Data Review, Validation and Verification

“All data should be considered VALID unless otherwise proven invalid”

- Reggie Smith, California Air Resources Board
- PQAO Training 2017
FRIDAY, 4.59PM
Training Objectives

- Define data review, verification, and validation
- Discuss QA handbook critical, operational and systematic criteria
- Describe general task performed for a multi-level data review
- Review basic AQS upload process and common upload issues
Define Terms

- Data review – Day to day actions used to accept, reject or qualify data in an **objective** and **consistent** manner.

- Data validation - evidence that the particular **requirements for a specific intended use** are fulfilled.

- Data verification - evidence that **specified requirements** have been fulfilled.
Data Validation Criteria

- Code of Federal Regulations
- QA HB Vol II (Appendix D)
- SOP & QAPP’s
- Instrument Operating Manuals
- Quality Assurance Bulletins
- Critical Data Validation Criteria (red)

<table>
<thead>
<tr>
<th>Ozone Validation Template</th>
<th>2) Frequency</th>
<th>3) Acceptance Criteria</th>
<th>Information / Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Point QC Check Single analyzer</td>
<td>1/2 weeks</td>
<td>≤ ±7% (percent difference)</td>
<td>1 and 2) 40 CFR Part 58 App A Sec 3.2</td>
</tr>
<tr>
<td>Zero/span check</td>
<td>1/2 weeks</td>
<td>Zero drift ≤ ± 1.5 ppb Span drift ≤ ± 7%</td>
<td>1 and 2) QA Handbook Volume 2 Section 12.3</td>
</tr>
</tbody>
</table>

- Operational Criteria (yellow)

<table>
<thead>
<tr>
<th>Verification/Calibration</th>
<th>Frequency</th>
<th>Acceptance Criteria</th>
<th>Information / Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon receipt/adjustment/repair/installation/moving and repair and recalibration of standard of higher level 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily</td>
<td>1/year</td>
<td>All points within ± 2% of calibration range of best-fit straight line Linearity error &lt;5%</td>
<td>1) 40 CFR Part 50 App D 2) Recommendation 3) Recommendation - Linearity error 40 CFR Part 50 App D Multi-point calibration (0 and 4 upscale points) 40 CFR Part 50 App D sec 5.2.3</td>
</tr>
</tbody>
</table>

- Systematic Criteria (green)

<table>
<thead>
<tr>
<th>Sample Residence Time Verification</th>
<th>Frequency</th>
<th>Acceptance Criteria</th>
<th>Information / Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/year</td>
<td>&lt; 20 seconds</td>
<td></td>
<td>1) 40 CFR Part 58 App E, section 9 (c) 2) Recommendation 3) 40 CFR Part 58 App E, section 9 (c)</td>
</tr>
</tbody>
</table>
QA Handbook
Validation Criteria

- **Critical** – Observations not meeting each and every criterion should be invalidated unless there is a compelling reason.

- **Operational** – A violation of these may be a cause of invalidation.

- **Systematic** – Important for interpretation of data but usually do not impact data validity.
Critical Criteria for Continuous PM$_{2.5}$

<table>
<thead>
<tr>
<th>1) Criteria (PM$_{2.5}$ Cont)</th>
<th>2) Frequency</th>
<th>3) Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CRITICAL CRITERIA- PM$_{2.5}$ Continuous, Local Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sampling Period 24 hour estimate</strong></td>
<td>every sample period</td>
<td>$\geq 75%$ (18) of hourly averages</td>
</tr>
<tr>
<td>Hourly estimates</td>
<td>Every hour</td>
<td>Instrument dependent</td>
</tr>
<tr>
<td><strong>Sampling Instrument</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average Flow Rate</strong></td>
<td>every 24 hours of op</td>
<td>average within 5% of 16.67 liters/minute</td>
</tr>
<tr>
<td><strong>Variability in Flow Rate</strong></td>
<td>every 24 hours of op</td>
<td>$CV &lt; 2%$</td>
</tr>
<tr>
<td><strong>One-point Flow Rate Verification</strong></td>
<td>1/mo</td>
<td>$\pm 4%$ of transfer standard $\pm 5%$ of flow rate design value</td>
</tr>
<tr>
<td><strong>Reference Membrane Span Filter Verification (BAM)</strong></td>
<td>Hourly</td>
<td>$\pm 4%$ of ABS Value</td>
</tr>
</tbody>
</table>

BAM Specific Critical Criteria
Best practices or rule of “thumb”

- Standard procedures/QAPP
- Review data frequently (recommended daily)
- Clear concise notes and logs
- Timely reviews/reporting (data review schedule)
- Document retention
- Flag missing or invalid data (reason???)
AQS Data Codes and Flags

- Referred to as Qualifier Codes in AQS
- 4 Types
  - Quality Assurance (code)
  - Null (code)
  - Informational (flag)
  - Request for Exceptional Event (flag)

- Typically can be applied at any review level
- Be consistent
- Most data systems can auto apply codes/flags
Automated QC Checks

- Done by most Data Management Systems
- Typical screening criteria
  - Min/Max values
  - Rate of change (hourly)
  - Sticking or repeating values
  - Excessive negative values
- May not work at every site
- Not take place of manual reviews
Multi-Level Data Review Process

- General multi-level review process
  - Station Operator (1st Level)
  - AM Specialist (2nd Level)
  - AM Lead / AM Supervisor (3rd Level)

- Same person may accomplish two levels at small agencies
<table>
<thead>
<tr>
<th>Level 1</th>
<th>Goal</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Distinguish measurements from measurement errors or interferences</td>
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</table>

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Goal</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Verify Level 1 review and ensure data quality control requirements are met</td>
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</table>

<table>
<thead>
<tr>
<th>Level 3</th>
<th>Goal</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Approve agency data suitability for release to AQS</td>
</tr>
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</table>
1st Level Reviewer Tasks

- Most important step in the review process
- Documentation
  - QC forms
  - Station logs
  - Control charts
- Missing data or downtime
- Instrument operation
- Flag suspect data for further review
2nd Level General Tasks

- Data Verification
- Review site operator edits/notes
- Quality Control review
  - 1-point QC checks
  - Flow rate verification
  - Preventative maintenance
- Mins, Maxs, NAAQS, SAAQS
- Site Buddy Checks
3\textsuperscript{nd} Level General Tasks

- Review data capture rates and completeness
- Request for exceptional events
- Sign data validation letter/memo
- Approve data for upload to AQS
AQS Upload

- **Basic AQS upload process**
  - Stage, Load, Post

- **Direct submitters v ARB reporting agencies**

- **Common AQS Upload issues**
  - No monitor available in AQS
  - Uploading over existing data
  - Inconsistent POC
AQS Upload Process
Post AQS Data Confirmation

- QA Bulletin 005
- Ensures AQS uploads are accurate and complete
- Quarterly Reviews
  - AMP256 – Data Quality Indicator
  - AMP350 – Raw Data
  - AMP430 – Data Completeness
- Annual Reviews
  - AMP600- Certification Evaluation
Summary

- Define Terms
- Data Validation Criteria
- General multi-level review process
- AQS submittal process
REMEMBER!!

“All data should be considered VALID unless otherwise proven invalid”
Break Out Sessions

Data Validation/Certification
- Room - Mountain Vista 1
- 1:45 – 3:15 pm (session 1)
- 3:30 – 5:00 pm (session 2)
  - Janice Lam Snyder (Sac Metro)
  - Nathan Trevino (San Joaquin)

AQS
- Room - Auditorium
- 1:45 – 2:25 pm (session 1)
- 3:30 – 4:10 pm (session 2)
  - Jennifer Williams (US EPA)