provide a quantitative mechanism to defend the quality of data.
- Provide information to monitoring organizations on how they compare with the rest of the nation, in relation to the acceptance limits and to assist in corrective actions and/or data improvements.

Some type of national PE program is implemented for all of the ambient air monitoring activities. Table 15-1 provides more information on these activities. It is important that these performance evaluations be independent in order to ensure they are non-biased and objective. With the passage of the Data Quality Act[3], there is potential for EPA to receive challenges to the quality of the ambient air data. Independent audits help provide another piece of objective evidence on the quality of a monitoring organizations data and can help EPA defend the quality of the data.

Table 15-1 National Performance Evaluation Activities Performed by EPA

Program/ Lead Agency	Explanation
NPAP OAQPS	National Performance Audit Program provides audit standards for the gaseous pollutants either as devices that the site operator connects to the back of the instrument or through the probe in which case the audits are conducted by presenting audit gases through the probe inlet of ambient air monitoring stations. Flow audit devices and lead strips are also provided through NPAP. NPAP audits are required at 20% of a primary quality assurance organizations sites each year with a goal of auditing all sites in 5-7 years.
$PM_{2.5}$ $PM_{10-2.5}$ PEP OAQPS	Performance Evaluation Program. The strategy is to collocate a portable FRM $PM_{2.5}$ or $PM_{10-2.5}$ air sampling audit instrument with an established primary sampler at a routine air monitoring site, operate both samplers in the same manner, and then compare the results. Each year five PEP audits are required for primary quality assurance organizations (PQAOs) with less than or equal to 5 monitoring sites or eight audits are required for PQAOs with greater than five sites. These audits are not required for PM_{10}
NATTS PT OAQPS	A National Air Toxics Trend Sites (NATTS) proficiency test (PT) is a type of assessment in which a sample, the composition of which is unknown to the analyst, is provided to test whether the analyst/laboratory can produce analytical results within the specified acceptance criteria. PTs for volatile organic carbons (VOCs), carbonyls and metals are performed quarterly for the ~22 NATTS laboratories
SRP ORIA-LV	The Standard Reference Photometer (SRP) Program provides a mechanism to establish traceability among the ozone standards used by monitoring organizations with the National Institute of Standards and Technology (NIST). Every year NIST certifies an EPA SRP. Upon certification, this SRP is shipped to the EPA Regions who use this SRP to certify the SRP that remains stationary in the Regional Lab. These stationary SRPs are then used to certify the ozone transfer standards that are used by the State, Local and Tribal monitoring organizations who bring their transfer standards to the Regional SRP for certification.
PAMS Cylinder Certs ORIA LV	EPA developed a system to certify the standards used by the monitoring organizations to calibrate their PAMS analytical systems. The standards are sent to the EPA Office of Radiation and Indoor Air (ORIA-LV) who perform an independent analysis/certification of the cylinders. This analysis is compared to the vendor concentrations to determine if they are within the contractually required acceptance tolerance.
STN/IMPROVE Round Robins PTs and Audits ORIA-AL	$PM_{2.5}$ Speciation Trends Network (STN) and IMPROVE Round Robins are a type of performance evaluation where the audit samples are developed in ambient air; therefore, the true concentration is unknown. The Office of Indoor Air and Radiation (ORIA) in Montgomery, AL) implement these audits for the STN/IMPROVE programs and for the PEP weighing laboratories. The audit is performed by collecting samples over multiple days and from multiple samplers. These representative samples are then characterized by the ORIA lab and sent to the routine sample laboratories for analysis. Since the true concentrations are unknown, the reported concentrations are reviewed to determine general agreement among the laboratories. In addition ORIA implements technical systems audits of IMPROVE and STN laboratories
Protocol Gas OAQPS	EPA Protocol Gases are used in quality control activities (i.e., calibrations, audits etc.) to ensure the quality of data derived from ambient air monitors used by every State in the country. EPA developed the Protocol Gas Program to allow standards sold by specialty gas producers to be considered traceable to NIST standards. This program was discontinued in 1998. In 2002, there was interest by the gas vendors and EPA to reestablish this program. The program is presently (as of 2008) undergoing re-structuring.

