

Quality Assurance Program

Quality Assurance Plan
Periodic Audits
Standard Operating Procedures
Preventive Maintenance



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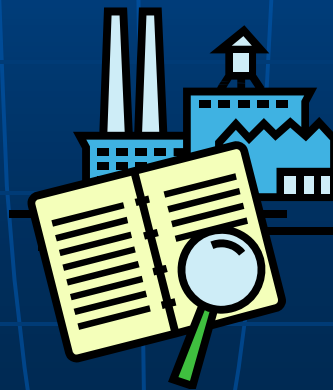
Quality Assurance Plan

- What is a Quality Assurance Plan (QAP)?
- Why is a QAP required?
- What does a QAP typically include?



What is a QAP

- A QAP is a document that contains procedures and activities that must be performed on CEMS equipment to produce reliable, precise and accurate data collection with a minimum amount of downtime.



Why is a QAP required?

- QAP's are required by several Federal, State and local level regulatory agencies and written into Rules as a requirement for CEMS operation.



What does a QAP typically include?

- Facility and major equipment component overview
- Required quality assurance activities
- Required quality control activities
- Standard Operating Procedures
- Reporting instructions
- Preventive maintenance schedule

Quality Assurance Plan Overview

- Quality Assurance Policy
 - Definition of Quality Control and Quality Assurance
 - Objective of Quality Control Plan
- Quality Audit Procedures
- Quality Assurance Status

Definition of Quality Control and Quality Assurance

- Quality Control (QC) is the procedures, policies, and corrective actions necessary to ensure product quality. QC procedures are routine activities. These activities include but are not limited to daily calibrations and routine preventive maintenance activities as defined by manufacturers of the various hardware components of the CEM system and/or by regulatory agencies.
- Quality Assurance (QA) is a series of checks performed to ensure the QC procedures are functioning properly. Quality assurance is often used to define “external” activities (i.e., functions performed on a more occasional basis). The activities include but are not limited to required periodic quarterly and annual audits. Which assesses the quality of data.

Objective of Quality Control Plan

- The objective of the QAP is to establish a series of QA and QC activities that will provide a high level of confidence in the data reported by the CEMS. The QAP provides guidelines for implementing QA and QC activities needed to ensure that emissions monitoring data are complete, representative, and of known precision and accuracy.



Periodic Audit Requirements

- Part 60 Systems

Daily calibration drift – all analyzers

Quarterly CGAs – gas analyzers

Quarterly calibration error – opacity monitor

Quarterly leak check – Delta P type stack flow monitors

Annual RATA – all analyzers

Periodic Audit Requirements – Cont.

- Part 75 systems

- Daily error check – all analyzers

- Daily interference check – stack flow monitors

- Quarterly linearity check – gas analyzers

- Quarterly leak check – Delta P type stack flow monitors

- Quarterly stack flow-to-load analysis – stack flow monitors

- Semiannual/annual RATA & bias check – all analyzers

- Annual fuel flow meter accuracy check – Part 75

- Appendix D reporting systems

Facility Responsibilities

Environmental Office (or facility equivalent):

- Oversees the CEM QA/QC program.
- Reviews all plans and reports for accuracy.
- Prepares certification/recertification applications and notifications.
- Stays abreast of EPA regulation updates that may affect the CEM programs and interprets as required.
- Coordinates and schedules CEMS audits, diagnostic tests and certification/recertification tests as required.
- Reviews the quarterly CEM reports from each plant prior to submittal.
- Submits quarterly reports and certification/recertification test results to the applicable regulatory agencies.
- Supports and provides training in the administration and maintenance of the CEMS Data Acquisition and Handling System (DAHS).
- Develops the CEMS QAP and generic CEMS Standard Operating Procedures (SOP) documents.
- Reviews CEMS data for validity and makes any necessary corrections so the proper data will be entered in the quarterly reports.
- Ensures records are maintained for out-of-control conditions.
- Notifies the Plant Manager of any abnormal conditions that cannot be resolved within existing CEMS procedures in a reasonable amount of time.
- Maintains files of all plant CEMS data (hard copy and electronic), reports, calibration gas certificates, etc. for three years as required by the EPA (or as applicable to local regulatory requirements).
- Notifies appropriate plant personnel of scheduled CEMS audits and certification/re-certification tests.
- Arranges for support needed by contractors for relative accuracy test audits (RATAs) and certification/re-certification tests.
- Provides plant resources to assist contractors during RATAs and certification/re-certification testing.

