Technical Systems Audits

QA 101 Session

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Technical Systems Audits (TSAs)

Let's break it into 3 parts…

- ✓ What is a TSA and why do we do them?
- ✓ How do you conduct a good and effective TSA? Tips for conducting audits!
- ✓ Technical Systems Audit Workgroup: What is it and what are we doing?

What is a TSA?

40 CFR Part 58, Appendix A Section 2.5 says in black and white…

2.5 Technical Systems Audit Program. Technical systems audits of each PQAO shall be conducted at least every 3 years by the appropriate EPA Regional Office and reported to the AQS. If a PQAO is made up of more than one monitoring organization, all monitoring organizations in the PQAO should be audited within 6 years (two TSA cycles of the PQAO). As an example, if a state has five local monitoring organizations that are consolidated under one PQAO, all five local monitoring organizations should receive a technical systems audit within a 6-year period. Systems audit programs are described in reference 10 of this appendix.

"Reference 10" is…

What is a TSA?

The Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II

Otherwise known as

"**The QA Handbook**"

If you don't know this by now, Remedial QA is down the hall…

What is a TSA?

What does it say?

Section 15.3 Technical Systems Audit

"A technical 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."

What is a TSA?

The QA Handbook states that a TSA should address and report on the following key areas:

- Planning
- Field Operations
- Laboratory Operations
- Quality Assurance/ Quality Control
- Data Management
- Reporting

What is a TSA?

Planning

- Network Design
- Monitoring Strategy
- Representativeness
- Meeting Monitoring Requirements
- Funding Needs
- Resources (Staffing, Equipment)

What is a TSA?

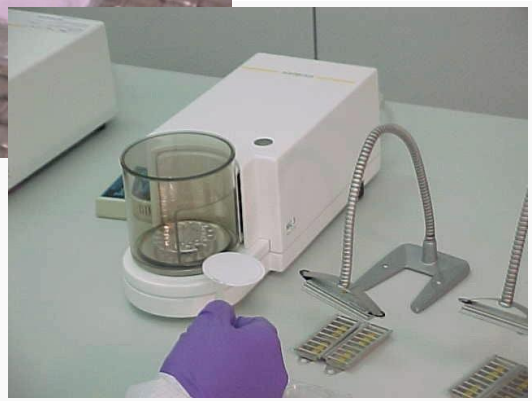
Field Operations

- Use of approved analyzers and samplers for monitoring objective (FRM,FEM)
- Use of analyzers and samplers according to FRM/FEM requirements
- Following documented sampling procedures
- Proper siting of monitoring stations, samplers, and probes
- Maintenance capacity
- Cross-training
- Site housekeeping
- Age of equipment
- Site safety concerns

What is a TSA?

Laboratory Operations

- Use of appropriate analytical equipment
- Following documented analytical procedures
- Cross-training
- Maintenance capabilities
- Housekeeping
- Age of equipment
- Sample storage



What is a TSA?

Quality Assurance and Quality Control

- Approved and updated QMP and QAPP
- Consistent with EPA's Quality System
- Independence
- Proper collocated sampling
- QC checks (zero/precision/span checks, calibrations, etc) conducted properly
- QC checks conducted at the correct frequency
- Documented QA data reviews
- Separate instruments and standards for QA
- Review of electronic traces
- Audits

What is a TSA?

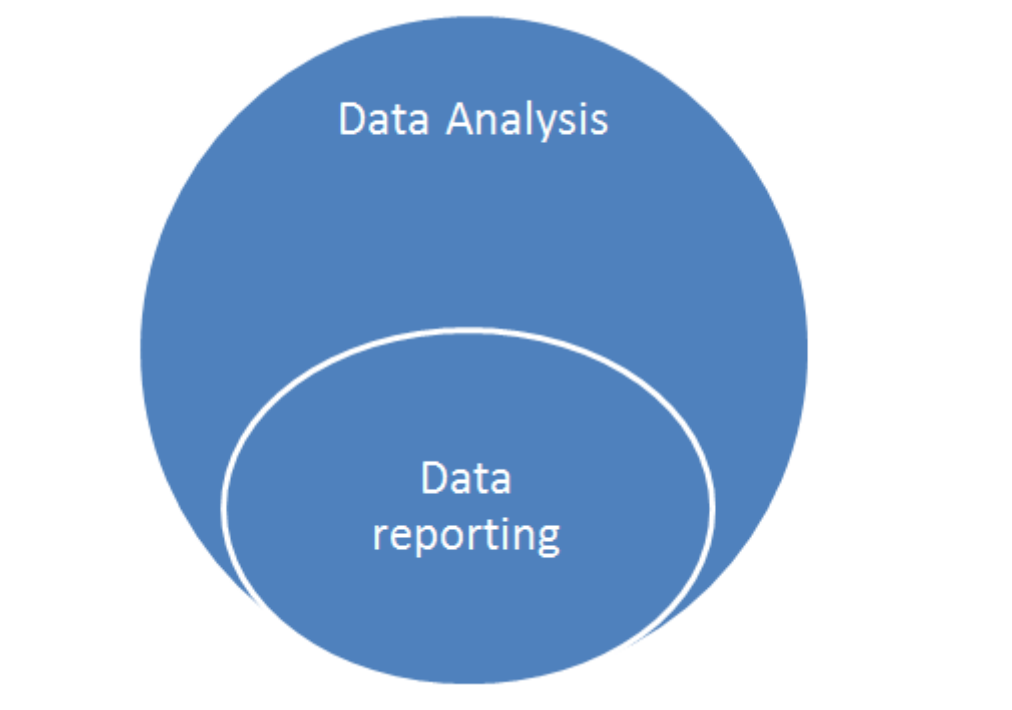
Data Management

- Data acquisition system
- Data backup
- Data flow SOP or flowchart
- Organization (can documentation actually be found?)
- Minute data
- Archival (paper and electronic)

What is a TSA?

Reporting

- Data in AQS
- Timely reporting
- Correct flagging
- Correct null coding
- Metadata
- Certification
- AIRNow



What is a TSA?

References

40 CFR Part 58, Appendix A, Section 2.5

Regulations - Requirements that ***must*** be followed

QA Handbook

Guidance and details on how best to perform a complete and effective audit

TSA Guidance Document

In development by the TSA workgroup –
Considered best practice for conducting a TSA

Who Audits Who?