Although Table 15-1 lists seven performance evaluation programs operating at the federal level, the NPAP and PEP Programs will be discussed in more detail. Additional information on both programs can be found on the AMTIC Website[4]. The October 17, 2006 monitoring rule identified the monitoring organizations as responsible for ensuring the implementation of these audits[5]. Monitoring organizations

[3] see www.eenews.net/Greenwire/Backissues/081604/08160403.htm
[4] http://www.epa.gov/ttn/amtic/npepqa.html
[5] http://www.epa.gov/ttn/amtic/40cfr53.html-Final - Revisions to Ambient Air Monitoring Regulations.

can either implement the program itself or continue to participate in the federally implemented program. This choice is provided to the monitoring organization on an annual basis through a memo from OAQPS through the EPA Regions. In order for monitoring organization to self-implement the program they must meet criteria related to the adequacy of the audit (number of audits and how it is accomplished) as well as meet independence requirements (see Figure 15.1).

15.2.1 National Performance Audit Program[6]

Monitoring organizations operating SLAMS/PAMS/PSD are required to participate in the National Performance Evaluation Programs by providing adequate and independent audits for its monitors as per Section 2.4 of 40 CFR Part 58, Appendix. One way of providing the audits is to participate in the NPAP program either through self-implementation or federal implementation.

The NPAP is a cooperative effort among OAQPS, the 10 EPA Regional Offices, and the monitoring organizations that operate the SLAMS/PAMS/PSD air pollution monitors. The NPAP's goal is to provide audit materials and devices that will enable EPA to assess the proficiency of monitoring organizations that are operating monitors in the SLAMS/PAMS/PSD networks. To accomplish this, the NPAP has established acceptable limits or performance criteria, based on the data quality needs of the networks, for each of the audit materials and devices used in the NPAP.

All audit devices and materials used in the NPAP are certified as to their true value, and that certification is traceable to a National Institute of Standards and Technology (NIST) standard material or device wherever possible. The audit materials used in the NPAP are as representative and comparable as possible to the calibration materials and actual air samples used and/or collected in the SLAMS/PAMS/PSD networks. The audit material/gas cylinder ranges used in the NPAP are specified in the Federal Register.

Initially the NPAP system was a mailable system where standards and gasses were mailed to monitoring organizations for implementation. In 2003, OAQPS started instituting a through the probe audit system where mobile laboratories are sent to monitoring sites and audit gasses are delivered through the inlet probe of the analyzers. The goal of the NPAP audit is:

- Performing audits at 20 percent of monitoring sites per year, and 100% in 5-7 years.
- Data submission to AQS.
- Development of a delivery system that will allow for the audit concentration gasses to be introduced to the probe inlet where logistically feasible.
- Use of audit gases that are NIST certified and validated at least once a year for CO, SO_2, and NO_2.
- Validation/certification with the EPA NPAP program through collocated auditing, at an acceptable number of sites each year. The comparison tests would have to be no greater than **5 percent** different from the EPA NPAP results.
- Incorporation of NPAP in the monitoring organization's quality assurance project plan (if self implementing).

Table 15-2 lists the acceptance limits of the NPAP audits.

[6] http://www.epa.gov/ttn/amtic/npapgen.html

Table 15-2 NPAP Acceptance Criteria

Audit	EPA determined limits
High volume/PM_{10} (SSI)	% difference ≤15% for 1 or more flows
Dichot (PM_{10})	% difference ≤15% for 1 or more flows
Pb (analytical)	% difference ≤15% for 1 or more levels
SO_2, NO_2, and CO	Mean absolute % difference ≤ 15%
O_3	Mean absolute % difference ≤ 10%
PAMS	
Volatile Organic Compounds	Compound Specific
Carbonyls	Compound and level specific

15.2.2 $PM_{2.5}$ and $PM_{10-2.5}$ Performance Evaluation Program (PEP)

