

SPECIAL POINTS
OF INTEREST:

- **OIG Management Alert**
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- **QA Handbook Finished**
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- **Low Concentration Webinars Answer Questions**
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The QA EYE

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Office of Inspector General Issues Management Alert

On January 8, 2016, the Office of Inspector General (OIG) initiated a project to evaluate data from the ambient air program. The stated purpose was to pursue the following questions:

- Do data revisions comply with EPA criteria?
- Do data exclusions or gaps comply with EPA criteria?

Although their review continues, OIG was aware that ozone design values would be evaluated very soon and in order to be helpful, issued a Management Alert on February 6, 2017 titled: "Certain State, Local, and Tribal Data Processing Practices Could Impact Suitability of Data for 8-Hour Ozone Air Quality Determination." which identified a number of QA related issues.

OAQPS has responded to the management alert and will be addressing some of their findings through corrective action. The

Alert and the OAQPS response can be found at <https://www.epa.gov/office-inspector-general/report-certain-state-local-and-tribal-data-processing-practices-could>.

OIG identified three issues so far: 1) Incorrect implementation of automatic zero adjustment of data, 2) monitoring organizations that were not implementing critical criteria as recommended in Appendix D of the QA Handbook (i.e., the Validation Template), and 3) QAPP revisions not occurring within a 5-year timeframe.

Zero Adjustment of Ozone Data

Some ambient air monitors are capable of making automatic zero and span adjustments. According to EPA's 2013 Quality Assurance Handbook, the proper process includes the zero air going through the sampling lines and the monitor, performing the zero

test every 24-hours, and saving the original results (before the adjustment) and the adjusted results for further review. The adjustment to the data is made to the data going forward (after the test) and not intended to correct any data prior to the test.

As part of the evaluation of this finding, OAQPS asked each Regional office to contact their states to determine the extent of zero adjustment procedures. Out of the 152 Primary Quality Assurance Organizations (PQAOs) in the national network monitoring for ozone, 137 PQAOs (or 90 percent) do not zero adjust, and 15 PQAOs (or 10 percent) have performed zero adjustments within 2013-2015. In summary, the majority of states are not performing the zero adjustment and some plan on discontinuing the practice.

Continued on Page 2

QA Handbook Vol II Finished.... Never!

OAQPS posted the 2017 revision of the QA Handbook on AMTIC in January 2017. With the March 28, 2016 revisions to 40 CFR Appendices A and B (see QA EYE Issue 20), the recent data quality issues surrounding PM2.5 and more recently ozone (see article above), a revision was in order. The 2017 document addresses the Appendix A revisions and provides updates to newer technologies. Two new appendices were added:

Appendix K- Guidance on the Verification of Zero Air Generators. Thanks to Yousaf Hameed (Clark County, NV), Mat Plate (Region 9), and Dennis Mikel (OAQPS) for drafting this appendix.

Appendix L-Rounding Policy for Evaluating NAAQS QC/QC Acceptance Criteria. There was a request from monitoring organizations to have a consistent policy across the regions on rounding. Region 4 had developed a policy that the EPA Regions agreed to adopt. We used this policy to revise the validation templates. *Continued on page 4*

Office of Inspector General Management Alert (continued from page 1)

EPA Guidance has always discouraged span adjustments. Although we did not encourage zero adjustment, it could be implemented under certain conditions. In the Jan 2017 QA Handbook Vol II, we have revised the language to the following:

“EPA discourages the use of either adjustment but considers automatic zero adjustments reasonable when: 1) the automatic zero standards pass through the sample inlet and sample conditioning system, 2) the zero point/adjustment is performed daily, and applied to the following 24-hour period, 3) the zero reading is within the 24-hour acceptance criterion, and 4) both the adjusted and unadjusted zero response readings can be obtained from the data recording device. Zero adjustments cannot be used to correct data prior to zero test.”

The 2017 Handbook language on zero adjustment is not significantly different than the 2013 document. Information in bold was added to the 2017 QA Handbook. EPA included language that the use of both adjustments are discouraged since they may mask issues in the zero test systems that should be corrected rather than “adjusted away.” We also added some language in step two and the last sentence to make it clear the adjustment is applied to data collected after the zero test, not the data collected before the zero test. The 2017 document also added step three to ensure that the zero test is within the 24-hour acceptance critical criteria in the gaseous validation templates in the QA Handbook.

In some cases, the OIG did not observe the zero test being run through the sample inlet (through the probe). In addition, we became aware that one of the data logging systems has a software program called the “EPA Two Step Zero Adjustment.” In talking to the software vendor, this adjustment may very well be something another EPA (from another country) asked to be developed. It has not been developed for or endorsed for use by the US EPA and should not be used. This command takes the difference between a previous zero test value and the next zero test value (approximately 24 hours apart) and then does a prorated post adjustment of the 24-hour data between the two zero values to adjust the routine data between the two tests. This process is inconsistent with Step 2 in the guidance above that requires the zero test and the correction to be applied only to the data following the test.

Critical Criteria in Validation Template

Another issue the OIG identified that OAQPS is focusing on is the implementation of the ozone 1-point quality control (QC) checks and whether monitoring organizations are following their QAPPs in regards to invalidating data failing to achieve the 1-point QC acceptance criteria of $\pm 7.1\%$.

The 1-point QC check is a critical criteria in the validation template, and along with the zero and span checks, have long been used to determine the validity of the routine data.

Critical is defined in Appendix D of the QA Handbook as follows:

“Observations that do not meet each and every criterion on the Critical Criteria should be invalidated unless there are compelling reason and justification for not doing so. In most cases, this criterion can identify a distinct group of measurements and time period. The sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated. Typically, EPA Regional Offices will be in the best position to assess whether there are compelling reasons and justification for not deleting the data. The evaluation will be informed by a weight of evidence approach, consider input from States/locals and EPA’s national office, and be documented”

From a QA perspective, the ozone 1-point QC check is not a difficult requirement to meet. It was developed and agreed to by a Workgroup made up of EPA Regions and monitoring organizations prior to completion of the QA Handbook in 2008. Figure 1 demonstrates that for 2014-2016 data, about 99% of the checks are within the $\pm 7.1\%$ criteria and about 96% are within $\pm 5\%$. Since the ozone NAAQS are based on daily maximum 8-hour values, the precision and bias for the daily maximum is reflected by the precision and bias estimates of the 1-point QC checks before and after each daily maximum value. Therefore, meeting the acceptance criteria during each check is critical to ensuring the quality of data for a particular time period. *Continued on Page 3*

