2023 TECHNICAL UPDATE

Particulate Matter Continuous Emission Monitoring System Data Evaluation

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Technical Update, July 2023

EPRI Project Manager
C. Shaban

EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com

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RTP Environmental Associates Inc.

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The following organization, under contract to EPRI, prepared this report:

RTP Environmental Associates Inc.
304-A West Millbrook Road
Raleigh, NC 27609

Principal Investigators
B. White
R. Barton

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ABSTRACT

On April 24, 2023, the Environmental Protection Agency (EPA) published in the Federal Register proposed changes to the Mercury Air Toxics Standard (MATS Rule).[1] Under the proposed rule, filterable particulate matter (PM) emission limits would be reduced, and the use of PM continuous emissions monitoring systems (PM CEMS) would be required for all existing electric generating units (EGUs). The preamble indicates that "not every EGU will need to adjust its existing correlation in order to continue to use its existing PM CEMS to demonstrate compliance with the proposed limits." Because the quality assurance (QA) specifications for PM CEMS are established as a percentage of the emission limit, it seems reasonable to assume that the frequency of PM CEMS QA test failures will increase as the emission limit decreases. Additionally, under the proposed rule, EPA proposed to increase the minimum sample volume requirement for performing MATS-modified EPA Reference Method 5 from 1 dscm to 4 dscm. The stated purpose of the increase in sample volume is to reduce the "random error" associated with the measurement to less than 15%. A study was conducted of existing EGUs with PM CEMS to determine the frequency of QA test failures at the proposed emission limit of 0.010 lb/mmBtu and the more stringent regulatory option of 0.006 lb/mmBtu (that is, alternative limit). This study also included a minimum sample evaluation of quarterly tests and the LEE tests at the current MATS Rule filterable particulate matter (fPM) emission limits, the proposed 0.010 lb/mmBtu compliance limit, and the proposed alternative compliance limit of 0.006 lb/mmBtu.

Keywords

Electric generating units (EGUs)
Emission limits
Particulate matter continuous emission monitoring systems (PM CEMS)

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1 QUALITY ASSURANCE TEST EVALUATION

On April 24, 2023, the Environmental Protection Agency (EPA) published in the Federal Register proposed changes to the Mercury Air Toxics Standard (MATS Rule)[2] [1]. Under the proposed rule, filterable particulate matter (PM) emission limits would be reduced, and the use of PM continuous emissions monitoring systems (PM CEMS) would be required for all existing electric generating units (EGUs). The preamble indicates that "not every EGU will need to adjust its existing correlation in order to continue to use its existing PM CEMS to demonstrate compliance with the proposed limits." Because the quality assurance (QA) specifications for PM CEMS are established as a percentage of the emission limit, it seems reasonable to assume that the frequency of PM CEMS QA test failures will increase as the emission limit decreases. A study was conducted of existing EGUs with PM CEMS to determine the frequency of QA test failures at the proposed emission limit of 0.010 lb/mmBtu and the more stringent regulatory option of 0.006 lb/mmBtu (that is, alternative limit).

Background

The QA requirements for PM CEMS are addressed in the MATS Rule Appendix C, which refers to 40 CFR Part 60, Appendix F, Procedure 2 (Procedure 2) and 40 CFR Part 60, Appendix B, Performance Specification 11 (PS-11). The QA tests include a relative response audit (RRA) once every 4 calendar quarters and a response correlation audit (RCA) once every 12 calendar quarters.

An RRA consists of collecting three simultaneous reference method (RM) PM concentration measurements and PM CEMS measurements at the as-found source operating conditions and PM concentration. To pass an RRA, all three data points must be less than the greatest PM CEMS response value used to develop the correlation curve, and at least two of the three sets of PM CEMS and reference method measurements must fall within the specified area on a graph defined by two lines parallel to the correlation curve, offset at a distance of ±25 percent of the numerical emission limit value. An example correlation (solid line) and acceptable graph area based on ±25 percent of the current MATS emission limit value (dotted lines) is shown in Figure 1. If an RRA does not meet the specifications, an out-of-control period begins immediately after the last test run until the last test run of a subsequent successful audit. A source must take corrective action until the PM CEMS passes the RRA criteria. If the RRA criteria cannot be achieved, an RCA must be conducted.

[2] 88 Fed. Reg. 24854 (Apr. 24, 2023).

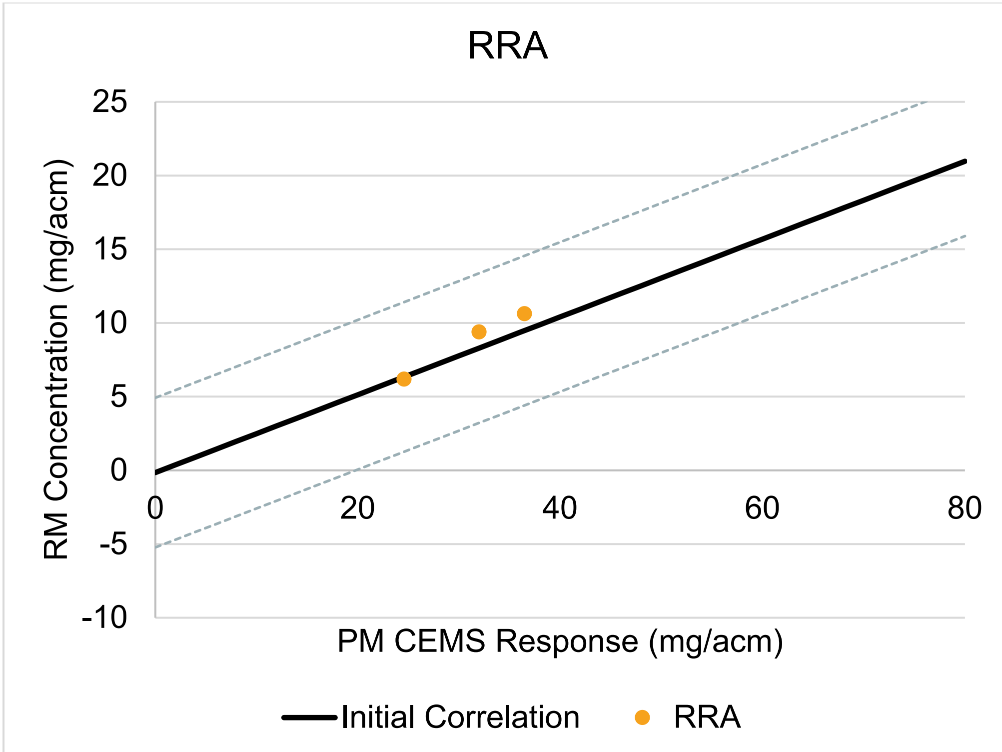

Figure 1. Graphical Representation of PM CEMS Correlation and Procedure 2 “Specified Area”

Once every 12 calendar quarters, an RCA is required for PM CEMS. An RCA is conducted by collecting at least 12 simultaneous reference method PM concentration measurements and PM CEMS measurements at three different levels of PM mass concentration. To pass an RCA, all 12 data points must be less than the greatest PM CEMS response value used to develop the correlation curve, and at least 75 percent of the 12 sets of PM CEMS and reference method measurements must fall within the specified area on a graph of the correlation regression line. If an RCA does not meet the specifications, the current data set may be combined with the existing correlation curve data set to determine a new correlation curve using the combined data set. If the combined data set does not meet the specifications, a new correlation curve may be determined using only the current RCA data set. If neither of the approaches results in a correlation curve meeting the requirements of PS-11, the source must inspect the PM CEMS and repair, replace, relocate, or petition the Administrator for an alternative within 90 days. An out-of-control period begins immediately after the last test run of a failing test until the last test run of a subsequent successful audit.