The Performance Evaluation Program[7] is a quality assurance activity which will be used to evaluate measurement system bias of the $PM_{2.5}$ and the $PM_{10-2.5}$ monitoring networks. The pertinent regulations for this performance audit are found in 40 CFR Part 58, Appendix A. The strategy is to collocate a portable PEP instrument with an established routine air monitoring site, operate both monitors in exactly the same manner and then compare the results of this instrument against the routine sampler at the site. For primary quality assurance organizations with less than or equal to five monitoring sites, five valid performance evaluation audits must be collected and reported each year. For primary quality assurance organizations with greater than five monitoring sites, eight valid performance evaluation audits must be collected and reported each year. A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and above 3 µg/m^3. Additionally, each year, every designated FRM or FEM within a primary quality assurance organization must: (1) have each method designation evaluated each year; and, (2) have all FRM or FEM samplers subject to a PEP audit at least once every six years; which equates to approximately 15 percent of the monitoring sites audited each year.

Since performance evaluations are independent assessments, Figure 15.1 was developed to define independence for the FRM performance evaluation to allow monitoring organizations to implement this activity.

Independent assessment - an assessment performed by a qualified individual, group, or organization that is not part of the organization directly performing and accountable for the work being assessed. This auditing organization must not be involved with the generation of the routine ambient air monitoring data. An organization can conduct the PEP if it can meet the above definition and has a management structure that, at a minimum, will allow for the separation of its routine sampling personnel from its auditing personnel by two levels of management, as illustrated in the figure below. In addition, the pre and post weighing of audit filters must be performed by separate laboratory facility using separate laboratory equipment. Field and laboratory personnel would be required to meet the FRM Performance Audit field and laboratory training and certification requirements. The State and local organizations are also asked to consider participating in the centralized field and laboratory standards certification process.

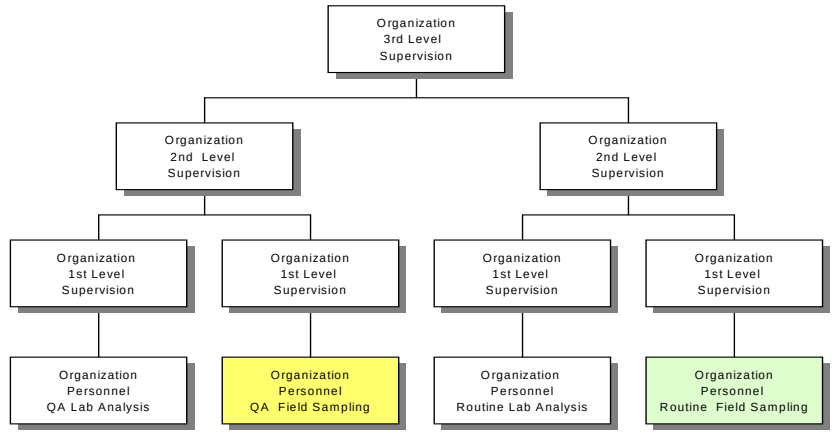

Figure 15.1 Definition of independent assessment

[7] http://www.epa.gov/ttn/amtic/pmpep.html

Since the regulations define the performance evaluations as an NPAP like activity, EPA has made arrangements to implement this audit. Monitoring organizations can determine, on a yearly basis, to utilize federal implementation by directing their appropriate percentage of grant resources back to the OAQPS or implement the audit themselves. The following activities will be established for federal PEP implementation:

- field personnel assigned to each EPA Region, the hours based upon the number of required audits in the Region; and
- one national laboratory in Region 4 will serve as a national weighing lab and will include data submittal to AQS.

All documentation including the PEP Implementation Plan, QAPP, Field and Laboratory SOPs, and reports can be found on the AMTIC Bulletin Board at the PEP Website[8].