Facility Responsibilities - Cont.

Plant manager:

- Designates and manages manpower and other resources needed to properly maintain and operate the CEMS.
- Reviews and approves all plant-specific CEM plans, procedures, and reports.

Facility Responsibilities - Cont.

Maintenance managers and shift supervisors:

- Reviews CEMS calibration reports on a daily basis and responds to CEMS alarms.
- Notifies the Plant Manager of any abnormal conditions so immediate action can be taken to return the system to normal operating conditions.
- Notifies the environmental staff and maintenance technicians of CEMS malfunctions.
- Verifies that the unit is operated in compliance with the monitoring plan.
- Ensures that a spare parts inventory is maintained based on manufacturers' recommendations and plant operating experience with the CEMS.
- Ensures that the inventory of EPA Protocol (as required) calibration gases is well maintained.
- Ensures that work requests for preventive maintenance and priority jobs on the CEMS are scheduled and completed in a timely manner.

Facility Responsibilities - Cont.

Maintenance and instrument technicians:

- Performs all maintenance (routine and corrective) to keep the CEMS running according to specifications.
- Maintains a complete CEMS maintenance log.
- Assists contractors during audits and certification/recertification testing.
- Checks the conditions of all analyzer shelters.
- Informs responsible managers/supervisors of the CEMS status on at least a weekly basis.

Quality Assurance Status

- A monitor is considered out-of-control (OOC) starting with the hour of the failure of any quality assurance test. A test that is initiated and discontinued because the monitoring system is failing to meet the applicable performance specification or is otherwise found to be out-of-control is considered a failed test and the monitoring system is considered out-of-control starting with the hour in which the test was discontinued.
- A system is also considered out-of-control beginning in the first hour following the expiration of a previous test if the owner/operator fails to perform a required periodic test.
- A system is considered in-control in the hour in which all tests were failed or missed is successfully completed.



Standard Operating Procedures: CEM Startup, Calibration, and Routine Operation

- General
 - Safety Check
 - Component Check
- Initial Startup
 - Normal System Sampling Flow Verification
- Automatic Operation
- Calibration
- Probe Purge
- Start-Up Procedures Following a Shutdown
 - Power Verification
 - Start-Up After a Short Shutdown
- Minimize Downtime During Routine Operation
- Minimize Time in Maintenance Mode

Quality Control Activities

- Calibration and Audit Gases
 - Daily Calibration Gases
 - Quarterly Audit Gases
- Daily Requirements
- Calibration Drift Tests for Gas Analyzers
 - Re-calibration Limits
 - Out-of-Control Limits – Gas Monitors
- Calibration Drift Test for Flow Monitors
 - Re-calibration Limit for Flow Monitors
 - Interference Check
 - Out-of-Control Period - Flow
- Daily Calibration Drift Tests for Opacity Monitors
 - Re-calibration Limits
 - Out-of-Control Limit
- Data Recording and Written Records



Daily Calibration Drift Tests - Part 60

- The calibration drift tests will be performed at two concentrations:
- Zero Level (0-20% of span)
- High Level (50-100% of span)
- Daily calibration gas concentrations need not be certified. The calibration gas will be introduced at the gas injection port.



Out-of-Control Limits – Gas Monitors - Part 60

Analyzer	CD Specification (Maintenance Level)	Excessive CD 5 Consecutive Days (2 X PS) (Analyzer Out-of- Control)	Excessive CD 24 Hr. Criteria (4 X PS) (Analyzer Out-of- Control)
NO _x	2.5% span error*	5.0% span error	10.0% span error
SO ₂	2.5% span error*	5.0% span error	10.0% span error
CO	5.0% span error*	10.0% span error	20.0% span error
CO ₂ /O ₂	0.5% CO ₂ /O ₂ difference**	1.0% CO ₂ /O ₂ difference	2.0% CO ₂ /O ₂ difference

Out-of-Control Limits – Flow

- Part 60

Analyzer	CD Specification (Maintenance Level)	Excessive CD 5 Consecutive Days (2 X PS) (Analyzer Out-of-Control)	Excessive CD 24 Hr. Criteria (4 X PS) (Analyzer Out-of-Control)
Flow	3.0% span error*	6.0% span error	12% span error

Out-of-Control Limits – Opacity - Part 60

Analyzer	CD Specification (Maintenance Level)	Excessive CD (2 X PS) (Analyzer Out-of-Control)
Opacity	2.0% span error	4.0%