Because the acceptable graph area for the RRA and RCA is offset from the correlation as a percentage of the numerical emission limit value (“±25 percent of the numerical emission limit value”), a change in the emission limit—such as that which was proposed—would impact the ability of data sets to continue to meet the QA specifications of Procedure 2. The preamble indicates that “not every EGU will need to adjust its existing correlation in order to continue to use its existing PM CEMS to demonstrate compliance with the proposed limits.”

This study evaluates a subset of EGUs with existing PM CEMS to determine if existing correlations would meet the RRA and RCA specifications of Procedure 2 based on the proposed emission limit of 0.010 lb/mmBtu and the more stringent regulatory option of 0.006 lb/mmBtu.

In addition, the following tasks were performed to further evaluate the impact of the proposed limits on EGUs with existing PM CEMS:

- Assessment of failed RCAs and developing a new correlation based on the RCA data set
- Assessment of the candidate units' ability to meet PS-11 criteria based on the proposed limits
- Survey of sampling volumes used by candidate units

Selection of Candidate Units

The preamble indicated that PM CEMS are used for compliance purposes by about one-third of EGU owners or operators. Candidate units were selected based only on single-unit, single-stack configurations to eliminate any differences in firing configurations between subsequent test programs. The database was further refined to consider only those units that reported the use of PM CEMS in the Supplemental MATS Record in their fourth quarter 2022 Emissions Collection and Monitoring Plan System (ECMPS) electronic monitoring plan. A total of 76 unique ORIS code/unit IDs were identified as using PM CEMS, reflecting 20% of single-unit, single-stack MATS-affected EGU configurations included in fourth quarter 2022 reporting. Because the reporting of the Supplemental MATS record in ECMPS is optional, some sources using PM CEMS for MATS compliance demonstrations have likely elected to not voluntarily report the information.

The sources were further subcategorized based on their particulate control devices. The monitoring plan includes primary particulate control codes for baghouses ("B") and electrostatic precipitators ("ESP") with some sources reporting secondary controls including wet scrubbers ("WS"),[3] wet ESPs ("WESP"), and other ("O"). Table 1 summarizes the number of units in each control type grouping. Of the 76 units identified, 28 were listed as using baghouses as their primary particulate control and were identified as Baghouse "B" units. The remaining units identified the use of ESP as their primary particulate control with 21 units reporting the use of both ESP and WS, which were identified as ESP/WS or "W" units, and 27 reporting the use of only ESP or combinations of ESP and WESP or ESP and Other, which were identified as ESP only or "E" units. Because the flue gas characteristics and monitoring technologies are different for units that use wet scrubbers, the "W" grouping was analyzed separately from the "E" grouping. Based on a review of the test reports, we know that some sources listed as "E" actually included wet scrubbers. Because WFGD systems are not primarily installed for PM control but sulfur dioxide control and co-benefit of mercury control, not all sources list WFGD as PM control devices in the ECMPS monitoring plan. To remain unbiased in the review, a simplified random sampling approach was used. The units were subcategorized

[3] *WS* is used to denote wet venturi scrubbers and wet flue gas desulfurization (WFGD) systems.

based solely on control devices as reported in the ECMPS monitoring plan—not on independent knowledge of selected sources. Twenty-five percent of the units in each control type grouping were included for further analysis. The units were selected at random using the Excel "RAND" function.

Table 1. Summary of Units in Each Control Type Grouping

Control Type Grouping	Number of Single-Unit, Single-Stack Units	%	Number of Units Included in Evaluation
Baghouse ("B")	28	37%	7
ESP/WS ("W")	21	28%	6
ESP only ("E")	27	36%	7
Total	**76**	-	**20**

Historical Quality Assurance Test Availability

For each unit included in the evaluation, PS-11 correlation, RRA, and RCA reports were downloaded from publicly available records through EPA's WebFIRE database [2]. No additional input was sought or obtained from individual owners or operators to ensure impartiality in the review.

For a single-baghouse candidate unit, no PM CEMS records were found in WebFIRE. A replacement baghouse–controlled unit was selected again using the Excel "RAND" function to ensure that at least 25% of the units in each control type grouping were analyzed.

Each test result was included in the analysis. Some candidate units included test results as far back as 2015, whereas others appeared to reflect new PM CEMS installations with test results starting in 2020. If a test result was not available in WebFIRE or was corrupted or unreadable, the test result was not included in the analysis. If a test result included both failed tests (at the current MATS limit) as well as a subsequent passing test, each test was included in the evaluation.[4] This resulted in a range of available tests for each unit as shown in Table 2. For each unit included in the evaluation, at least three individual test results were considered. A total of 140 individual tests were included in the evaluation.

[4] A test that failed at the current MATS limit would also fail at the proposed limits.

Table 2. Number of Available QA Tests and Failure Rate at Current Emission Limitation

Study Control Type and Study #	# of Tests	Failure Count (0.030 lb/mmBtu)
B1	8	0
B2	6	0
B3	7	0
B4	6	0
B5	3	0
B6	7	1
B7	6	0
W1	7	0
W2	7	3
W3	7	0
W4	7	0
W5	8	2
W6	7	0
E1	10	0
E2	7	1
E3	11	5
E4	6	0
E5	4	0
E6	8	0
E7	8	0
Total	**140**	**12**

Historical Quality Assurance Test Analysis

The available tests for each candidate unit were analyzed using simultaneous reference method PM concentration measurements and PM CEMS measurements. The reference method and PM CEMS measurements were transposed exactly as they were presented in the summary tables provided in the downloaded QA test report, without consideration of significant figures or rounding. Runs were excluded from analysis only if they were clearly noted in the summary table to be “not used” or “excluded.” The currently active correlation equation was likewise taken directly from the summary included in the QA test report, without consideration of significant figures or rounding.

