CEMS Certification and Compliance Testing Lessons Learned on Turbines

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Background

◆ While with RMB, assisted with the air-related regulations and/or was present for testing at 50+ turbines since CY 2000

- Via project management (air), EPRI research, construction, certifications/testing, consent decrees

◆ Want to dispense some "wisdom" and reminders based upon those projects

- Focus on <u>new</u> simple-cycle and combined-cycle turbines emitting < 10 ppm NO_x and < 1 ppm CO
    » While firing gas

Regulatory Applicability

◆ NO_x and O_2 (or CO_2) monitors are subject to 40 CFR Part 75

◆ CO monitors are subject to 40 CFR Part 60

◆ SO_2 monitors are exempted via fuel sampling

◆ Opacity monitors are exempted via gas-firing

Part 60, NSPS Subpart GG, §60.334(b)(1) and (b)(3)(iii) and
Part 60, NSPS Subpart KKKK, §60.4345(a)
state that Part 75 monitors installed on turbines are exempted
from Part 60!!

CEMS Certifications

◆ 1. Linearity
- Verify that your monitor works and is in fact linear

◆ 2. 7-Day drift
- Can take awhile
- Do this while there's no deadline pressure yet

◆ 3. RATA
- Do this after tuning/shakedown, just before turnover

◆ 4. Cycle time
- Do this at the end of the project
- Easy to pass
- "Stall" if at the end of a quarter (avoid EDR report)

CEMS Certifications

Do the tests in this <u>recommended</u> order. You "know" you will pass the cycle time test, so save it for last once you have "all of your ducks in a row" and are fully ready to report valid data.

If a regulatory agency tells you that (a) you have to do these tests in a certain order and/or (b) you have to repeat all 4 tests if you fail any of the tests they are wrong on both counts!

CEMS Certification Deadlines

◆ March 2011 revisions to Part 75

◆ Change CEMS certification deadline for new units from 90 unit operating days to 180 calendar days (after CCO)

- If have a combined-cycle turbine with a main stack <u>and</u> a bypass stack, the 180-day deadline will be based on the <u>first</u> stack to be fired and the same deadline will apply to <u>both</u> stacks (since both stacks comprise the same "unit")

- If you don't treat it this way, ECMPS will spit out errors!

CEMS Certification Deadlines

◆ Deadline for existing units with new stacks (and/or control devices)

- <u>Still</u> based on earlier of 90 unit operating days or 180 calendar days after emissions first pass through new stack (and/or control device)

Definitions

◆ Commence commercial operation (CCO)

- Date is used to trigger CEMS certification deadlines

◆ EPA CCO (synch-to-grid) = to have begun to generate electricity for sale

◆ Plant CCO (turnover) = when the people building the unit(s) turn the unit(s) over to the people owning and operating the unit

EPA CCO happens a few months before Plant CCO!!

Equipment

◆ Replace your NO_x converter at a prescribed frequency

- Not required by Part 75 or Part 60
- Voluntarily add procedure to your CEMS QA Plan
  - » Recommend once per year
- If your converter is shot, you will not be measuring the NO_2 in your stack gas, and will have a NO_x value that is biased low
  - » More pronounced on sources < 5 ppm NO_x
  - » Can cause a failed RATA and will cause a bias (B.A.F.)

Calibration Gases

◆ The "Green Book" was updated in May 2012

- *"EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards"*
- You can now request retroactively revised (extended) expiration dates on older Protocol gas cylinders
  - » Assuming you still have some gas left inside the cylinder
- Get a new cert sheet for your NO_x cylinder(s) <u>without having to return</u> the cylinder(s)
  - » NO_x (balance air or nitrogen) $\geq$ 3 ppm = 3 years
- Example –
  - » 9 ppm NO_x cylinder (balance air) analyzed January 5, 2011
  - » Original cert sheet expiration date is January 5, 2012
  - » Request a revised cert sheet with an expiration date of January 5, 2014

Calibration Gases

◆ For your high-level daily calibration and/or linearity gas, order a gas near <u>90%</u> of span

- If you order a gas near 100% of span, then the calibration response may not be properly assessed

- For example –

  » Monitor Span = 10 ppm

  » High-Level Gas = 9.9 ppm

  » Calibration Response = 10.4 ppm

    ◆ How do you know really know this, if the span of the instrument is set to 10 ppm?