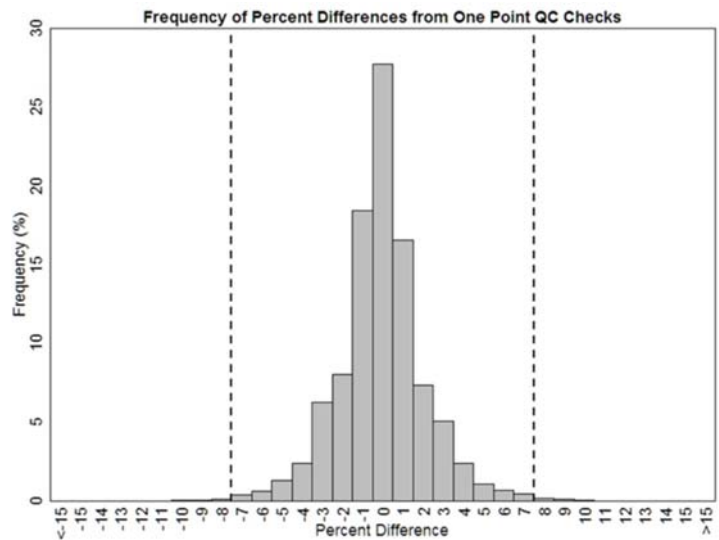


Figure 1. Frequency distributions of 1-point QC checks in AQS 2013-2015

Office of Inspector General Management Alert (continued from page 2)

The 2014-2016 data also showed that about 72% of the ozone monitors nationwide had all 1-point QC checks meeting the $\pm 7.1\%$ criteria over the 3-year period. Another 19% of the monitors had one to three 1-point QC checks not meeting the $\pm 7.1\%$ criteria over the 3-year period, leaving 9% of the monitors with four or more 1-point QC checks not meeting the $\pm 7.1\%$ criteria over the 3-year period.

There are only 3 critical criteria checks associated with the 4 gaseous criteria pollutants; the zero, span and 1-point QC check; the 1-point QC is the only one of the three that's reported to AQS. Most monitoring organization QAPPs follow the QA Handbook language and invalidate data back to the last acceptable QC check. However, we are seeing, as described above, about 1% of the QC data showing exceedances of the 7.1%, with some exceedances being fairly high. The EPA Regions and monitoring organizations are working together to review these data and either invalidate routine data around the exceedance, or determine whether there is compelling evidence to keep the routine data. Compelling evidence is data, such as an independent audit point(s) or a multi-point verification, that establishes whether the analyzer was in fact operating within precision and bias acceptance criteria. Regions should minimally review the compelling evidence to ensure that the decisions are appropriate. OAQPS and the Regions are also working together to develop a null code/flagging technique that will provide a consistent process to identify the data.

We encourage monitoring organizations, upon a failure of critical criteria, to take immediate action (root-cause analy-

sis and corrective action) to bring monitoring systems back into compliance in order to prevent any additional data loss.

QAPP Revision

The OIG found that about 38% of the monitoring agencies did not have ozone monitoring QAPPs approved within the last 5 years. OIG also found that monitoring organizations were not implementing what they wrote in their QAPPs. EPA has already taken steps to improve the timely development and revisions of QAPPs:

- The 2016 ambient monitoring rule requires monitoring organizations and the regions to record QAPP submittals and approvals in AQS.
- During annual data certifications, the AQS AMP600 Certification Evaluation and Concurrence Report will flag any PQAO whose QAPP approval is more than 5 years.
- EPA will develop a report, by PQAO, of agencies whose QAPPs are > 5 years and request that they correct this situation prior to the 2017 data certification process.

OAQPS will wait until end of May and pull an AQS report of all monitoring organizations (by pollutant) whose QAPP is over 5 years old. Since QAPP reports were posted on AMTIC in the past, we are contemplating posting this report on AMTIC and informing the Regions to engage their monitoring organization to revise QAPPs.

In some cases a 5-year revision to a QAPP does not include a total re-write and resubmission of a document. OAQPS will develop guidance, with Regional input, on more efficient ways to revise QAPPs that may currently be technically sound but for a few minor revisions.

Low Level Audit Concentration Webinars Answer Questions

The March 28, 2016 revision to the 40 CFR Appendix A criteria for the Annual Performance Evaluation caused quite a stir at the August 2016 National Ambient Air Conference. The Annual PE revision called for monitoring agencies to audit at a point 2-3 times the MDL of the monitors in use. More details on the requirements can be found in 40 CFR Part 58 Appendix A Section 3.1.2, as well as Issue 20 of the QA EYE. Two people in EPA that have

been tackling the issue of low concentration audits are Avraham (Avi) Teitz from EPA Region 2 and Chris St. Germain from EPA Region 1. Avi and Chris provided a presentation of their work at the Conference. Since it's hard to see everything you want at the conference, OAQPS asked Avi to provide a few webinars of his material.

Avi welcomed the opportunity and has provided two webinars: one on January 24, and the second on March 28. Both Webinars were recorded and are post-

ed along with the slides on AMTIC at: <https://www3.epa.gov/ttn/amtic/qatraining.html>. The webinars include a host of great questions from the monitoring organizations that Avi answers. The bottom line: with the right equipment, standards, and care, these audit concentrations can be achieved. On another front, EPA is also pursuing an assessment of the MDLs that are reported to AQS from monitor vendors. See the article on page 9.

Update on the CSN Mega PE and National Gravimetric Lab Round Robin

After a longer than expected hiatus following the transition of the annual CSN Mega PE and biannual National Gravimetric Lab Round Robin PE programs from the Office of Radiation and Indoor Air (ORIA) to OAQPS, both programs are poised to resume this summer.

The primary reasons for the extended delays are:

1. The equipment received from NAREL required extensive servicing and refurbishment. Rather than invest funds on the old equipment (or spend more than desired on new equipment), OAQPS developed a sampling array (picture on right) to make the filter loading effort needed for both programs more expeditious and efficient;
2. It was determined that to manually weigh the number of filters required for the two programs would be excessively time-consuming.

As a result, OAQPS joined with ORD to use their MTL Automated Filter

Weighing System. However, due to lack of consistent usage, this system required calibration and routine maintenance to ensure accuracy in the filter weighing process.

The completion of both of these efforts took much longer than anticipated. As a result, both the CSN Mega PE and the gravimetric round-robin were halted until everything could be completed to OAQPS's satisfaction.

Sampling array design – the sampling ar-

ray was designed by Jenia Tufts, with the goal to mimic the Met One SuperSASS. Essentially, there are four sampling heads with eight (8) PM2.5 sampling ports to allow for the collection of thirty-two (32) collocated filter samples. The array was completed in March 2017, and replicate testing is

scheduled to occur during the month of May (to ensure the loaded filters are all within 5%). Once the system has been verified by comparing gravimetric results, and QC criteria are met, OAQPS will begin collection of both MegaPE and PM2.5 Round Robin filters, which are anticipated to be sent to participating laboratories in the summer of 2017. - *Solomon Ricks and Jenia Tufts*



QA Handbook Vol II Finished (Continued from Page 1)

The validation templates were revised to ensure that they reflect recent validation decisions. In order to help the monitoring organizations identify these changes, OAQPS compared the 2013 validation template to the 2017 version and posted it on AMTIC at: <https://www3.epa.gov/ttn/amtic/qalist.html>.