The equivalent emission limit was taken from the QA test report but at times had to be adjusted. Certain test reports did not clearly identify the equivalent emission limit, and others identified an equivalent emission limit that was not reasonable based on the current MATS PM limit of 0.030 lb/mmBtu[5]. Variation in the equivalent emission limit is expected based on variations in F-factor, CO2 concentration, PM CEMS sampling temperature, and pressure. For example, an *in situ* CEMS will measure at the temperature and pressure of the actual effluent whereas an extractive CEMS will measure at the temperature and pressure of the sample cell. The equations used to calculate the PM concentration at measurement conditions are presented next. Values between 14 mg/acm and 33 mg/acm were considered reasonable equivalent emission limit values based on a range of CO2 concentration values between 8% CO2 and 14% CO2 and a range of temperatures between 120°F and 350°F for units combusting bituminous or subbituminous fuel. If the equivalent emission value at measurement conditions was not presented in the test report or was unreasonable, an equivalent emission limit was manually calculated using individual test runs conducted near the 0.030 lb/mmBtu MATS limit.

$$0.030 = 6.24 \times 10^{-8}\, C_a \left(\frac{460+T_{CEMS}}{P_{CEMS}}\right)\left(\frac{P_{std}}{460+T_{std}}\right) F_C \frac{100}{\%CO_2} \qquad \text{Eq. 1}$$

Rearranging Equation 1-1:

$$C_a = \frac{0.030}{6.24 \times 10^{-8}}\left(\frac{P_{CEMS}}{460+T_{CEMS}}\right)\left(\frac{528}{29.92}\right)\left(\frac{1}{F_C}\right)\left(\frac{\%CO_2}{100}\right) \qquad \text{Eq. 2}$$

Where:

C_a = PM concentration at measurement conditions (mg/acm)

T_{CEMS} = CEMS Measurement Temperature (°F)

P_{CEMS} = CEMS Measurement Pressure (in. Hg)

P_{std} = Standard Pressure (29.92 in. Hg).

T_{std} = Standard Temperature (68 °F)

F_C = F-factor (scf CO_2/million Btu)

$\%CO_2$= Concentration of carbon dioxide on a wet basis, percent

Quality Assurance Failure Rate

Using the existing correlation and the equivalent emission limit at measurement conditions at 0.030 lb/mmBtu, the “specified area” as defined in EPA Procedure 2, Section 10.4(5)(ii) was determined mathematically at 0.010 lb/mmBtu and 0.006 lb/mmBtu. Each RRA was evaluated to determine if at least two out of three runs were within the new specified area. Each RCA was

[5] For example, some sources identified a value over 100 mg/acm as the equivalent emission limit, which may be equivalent to a permit or NSPS limit of 0.10 lb/mmBtu but could not be equivalent to the MATS 0.03 lb/mmBtu limit under any anticipated operating conditions.

evaluated to determine if at least 75% of the test runs were within the new specified area. For this evaluation, all tests with more than three test runs were considered RCAs.

The data in Figure 2 highlight that 44% of the total number of tests would not be successful using a specified area determined at an emission limitation value equivalent to 0.10 lb/mmBtu and that 68% of the total number of tests would not be successful using a specified area determined at an emission limitation value equivalent to 0.006 lb/mmBtu. Figure 3 presents the failure rate at each of the three equivalent emission limitation values (0.30 lb/mmBtu, 0.10 lb/mmBtu, and 0.006 lb/mmBtu) for each grouping of control device type ("B" for baghouse, "W" for ESP and wet scrubber, "E" for ESP only). The results show that failure at the current MATS limit is less likely for baghouse-equipped units but relatively consistent failure rates at either the proposed limit of 0.10 lb/mmBtu or the more stringent limit of 0.006 lb/mmBtu. Figure 4 presents QA test failure rate by emission limit and by PM CEMS technology type. Figure 5 presents an overview of the QA test failure rate by emission limit and unit.