Back to 40 CFR Part 58, Appendix A:

"Technical systems audits of each PQAO shall be conducted at least every 3 years by the ***appropriate EPA Regional Office*** *and reported to the AQS."*

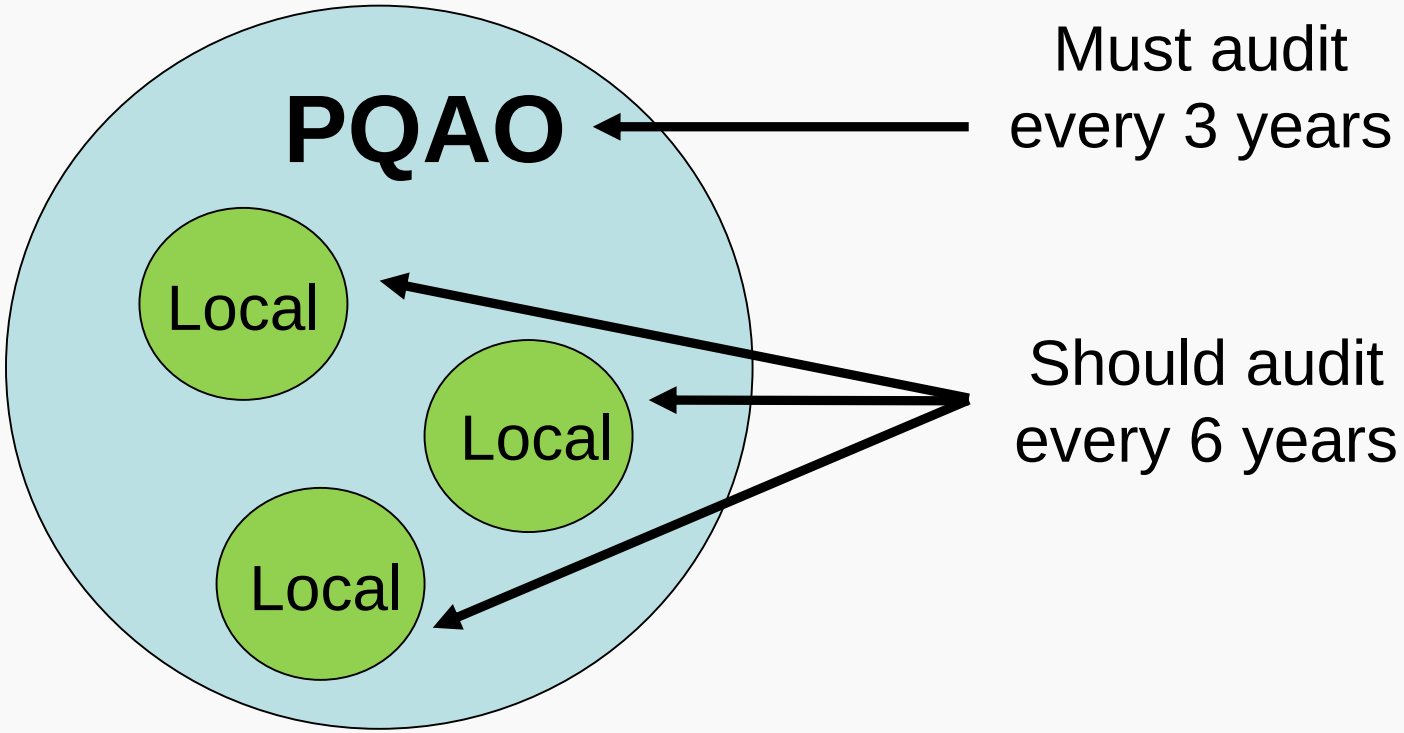
The EPA Regional Offices have the responsibility to conduct Technical Systems Audits.

When Do We Do TSAs?

- The EPA Regional Offices are **required** to conduct TSAs on PQAOs in their respective regions at least **every 3 years**.
- If a PQAO is made up of more than one monitoring organization, **all monitoring organizations in the PQAO should be audited within 6 years.**
- EPA Regional staff may follow up with **more frequent** TSAs if deficiencies are noted that require attention

When Do We Do TSAs?

Consolidated PQAO with 3 monitoring agencies



How to Conduct Effective TSAs

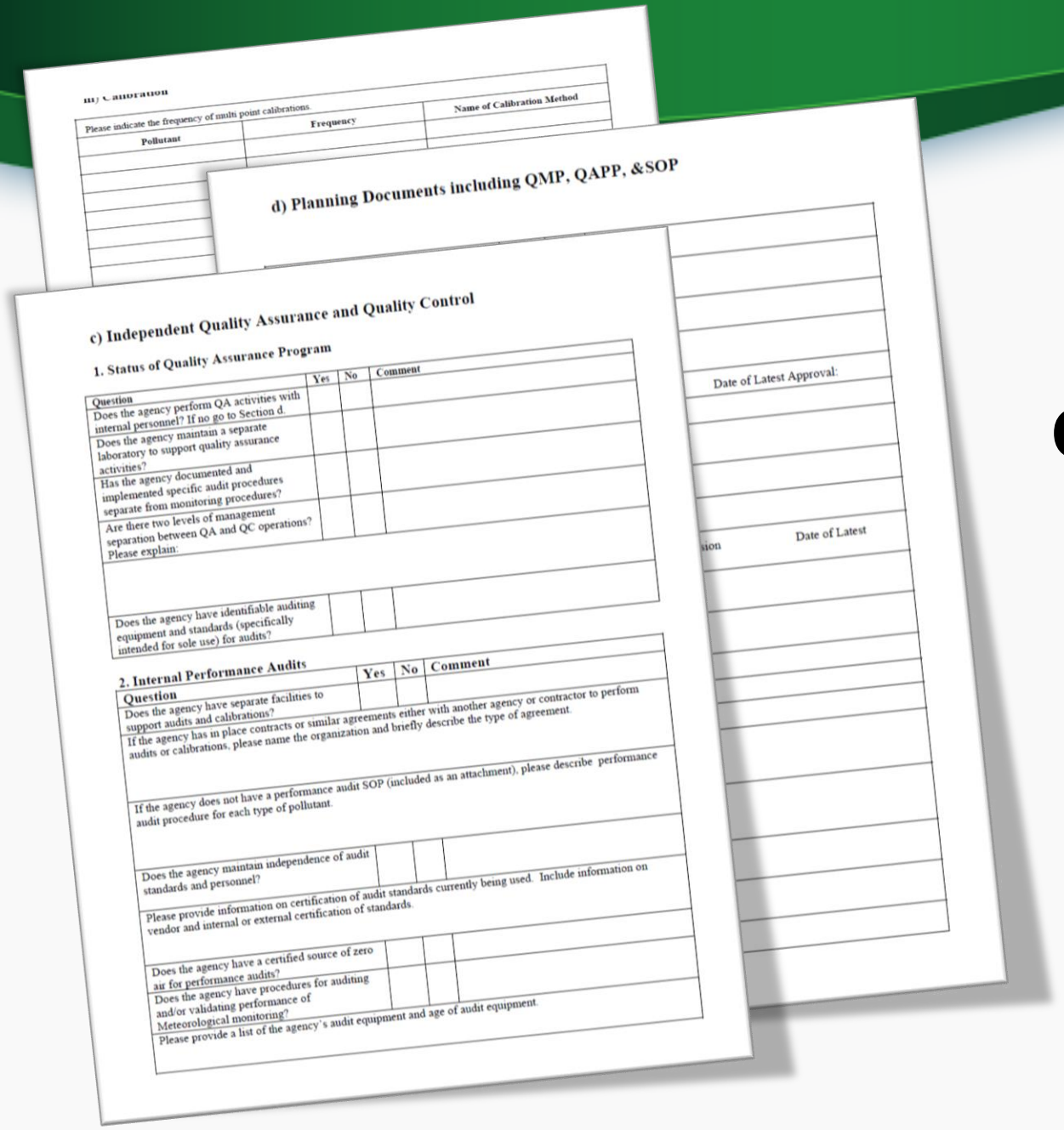
- Tools!
- Pre-audit activities
- On-site assessment & interviews
- Post-site assessment activities