Cycle Time Test

◆ If you use a mid-level NO_x gas for your daily calibrations on the low-range of your NO_x monitor, you will need to round up a high-level NO_x gas to properly complete the NO_x cycle time test

- That is, even though you may not think you'll need this gas in your inventory since a linearity isn't required on monitor spans < 30 ppm, you will in fact need it "this one time" since it is required for the cycle time test used for initial certification of the CEMS

7-Day Drift Test

◆ The thorn in everyone's side

◆ Common mistakes –

- Not tweaking after a successful calibration, if needed
- Not performing a calibration while the unit is operating
- Not performing a calibration for "short" operating days
- For consecutive unit operating days, calibrations not performed ~24 hours apart

RATA Testing

- ◆ Take advantage of "non-routine calibration adjustments" to minimize BAFs
- ◆ Allowable per Part 75, App. B, §2.1.3(c)
  - • But <u>only prior to</u> RATAs and linearity tests
- ◆ Rule created to account for potential error in certified calibration gas values
- ◆ Allowed to "tune away" from the tag value of the cylinder by –
  - • $\pm$ 2.5 % of span for NO_x
    - » This equates to 0.25 ppm on a 10 ppm span NO_x monitor
  - • $\pm$ 0.5 % absolute difference for O_2 (or CO_2)

RATA Testing

◆Example –

CEMS Cylinder Tag Values
NO_x = 9.1 ppm
O_2 = 18.7 %

CEMS Calibration Responses
NO_x = 9.1 ppm
O_2 = 18.7 %

Test Firm RATA Results
NO_x = 3.4 ppm
O_2 = 13.8 %
ER = 0.010 lb/mmBtu

Plant CEMS RATA Results
NO_x = 3.1 ppm
O_2 = 13.8 %
ER = 0.009 lb/mmBtu
B.A.F. = 1.097

RATA Testing

◆ Example (continued) –

CEMS Cylinder Tag Values
$NO_x = 9.1$ ppm
$O_2 = 18.7$ %

CEMS Calibration Responses
$NO_x = 9.3$ ppm
$O_2 = 19.2$ %

Tweak both the NO_x and O_2 "high"
(or one or the other)

Test Firm RATA Results
$NO_x = 3.4$ ppm
$O_2 = 13.8$ %
$ER = 0.010$ lb/mmBtu

Plant CEMS RATA Results
$NO_x = 3.3$ ppm
$O_2 = 14.1$ %
$ER = 0.011$ lb/mmBtu
B.A.F. = 1.000

RATA Testing

◆ CO RATAs are subject to Part 60 instead of Part 75

◆ If the pre-test stratification check is failed, Part 60 requires a 3-point RATA traverse at 16.7, 50.0, and 83.3% of the stack diameter

- To pass stratification test, all 12 test points must be within 10% of the average concentration of the stack

- What if the average CO is 0.5 ppm and one of the test points is 0.7 ppm?

- What test firm carries around a 17 foot sample probe?

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RATA Testing

◆ Propose an alternative stratification criteria

◆ Allowed per Part 60, Appendix B, PS-2, §8.1.3.2
  - State agencies have the authority to approve

◆ For low CO (i.e., < 2 ppm) stacks, suggest –
  - "Short" 3-point traverse if all 12 points are within ± 1 ppm of average
  - Single-point traverse if all 12 points are within ± 0.5 ppm of average
  - Much more stringent than the Part 75 requirement of all 12 points needing to be within ± 3 ppm of average

CO Monitoring

◆ Part 75 exempts units from having to perform linearity checks in quarters where the unit operates ≤ 168 unit operating hours

◆ Part 60 <u>does not</u> exempt units from having to perform CGAs in quarters where the unit operates ≤ 168 unit operating hours

● In fact, CGAs are still technically required if the unit doesn't operate <u>at all</u> during a quarter

CO Monitoring

◆ Petition your State regulatory agency –

- Proposal A: May we utilize the Part 75 "unit operating quarter" criteria to determine whether or not a CGA is performed?

- Proposal B: If Proposal A is rejected, can we at least perform the quarterly CGAs while the unit is off-line?