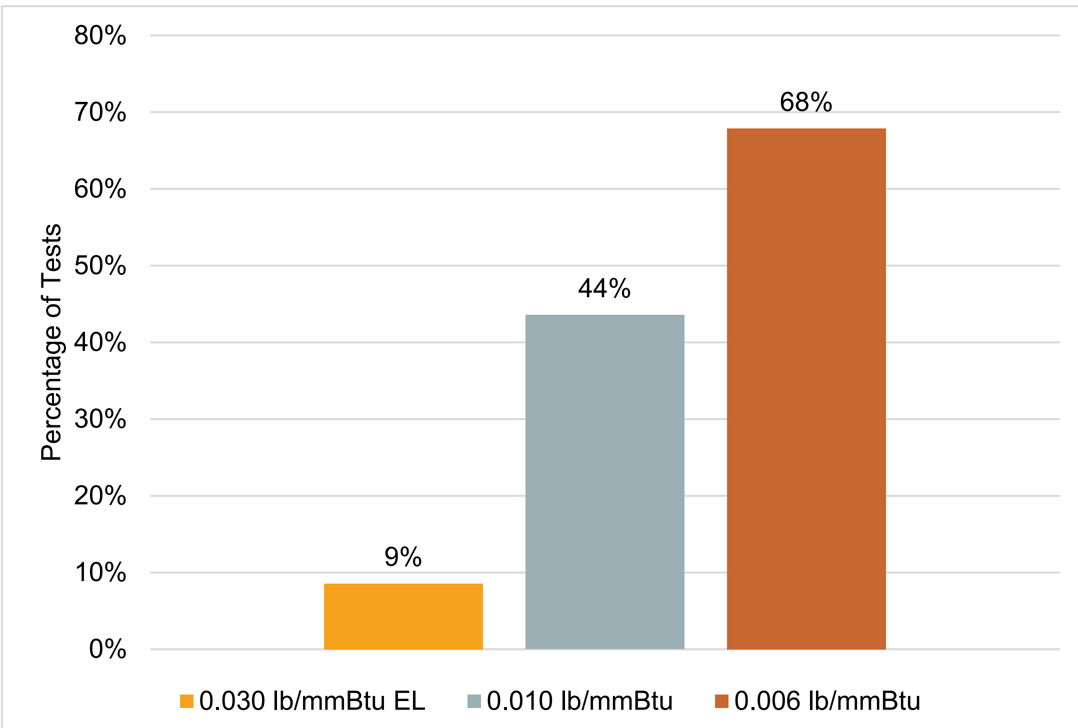

Figure 2. QA Test Failure Rate by Emission Limit

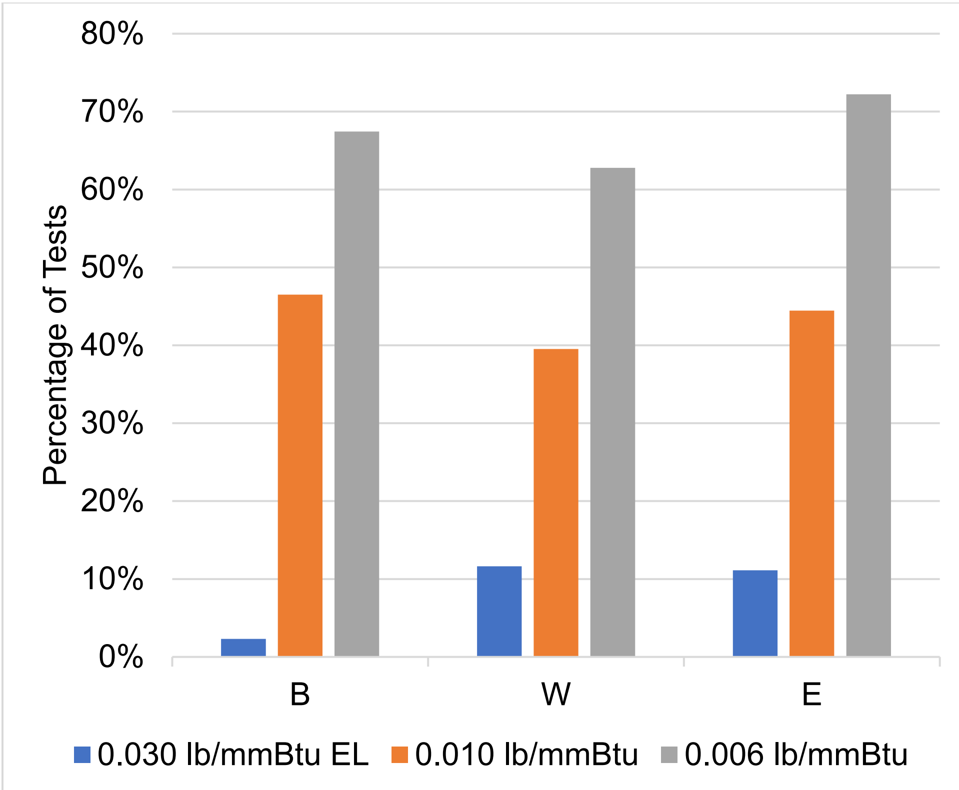

Figure 3. QA Test Failure Rate by Emission Limit and Control Type

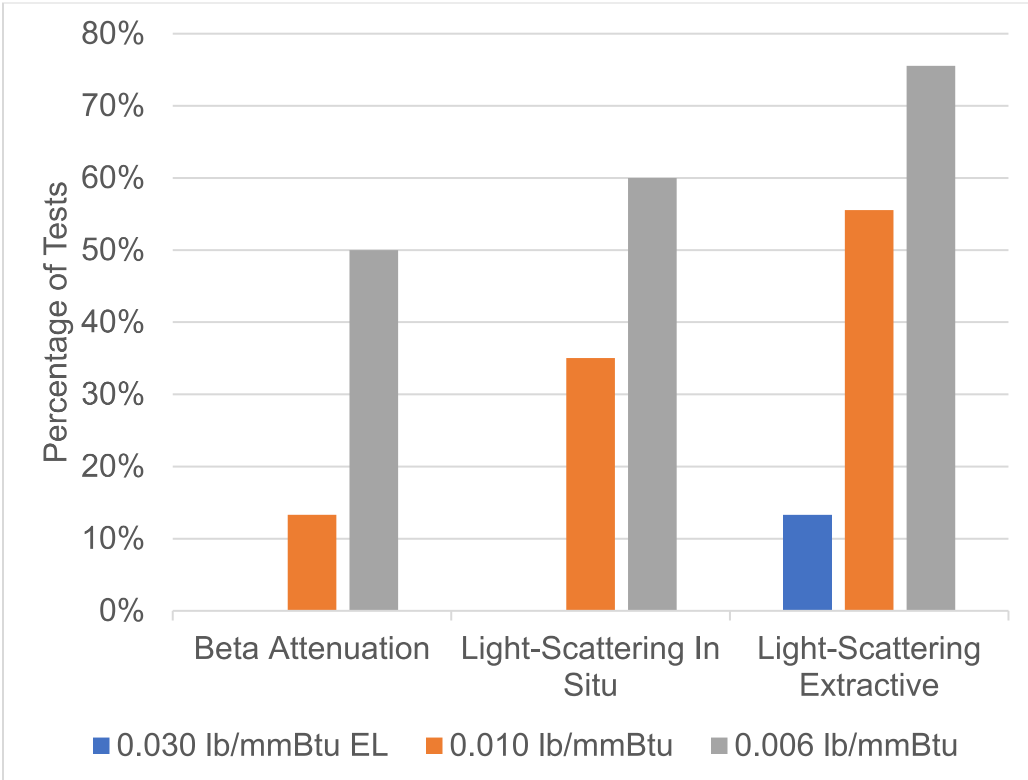

Figure 4. QA Test Failure Rate by Emission Limit and PM CEMS Type

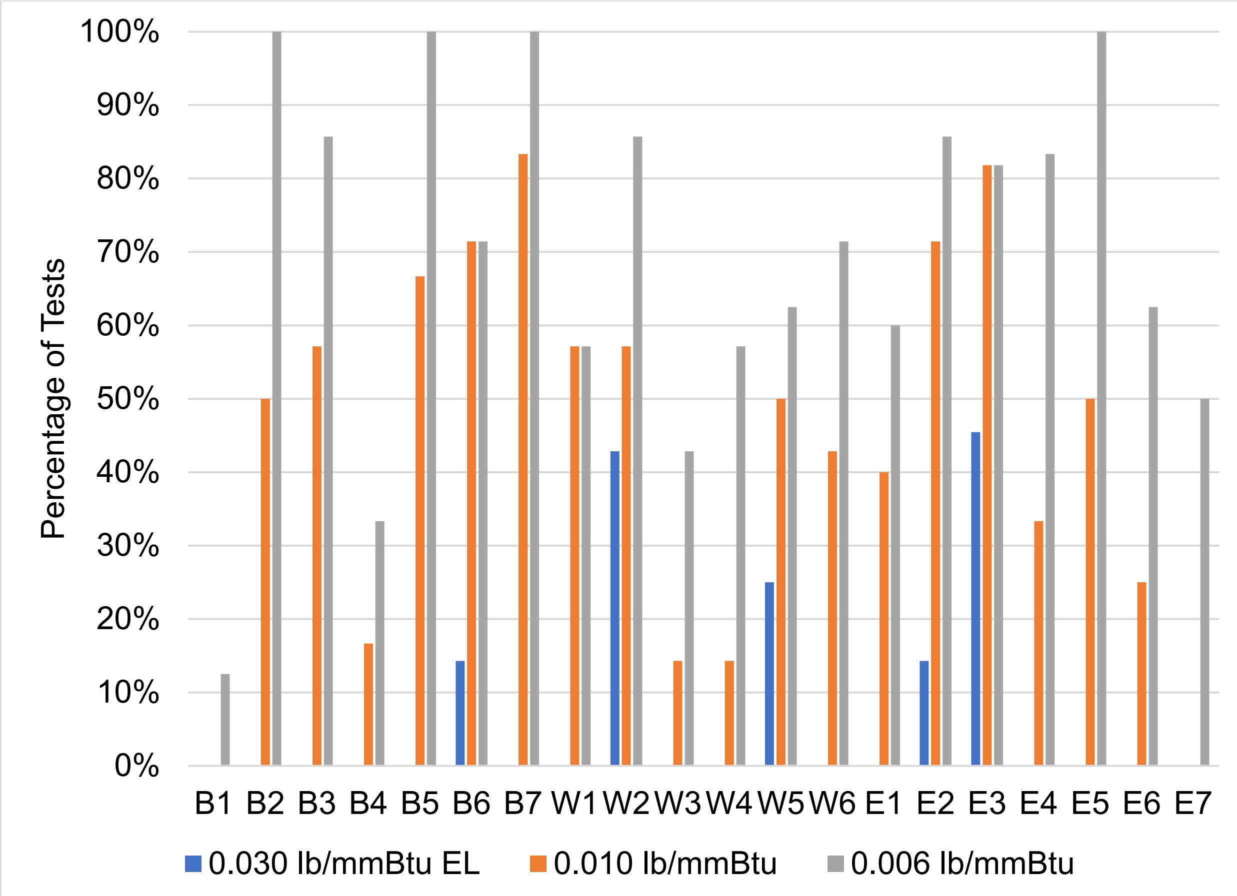

Figure 5. QA Test Failure Rate by Emission Limit and Unit

Assessment of Failed Response Correlation Audits

An evaluation was conducted on whether a unit that failed an RCA could successfully develop a new correlation curve that meets the PS-11 statistical criteria using only the RCA data set, as described above. This evaluation was conducted for select candidate units that failed an RCA based on either limit.[6] Thirteen individual tests were evaluated. The data show that only three of the tests could meet PS-11 specifications using the RCA data set based on the proposed limit (0.010 lb/MMBtu) and that none of the units would meet PS-11 based on the alternative limit (0.006 lb/MMBtu).

PM CEMS Recertification Rate

An evaluation was conducted on whether a unit that failed an RCA could successfully develop a new correlation curve According to MATS Appendix C, Section 4.1.1, "a PM CEMS that has been installed and certified according to PS-11 as a result of another state or federal regulatory

[6] Unable to evaluate all units because of time and budget constraints.

requirement or consent decree prior to the effective date of this subpart shall be considered certified for this subpart if you can demonstrate that your PM CEMS meets the PS-11 acceptance criteria based on the applicable emission standard in this subpart." Existing PM CEMS do not need to be recertified for the MATS RTR if the existing correlation data set can meet the PS-11 statistical criteria based on the proposed limit. Based on the RRA and RCA evaluations presented above, revisions to existing correlations should be expected based on the proposed limit (0.010 lb/MMBtu) or the alternative limit (0.006 lb/MMBtu).

Correlation tests were evaluated for selected candidate units.[7] Seventeen individual tests were evaluated.[8] The data show that only five (29%) of the units can meet the PS-11 statistical criteria with the proposed limit of 0.010 lb/MMBtu and that only one unit (6%) meets the criteria with the alternative limit of 0.006 lb/MMBtu. These data suggest that most candidate units would need to recertify the PM CEMS regardless of the proposed limit. It should be noted that the data do not suggest that these same units would be unable to meet PS-11 requirements upon recertification testing. As noted previously, increasing the sampling volume and conducting a more controlled test can significantly reduce data variability, increasing the potential of meeting the performance specifications.

Sample Volume

The sampling time/volume associated with each test run for seven of the candidate units,[9] which included 29 RRAs and 19 PS11/RCA tests, was also evaluated.