TSAs cover a lot of territory in a short amount of time! It is important to be prepared and organized!

Conducting TSAs: Pre-Audit

Gather Your Tools

- ✓ CFR
- ✓ QA Handbook
  - Validation Templates
- ✓ Guidance Documents
- ✓ FRM/FEM Designations
- ✓ Audit Forms
- ✓ AQS
- ✓ **Time!!!**

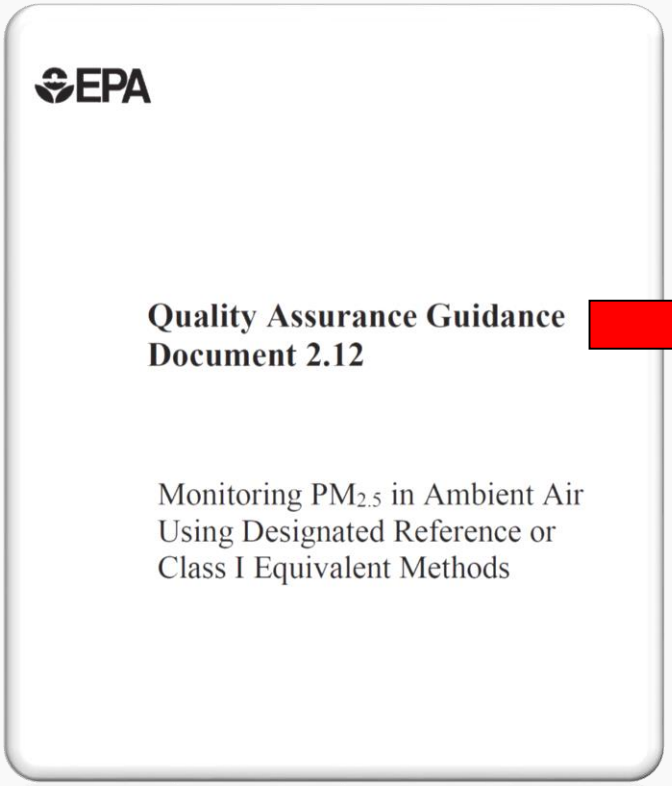


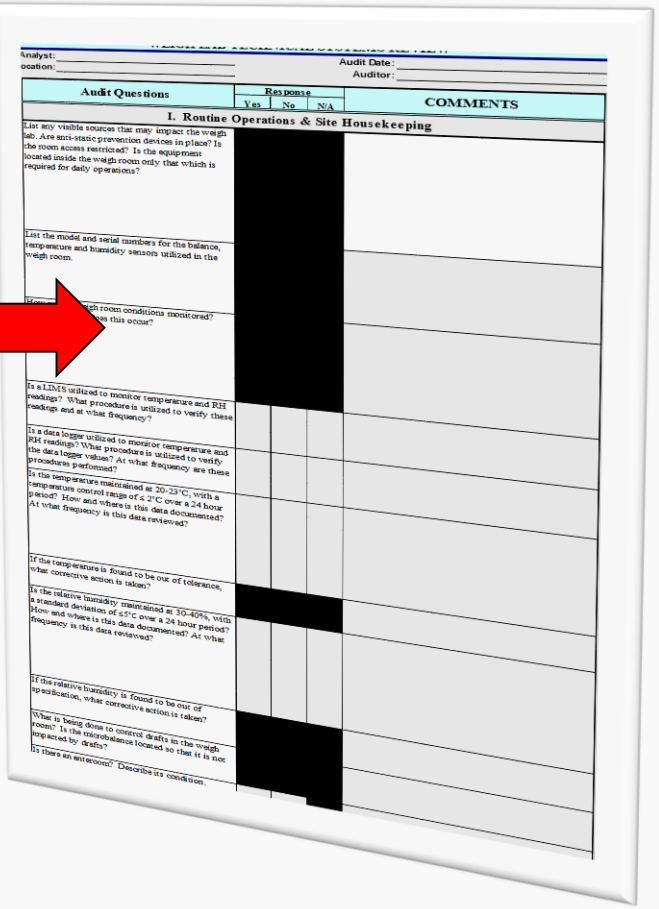
TSA Questionnaire

- Use EPA questionnaire directly, or modify it to your agency's needs!

Conducting TSAs: Pre-Audit

Individual Method Checklists





Utilize those available or make your own!

Conducting TSAs: Pre-Audit

Plan & Organize

- Review the agency's monitoring network
  - Does the agency have a PM_{10} or $PM_{2.5}$ weigh lab?
  - Does the agency do trace-level or near-road monitoring?
  - Does the agency participate in NATTS or special purpose toxics monitoring?
  - Is there an analytical lab involved?
- Know the methods you are auditing!