Daily Calibration Error Checks – Part 75

- The calibration error tests are performed at two concentrations:
- Zero Level (0-20% of span)
- High Level (80-100% of span)
- Daily calibration gas concentrations must be EPA Protocol certified



Out-of-Control, Gas Analyzers – Part 75

- Out-of-control is equal to 2 times the performance specification for all gas analyzers

NO_x/SO₂ out-of-control = 5.0% of span

CO₂/O₂ out-of-control = 1.0% difference

Alternate criteria exists for NO_x/SO₂ analyzers based on analyzer range



Out-of-Control, Flow Monitors – Part 75

- Out-of-control is equal to 2 times the performance specification for flow monitors

Flow out-of-control = 3.0% of span



Daily Operational Checks

- Daily analyzer operation parameter check
 - Monitor analyzer status indicators and compare with data controller readings
 - Vacuum pump readings
 - Flow rotameter readings
 - System air supply pressure
- Alarm log daily check
 - View alarm log
 - Acknowledge alarms
 - Maintain CEMS logbook



Daily Operational Checks Cont.

- Check Set Points (will vary depending on individual configurations)
 - Check pressure readings
 - Plant air
 - Sample pressure
 - Probe vacuum
 - Sample probe purge air
 - Check flows
 - Total sample system flow
 - Analyzer flow
 - Cal gas flow
 - Visual checks
 - Room/enclosure temperature
 - Moisture sensor/filter
 - Cooler temperature
 - Drain pump
 - Sample line temperature control



Data Recording and Written Records

- Record and tabulate all calibration-error test data according to month, day, clock-hour, and magnitude in ppm or percent volume. For program monitors that automatically adjust data to the corrected calibration values either record the unadjusted concentrations measured in the calibration error test prior to resetting the calibration or the magnitude of any adjustment.
- All measurements from the CEMS must be retained on file for a minimum of two years.
- Emission data obtained while the CEMS is out-of-control may not be included as part of the minimum daily data requirement, neither can the data be used for calculation of reported emissions for that period.



Quality Assurance Activities

- Quarterly Assessments
- Cylinder Gas Audit and Linearity Check
 - Out-of-Control Period
- Opacity Calibration Error Assessment
 - Out-of-Control Period
- Relative Accuracy Test Audit Procedures
 - Out-of-Control Period



Cylinder Gas Audit (CGA) - Part 60

CGA Calibration Gas Requirements

Audit Point	Pollutant Analyzers % of Span	CO ₂ % by volume (actual concentration)	O ₂ % by volume (actual concentration)
1	20 to 30	5 to 8	4 to 6
2	50 to 60	10 to 14	8 to 12



Quarterly Opacity Calibration Error Assessment – Part 60

Calibration filters are chosen in accordance with ASTM D6216-98, section 7.5. Using any applicable pathlength correction factor and opacity standard values from ASTM D6216-98, section 7.2 or 7.3, calibration filters are selected that provide an opacity monitor response corrected to single-pass opacity values for the emission outlet pathlength in accordance with the following:

<i>Applicable Standard</i>	<i>10 to 19% Opacity</i>	<i>≥20% Opacity</i>
Low level	5 to 10%	10 to 20%
Mid level	10 to 20%	20 to 30%
High level	20 to 40%	30 to 60%

Additional guidance for conducting this test is included in Section 7.0 of PS-1. The low-, mid-, and high-range calibration error results shall be computed as the mean difference and 95 percent confidence interval for the difference between the expected and actual responses of the monitor as corrected to stack exit conditions. These values shall be calculated using the procedures of Section 8.0 of PS-1.

The calibration error should not exceed 3.0 percent opacity. The calibration error of the opacity monitor is expressed as the sum of the absolute value of the mean and the absolute value of the confidence coefficient as shown in the equation below:

Opacity Calibration Error 40 CFR 60, Appendix B, Performance Specification 1 (PS-1)	
$CE = \bar{X} + cc $	CE = Calibration error \bar{X} = Mean difference cc = Confidence Coefficient

CGA and Opacity - Out-of-Control Period

- An out-of-control period occurs when the CGA at any of the two concentrations (four for dual range) exceeds the applicable specifications (>15% error or 5 ppm difference). The out-of-control period begins with the hour of the failed CGA and ends with the hour of a satisfactory CGA following the corrective action.
- Opacity out-of-control occurs when any of the 3 audit levels exceeds 3% opacity
- During the time the CEMS is out-of-control the CEMS data may not be used in calculating emission compliance nor be counted toward meeting minimum data availability.