During this comparison we found a few minor changes that were needed for the 2017 validation templates initially posted in January 2017. We posted a revised version of the validation templates in March 2017 and also posted a document called "Minor

Changes to the January 2017 Version of the Validation Template" at the same site identified above. The validation templates do change more frequently than the QA Handbook, so OAQPS decided not to embed the Validation Templates (Appendix D) in the QA Handbook but left the Appendix in the document with a URL to the AMTIC location. If any changes occur to the Validation Template prior to the next Handbook revision they will be posted on the "Minor Change" table described above along with the date of the change. OAQPS will also provide a memo to the EPA Regions of the change that can be disseminated to the monitoring organi-

zations, and post a new date on the AMTIC Table that will alert those reviewing the site to changes.

We thank the EPA and monitoring organization staff on the QA Handbook Workgroup for their review, comments, and cooperation. Revising this Handbook is always a major endeavor and can't be accomplished without the efforts of all in our monitoring community. We hope we are good to go for the next 3-5 years. With sensor technologies increasing in use, accuracy and sensitivity who knows... the Handbook is never finished!

Availability of PM2.5 Data Quality Visual Assessment

A new automated PM2.5 Data Quality Visual Assessment application is being developed (see: https://sti-r-shiny.shinyapps.io/QVA_Dashboard/). Assessment outputs are expected to be available through a web site that allows users to select any PQAQ of interest. The assessment application is expected to have three major advantages over existing assessments:

1. the data are visualized, allowing lots of information to be illustrated in a concise way;
2. the assessment will compare the PQAQ of interest to all other PQAQs, allowing agencies to understand if their program's data quality is similar to other agencies or perhaps an outlier; and,
3. the assessment application is expected to remain openly available so that users won't have to worry about tracking user IDs and passcodes. In this way, we hope that users will efficiently find their programs PM2.5 FRM data quality.

We took this project on as we continue to hear positive feedback on the one-page PM2.5 Continuous Monitor Comparability Assessment. However, it's hard to know if you're getting good PM2.5 continuous monitoring data without knowing the quality of your FRM data. This new assessment on the FRM data quality is an attempt to efficiently answer this question.

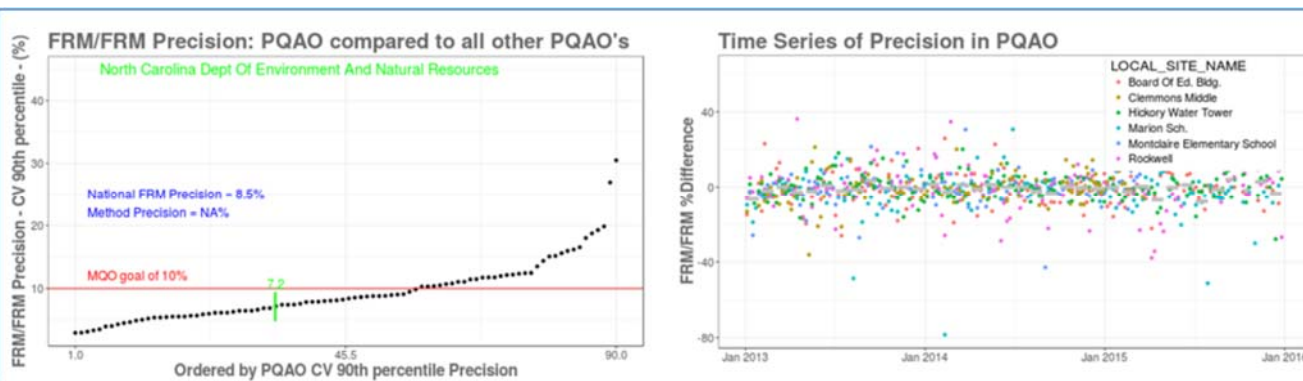
The PM2.5 FRM Data Quality Visual Assessment is being designed to cover four indicators of PM2.5 FRM data quality:

- Collocated Precision;
- Bias via the Performance Evaluation Program;
- Flow rate audits/flow rate verifications; and,
- Field blanks.

Below is an example of how the Collocated Precision is displayed in the tool. On the left side of the page we provide the national precision (8.5%) for the three-year period, as well as show the selected PQAQ compared to all other PQAQ's. The red line represents the measurement quality objective goal for collocated FRM methods (i.e., the upper 90 percent confidence limit for the coefficient of variation is within 10 percent). In this way agencies can see both if they meet the MQO, and how they compare to other PQAQs. On the right side of the page we provide a time series for the % difference of the individual precision checks within the PQAQ selected. Sites are color coded in the time series.

Other functions we are working on for the assessment tool include allowing individual monitoring agencies within a PQAQ (when there are multiple monitoring agencies within one PQAQ) to see their data visualized in the assessment, allowing any three-year block of data to be selected, and allowing the method of interest (if an agency operates more than one FRM method) to be selected. We are able to do this work without user IDs and passwords by utilizing outputs of data from the DataMart that are made available to an R-shiny server where the code is run. Since this is a read-only application, user IDs and passwords are not necessary. Our current thinking is to update the dataset once a week, which we will revisit as we take more assessments into production. Therefore, as data are updated in AQS, within a week they would be available for visual assessments.

While we are still developing this project with STI, we are sharing details now for those agencies interested in taking a look. Also, we intend to use visual assessments of data quality for other pollutants, so if there is an interest in providing feedback, we welcome any comments on this work. Please email any comments to Tim Hanley in EPA's Ambient Air Monitoring Group (hanley.tim@epa.gov). –Tim Hanley



Managing Ozone Quality Assurance and Maintenance Activities While Maintaining a Complete Day

The new ozone standard, as explained in 40 CFR Part 50 Appendix U, only considers 8-hr averages between start time 07:00 and 23:59, so taking a monitor offline for QC (calibrations, annual PEs, NPAP, zero, span, I-point QC) or for maintenance purposes for as little as 3 consecutive hours can invalidate the entire day (i.e., rule requires 13-17 start hours with at least 6 of 8 hourly values available). Figure 1 demonstrates that three-hour down time in the middle of the day equates to only 11 valid 8-hour blocks. Monitoring organizations should take this tighter limit into consideration when performing maintenance, QC, and/or audits.