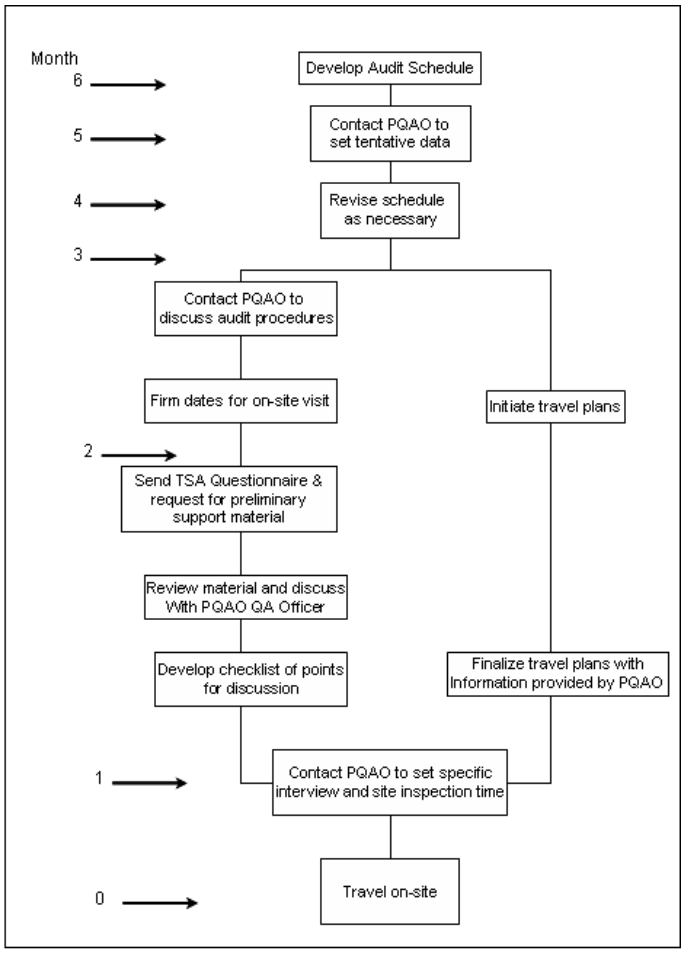

Figure 15.2 Pre-audit activities

15.2.3 State and Local Organization Performance Audits

Any of the performance evaluation activities mentioned in this section can be performed internally by the monitoring organizations. If the monitoring organization intends to self-implement NPAP or PEP then they will be required to meet the adequacy and independence criteria mentioned in earlier sections. Since a monitoring organization may want more audits then can be supplied by the NPAP and PEP, it may decide to "augment" the federally implemented programs with additional performance audits. These audits can be tailored to the needs of the monitoring organization and do not necessarily need to follow NPAP and PEP adequacy and independence requirements. Some information on the procedures for this audit can be found in Appendix H.

15.3 Technical Systems Audits

A systems audit is an on-site review and inspection of a monitoring organization's ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. A systems audit of each monitoring organization within an EPA Region is performed every three years by a member of the Regional Quality Assurance (QA) staff.

[8] http://www.epa.gov/ttn/amtic/pmpep.html

Detailed discussions of the audits performed by the EPA and the State and local organizations are found in Appendix H; the information presented in this section provides general guidance for conducting technical systems audits. A systems audit should consist of three separate phases:

- Pre-audit activities.
- On-site audit activities.
- Post-audit activities.

Summary activity flow diagrams have been included as Figures 15.2, 15.3 and 15.5, respectively. The reader may find it useful to refer to these diagrams while reading this guidance.

15.3.1 Pre-Audit Activities

At the beginning of each fiscal year, the audit lead or a designated member of the audit team should establish a tentative schedule for on-site systems audits of the monitoring organizations within their Region. It is suggested that the audit lead develop an audit plan. This plan should address the elements listed in Table 15-3. The audit plan is not a major undertaking and in most cases will be a one page table or report. However, the document represents thoughtful and conscious planning for an efficient and successful audit. The audit plan should be made available to the organization audited, with adequate lead time to ensure that appropriate personnel and documents are available for the audit. Three months prior to the audit, the audit lead should contact the quality assurance officer (QAO) of the organization to be audited to coordinate specific dates and schedules for the on-site audit visit. During this initial contact, the audit lead should arrange a tentative schedule for meetings with key personnel as well as for inspection of selected ambient air quality monitoring and measurement operations. At the same time, a schedule should be set for the exit interview used to debrief the monitoring organization director or his/her designee, on the systems audit outcome. As part of this scheduling, the audit lead should indicate any special requirements such as access to specific areas or activities. The audit lead should inform the monitoring organization QAO that the QAO will receive a questionnaire, which is to be reviewed and completed.