  » Does it make any environmental common sense at all if you have to start up a turbine just to perform a CGA?

Compliance Testing

◆ Remove test port nuts and bolts from stacks prior to painting, and reinstall once complete

◆ Use stainless steel test port nuts and bolts

◆ While VOC testing, do not paint the stacks or pave the roads during testing
- For permit limits < 1 ppm, this can cause a failed test

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Compliance Testing

◆ If possible, negotiate with your State agency to remove any PM testing requirements

◆ Ensure that the stack test firm measures NO_x via Method 7E at a monitor <u>range</u> of 10 ppm
  - CO is a little more tricky, so a range of 30 ppm has been shown to be sufficient

● Ensure that the stack test firm is AETB qualified, has a QI on-site, and uses PGVP calibration gases

Compliance Testing

◆ If it is warm out, you will NOT achieve the maximum potential MW load of the unit

◆ Include a disclaimer in your test report to educate the report reviewer who may not be aware of this scientific concept, e.g. --
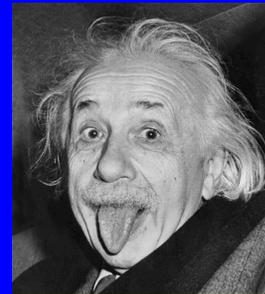
"…for the compliance test program, testing was performed <u>at 100% of the maximum achievable load point</u> for the ambient characteristics in evidence during the time of the compliance test…"

DAHS

◆ Perform a cursory DAHS check and look for these typical values, <u>based upon the units</u> –

200 MW Turbine @ High Load

DAHS

Gas-Fired (2.5 ppm NOx Limit)

Load = 190 MW
Gas Flow = 26 lb/sec
Gas Flow = 1,560 lb/min
Gas Flow = 94 kpph
Gas Flow = 2,075 kscfh
Gas Flow = 20,750 hscfh
GCV = 1,015 Btu/scf
GCV = 101,500 Btu/hscf
Heat Input = 2,100 mmBtu/hr
NH_3 Flow = 0.83 lb/min
NH_3 Flow = 50 lb/hr

Oil-Fired (10 ppm NOx Limit)

Load = 190 MW
Oil Flow = 97 kpph
Oil Flow = 230 GPM
GCV = 19,600 Btu/scf
GCV = 138,000 Btu/lb
Heat Input = 1,900 mmBtu/hr
NH_3 Flow = 4.7 lb/min
NH_3 Flow = 280 lb/hr
H_2O Flow = 65 GPM
H_2O Flow = 520 lb/min
H_2O Flow = 31 kpph

DAHS

◆ The Part 75 "Formula Verification Report" is not sufficient!

◆ Double-check the calculations while the unit <u>is operating</u>

◆ Ensure that the data is being recorded

◆ Ensure that the data is not "stuck" or "pegged"

Miscellaneous

◆ "1-stop shops" are often too good to be true

  ● Company will propose to build the unit, install and certify CEMS, perform the stack testing, draft the Monitoring Plan, draft the QA Plan, etc.

◆ Recommend to hire several contractors that concentrate on a given specialty

  ● Company A = builds the turbine(s)
  ● Company B = installs the CEMS
  ● Company C = performs the testing
  ● Company D = prepares the regulatory documents

Miscellaneous

- The owner/operator should choose the CEMS vendor -- not the builder or A&E firm
- Spend some $$$ and install a reliable CEMS
  - Too much risk involved with installing a cheap CEMS
- Install the same CEMS make/models across multiple units and plants
- Obtaining fuel flowmeter certification data can be more time consuming than you think

Miscellaneous

◆ Get any Part 60 language or references that pertain to the NO_x and O_2/CO_2 monitors out of your air permit

- Remember, NSPS Subparts GG and KKKK provide exemptions

◆ Part 60 will still apply to CO monitors, however

Conclusion

◆ There is an absolute definite need for competent, detailed, and organized project planning!

◆ Need someone to –

- Interpret air permit requirements
- Maintain calendar of events → deadlines
  - » Startup, CCO, maximum production, etc.
- Maintain regulatory matrices
  - » A myriad of notifications, protocols, and reports
- Kill 2 birds with 1 stone where possible
  - » For example, use RATA test data as compliance test data

The End

Any Questions?