Balance Resources

- How much time do you need to complete your audit?
  - Recommend at least one week per agency
- Based on the size & scope of the network, do you have the right team of auditors assembled?
- Talk to your management if you think you may need additional time or resources
- Complete as much prep work as you can in-house, in order to optimize time available in the field

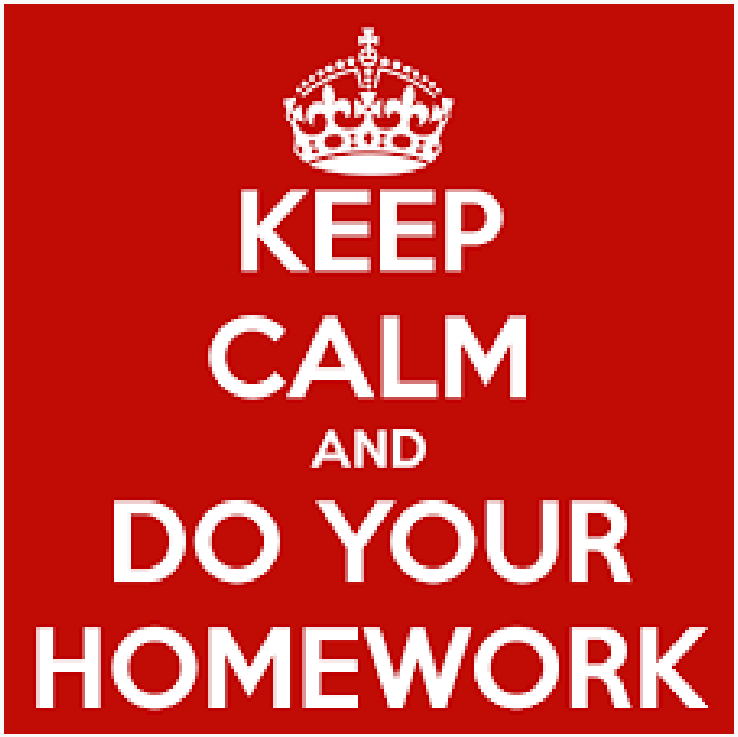
Conducting TSAs: Pre-Audit

Communicate with the Agency

- Schedule the audit with the agency
- Send the agency contact your TSA questionnaire a month or more in advance of the audit
- Request copies of their quality documents
- Request a copy or link to their annual network plan

Conducting TSAs: Pre-Audit

Document Review



- **QAPP and SOPs**
  - Are any of these documents more than 5 years old?
  - Have they been approved by EPA? If not, why?
  - Do the stated procedures meet method requirements? FRM/FEM specifications?
  - Are there details within the documents?
- Earmark any “red flags” as future questions to be asked during the TSA

Conducting TSAs: Pre-Audit

– Review the responses provided by the agency in the **TSA questionnaire**
  - Do the responses line up with the QAPP/SOPs you have reviewed?
  - Were any questions left blank?
  - Do any answers make you go “Hmmm?”
– Earmark answers (or blanks) in the questionnaire for follow-up

Conducting TSAs: Pre-Audit

Review Data!!

- Pull the agency's data from AQS
  - AMP 350 (Raw Data Report)
  - AMP 251 (QA Raw Data Assessment Report)
  - AMP 256 (QA Data Quality Indicator Report)
  - AMP 430 (Data Completeness Report)
  - AMP 480 (Design Value Report)
  - AMP 503 (Extract Sample Blank Data)
  - AMP 504 (Extract QA Data)
  - AMP 600 (Certification Evaluation & Concurrence)
- Mark data that catch your eye!

Conducting TSAs: Pre-Audit

The AMP 350 Tells a Story

Code change?

What malfunctioned?
Where is maintenance & recalibration?