[10] The results show that RRAs and the RCA/PS-11 low-level (as-found) test conditions are generally conducted using the same sampling time (120 minutes or ~2.5 dry standard cubic meter [dscm]). The RCA/PS-11 mid- and high-level (de-tuned) test conditions are also typically conducted using the same sampling time (60 minutes or ~1.3 dscm). Many of the RCA/PS-11 test programs used longer run times for the low-level test conditions than the mid- and high-level conditions. The test reports did not provide justification for the test run times used in each test program nor do the reports provide an assessment of measurement uncertainty at each test condition. Presumably, the reason for this approach was to improve measurement precision at lower PM concentrations while minimizing the overall test duration especially at de-tuned conditions. The use of varying sampling volumes (sampling times) for each test condition may enable a reduction in test program duration under the proposed MATS RTR, if measurement uncertainty at each test condition is adequately addressed.

Finally, none of the tests was conducted with a sampling volume of 4 dscm/run (~190 minutes/run), as proposed in the RTR. Therefore, the results presented in this study may

[7] Unable to evaluate all units because of time and budget constraints.

[8] Unable to evaluate all units because of time and budget constraints.

[9] Unable to evaluate all units because of time and budget constraints.

[10] The sample data set had differing numbers of RRA, RCA, and PS-11 tests for each unit. Therefore, results are biased toward units that report a greater number of tests and may not necessarily represent the fleet.

overestimate failure rates because they do not reflect the potential reduction in measurement variability typically associated with higher sample volumes. Although this study did not directly evaluate measurement variability or failure rates based on sampling volume, it does suggest that sampling volumes of 4 dscm/run or greater are not a requirement for meeting PS-11. Additional research is needed to further quantify these effects.

Summary of Evaluation Findings

On April 24, 2023, the EPA proposed a PM emission limitation of 0.010 lb/mmBtu and discussed a more stringent regulatory option of 0.006 lb/mmBtu. EPA also proposed the use of PM CEMS as the only compliance option for existing EGUs. This study evaluated QA tests conducted on existing PM CEMS to determine the relative failure rate at the proposed emission limitations. Specifically, the study included 76 unique ORIS code/unit IDs and a total of 140 individual tests were included in the evaluation.

The results demonstrate that the rate of failure of RRAs and RCAs will increase at the proposed emission limitations. The QA test failure rate was found to be 44% for an emission limit of 0.010 lb/mmBtu and 68% for an emission limit of 0.006 lb/mmBtu. The failure rate increased regardless of the control technology or PM CEMS type. The data suggest that most units should expect to adjust existing correlations to use existing PM CEMS to comply with the proposed limit or alternative limit.

2 MINIMUM SAMPLE VOLUME EVALUATION

On April 24, 2023, EPA published in the Federal Register proposed changes to the MATS Rule[11] [1]. Under the proposed rule, EPA proposed to increase the minimum sample volume requirement for performing MATS-modified[12] EPA Reference Method 5 from 1 dscm to 4 dscm. The stated purpose of the increase in sample volume is to reduce the "random error" associated with the measurement to less than 15%. There is concern that this proposal will limit the flexibility to obtain the necessary sample for accurate characterization of the particle loading level being tested. The increased PM test run sample volume and duration are not necessarily representative of true upset conditions and lead to excess emissions.