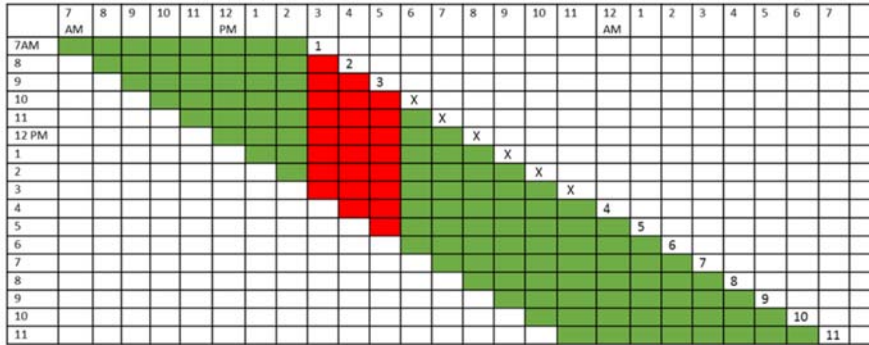


Figure 1. Incomplete day with only three hour down-time period

Within any one day (start day at 07:00) a monitoring organizations can, at a maximum, be offline for six consecutive hours from 7:00 AM until 12:59 PM and still manage to complete a day (see Figure 2). In addition, the monitor cannot be offline for more than two hours in any other 8 hour block until 7 pm. So, a monitoring organization can still perform zero/span/precision checks at night (example 11-12 QC) and meet the completeness requirement.

Figure 3 is similar to Figure 2 in that it still demonstrates a complete day but places the 2 hours for the zero/span/precision checks at 5:00 to 6:59 PM and, in this way, effects fewer 8-hour blocks than the scenario in Figure 2. Traffic sometimes causes spikes in the evening, especially in downwind areas, which may be a reason to avoid QC checks around midnight, but by 5:00 AM ozone is usually low everywhere and may be the optimal time to perform these automated QC checks.

If the QA/maintenance is performed during the early morning hours (5:00 AM – 8:59 AM local time), then the monitor can be offline for up to 4 hours and not even lose a single 8-hour average since some down time would be equated to the previous day, and part of the downtime would be equated to the current day. The monitor can actually be offline for up to 8 hours (3:00 AM – 10:59 AM local time) and still get credit for the day since you would be losing hours for the previous day (3:00-6:59 AM) and the next (7:00- 10:59 AM).

To summarize, it is important to know the completeness requirements of the new ozone rule. There are a number of permutations beyond those that are presented here that will allow for

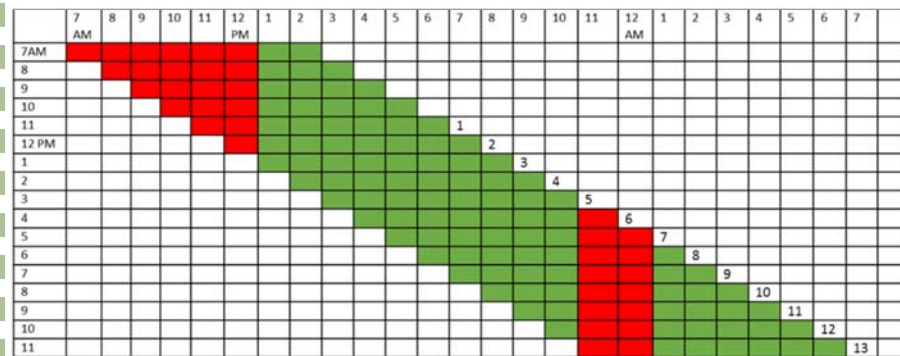


Figure 2. A complete day for a 24 hour day starting at 7:00 with 8 hours of down time.

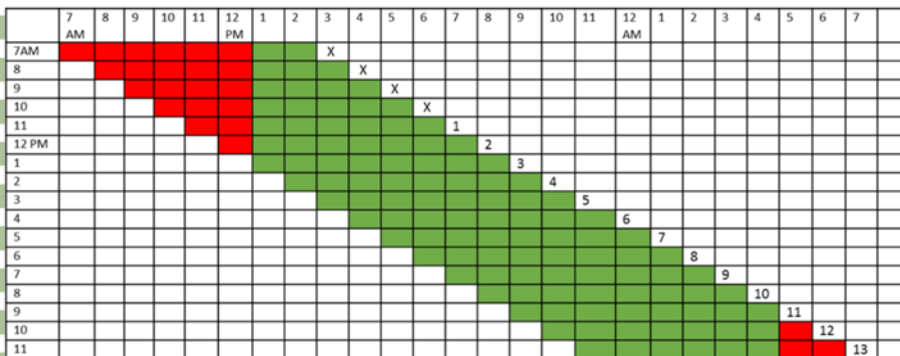


Figure 3. A complete day for a 24 hour day starting at 7:00 with 8 hours of down time

down time while meeting data completeness for a 24-hour day starting at 7:00 AM. The following are a few general suggestions:

- Review the scenarios above with operators and QA staff and develop acceptable time periods for any down-time work.
- Strive to get work done before 10:00 AM to avoid running up against the critical time period due to unforeseen circumstances and to avoid elimination of high ozone concentration 8-hour blocks. A 3-hour QC check can be performed from 1:00-10:00 AM
- Try to automate zero, span, and I-point QC for early morning hours (5:00-6:59 AM).
- If a high ozone day is forecast and QC (Annual PE Audits or a NPAP Audit) and/or maintenance activities are not critical, consider postponing this work for a “cleaner” day. -Chris Hall & Ben Wells

The Performance Evaluation Program (PEP) Bias: An Enigma of Our Success in Reducing PM2.5

Taken from “Determining PM2.5 Sampler Bias at Low Ambient Concentrations” a poster at the National Ambient Air Monitoring Conference August 8-10, 2016, by Dennis Crumpler, PM2.5 Performance Evaluation Program Lead, US EPA, OAQPS; Robert A. Lordo, Ph.D., PMP, Battelle Memorial Institute; Ian C. MacGregor, Senior Research Scientist, Battelle Memorial Institute

Part II: The effect on bias when a majority of measured concentrations fall below 10 µg/m3

While EPA’s regulatory initiatives have contributed to an overall reduction of ambient PM2.5 concentrations in recent years, this success has ironically created a conundrum for the individual monitoring organizations’ achievement of the PM2.5 Network “bias” Data Quality Objective (DQO), prescribed by **40 CFR Part 58 Appendix A, Section 2.3.1**. This DQO states that the percent difference between a reference measurement (acquired within a PEP sampling event) and the SLT coincident routine 24-hour measurement should be within ±10%. The complicit requirements are:

- The frequency of PEP sampling events per year and per primary quality assurance organization (PQAO) is either 5 or 8, as stated in **40 CFR part 58 Appendix A, Section 3.2.4**
- The one-year aggregation period for SLT—PQAO bias assessments found in the PM2.5 Federal Reference Method, **40 CFR part 50 Appendix L, Section 4.3, and at 40 CFR part 58 Appendix A, Section 3.2.4**
- The 3 µg/m3 cut-off for ambient air concentration measurements entering into the average bias calculation at **40 CFR Part 58, Appendix A, Section 3.2.4** and finally,
- The PM2.5 FRM method lower detection limit (2 µg/m3) at **40 CFR part 50 Appendix L, Section 3.1**. You might recall from Part I of this series that over the past several years the PEP MDL is 0.8 µg/m3 based a similar determinant methodology.