Table 15-3 Suggested Elements of an Audit Plan

Audit Title -	Official title of audit that will be used on checksheets and reports
Audit #-	Year and number of audit can be combined; 08-1, 08-2 Date of audit
Scope -	Establishes the boundary of the audit and identifies the groups and activities to be evaluated. The scope can vary from general overview, total system, to part of system, which will determine the length of the audit.
Purpose -	What the audit should achieve
Standards -	Standards are criteria against which performance is evaluated. These standards must be clear and concise and should be used consistently when auditing similar facilities or procedures. The use of audit checklists is suggested to assure that the full scope of an audit is covered. An example checklist for the Regional TSA is found in Appendix H.
Audit team -	Team lead and members.
Auditees -	People who should be available for the audit from the audited organization. This should include the program manager(s), principal investigator(s), monitoring leads, organizations QA representative(s), and other management and technicians as necessary.
Documents -	Documents that should be available in order for the audit to proceed efficiently. Too often documents are asked for during an audit, when auditors do not have the time to wait for these documents to be found. Documents could include QMPs, QAPPs, SOPs, GLPs, control charts, raw data, QA/QC data, previous audit reports etc.
Timeline -	A timeline of when organizations (auditors/auditees) will be notified of the audit in order for efficient scheduling and full participation of all parties.

The audit lead should emphasize that the completed questionnaire is to be returned within one (1) month (or time frame deemed appropriate) of receipt. The information within the questionnaire is considered a minimum, and both the Region and the monitoring organization under audit should feel free to include additional information. Once the completed questionnaire has been received, it should be reviewed and compared with the pertinent criteria and regulations. The AQS precision, bias and completeness data as well as any other information on data quality can augment the documentation received from the reporting organization under audit. This preliminary evaluation will be instrumental in selecting the sites to be evaluated and in the decision on the extent of the monitoring site data audit. The audit team should then prepare a checklist detailing specific points for discussion with monitoring organization personnel.

The audit team should be made of several members to offer a wide variety of backgrounds and expertise. This team may then divide into groups once on-site, so that both audit coverage and time utilization can be optimized. A possible division may be that one group assesses the support laboratory and headquarters operations while another evaluates sites, and subsequently assesses audit and calibration information. The audit lead should confirm the proposed audit schedule with the audited organization immediately prior to traveling to the site.