Background

The memorandum states that the method detection level (MDL) for EPA Reference Method 5 is 2.0 mg/dscm.[13] The referenced memo does not provide any supporting information on how the MDL was derived and differs significantly from other guidance on the MDL for EPA Reference Method 5. In the January 14, 2019, version of EPA Reference Method 5I, Section 2.3.b provides the following statement on the appropriate MDL for EPA Reference Method 5:

> Because the MDL forms the basis for our guidance on target sampling times, EPA has conducted a systematic laboratory study to define what is the MDL for Method 5 and determined the Method to have a calculated practical quantitation limit (PQL) of 3 mg of PM and an MDL of 1 mg.

This statement in a promulgated reference method that has withstood the rigors of public notice and comment would be understood to be the MDL used for any assessment of required sample times or sample volumes for the measurement of filterable particulate matter (fPM).

It is important to note that in Table 1 of the supporting documentation,[14] the fPM concentration units for describing the equivalent fPM concentration at the various emission limits are listed in units of milligrams per wet actual cubic meter (mg/wacm)[15] instead of milligrams per dry standard cubic meter (mg/dscm). Table 3 provides the true equivalent fPM concentration in units of mg/dscm.

[11] 88 Fed. Reg. 24854 (Apr. 24, 2023).

[12] Sample probe and sample filter temperatures maintained at 320°F (±25°F).

[13] PM CEMS Capabilities Memo, June 13, 2012, from Conniesue Oldham to Bob Schell, available at EPA-HQOAR-2018-0794.

[14] EPA-HQ-OAR-2018-0794-5786.

[15] Actual conditions refer to the temperature and pressure at which the PM CEMS makes the PM concentration measurement. All current commercially available PM CEMS measure PM concentration on a wet basis.

Table 3. Summary of fPM Equivalent Emission Limit Concentration

Emission Limit Descriptor	Emission Limit	Emission Limit Concentration		Target Compliance Level
	(lb/mmBtu)	(mg/wacm)	(mg/dscm)	(mg/dscm)
Current	0.030	21.9	34.2	17.1
New Unit	0.009	6.6	10.2	5.1
Proposal 1	0.010	7.3	11.4	5.7
Proposal 2	0.006	4.4	6.8	3.4

As mentioned previously, EPA Reference Method 5I calculated practical quantitation limit (PQL) of 3 mg of PM and an MDL of 1 mg. This corresponds with a presentation authored by Steffan Johnson, Leader of EPA's Measurement Technology Group, titled *Bringing Minimum Detection Levels into Focus*.[16] The presentation states that EPA's air test methods at or above the method's limit of quantification (LOQ) have a measurement uncertainty of ±15–20%, where LOQ in the presentation was defined as three times the MDL and has the same practical definition as PQL given in EPA Reference Method 5I.

If one used 1 mg as the MDL for a MATS-modified EPA Reference Method 5 test run and an associated PQL/LOQ of 3 mg, a minimum sample volume of 1 dscm should result in sufficient mass in demonstrating reliable results at the current proposed fPM emission limits. At the lowest proposed limit of 0.006 lb/mmBtu, a 1-hour MATS-Modified EPA Reference Method 5 test run operated at a nominal sample rate of 0.75 dry standard cubic foot per minute (dscfm) would yield a sample volume of ~45 dscf (that is, 1.27 dscm). At a "desired target concentration" of 3.4 mg/dscm, a 1-hour test duration should yield a sample mass of ~4.3 mg. That expected sample mass is ~44% higher than the PQL/LOQ of 3 mg. Source operators and their qualified stack testers should retain flexibility to obtain the necessary sample in whatever run time is appropriate for accurate characterization of the particulate loading level being tested and to avoid unnecessary excess emissions caused by testing. EPA should not mandate a minimum sampling collection of 4 dscm of sample per run.

Review of Low-Level Measurements of PM CEMS Correlations

In its proposal—and in the 2012 portland cement rulemaking—EPA recognizes that the agency was aware of the difficulty in using PM CEMS to demonstrate compliance with an fPM emission limit in the range of 5 to 8 mg/dscm and that such issues could not be addressed simply by increasing the duration of test runs:[17]

> Extending the duration of the Method 5 test gives this reference method additional opportunity to collect more sample mass, but this is no guarantee that

[16] https://www3.epa.gov/ttnemc01/meetnw/2015/moreado.pdf.

[17] 77 FR 10017 (February 12, 2013).

> the time added to the test will collect enough particulate mass to resolve detection issues, especially when testing is conducted at the better performing (lower emitting) sources. Longer test runs inherently increase the variability of the PM CEMS data collected during the test, which may cause further difficulties with the correlation between instrument and reference method.

In the preamble, EPA presumes that these same issues will not be experienced by EGUs and cites uniform and consistent fuel use by EGUs as well as fuel combustion particle consistency as its rationale. EPA also states that consistent fPM particle characteristics for EGUs provide stable correlations for those EGUs with existing PM CEMS. EGU experience correlating PM CEMS to demonstrate compliance with low level (<0.010 lb/mmBtu) emission limits has been limited at best. In its assessment, EPA presumes that all issues are based on insufficient mass collection and does not seem to be considering the impacts caused by the variability in particulate characteristics as well as PM CEMS response.

A review of PM CEMS correlations (see Figure 6 to Figure 9) found low level variations in the Y axis (RM fPM concentration) without a corresponding change in the X axis (PM CEMS concentration). This could be caused by tester error, random error because of quantification issues discussed above, or lack of PM CEMS response at such low levels. These issues cannot be addressed by increased sample volume alone.

In this review, a high degree of scatter in most data points collected at elevated PM concentrations is observed. This scatter certainly would not be resolved by increased sampling time because the “random error” associated with reference method quantification levels is clearly met. Rather, elevated PM measurements typically reflect periods of abnormal operation in which sources are intentionally creating emissions solely to correlate the PM CEMS. These conditions do not reflect normal, stable operations. The scatter in these data points is more likely related to operational instability, not “random error.” Extended test runs under these conditions would likely cause more variability in both the test method and PM CEMS response in addition to increased environmental impacts. The data scatter (at both low levels and elevated fPM levels) is more pronounced for EGUs controlled by wet scrubbers regardless of the measurement technique. A key takeaway from this evaluation is that the responsiveness of the PM CEMS may be a bigger factor than the duration of the sample test run.