RATA Out-of-Control Period - Part 60

- An out-of-control period occurs when any of the following conditions exist:
- When the relative accuracy of the NOX/SO2 CEMS exceeds 20% of the reference method mean (or 10% of the applicable emission standard, whichever is less restrictive).
- When the relative accuracy of the O2/CO2 CEMS exceeds 20% of the reference method mean (or 1% O2/CO2, whichever is greater).
- When the relative accuracy of the CO CEMS exceeds 10% of the reference method mean (or 5% of standard, whichever is greater).
- The out-of-control period begins with the hour of completion of the first failed RATA and is over at the end of the hour of a passing RATA.
- During the period the CEMS is out-of-control, the CEMS data may not be used in calculating emission compliance nor counted toward meeting minimum data availability.

Linearity Check – Part 75

- Cal gas requirements are based on % of span per the following:

Low	20 – 30% of span value
Mid	50 – 60% of span value
High	80 – 100% of span value

- Calibration gases must be EPA Protocol certified
- Out-of-control occurs if any of the three audit level runs exceeds 5% or alternately 5 ppm difference for NO_x/SO₂ or 0.5% difference for CO₂/O₂
- Exemptions and grace periods exist for linearity

RATA – Part 75

- RATAs performed on an annual or semiannual basis depending on results of previous RATA
- Flow RATAs are performed at 3 operating load levels with some exemptions to the 3-load requirement
- Gas analyzer RATAs are performed at the designated normal operating load level as noted in the facility's Part 75 monitoring plan.
- Grace periods and extensions exist for a missed RATA or non-operating quarter

RATA Out-of-Control – Part 75

RATA	Semiannual ¹	Annual ¹
SO ₂ or NO _x ³	7.5% < RA ≤ 10% or ±15 ppm ^{2, 4}	RA ≤ 7.5% or ±12 ppm ^{2, 4}
SO ₂ /diluent	7.5% < RA ≤ 10% or ±0.030 lb/mmBtu ^{2, 4}	RA ≤ 7.5% or ±0.025 lb/mmBtu ^{2, 4}
NO _x /diluent	7.5% < RA ≤ 10% or ±0.020 lb/mmBtu ^{2, 4}	RA ≤ 7.5% or ±0.015 lb/mmBtu ^{2, 4}
CO ₂ /O ₂	7.5% < RA ≤ 10% or ±1.0% CO ₂ /O ₂ ²	RA ≤ 7.5% or ±0.7% CO ₂ /O ₂ ²
Moisture	7.5% < RA ≤ 10% or ±1.5% H ₂ O ²	RA ≤ 7.5% or ±0.1.0% H ₂ O ²
Flow	7.5% < RA ≤ 10% or ±2.0 fps ²	RA ≤ 7.5% or ±1.5 fps ²

RATA Out-of-Control – Part 75

Cont.

- 1 – The deadline for the next RATA is the end of the second (if semiannual) or fourth (if annual) successive QA operating quarters following the quarter in which the CEMS was last tested. Exclude calendar quarters with fewer than 168 operating hours (or, for common stacks and bypass stacks, exclude quarters with fewer than 168 stack operating hours) in determining the RATA deadline. For SO₂ monitors, QA operating quarters in which only very low sulfur fuel as defined in § 72.2, is combusted may also be excluded. However, the exclusion of calendar quarters is limited as follows: the deadline for the next RATA shall be no more than 8 calendar quarters after the quarter in which a RATA was last performed.
- 2 – The difference between monitor and reference method mean values applies to moisture monitors, CO₂, and O₂ monitors, low emitters, or low flow, only.
- 3 – A NO_X concentration monitoring system used to determine NO_X mass emissions under § 75.71.
- 4 – If average reading of NO_X is ≤ 0.20 lb/mmBtu then use the ± 0.02 lb/mmBtu semiannual and ± 0.015 lb/mmBtu annual alternate criteria. If average reading of SO₂ is ≤ 0.50 lb/mmBtu then use the ± 0.03 lb/mmBtu semiannual and ± 0.025 lb/mmBtu annual alternate criteria. If average NO_X or SO₂ reading is ≤ 250 ppm then use the ± 15 ppm semiannual and ± 12 ppm annual alternate criteria.