The equation for bias as given in **Appendix A, Section 4.1.1 and 4.1.2** is shown below.

From **40 CFR Part 58 Appendix A Sections 4.1.1 & 4.1.2**

$$\text{Bias} = \frac{1}{n_j} \sum_{j=1}^{n_j} \left(\frac{\text{SLT} - \text{PEP}}{\text{PEP}} \right)_j \times 100\%$$

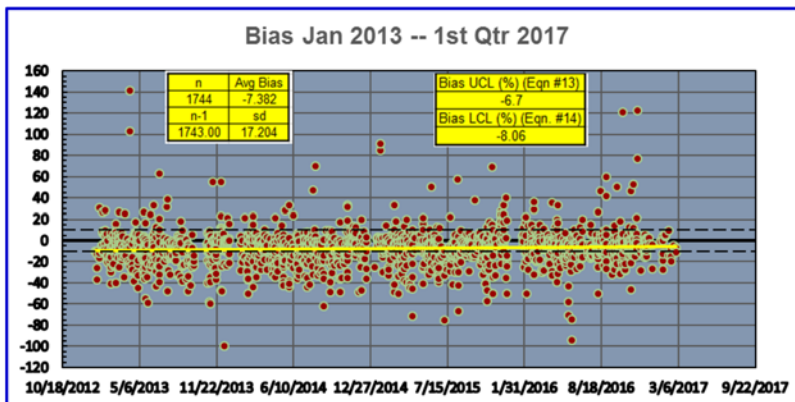
where n_j is the number of bias pairs to be averaged. Note that this term $\left(\frac{\text{SLT} - \text{PEP}}{\text{PEP}} \right)_j$ is “ d_i ” in Equation 1 of Appendix A.

See the DASC tool at <https://www3.epa.gov/ttn/amtic/files/ambient/qaqc/dascv3.xls>

The most desirable bias result is when the above average bias trends to zero. This occurs, for example, when the matched PEP and SLT sample measurements are nearly identical for all measurement pairs in a given data set (i.e., for a given PQAO demonstration).

We assess bias in our national network by aggregating bias measurements from all PEP sampling events across all PQAOs over 3 years. Figure 1 portrays national network bias by plotting the percent difference between paired SLT and PEP sample measurements versus time, for over 1,700 data pairs collected from January 2013 through 1st Qtr. 2017. This plot utilizes data stored in AQS and was generated using our Data Assessment

Statistical Calculator (DASC) tool. See <https://www3.epa.gov/ttn/amtic/qareport.html>



Note that the percent differences in Figure 1 include pairs for which at least one of the two PM2.5 concentrations is 3 µg/m3 or less, which would be excluded from calculation of average bias according to Appendix A. The interval (-10%, +10%) is represented by dashed lines in Figure 1 and is the range within which percent differences for individual sample pairs satisfy the DQO for bias. *Continued on page 8*

Figure 1. National Bias data pairs from Jan 2013 – 1st QTR 2017 Including data pairs with at least one concentration ≤3 µgm3

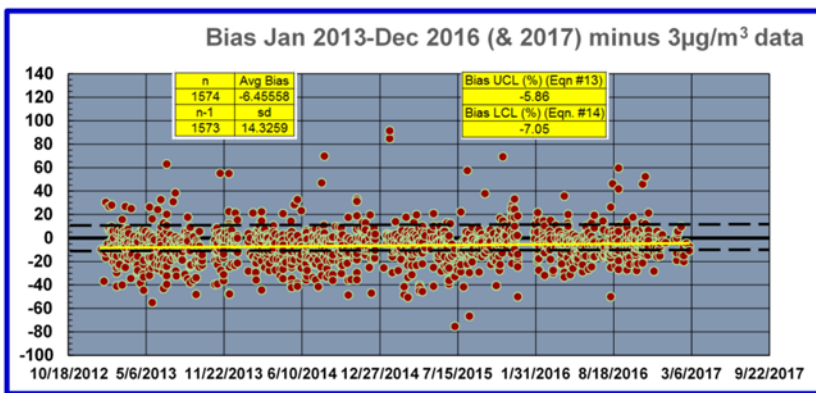
PEP Bias (Continued from page 7)

The average bias in Figure 1 is -7.4%. Historical 3-year averages have ranged from -3% to -9% (see proceedings of the past National Ambient Air Monitoring Conferences; <https://www.epa.gov/amtic/national-ambient-air-monitoring-conference>). The trend depicted by the yellow line appears to show a small improvement over the period. The 90% confidence interval on the average bias, (-8.1%, -6.7%), expresses uncertainty in the average bias estimate (rather than uncertainty in percent difference for individual sample pairs). In other words, there is a high degree of confidence that the average bias over this period is negative and falls within this interval.

In part, the confidence interval associated with the average bias is driven by the large number of pairs included in the calculation. The standard deviation of the percent differences (17.2%) however, illustrates considerable variability exists among the pairs. Forty-four percent (44%) of the paired percent differences exceeded the ±10% DQO limits; of these differences, 84% of those are negative (i.e., differences that fall below -10%). The average absolute value of the percent differences plotted in Figure 1 is 12.8%, while the median is 8.8%.

For about two-thirds of the 1744 data pairs in Figure 1, the PM2.5 concentrations for the PEP sample is 10 µg/m3 or less, a range in which small differences between the PEP and routine sample concentrations can lead to large percent differences. The remainder of this article begins to explore the implications of this phenomenon.

There are 168 data pairs (9.6% of the percent differences plotted in Figure 1 for which at least one concentration in the pair is less than or equal to 3 µg/m3. The data set was purged of these pairs and replotted in Figure 2, to determine the extent to which they might contribute to the large overall standard deviation in the percent differences, and if their exclusion dramatically improve the average bias and associated confidence limits. (Recall that within the AMP 256 and AMP 600 reports, the AQS utilizes only data pairs for which both concentrations are greater than 3 µg/m3.)



Within Figure 2, 64% of the data pairs include PEP sample concentrations between 3 and 10 µg/m3. The average bias estimate over this four-year period (-6.3%) and the variability of the percent differences (as measured by the standard deviation: 14.9%) show small improvement from Figure 1. However, as in Figure 1, nearly 50% of the percent difference values plotted in Figure 2 exceed the DQO limits of ±10%. This supports the conclusion that very low concentrations are not the single causal factor in the prevalence of measurements falling outside the DQO. Among the 168 sample pairs excluded from Figure 2 (due to having at least one concentration in the pair less than or equal to 3 µg/m3), the average bias estimate is -17.5%, and 74% of the pairs have a percent difference exceeding the DQO limits of ±10%.