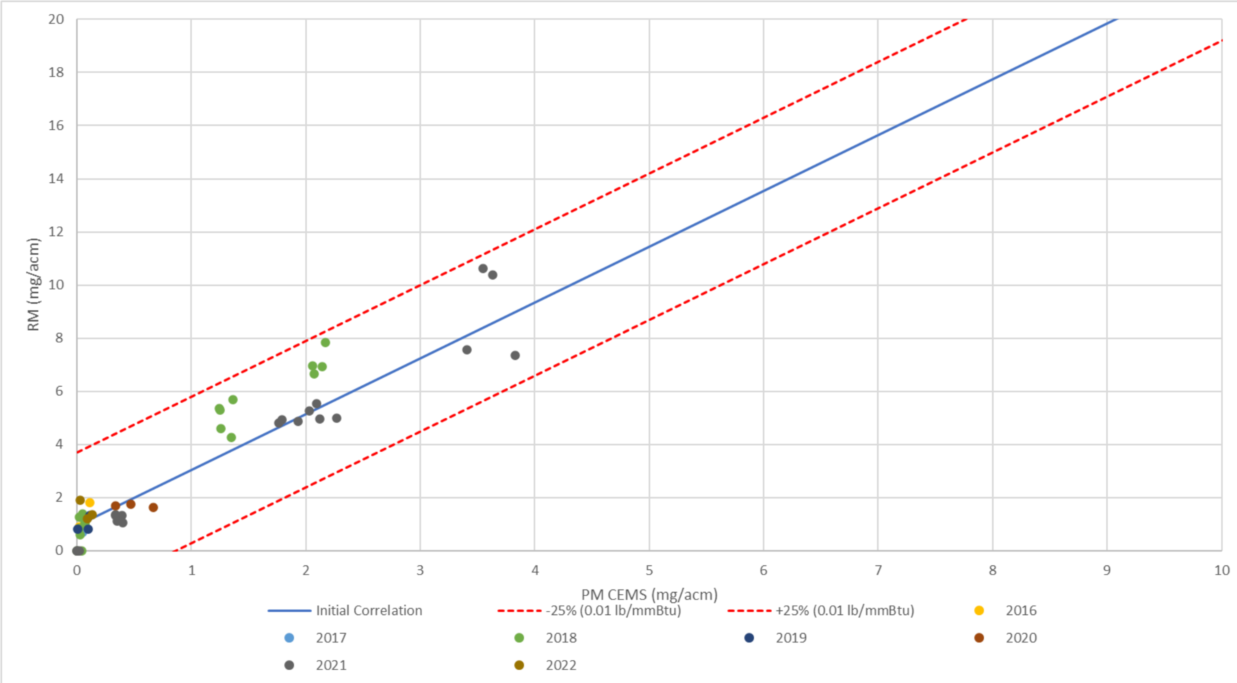

Figure 6.Example Correlation and QA Tests: Baghouse and Dry Scrubber with Beta Attenuation PM CEMS

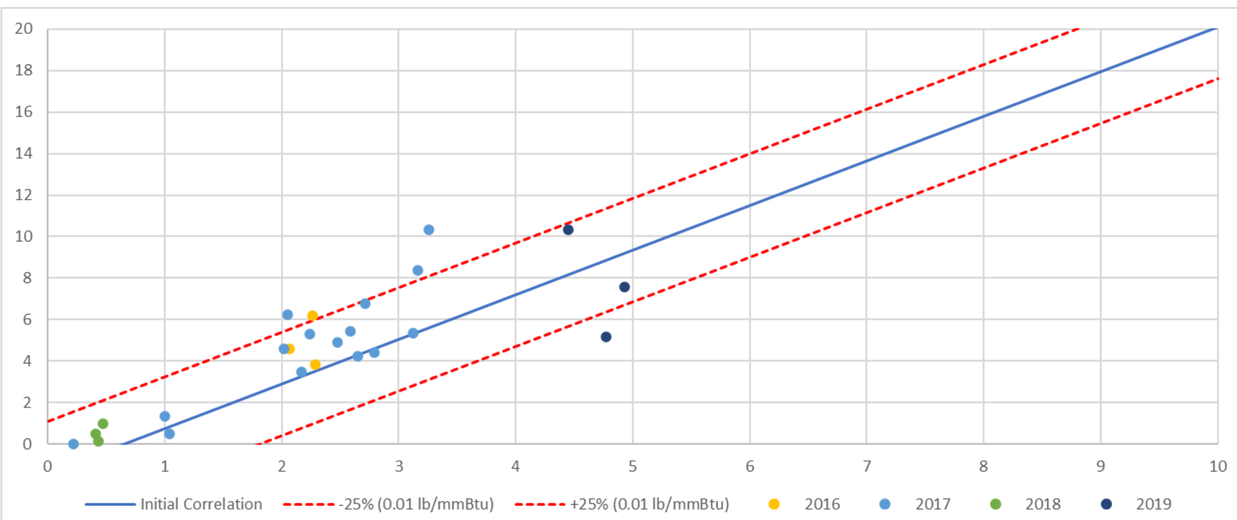

Figure 7. Example Correlation and QA Tests: ESP and Wet Scrubber with Beta Attenuation PM CEMS

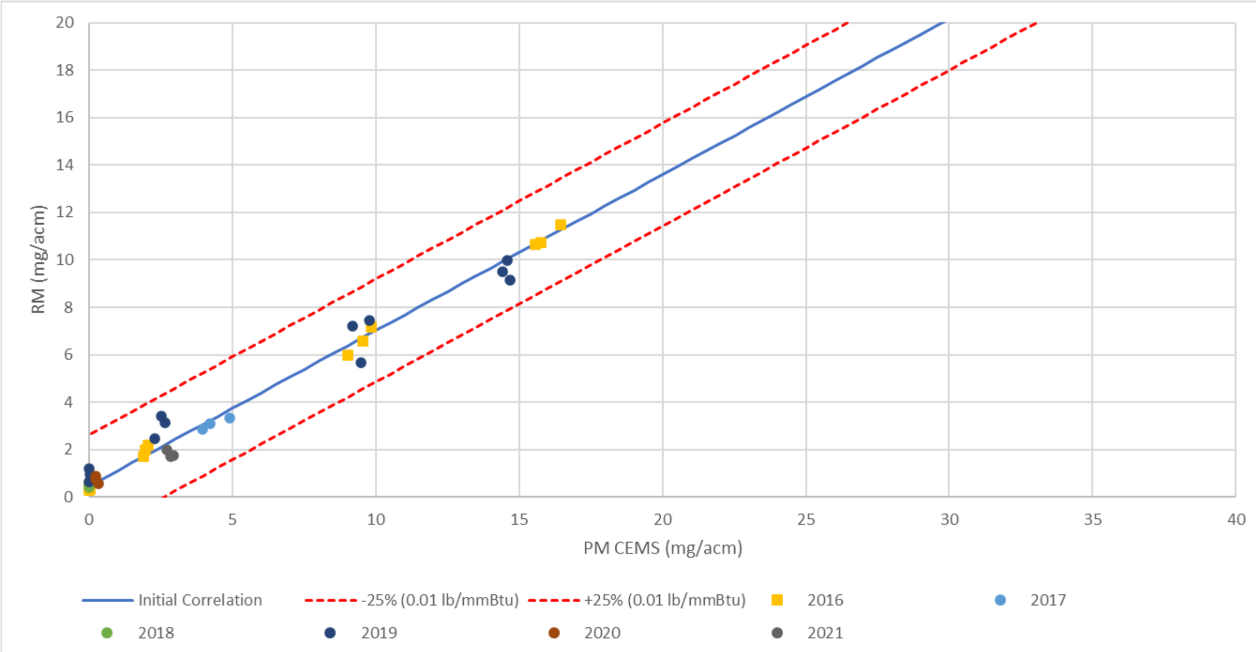

Figure 8. Example Correlation and QA Tests: Baghouse and Dry Scrubber with Optical PM CEMS