Routine Preventive Maintenance

- Note that Part 75 and Part 60 consider routine maintenance of the CEMS and its components per manufacturers' recommendations is a regulatory/compliance specification
- Corrective Actions Requiring Re-Certification
- Logbook Maintenance
- System Checks
 - Calibration Failure, Excessive Zero Drift, Water Contamination
 - Routine Maintenance for the Sample Probe
 - Routine Maintenance for the Sample Line
 - Routine Maintenance for the Sample Conditioning Unit
- CEMS Preventive Maintenance Schedule
 - Daily Preventive Maintenance
 - Weekly Preventive Maintenance
 - Monthly Preventive Maintenance
 - Quarterly Preventive Maintenance
 - Semi-Annual Preventive Maintenance
 - Annual Preventive Maintenance
 - Long Term Maintenance



Corrective Actions Requiring Re-Certification

- The following are examples of situations that require re-certification. These changes include, but are not limited to:
 - Changes in gas cells
 - Path lengths
 - Sample probe
 - System optics
 - Replacement of analytical methods (including the analyzers, monitors)
 - Change in location or orientation of the sampling probe or site
 - Rebuilding of the analyzer or all monitoring system equipment
- These changes may require EPA notification and re-certification. Replacement of analyzers in total will require re-certification unless the analyzer was previously certified as a backup for a given CEM.
- Upon completion of any maintenance work a manual calibration must be performed to demonstrate the system is working properly.

Maintenance and Diagnostic Testing – Part 75

- Under Part 75 certain types of maintenance may require the need for additional testing to demonstrate proper working condition of the system. Tables can be found in the EPA's *Part 75 Emissions Monitoring Policy Manual* (latest draft published April 2010)
 - Diagnostic drift check
 - Diagnostic or abbreviated linearity
 - Diagnostic or abbreviated cycle response time
 - Full recertification
 - Inclusion of a QA/Cert record in the quarterly EDR (ECMPS/Client Tool)
- There are deadline requirements for completing any required post maintenance test events.
- Note that the SCAQMD has similar post maintenance test requirements.

Maintenance and Diagnostic Testing – Part 75 Cont.

Table 7-1: Recertification and Diagnostic Test Policy for Dry-Extractive CEMS

Recertification and Diagnostic Test Policy for Dry-Extractive CEMS ¹								
Description of Event	Event Status ²	RATA	7 Day Cal Error ³	Cycle Time Test	Linearity Check	Calibration Error Test ⁴	Submit an Event Record	Comments
Permanently replace NO _x , SO ₂ , O ₂ or CO ₂ analyzer with like-kind analyzer as defined in Acid Rain Program Policy Manual Question 7.13.	R	X	X		X	X	X	Permanent replacement of an analyzer is a recertification event. EPA does not require the cycle time test in this case, since the analyzer is like-kind and the rest of the system is the same. Modify monitoring plan as necessary.
Permanently replace NO _x , SO ₂ , O ₂ or CO ₂ analyzer with new analyzer that does not qualify as a like-kind analyzer.	R	X	X	X	X	X	X	Modify monitoring plan as necessary.
Replace or repair any of the following components:								EPA will conditionally allow the abbreviated linearity check and the alternative response check (footnotes 5 and 6).
Photomultiplier	D				5	X	A	
Lamp	D				5	X	A	
Internal analyzer particulate filter	D			6		X	A	
Analyzer vacuum pump	D			6	5	X	A	

Logbook Maintenance

- Any testing, adjustment, repair, replacement, or preventive maintenance action performed on any monitoring system,
- Corrective actions associated with a monitor's outage period,
- Any adjustment that re-characterizes a system's ability to record and report emissions data must be recorded (e.g., changing of temperature and pressure coefficients and dilution ratio settings),
- The procedures used to make the adjustment.
- Individual entries must include the date, time and description of corrective and preventive maintenance procedures performed on each CEMS.
- A Regulatory Agent may ask to review Maintenance logbooks and checklists during an on-site inspection.