HOUR

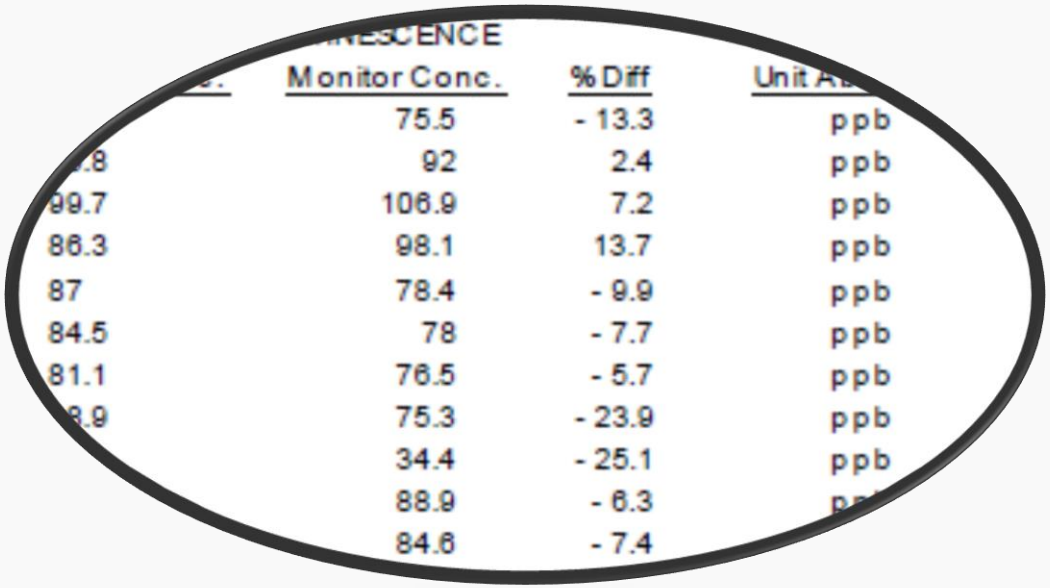
DAY	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	OBS	MAXIMUM
1	5.5	1.8	3.2	2.9	3.2	2.1	2.3	3.4	7.1	5.6	2.9	2.7	2.1	3.2	5.7	8.1	11.0	2.7	1.7	2.3	2.2	1.8	2.4	3.0	24	11.0
2	4.7	4.1	4.1	5.5	5.2	2.6	1.3	2.0	2.9	2.2	1.9	1.0	.9	.7	.7	.7	.8	.6	.6	.6	.5	.6	.8	1.0	24	5.5
3	1.5	.9	.7	.7	.6	.8	.6	1.0	1.0	.7	.7	1.3	1.1	1.5	1.0	.9	.5	.5	.5	.4	.5	.5	.4	.5	24	1.9
4	1.5	.7	.5	.4	.4	.4	.4	.4	.8	2.5	3.6	4.9	8.6	1.1	.9	.8	.7	.7	.7	.8	.5	.4	.5	.4	24	8.6
5	2.6	1.0	.7	.6	.6	.6	.7	.7	.9	1.1	1.9	2.7	BF	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	12	2.7
6	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	BL	AN	AN	AN	AN	AN	AN	0	
7	AN	AN	AN	AN	AN	AN	AN	AN	AN	BA	BA	BA	AN	BC	BC	BL	AN	AN	AN	AN	AN	AN	AN	AN	0	
8	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	BA	BC	BC	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	0	
9	AN	AN	AN	AN	AN	AN	AN	AN	AN	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	0	
10	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	0	
11	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	0	
12	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	0	
13	AS	AS	AS	AS	AS	AS	AS	AS	AS	AY	AS	AY	AY	.0	.7	.3	.2	.1	.4	.3	.2	.3	.5	.4	11	1.0
14	4.3	1.6	1.0	1.2	1.5	1.3	1.3	1.2	1.4	1.9	2.9	2.4	2.1	2.4	2.0	1.8	1.6	1.4	1.5	2.4	4.3	3.5	2.3	1.4	24	4.3
15	4.4	1.7	1.5	1.2	1.2	.5	.5	.6	2.3	4.3	4.4	4.7	8.5	13.2	12.9	10.1	8.1	8.3	5.7	2.1	.8	.5	.4	.4	24	13.2
16	4.6	1.4	.7	.5	.5	.4	.6	.5	.4	1.0	4.9	8.5	8.8	6.2	5.3	4.9	17.6	21.7	6.7	2.6	1.6	1.7	2.0	2.2	24	21.7
17	4.0	1.5	.9	.8	.8	.7	.6	.5	.5	2.8	4.7	4.1	3.7	3.3	3.1	2.8	2.4	1.9	1.5	1.4	1.2	1.1	1.1	1.0	24	4.7
18	3.6	1.9	1.5	1.1	.6	.9	.9	.9	.8	2.1	3.9	6.3	12.9	8.9	6.7	5.7	6.5	5.5	3.1	1.8	1.1	.5	.4	.3	24	12.9
19	3.7	1.1	.7	.7	.7	.6	.6	.5	.7	1.8	3.4	7.0	BF	10.0	6.7	4.0	3.3	3.0	2.9	2.8	2.3	2.1	1.7	1.6	23	10.0
20	3.8	2.5	1.8	1.6	1.7	1.0	.7	.6	1.2	3.0	3.7	6.5	9.2	8.7	7.3	8.0	6.1	5.0	5.4	6.0	5.8	4.9	4.6	3.1	24	9.2
21	3.8	1.9	1.4	.9	.8	1.3	1.0	.9	1.4	1.6	2.4	4.7	7.8	10.7	6.6	5.1	4.2	2.5	1.9	1.7	1.2	.7	.5	.5	24	10.7
22	3.1	1.2	.8	.7	.8	.4	.5	.5	.7	.6	1.0	7.4	28.6	18.1	9.2	4.3	2.5	1.5	1.3	1.3	1.5	3.2	4.0	2.9	24	28.6
23	4.1	4.7	12.5	13.1	8.0	2.5	2.0	1.0	.3	.3	.2	.1	.2	.1	.1	.9	.1	.0	.0	.0	.0	.1	.1	.0	24	13.1
24	1.5	.5	.3	.1	.0	.0	.2	.1	.3	.6	.4	.3	.4	.1	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	24	1.5
25	3.2	1.3	1.1	2.3	3.2	3.2	3.6	3.9	5.0	3.5	3.5	10.4	6.3	4.4	4.3	4.4	4.9	2.8	2.6	1.8	1.9	1.4	.9	.8	24	10.4
26	2.4	1.0	.6	.3	.3	.4	.3	.6	.6	1.4	2.2	2.1	2.7	3.3	2.1	1.7	2.1	2.8	4.6	5.5	1.9	1.2	1.4	2.2	24	5.5
27	3.6	1.1	.7	.4	.3	.1	.2	.2	.4	5.4	5.6	4.9	13.3	5.4	1.1	.5	.2	.1	.2	.0	.0	.0	.0	.0	24	13.3
28	4.0	1.2	.9	.6	.5	.6	.4	.4	.5	.5	1.4	8.2	6.7	3.6	2.5	1.9	2.1	2.0	1.1	.5	.2	.1	.3	.2	24	8.2
29	3.3	1.2	.7	.7	.6	.6	.8	.6	1.4	1.7	2.1	23.0	16.1	27.1	23.7	14.1	10.0	14.7	4.1	2.4	1.4	1.4	1.9	4.3	24	27.1
30	7.9	4.0	2.8	2.5	2.4	2.2	2.3	3.6	6.4	5.3	4.6	3.6	2.6	2.4	2.4	4.4	7.2	2.3	1.2	1.0	.9	.7	.4	.4	24	7.9

Mark charts needing further review at the agency!

Conducting TSAs: Pre-Audit

QA/QC Data Review: AMP 251

- Look for high %d's!
- Reconcile against the AMP 350
- Can be hundreds of pages long for a large agency, though!



	Monitor Conc.	% Diff	Unit
	75.5	- 13.3	ppb
.8	92	2.4	ppb
99.7	106.9	7.2	ppb
86.3	98.1	13.7	ppb
87	78.4	- 9.9	ppb
84.5	78	- 7.7	ppb
81.1	76.5	- 5.7	ppb
8.9	75.3	- 23.9	ppb
	34.4	- 25.1	ppb
	88.9	- 6.3	
	84.6	- 7.4	

Conducting TSAs: Pre-Audit

Handy Tool: AMP 504
Sort the QA Data in Excel!

Action Type	Site	Param	POC	Date	Days	Method	Unit	Monitor Conc	Actual Conc	% Diff
1-Point QC	3002	44201	1	17-Jul-13	15	047	008	73.4	75	-2.1%
1-Point QC	3002	44201	1	22-Jul-13	5	047	008	74.4	75	-0.8%
1-Point QC	3002	44201	1	22-Jul-13	0	047	008	74.8	75	-0.3%
1-Point QC	3002	44201	1	31-Jul-13	9	047	008	73	75	-2.7%
1-Point QC	3002	44201	1	8-Aug-13	8	047	008	82.4	75	9.9%
1-Point QC	3002	44201	1	8-Aug-13	0	047	008	75	75	0.0%
1-Point QC	3002	44201	1	21-Aug-13	13	047	008	74.4	75	-0.8%
1-Point QC	3002	44201	1	9-Oct-13	49	047	008	105	75.6	38.9%
1-Point QC	3002	44201	1	9-Oct-13	0	047	008	74	75.6	-2.1%
1-Point QC	3002	44201	1	14-Oct-13	5	047	008	41.8	76.2	-45.1%
1-Point QC	3002	44201	1	14-Oct-13	0	047	008	75.8	75.8	0.0%
1-Point QC	3002	44201	1	30-Oct-13	16	047	008	75	75.8	-1.1%
1-Point QC	3002	44201	1	19-Nov-13	20	047	008	74	74.8	-1.1%

Conducting TSAs: Pre-Audit

Summary Hit List

- Rank & prioritize your preliminary findings
- Pack your briefcase (and laptop!)
  - Agency's TSA questionnaire response
  - Agency's quality documents
  - Data packages
  - Blank checklists & field logbooks for audit notes
  - Other tools
    - Camera
    - Range finder and/or tape wheel
    - Compass

Conducting TSAs: On-Site Assessment

Audit Time!