Figure 2. National Bias data pairs from January 2013 – 1st QTR 2017 excluding ≤3 µg/m³ data

In the average bias equation, as the true ambient PM2.5 concentrations at the monitoring site gets progressively lower, the measured concentration in the SLT sample must more closely approach the measured PEP sample concentration in order for the sample pair to achieve the ±10% DQO for bias. For example, when the PEP sample concentration equals 10 µg/m3, the paired SLT sample concentration must be between 9 and 11 µg/m3 for the sample pair to achieve the ±10% DQO. The additional example given by Figure 3 further illustrates the amplifying impact of decreasing concentrations on the bias assessment, assuming the absolute difference in the measurement is constant. (Recall again the method lower detection limit (MLDL) published for the PM2.5 Federal Reference is 2 µg/m3, but the PEP has a compelling

historical data base that supports a value of 0.8 µg/m3.)

The SLT sampler has produced a concentration measurement of 5 µg/m³ and the PEP sampler 6 µg/m³. According to Equation 1:

$$\text{Bias} = \left(\frac{5 \mu\text{g}/\text{m}^3 - 6 \mu\text{g}/\text{m}^3}{6 \mu\text{g}/\text{m}^3} \right) \times 100\%$$

A “1 µg/m³” difference yields a Bias = -17%

SLT and PEP values of 4 and 5 µg/m3, respectively, would yield a bias of -20%, etc.

Figure 3. Example illustrating the bias skewing effect of concentrations at or below 10 µg/m³.

Recall from Part I of this series that the Air Quality Analysis Group in 2016, published a finding via “Air Quality Trends” that by 2015, the national average of ambient PM2.5 concentrations had fallen below 10 µg/m3 (see <https://www.epa.gov/air-trends/particulate-matter-pm25-trends#pmnat>). The PEP has been concerned about the implications of this trend. Therefore, as part of our annual internal tracking, we pulled all SLT-measured concentrations (n=108,014) reported to AQS in 2016.

Continued on page 10

The Pursuit of the Method Detection Limit (MDL)

Over the years since we've been implementing our ambient air monitoring network, our average ambient air concentrations are falling and we have been encouraging our monitoring agencies to purchase more sensitive, precise and unbiased monitors. Our new QA rule (March 2016) requires monitoring organizations to implement the annual performance audits at lower concentrations and states the following for the selection of the audit concentration ranges:

The evaluation is made by challenging the monitor with audit gas standards of known concentration from at least three audit levels. One point must be within two to three times the method detection limit of the instruments within the PQAOs network, the second point will be less than or equal to the 99th percentile of the data at the site or the network of sites in the PQAO or the next highest audit concentration level. The third point can be around the primary NAAQS or the highest 3-year concentration at the site or the network of sites in the PQAO.

We posted a [technical memo](#) on this subject on 5/03/2016, where we provided the monitoring organizations a listing of the Federal MDLs for each monitor.

The main issue of concern with the monitoring agencies is the method detection limit (MDL). In the technical memo, we listed what we call the "Federal MDLs" for each method code that is in AQS. The Federal MDLs are reported to AQS by the ambient air monitoring lead in the Ambient Air Monitoring Group (AAMG) once a method is approved. Monitoring organizations are questioning the Federal MDLs and are asking how this value equates to the Lower detectable limit (LDL) requirement that can be found in Table B-1 of the FRM/FEM requirements in 40 CFR Part 53.

With the help of ORD, OAQPS set out to determine what the differences are with the LDL data and the Fed MDL data we currently have in AQS. It appears that:

1. The Federal MDLs provided in AQS are based on the detection limits provided in instrument manuals or technical brochures, and
2. The LDLs provided in instrument manuals or technical brochures do not match the LDLs that were calculated from the data provided in the FRM/FEM application. In the cases of the data reviewed for this evaluation, the LDLs in the applications are higher than those in the instrument manuals or technical brochures.

As an example, a vendor listed a detection limit in its specification and manuals that was about 4 ppb lower than the LDL derived from the application. Running the same application data set through the new MDL Method Update Rule (MUR), the MDL was about 0.2 ppb higher than the specification in the manual. While the FEM LDL was much higher than the vendor specification, the MUR MDL is also higher but might be a better Federal MDL for listing in AQS and would help the monitoring organizations select audit levels achievable for their calibration equipment and standards.

Over 2017, OAQPS will work with ORD and vendors to review their data, particularly for trace-gas monitors as well as any new monitors applying for FRM/FEM status. OAQPS has been in conversation with ORD on the possibility of adopting the MDL MUR methods but the timing, at present, may not be conducive for regulatory changes. However, with vendor support we may be able to apply reasonable ambient air MDLs to AQS.

OAQPS/Regional Office QA Meeting Planned for June

In the past, OAQPS and the Regions have been able to get together on an annual basis during the OEI National Quality Assurance meetings. Although we now get together for a day every two years following the National Ambient Air Quality Meeting, OAQPS and the Regional QA Contacts felt a number of issues have come up that need more time to discuss face-to-face. We are planning for a meeting the week of June 26 in Chicago. We have about 10 topics on the agenda to cover in a 3 day period. The theme of the meeting

will be developing a consistent approach to the way we implement our QA program across the country. The Regions have different experiences and expertise and the conversations will be helpful to all when coming to agreement on a final approach. The Regions and OAQPS have been working on a technical systems audit (TSA) guidance document for close to a year; the first day will be devoted to completion of that document. The remaining two days will cover topics ranging from:

- QA Consistency in quality system implementation

- handling of QMPs and QAPPS,
- revisions of established guidance and what new guidance is needed
- Visual data quality assessment tools
- Data validation. and
- Revisions to AQS

to name a few. If there is some quality system issue you'd like addressed contact your Regional QA coordinator. We can't promise that we'll get to it but it would be good to know the issues concerning the monitoring organizations.

PEP Bias (continued from Page 8)

Figure 4 contains summaries by region (and by those states that self-implement a performance evaluation program). Over the entire national network (last row of Figure 4), 75 percent of these SLT samples have measured PM_{2.5} concentrations that are below 10 µg/m³. These findings are consistent with the overall trend seen through 2015 and published previously by the Air Quality Analysis Group. In addition, about 7.5% of the samples in 2016 have measurements below 3 µg/m³; the overall mean concentration is 8.0 µg/m³, and the median is 7.0 µg/m³.

Keep in mind that Figure 4 summarizes concentrations measured in the actual SLT sampling network; we have incentive to try to plan PEP sampling events in periods when higher PM_{2.5} concentrations in ambient air are expected. It appears to have a small positive effect.