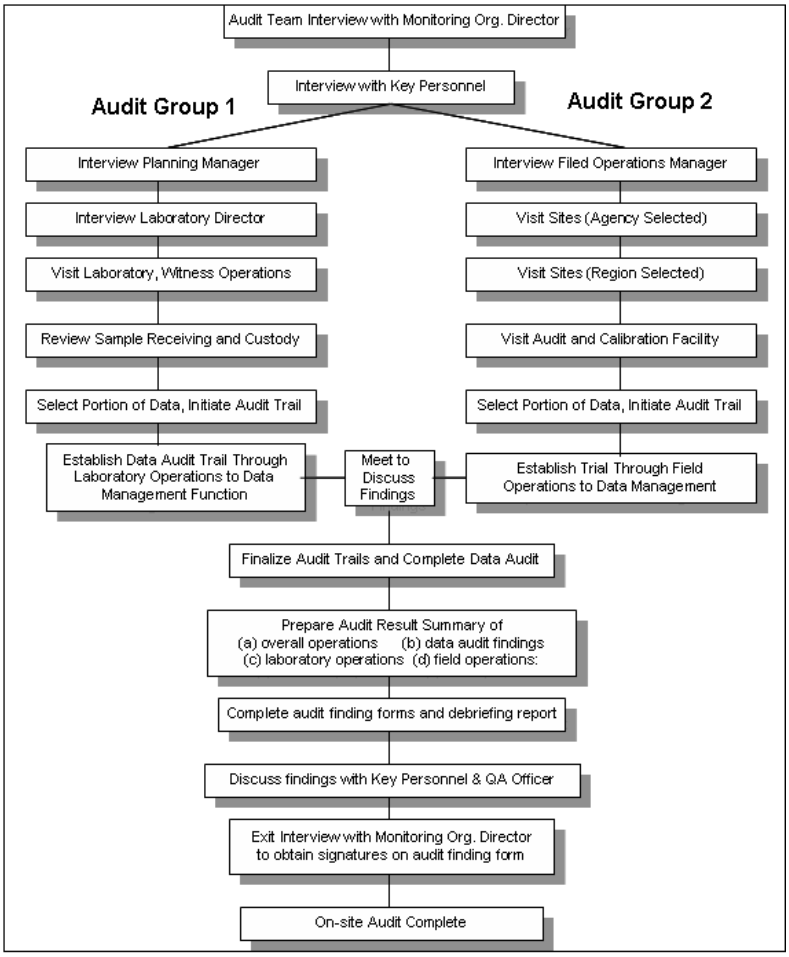

Figure 15.3 On-site audit activities

15.3.2. On-Site Activities

The audit team should meet initially with the audited monitoring organization's director or his/her designee to discuss the scope, duration, and activities involved with the audit. This should be followed by a meeting with key personnel identified from the completed questionnaire, or indicated by the monitoring organization QAO. Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management and reporting. At the conclusion of these introductory meetings, the audit team may begin work as two or more independent groups, as illustrated in Figure 15.3. To increase uniformity of site inspections, it is suggested that a site checklist be developed and used. The format for Regional TSAs can be found in Appendix H.

The importance of the audit of data quality (ADQ) cannot be overstated. Thus, sufficient time and effort should be devoted to this activity so that the audit team has a clear understanding and complete documentation of

data flow. Its importance stems from the need to have documentation on the quality of ambient air monitoring data for all the criteria pollutants for which the monitoring organization has monitoring requirements. The ADQ will serve as an effective framework for organizing the extensive