- Entrance briefing with management
- Take the office tour!
  - File Room
  - Repair shop
  - Certification/QA shop
  - Warehouse
  - Laboratory

Have a Scribe!

- Document your findings – be specific and detailed!
- Have teammates record observations, as well as take notes during interviews with staff
- Notes from all auditors can be combined post-audit to make report writing easier!

Staff Interviews

- Go over the TSA questionnaire
- Ask clarifying questions from SOP review
- Talk to the staff who actually do the work
- Listen closely
- Trust, but verify!

Agency Records Review

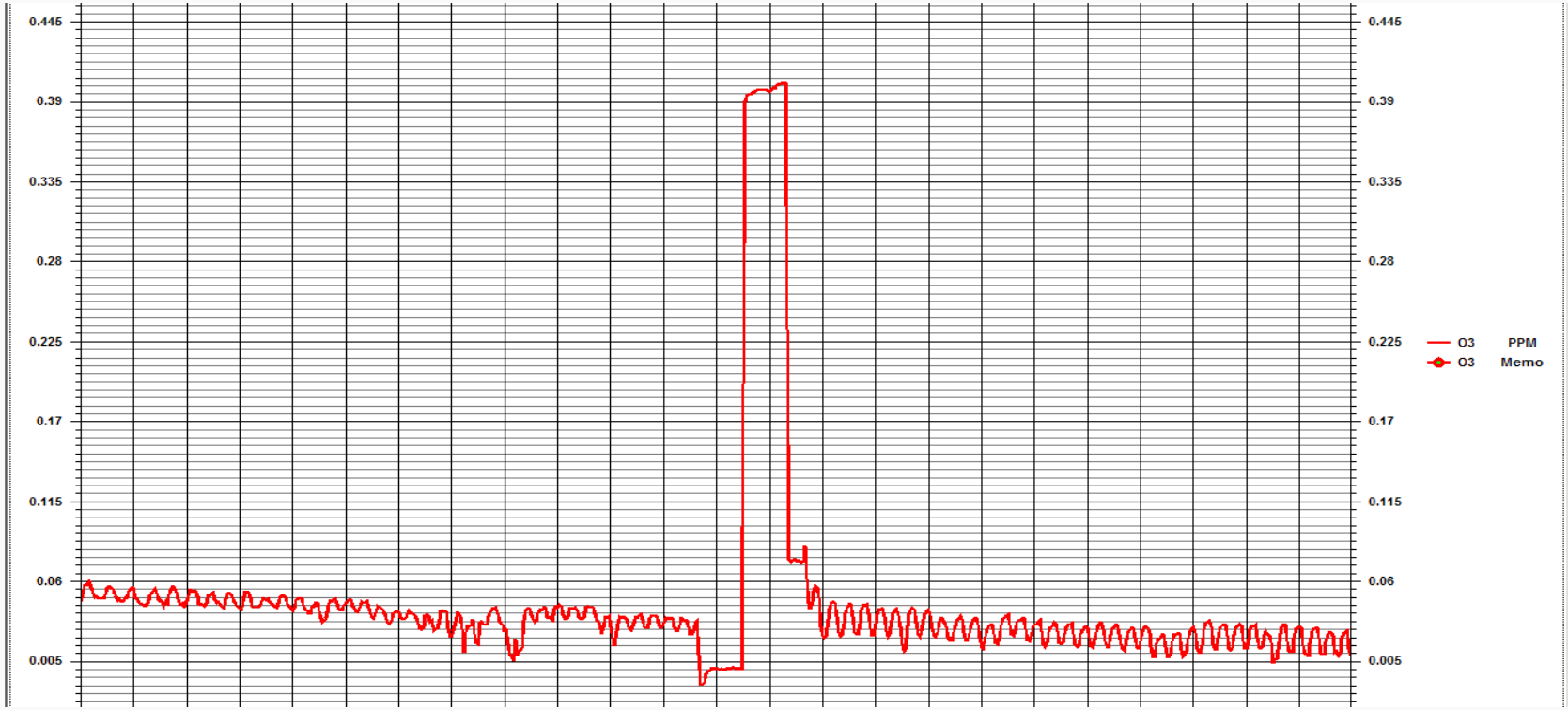
- Ask to see certification records from each pollutant category
- Choose sites at random
- Have agency staff pull 3 years of records
- Expiration dates?
- Are standards traceable?
  - Photometers
  - Gas Calibrator Flows
  - Other flow devices ($PM_{2.5}$, PM_{10}, lead)
  - Thermometers
  - Barometers
  - Mass reference standards (check weights)

Agency Records Review

- Ask to see records for all data marked during pre-audit activities
- QA/QC Records
  - Calibrations
  - Verifications
  - Maintenance
- Is there enough detail in the records that you can **easily** recreate events & justify null value codes?

Conducting TSAs: On-Site Assessment

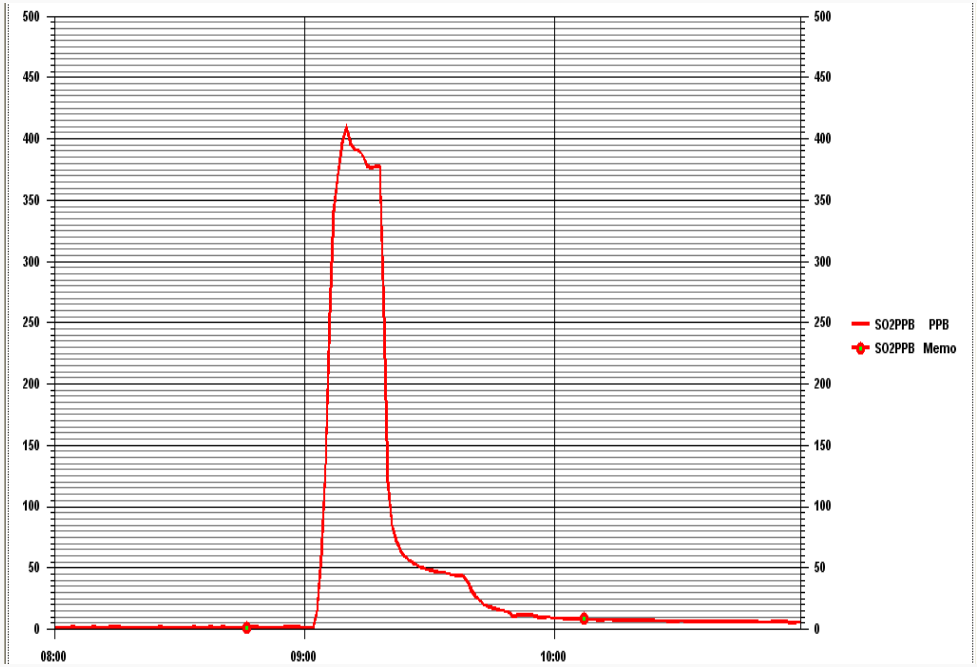
Review Minute Data!