Region	# Samples	% < 3 µg/m ³	Mean	Minimum	10 th % ile	25 th % ile	Median	75 th % ile	90 th % ile	Maximum
1	5,450	17.6%	5.8	0.0	2.4	3.5	5.2	7.3	9.8	28.9
2	3,003	5.1%	7.8	1.1	3.5	4.8	7.0	9.9	13.0	33.6
3	13,532	5.6%	8.1	0.0	3.6	5.2	7.4	10.2	13.1	56.8
4	24,471	2.7%	8.0	0.0	4.1	5.4	7.3	9.7	12.3	105.7
5	21,540	7.0%	8.1	0.0	3.4	4.9	7.4	10.5	13.9	54.6
6	7,663	3.4%	8.3	0.1	4.1	5.6	7.6	10.3	13.2	53.7
7	6,515	6.2%	7.4	0.3	3.4	4.7	6.6	9.2	12.4	43.0
8	6,944	23.1%	6.5	0.0	2.0	3.1	4.9	7.5	11.6	67.2
9	11,564	6.7%	9.9	0.0	3.5	5.4	8.5	12.3	17.3	145.6
10	3,722	18.9%	7.5	0.0	2.2	3.4	5.3	8.6	15.5	111.2
MO	135	2.2%	8.9	1.8	4.8	6.4	8.0	10.6	13.7	27.8
NY	2,854	11.2%	6.8	0.0	2.9	4.0	6.1	8.8	11.5	27.1
PR	621	6.4%	7.3	1.5	3.2	4.4	6.3	8.5	14.2	45.9
Overall	108,014	7.5%	8.0	0.0	3.3	4.8	7.0	10.0	13.3	145.6

Figure 4. Distribution of SLT PM_{2.5} values for 2016, aggregated by EPA Region and three agencies self-implementing the PEP sampling events (Courtesy of Battelle Memorial Institute)

As shown in the previous figures, on average, 50% of the data will fall outside of the current DQO for bias when the PEP sample value is between 3 and 10 µg/m³, while this percentage declines to about one-third of sample pairs where the PEP sample value exceeds 10 µg/m³. We are seeing an increased probability that any one sampling event may fall outside the DQO for bias due to decreasing concentrations.

Because the SLT's bias assessments are determined on an annual basis, the PEP sampling frequency becomes a critical factor in the confidence level of the bias determination. Each PQAQ is required to perform only 5 or 8 PEP sampling events per year depending on the number of sites in its network. Recall that if either the PEP or SLT concentration measurement yields a result of 3 µg/m³, the pair is eliminated from the bias assessment. Also, as the overall ambient concentrations have decreased, the relative frequency of measuring values at 3 µg/m³ or lower has increased (see Part I of this series). The opportunity to perform additional PEP events in a given year are limited by time and money; therefore, it is very likely that a PQAQ might end-up with 1 or 2 PEP measurements short of the desired 5 or 8 sample pairs.

Consequently, we must conclude that when annual bias assessments involve fewer than 5 to 8 sample pairs, and when ambient air quality concentrations are consistently at or below 10 µg/m³, the sample pair will likely exceed the DQO (even though the differences between the PEP and SLT sample measurements may be 1.0 µg/m³ or lower. This phenomenon will increase the tendency for individual SLT networks to exceed the annual DQO for bias.

Notwithstanding these conclusions, the observed bias suggests that no systemic bias problems are apparent in the network's underlying measurement process. Figure 5 below is a scatter plot of the coincident PEP vs SLT measurements for 390 PEP sampling events in 2016 in which both measurements exceeded 3 µg/m³. Except for a few outliers (which we actually confirmed and removed from the bias calculations in Figures 1 and 2) the paired SLT and PEP sampler measurements are generally very close. As we noted in Part I, when ambient concentrations are low, the majority of observed differences between the SLT and PEP measurements within a sample pair are often less than 2 µg/m³ and tend to cluster around 1 µg/m³. This is seen in Figure 5 by the width of the cluster of points typically being no more than about 4 µg/m³ in the vertical direction at any point along the horizontal axis of the plot. If an ordinary least squares linear regression line was fitted to these points, the fitted linear equation is:

$$PEP\ conc. = 0.879 + (0.945 * SLT\ conc.)$$

(The R-squared value for this regression line fit is 0.873). This fitted line is statistically significantly different from the line with slope 1 and intercept 0 (p<0.0001); this latter line represents equality between paired SLT and PEP sample results. If the fitted line is assumed to be representative of the relationship between PEP and SLT measurements down to 0 µg/m³, the intercept estimate (0.879, with standard error 0.155) suggests that PEP concentrations average 0.88 µg/m³ higher than the paired SLT concentrations at pristine conditions. This bias decreases slowly in magnitude as the SLT measurement increases. *Continued on page 11*

PEP Bias (continued from Page 8)

On average, the expected increase in PEP sample measurement over the paired SLT sample measurement is significantly different from 0 (at the 0.05 level) when the latter is below 12.4 $\mu\text{g}/\text{m}^3$. Figure 6 shows predicted bias at various levels at 10 $\mu\text{g}/\text{m}^3$ and below. Given the 2016 data, the predicted bias exceeds the 10% DQO. In Part III of this series, we will examine how the bias of individual agencies is affected by low concentrations and a few techniques a monitoring program can perform to determine the relative performance of their samplers when the percent difference equation is mathematically skewing the bias at low concentrations. —Dennis Crumpler; Bob Lordo and Ian MacGregor, Battelle

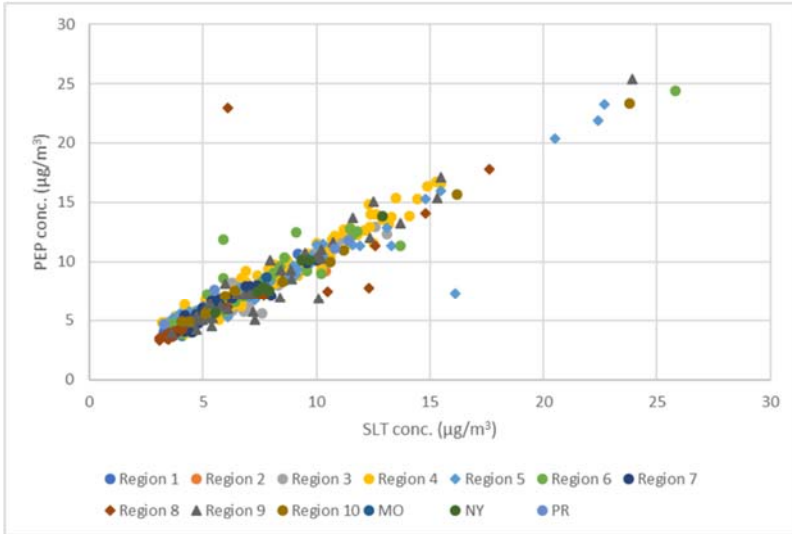


Figure 5. Scatter plot of the coincident PEP vs SLT measurements in 2016.