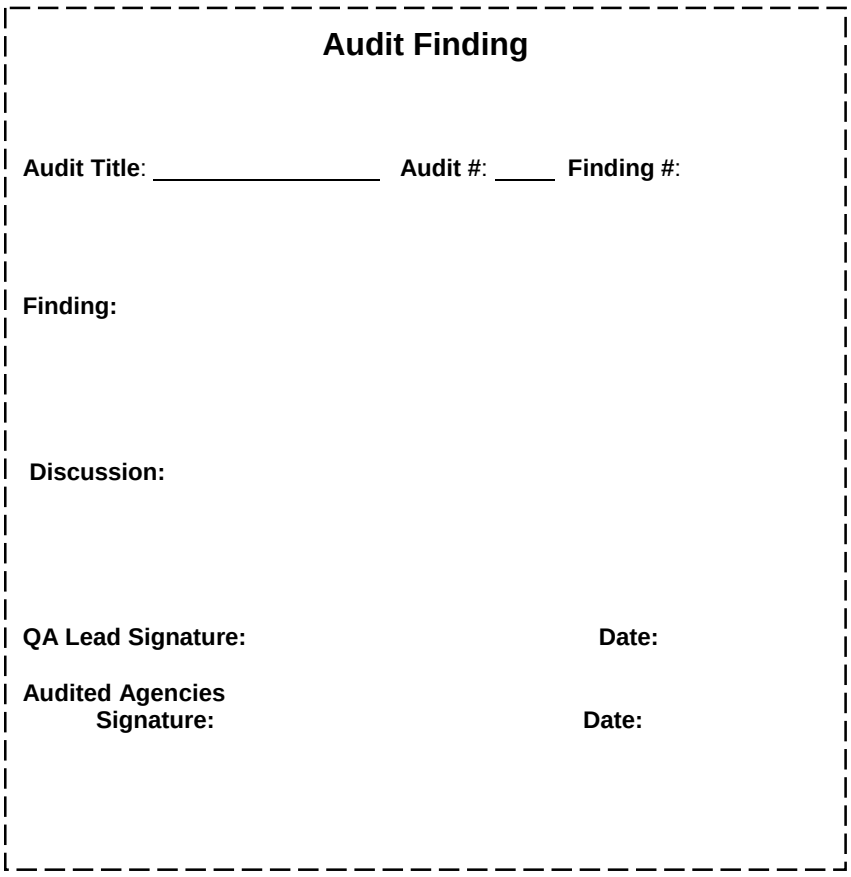

Figure 15.4 Audit finding form

amount of information gathered during the audit of laboratory, field monitoring and support functions within the monitoring organization.

The entire audit team should prepare a brief written summary of findings, organized into the following areas: planning, field operations, laboratory operations, quality assurance/quality control, data management, and reporting. Problems with specific areas should be discussed and an attempt made to rank them in order of their potential impact on data quality. For the more serious problems, audit findings should be drafted (Fig. 15.4).

The audit finding form has been designed such that one is filled out for each major deficiency that requires formal corrective action. They inform the monitoring organization being audited about a serious finding that may compromise the quality of the data and therefore require specific corrective actions. They are initiated by the audit team, and discussed at the debriefing. During the debriefing discussion, evidence may be presented that reduces the significance of the finding; in which case the finding may be

removed. If the audited monitoring organization is in agreement with the finding, the form is signed by the monitoring organization's director or his/her designee during the exit interview. If a disagreement occurs, the QA Team should record the opinions of the monitoring organization audited and set a time at some later date to address the finding at issue.

The audit is now completed by having the audit team members meet once again with key personnel, the QAO and finally with the monitoring organization's director to present their findings. This is also the opportunity for the monitoring organization to present their disagreements.

The audit team should simply state the audit results, including an indication of the potential data quality impact. During these meetings, the audit team should also discuss the systems audit reporting schedule and notify monitoring organization personnel that they will be given a chance to comment in writing, within a certain time period, on the prepared audit report in advance of any formal distribution.

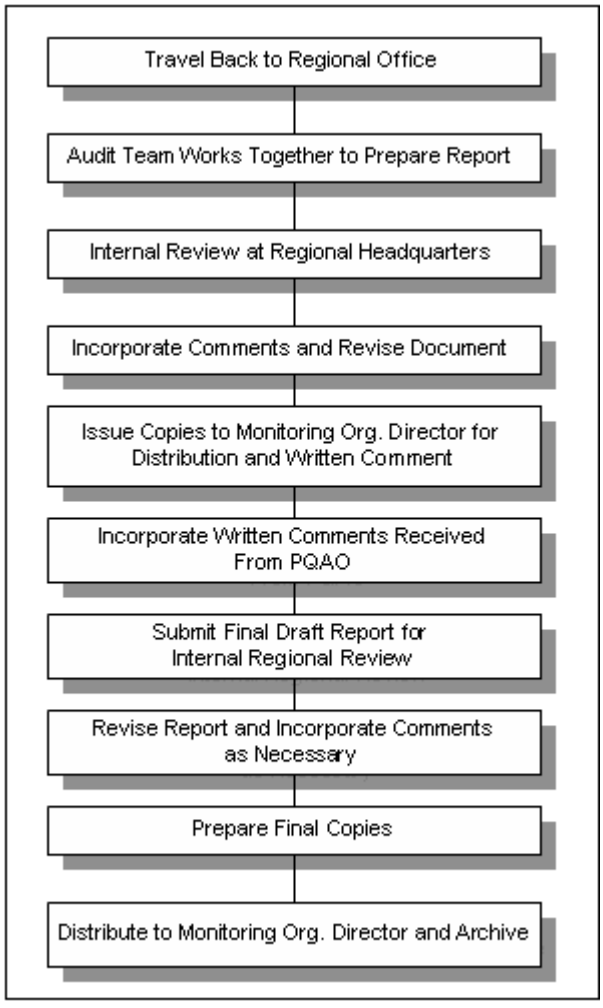

Figure 15.5 Post-audit activities

15.3.3 Post-Audit Activities

The major post-audit activity is the preparation of the systems audit report. The report will include:

- audit title, number and any other identifying information;
- audit team leaders, audit team participants and audited participants;
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process;
- summary and conclusions of the audit and corrective action requirements; and
- attachments or appendices that include all audit evaluations and audit finding forms.

To prepare the report, the audit team should meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA project plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. Within thirty (30) calendar days of the completion of the audit, the audit report should be prepared and submitted.

The technical systems audit report is submitted to the audited monitoring organization. It is suggested that a cover letter be used to reiterate the fact that the audit report is being provided for review and written comment. The letter should also indicate that, should no written comments be received by the audit lead within thirty (30) calendar days from the report date, it will be assumed acceptable to the monitoring organization in its current form, and will be formally distributed without further changes.

Audit Finding Response Form

Audit Title: _____ **Audit #:** ____ **Finding #:**

Finding:

Cause of the problem:

Actions taken or planned for correction:

Responsibilities and timetable for the above actions:

Prepared by: _____ **Date:**

Reviewed by: _____ **Date:**

Remarks:

Is this audit finding closed? _____ **When?**

File with official audit records. Send copy to auditee

If the monitoring organization has written comments or questions concerning the audit report, the audit team should review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form within thirty (30) days of receipt of the written comments. Copies of this report should be sent to the monitoring organization director or his/her designee for internal distribution. The transmittal letter for the amended report should indicate official distribution and again draw attention to the agreed-upon schedule for corrective action implementation.

Figure 15.6 Audit response form

15.3.4 Follow-up and Corrective Action Requirements

As part of corrective action and follow-up, an audit finding response form (Fig 15.6) is generated by the audited organization for each finding form submitted by the audit team. The audit finding response form is signed by the audited organization's director and sent to the organization responsible for oversight who reviews and accepts the corrective action. The audit response form should be completed by the audited organization within 30 days of acceptance of the audit report.

15.4 Data Quality Assessments

A data quality assessment (DQA) is the statistical analysis of environmental data, to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision, based on the data, is acceptable. The DQA process is described in detail in the guidance document: *Data Quality Assessment: A Reviewers Guide* (EPA QA/G-9R)[9], in Section 18 and is summarized below.

1) Review the data quality objectives (DQOs) and sampling design of the program: review the DQO and develop one, if it has not already been done. Define statistical hypothesis, tolerance limits, and/or confidence intervals.

2) Conduct preliminary data review. Review QA data and other available QA reports, calculate summary statistics, plots and graphs. Look for patterns, relationships, or anomalies.

3) Select the statistical test: select the best test for analysis based on the preliminary review, and identify underlying assumptions about the data for that test.

4) Verify test assumptions: decide whether the underlying assumptions made by the selected test hold true for the data and the consequences.

5) Perform the statistical test: perform test and document inferences. Evaluate the performance for future use.

A companion document to EPA QA/G-R, EPA QA/G-9S document provides many appropriate statistical tests. QAD is also developing statistical software to complement the document. Both can be found on the QAD Homepage (http://es.epa.gov/ncerqa).

OAQPS plans on performing data quality assessments for the pollutants of the Ambient Air Quality Monitoring Network at a yearly frequency for data reports and at a 3-year frequency for more interpretative reports. Reporting organizations and State and local monitoring organizations are encouraged to implement data quality assessments at their levels. Attaining the DQOs at a local level will ensure that the DQOs will be met when data is aggregated at higher levels.

[9] http://www.epa.gov/quality1/qs-docs/g9r-final.pdf