It will illuminate problems that daily summary (hourly) reports will mask!

Review Minute Data!

- Shows the stability of QC checks
  - Adherence to SOPs?
  - Good quality procedures?
- Opportunity to talk to QA staff and learn & observe their data handling procedures



Even More Records…

- Logbooks
- Chain of custody forms
- If it's not documented, it didn't happen!

Visit Field Sites

- Spread out!
  - Don’t just visit the sites that are near the central office!
  - Visit multiple sites to get a well-rounded view of the network
    - District offices, different operators
  - Auditors can break into teams, if needed, in order to maximize time

Field Operations

- Housekeeping
- Review logbooks
- Talk to the field technician!
  - Demonstrate procedures?
- Check sample lines
  - Proper plumbing?
  - Condensation free?
  - Approved materials?
- Evaluate Appendix E criteria
  - Take physical measurements!

Conducting TSAs: Post-Audit

Exit Briefing

- **Pre-meeting with audit team** to review all issues identified
- Categorize findings and develop a briefing summary
  - Outline with speaking points can be used as a framework for building the TSA report later!
  - Organize findings so that conversation flows in the most logical manner
  - Have regulatory citations on hand
  - Remember your audience!
- Be prepared to discuss potential corrective actions with agency staff

Conducting TSAs: Post-Audit

Exit Briefing

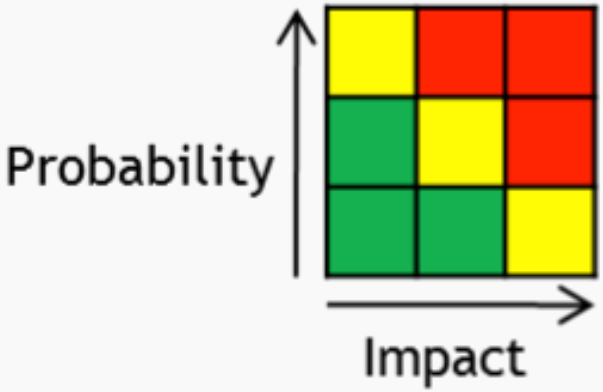
- **Face-to-face exit briefing is preferred**
  - Important to have the right people in the room during the meeting
- Clearly communicate the audit findings
- Be factual, concise, and professional
- Have team scribe take notes during the briefing, so any follow-up questions or requests are documented

A Few Words of Advice

- You can't account & plan for everything in a TSA
  - Findings revealed on-site (unplanned) may require additional records requests
  - Some findings may need additional research, analysis, or discussion with OAQPS
  - Discuss these pending issues during the exit briefing so there are no surprises!
  - Wrap up any post-audit information gathering within one week, if possible
- Follow-up conference call needed with agency to discuss outcome of additional analyses and/or to "close the loop" on outstanding issues

Write the TSA Report

- **Immediately start writing!!**
  - Details will still be fresh in the notes
  - If possible, request from management a week to focus solely on drafting the report
- Gather all logbooks and notes from audit team
- Document areas not reviewed during the on-site assessment, if necessary
- Route the report through internal technical and administrative review prior to issuance



Conducting TSAs: Post-Audit

The report should capture only the biggest ticket items!

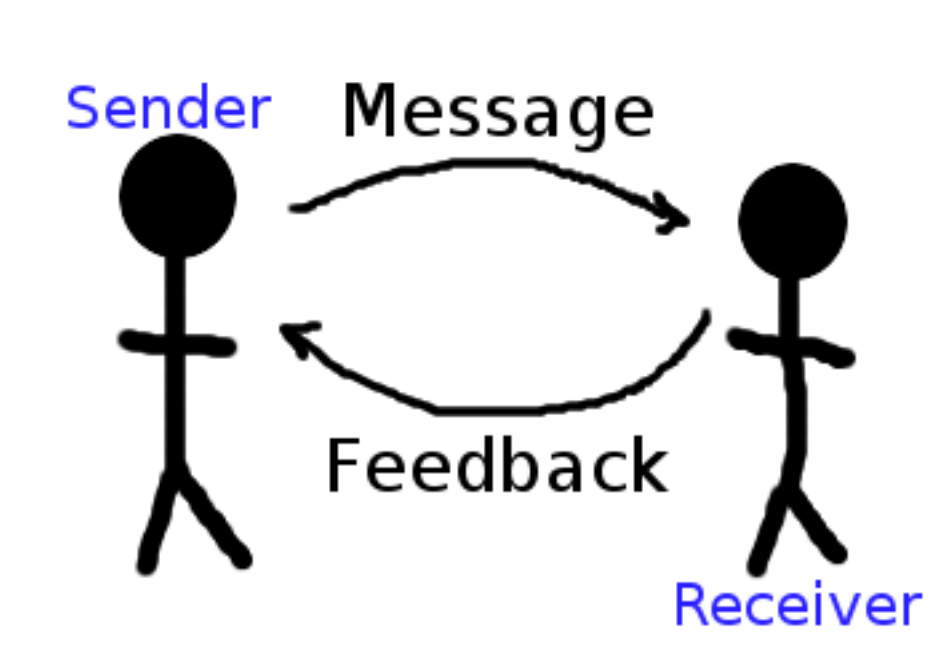
- Define Findings Categories
- Rank the findings in order to illustrate significance
- Provide clear, specific language in the report
  - Be concise and remember the audience!
  - Cite the appropriate regulations, QAPPs, SOPs
- Establish the minimum expected corrective action

Next Steps

- TSA does not end with issuance of report!
- Review agency response and Corrective Action Plan
- Track completion of corrective action items and assess efficacy
- Continue to communicate with agency & provide support until all identified issues have been successfully closed out