SLT Sample Conc.	Expected Absolute Difference from PEP Conc.	Expected Percent Difference from PEP Conc.
10 $\mu\text{g}/\text{m}^3$	-0.336 $\mu\text{g}/\text{m}^3$	-3.3%
7 $\mu\text{g}/\text{m}^3$	-0.499 $\mu\text{g}/\text{m}^3$	-6.7%
5 $\mu\text{g}/\text{m}^3$	-0.608 $\mu\text{g}/\text{m}^3$	-10.8%
3 $\mu\text{g}/\text{m}^3$	-0.717 $\mu\text{g}/\text{m}^3$	-19.3%
2 $\mu\text{g}/\text{m}^3$	-0.771 $\mu\text{g}/\text{m}^3$	-27.8%
1 $\mu\text{g}/\text{m}^3$	-0.825 $\mu\text{g}/\text{m}^3$	-45.2%

Figure 6. Estimated Percent Difference from PEP sample concentration for specified SLT measurements, based on 2016 sample data.

Annual PEP/NPAP Re-Certification – Big Changes

During April 9th through 15th, auditors and PEP/NPAP Regional leads descended on RTP, NC, for the annual PEP/NPAP re-certification event. All regions and their ESAT contractors were in attendance, as well as a few private contractors who were interested in providing support for the audit programs. Last year, OAQPS rolled out a new process for NPAP and this year’s training was an update on this progress and some honest discussion on what else needs to change with NPAP going

forward. Conducting low level audits was a topic of great interest and several ideas were teed up for consideration to improve the efficiency and accuracy of the audits. For PEP, this year was the roll-out of the new MoPED application and its AQS companion features. In a nutshell, the PEP program is migrating from our old labor intensive method of auditing to a new streamlined automated method. The new method will assist in selecting sites to audit, reduce data handling, and speed the upload of audit data to AQS.

This year also featured a collocation of representative PQ200 audit samplers from all regions, and new Mesa PQ200 samplers, to produce data on network bias within the PEP program. In all, 15 samplers were operated for three days over the course of the training. We plan on putting together an assessment over the next few weeks and a report will follow. All in all, it was a very successful training event! Many thanks to all of the EPA and contractor staff who attended. We know it’s a burden to dedicate a week out of busy schedules to attend, but we hope that the information exchanged was worth the trip. The feedback we get each year is invaluable as we move forward to improve our QA programs and make the data available to you. Again, thanks to all of you who attended, and see you next year! —Greg Noah



Happy Trails Mark Shanis

Many of you have worked with Mark Shanis over the years, most likely on the National Performance Audit Program (NPAP) or the Standard Reference Photometer (SRP) Program. Mark retired on February 17, 2017.

Mark has been around. He spent his formative years in Hull, Massachusetts where his dad retired from working with the US Navy as a civilian working on writing specs for the first 2 nuclear subs. He went to undergraduate school at Brandeis University, in Waltham, Mass, and got a BA in Biology with a lot of psychology courses as well.

He worked for several years at the Florida Dept of Agriculture, Division of Chemistry, doing fertilizer, then pesticide analyses. He then went to back to school and received a masters at the University of Florida, in Gainesville, FL, in the newly created Environmental Engineering Dept.

Mark came to work in OAQPS around 1998, just as we were getting the PM2.5 program off the ground. Prior to that he was working as a contractor for ORD and was handling some of our ambient air work through ORD who initially ran the SRP program and NPAP as a mailable program. So it was not hard for him to hit the ground running with us. Since ORD was divesting of the programs like SRP, NPAP and the protocol gas program, Mark was a natural to pick up two of those programs.

NPAP— Although NPAP continued for a while as a mailable program, the time had

come to update it and when we saw how California ARB was running the program through the probe, it made a lot of sense to develop and revitalize the program similar to CA-ARB system. We applied for some EPA initiative funds and were awarded the resources to get the program off the ground thanks to Mark and the EPA Regional workgroup he coordinated with. The program still stands and is a great way to independently evaluate our ambient air monitors. We are currently looking to ensure that our systems can audit at low levels and Greg Noah has now taken the helm to continue to steer the HMS NPAP.

SRP— After ORD divestment, the SRP program bounced around the country for a while. Region 6 implemented the program and then it went to the Office of Radiation and Indoor Air (ORIA) Las Vegas for a while when we partnered with them on a few projects. Mark kept track of the program from afar and kept it together. In about 2006, the SRPs found their way back to ORD and Mark and Scott Moore from ORD tag teamed to keep the program running. The program is running fine and we are planning to purchase one more SRP to avoid any down time when



an SRP needs repairs or maintenance. Joann Rice and Mike Papp will take responsibility for the program from the OAQPS side.

Mark was great person to ask for help on a technical issue. He liked talking to people and getting down to the nitty gritty details. In that manner he helped move a lot of our QA programs along. His smile and spirit will be missed.

Report All Your QC Checks to AQS

Due to the review and possible invalidation of some routine ozone concentration data due to 1-point QC exceedances beyond acceptance limits, monitoring organizations and the Regions are working together to find compelling evidence to keep some of the routine data that brack-

ets a 1-point QC exceedance. During these investigations, some of the Regions have become aware that monitoring organizations are performing additional QC checks but only reporting the minimum requirement (every 14 days) due to the additional work required to report them. However these additional checks, if re-

ported, can justify invalidating fewer routine data concentrations and can also provide more trend information on your quality system. Bottom line, report all the checks that you run. It can help! We also will be providing a home in AQS for zero/span checks in the future.



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The Office of Air Quality Planning and Standards is dedicated to developing a quality system to ensure that the Nation's ambient air data is of appropriate quality for informed decision making. We realize that it is only through the efforts of our EPA partners and the monitoring organizations that this data quality goal will be met. This newsletter is intended to provide up-to-date communications on changes or improvements to our quality system. Please pass a copy of this along to your peers and e-mail us with any issues you'd like discussed.

Mike Papp

Key People and Websites

Since 1998, the OAQPS QA Team has been working with the Office of Radiation and Indoor Air in Las Vegas, and ORD in Research Triangle Park in order to accomplish OAQPS's QA mission. The following personnel are listed by the major programs they implement. Since all are EPA employees, their e-mail address is: last name.first name@epa.gov.

The **EPA Regions** are the primary contacts for the monitoring organizations and should always be informed of QA issues.

Program

CSN/IMPROVE Lab PE and PM_{2.5} Round Robin
Tribal Air Monitoring
CSN/IMPROVE Network QA Lead
OAQPS QA Manager
Standard Reference Photometer Lead
National Air Toxics Trend Sites QA Lead
Criteria Pollutant QA Lead
NPAP Lead
PM_{2.5} PEP Lead
Pb PEP Lead
Ambient Air Protocol Gas Verification Program

Person

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Website

EPA Quality Staff
AMTIC
AMTIC QA Page

URL

[EPA Quality System](http://www.epa.gov/amtic)
<https://www.epa.gov/amtic>
<http://www3.epa.gov/ttn/amtic/quality.html>

Description

Overall EPA QA policy and guidance
Ambient air monitoring and QA
Direct access to QA programs