CEMS Preventive Maintenance

8.6.4 Quarterly Preventive Maintenance

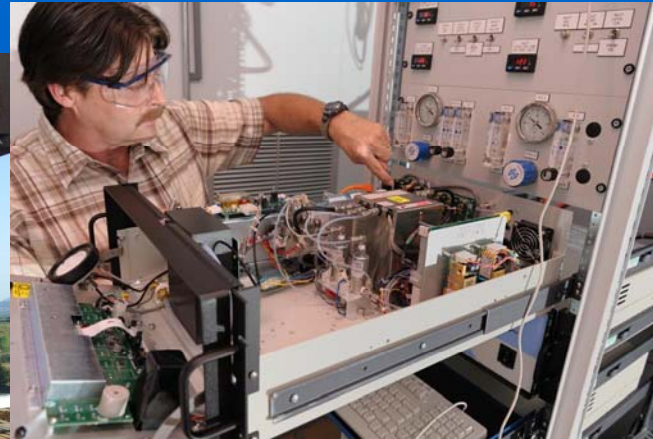
Perform the following checks and maintenance four times each year that the CEM system is in operation. Make corrections and/or repairs as necessary. Record any corrective maintenance or troubleshooting procedures performed on the CEMS and any out-of-control periods in the CEMS Maintenance Logbook.

Unit Number ID:	
Date of Checks:	
Technician(s) Initials:	

Sample System Checks – Quarterly	
Item	Value or Status (Completed, OK, Replaced)
Perform all daily, weekly, and monthly checks. Note that all routine maintenance is to be performed prior to the required quarterly audit test.	
If sample gas vacuum (VG1) shows an increase, perform probe maintenance. Replace the filter element and clean the filter chamber as necessary. Replace O-rings. Verify probe box heater is operating. If flow is low, check sample pump (SP1).	
Perform CEMS sample system leak check and flow balance procedure (Chapter 9).	
Check and replace ammonia scrubber media (AS1) as needed.	
Perform general housekeeping duties inside shelter/cabinet. Dust/clean all equipment surfaces.	

Corrective Maintenance

- Troubleshooting the CEMS System
 - Leak check procedures
 - Sample conditioning system
 - Probe checks
- Troubleshooting the Gas Analyzers
- Troubleshooting the Flow Monitor
- Troubleshooting the Opacity Monitor
- Spare Parts



Part 75 vs. Part 60 CEMS Specifications

- Part 60 CEMS operating specifications is found in 40 CFR 60, Appendix B – Performance Specifications, and Appendix F – Quality Assurance Procedures
- Part 75 CEMS operating specifications if found in 40 CFR 75, Appendix A – Specifications and Test Procedures, and Appendix B – Quality Assurance and Quality Control Procedures.

Differences

- Span and Range requirements
- Calibration Drift vs. Calibration Error Check
- Cylinder Gas Audit vs Linearity Check
- RATA Requirements
- Reference Method Requirements
- Moisture Monitoring Requirements

Calibration Drift vs. Calibration Error Check

- Part 60 Performance Specifications
 - 2.5% of span for NO_x/SO₂
 - 5.0% of span for CO
 - 0.5% O₂/CO₂ difference
- Part 75 Performance Specifications
 - 2.5% of span for NO_x/SO₂, or ≤ 5 ppm for spans < 200 ppm
 - 0.5% O₂/CO₂ difference
- Out-of-Control
 - Part 60 – first failed test over 4x the specification or fifth consecutive failure over 2x the PS
 - Part 75 – first failed test over 2x the PS or alternate standard

CGA vs. Linearity

■ Part 60 CGA

- 2 gases: low (20-30% of span) and mid (50-60% of span)
- Criteria $< 15\%$ or ≤ 5 ppm difference
- Performed in 3 quarters per year with RATA performed in 4th quarter

■ Part 75 Linearity

- 3 gases: low (20-30% of span), mid (50-60% of span), and high (80-100% of span)
- Criteria $< 5\%$ or ≤ 5 ppm difference
- Performed in every QA operating quarter

RATA Compared

■ Part 60

- $RA \leq 20\%$ or 10% of the applicable emission standard for NO_x/SO_2
- $RA \leq 20\%$ or 1.0% difference CO_2/O_2
- Test to be conducted with unit operating at more than 50% capacity or at normal load
- Repeat every four calendar quarters

■ Part 75

- $RA \leq 10\%$ or 15 ppm for NO_x/SO_2 (other alternative criterion exists)
- $RA \leq 10\%$ or 1.0% difference CO_2/O_2
- Test to be conducted with unit operating at normal load as specified in 75 App A, 6.5.2.1
- Repeat every 2 QA operating quarters unless $RA \leq 7.5\%$, then repeat every 4 QA operating quarters

Reference Method differences

- 40 CFR 60; test methods are specified in the applicable subpart
- 40 CFR 75; test methods are specified in 75.22
 - Not all of the sections in the reference methods are adopted in Part 75



The End

Questions