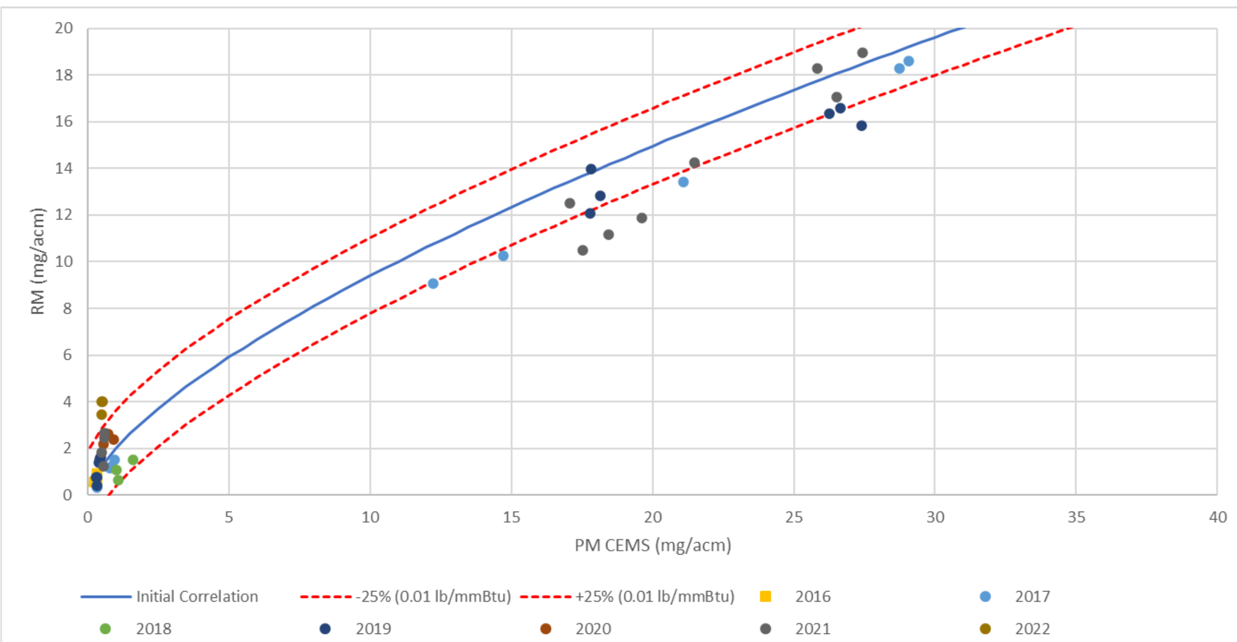

Figure 9. Example Correlation and QA Tests: ESP and Wet Scrubber with Optical PM CEMS

Minimum Sample Volume Evaluation

To assess the proposed minimum sample volume requirement, an evaluation was performed to compare the impact of sample volume variability using a subset of the available RRA and RCA data.

Under the current MATS Rule, sources have the option to demonstrate compliance with the 0.030 lb/mmBtu fPM emission limit by performing quarterly stack tests, which require a minimum sample volume of 1 dscm. Sources also have the option to qualify as a low emitting EGU (LEE) by demonstrating that the fPM emissions are less than 50% of the 0.030 lb/mmBtu emission limit (that is, 0.015 lb/mmBtu), which requires a minimum sample volume of 2 dscm.

Table 4 provides a summary of EPA's 2019 database[18] of compliance methodologies highlighting the impact of sample volume on the variability of the fPM mass emission rate measurement. Both the quarterly tests (presumed to be 1 dscm sample volume) and the LEE tests (presumed to be 2 dscm sample volume) were parsed into three subsections representing the current MATS Rule fPM emission limits (that is, 0.030 lb/mmBtu compliance limit and the 0.015 lb/mmBtu LEE qualification limit), the proposed 0.010 lb/mmBtu compliance limit, and the proposed alternative compliance limit of 0.006 lb/mmBtu. A relative standard deviation was calculated based on each available set of three to four test runs using the appropriate emission limit in the denominator rather than the average of the test runs. The data indicated that doubling the sample volume had no significant impact on the overall variability in the fPM emission rate measurement. There is no reason to believe that quadrupling the sample volume, as EPA has proposed, would have any significant impact on the overall variability in the fPM emission rate measurement.

Table 4. Effects of LEE Sampling Volume on Measurement Variability

Emission Level	Quarterly (1 dscm)			LEE (2 dscm)		
	# of Sets	Mean (lb/mmBtu)	Mean RSD	# of Sets	Mean (lb/mmBtu)	Mean RSD
≤0.006 lb/mmBtu	41	0.004	13.5%	134	0.005	18.0%
>0.006 and ≤0.010 lb/mmBtu	14	0.008	17.9%	34	0.008	15.3%
>0.010 and ≤0.015 lb/mmBtu	13	0.012	9.1%	12	0.012	14.2%
>0.015 lb/mmBtu	23	0.023	14.8%	3	0.017	11.2%

[18] EPA-HQ-OAR-2018-0794-5561.

Summary of Evaluation Findings

On April 24, 2023, EPA published in the Federal Register proposed changes to the MATS Rule[19] [1]. Under the proposed rule, EPA proposed to increase the minimum sample volume requirement for performing MATS-modified[20] EPA Reference Method 5 from 1 dscm to 4 dscm. The referenced memo does not provide any supporting information on how the MDL was derived and differs significantly from other guidance on the MDL for EPA Reference Method 5.

This study evaluated quarterly tests (presumed to be 1 dscm sample volume) and the LEE tests (presumed to be 2 dscm sample volume) tests at the current MATS Rule fPM emission limits (that is, 0.030 lb/mmBtu compliance limit and the 0.015 lb/mmBtu LEE qualification limit), the proposed 0.010 lb/mmBtu compliance limit, and the proposed alternative compliance limit of 0.006 lb/mmBtu. The results revealed that doubling the sample volume had no significant impact on the overall variability in the fPM emission rate measurement. Based on this evaluation, there is no reason to believe that quadrupling the sample volume, as EPA has proposed, would have any significant impact on the overall variability in the fPM emission rate measurement.

[19] 88 Fed. Reg. 24854 (Apr. 24, 2023).

[20] Sample probe and sample filter temperatures maintained at 320°F (±25°F).

3 REFERENCES

1. Environmental Protection Agency. *National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units Review of the Residual Risk and Technology Review*. Vol. 88. No. 78. April 24, 2023.
2. U.S. Environmental Protection Agency. WebFIRE Database available via https://cfpub.epa.gov/webfire/. Accessed May–June 2023.

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EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com