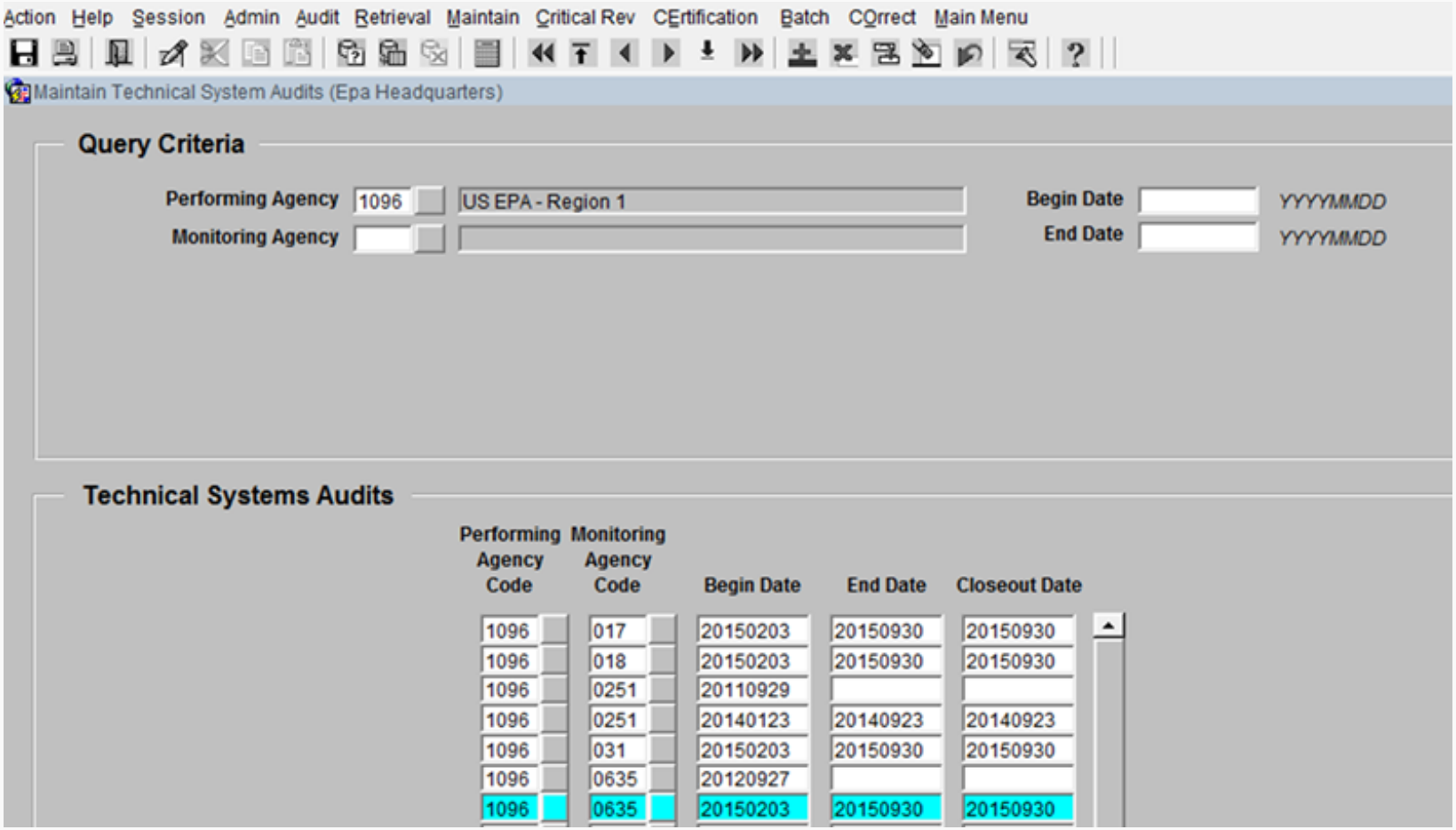
Conducting TSAs: Post-Audit

Continued communications and follow-through are critical to ensure success and high quality data!



Conducting TSAs: Post-Audit

Final Step: Enter the TSA close-out information in AQS!



TSA Workgroup

We have had general TSA Guidance in the QA Handbook for a while, but…

At the Atlanta National Monitoring Conference we found… **Regionally, we're all doing different things**

TSA Workgroup

So, we created the Technical Systems Audit Workgroup!

All 10 EPA regional offices invited to participate

Goal of the TSA Workgroup:
To develop a more consistent national TSA approach by:

- Developing audit guidance to guide all auditors in a consistent approach – Technical Systems Audit Guidance Document
- Building auditor expertise
- Developing audit tools
- Discussing audit follow-up
- Providing a forum to discuss audit findings and actions

TSA Workgroup

What's going on right now?

Meet every three weeks

Major focus right now is developing the TSA Guidance Document (TSAGD)

- Discussed how each region does TSAs according to section
- Completed rough drafts of all Sections
- Developing a new Excel-based TSA Questionnaire
- Regional participation in writing the sections
- Plan to include audit templates specific to pollutants and/or networks
- Looking to have a draft by end of the year

TSA Workgroup

Where are we going in the future?

- **Development of statistical tools to analyze monitoring and QC data**
- **Conduct webinars for auditors to develop auditing skills**
- **Provide a forum to discuss TSA audits with a national group of auditors**

TSA Workgroup

At the end of the day, what do we want?

- All regions to use a **consistent audit approach**
- A **guidance document** for TSAs that documents **requirements and best practices** we can all follow
- **Trained, technical auditors** that can efficiently assess a network
- An **independent forum** where auditors can ask questions about auditing and techniques
- **Consistent follow-up after audits to solve issues** discovered in the audit

Finally, and most importantly, we want to ensure quality data is being generated from our monitoring networks!

TSA Benefits

TSAs aren't just for EPA…

- One of the best practices an air agency can implement is to conduct **internal systems audits** on a routine basis!
- Include in QAPP
- States, locals, and tribal QA Staff

TSA Benefits

Mimic the EPA!

- Use same approach as the federal TSA!
- Develop a TSA audit form based on your agency's quality system requirements
- Develop audit schedule
  - Recommend annual audits, at minimum
- Document findings in reports routed through chain-of-command

Internal TSA Benefits

- Illustrates areas where supplemental training may be beneficial
- Prevents data loss
- Improves overall data quality
- Enhances quality system
- Small issues won't become big issues!
- Significantly reduces EPA findings during the regulatory TSA!