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# Continuous Compliance Monitoring Data Gone Bad

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# Outline

- Overview of a DAHS
- DAHS Basics
- Examples of DAHS Gone Bad
- How to QA Your DAHS

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# Overview of a DAHS

- DAHS: Data Acquisition & Handling System
- Twin Purpose of a DAHS
  - Demonstrate compliance with state and federal rules and standards
  - Provides real-time data to boiler operators
- Oftentimes, a black box
- Potential perils
  - False positive
  - False negative

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# DAHS Basics

- Typical Emissions
  - Mass
    - lb/hr, ton/day, etc.
  - Concentration
    - ppm, lb/MMBtu, etc.
  - Opacity
    - %

- Typical Parameters
  - Temperature (°F)
  - Exhaust Flow (scfm)
  - Excess dry $O_2$ (%)
  - Excess wet $O_2$ (%)
  - Pollutant concentration (ppm)
  - Opacity (%)

# DAHS Basics

- Equation A
  - lb/hr = ppm × Ideal Gas Law Constant × wet exhaust × (100% – moisture)
- Equation B
  - lb/MMBtu = ppm × Ideal Gas Law Constant × Fd factor × $O_2$ correction

| | | |
|---|---|---|
| Ideal Gas Law Conversion | p | 1atm |
| | v | 0.000001(1 ppm = 10^-6) |
| | R | 0.7302ft3 atm/mol R |
| | T | 528R |
| | MW | 28lb/mol CO |
| | | 64lb/mol SO2 |
| | | 46lb/mol NO2 |
| | m | 7.262E-08lb/ft3 for 1 ppm of CO |
| | | 1.660E-07lb/ft3 for 1 ppm of SO2 |
| | | 1.193E-07lb/ft3 for 1 ppm of NO2 |

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# DAHS Basics

- Data Reduction Rules
  - 1-min → 15-min → 1-hr
  - Include all data unless
    - CEMS maintenance/repair or system failure
    - Daily zero & span calibration drift tests
  - Hourly data validity check

# DAHS Procedures

- 40 CFR 60
  - §60.13 – Monitoring Requirements
- 40 CFR 63
  - §63.8 – Monitoring Requirements
- 40 CFR 75
  - 75.30-37 – Missing Data Substitutions

# Examples of DAHS Gone Bad

- Triggers/Alarms
- Form of the Standard
- Multi-Range Analyzer
- Incorrect Calculations
- Erroneous Data

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# Examples – Trigger/Alarm

- Design Value
  - $NO_X$ daily limit of 0.085 lb/MMBtu, but
  - Exceedance alarm set at 0.095 lb/MMBtu
- Design Value Units
  - $NO_X$ daily limit of 0.65 ton/day, but
  - Exceedance alarm set at 1,300 lb/day

# Examples – Form of the Standard

- Boiler MACT limit states
  - HCl – 0.0017 lb/MMBtu, except during periods of startup and shutdown
- But,
  - DAHS includes all emissions, even during periods of startup and shutdown

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# Examples – Multi-Range Analyzer

- High/Low Range CO Analyzer
  - Low Range: 0 – 300 ppm
  - High Range: 0 – 3,000 ppm
- Potential Errors
  - Not performing daily calibration checks
  - Relying on only high range measurements
  - Not correctly toggling/combining measurements from high/low ranges

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# Examples – Incorrect Calculations

- F Factor
  - Wood vs. Wood Bark (Table 19.2 to 40 CFR 60 Appendix A)
    - Fd: 9,240 dscf/MMBtu vs 9,600 dscf/MMBtu
  - Fuel-specific calculations from ultimate analysis

$$F_d = \frac{K\left(K_{kd}\%H + K_c\%C + K_s\%S + K_n\%N - K_o\%O\right)}{GCV} \qquad \text{Eq. 19-13}$$

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$$F_w = \frac{K\left[K_{kw}\%H + K_c\%C + K_s\%S + K_n\%N - K_o\%O + K_w\%H_2O\right]}{GCV_w} \qquad \text{Eq. 19-14}$$

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$$F_c = \frac{K\left(K_{cc}\%C\right)}{GCV} \qquad \text{Eq. 19-15}$$

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# Examples – Incorrect Calculations

- Correcting for Excess $O_2$
  - Equation to convert to stoichiometric
    - (20.9 – 0) / (20.9 – excess $O_2$)
  - Mixing up $O_2$ dry (always larger) and $O_2$ wet (always smaller)
    - Using wet rather than dry will under-report lb/MMBtu emissions

# Examples – Incorrect Calculations

- How to calculate lb/MMBtu when O2 dry approaches ambient (20.9%)?
  - CO: 300 ppm
  - Dry $O_2$: 20%
  - Fd Factor for Bituminous: 9,780 dscf/MMBtu
  - Equation B Output: 4.95 lb/MMBtu
- Arbitrary Cap
  - If cap is 2.0 lb/MMBtu, then DAHS reports 2.0 lb/MMBtu
- Diluent Cap
  - For Boilers, 5.0% $CO_2$ and 14.0% $O_2$
    - 2.1.2.1.(b) of Appendix A to 40 CFR 75
    - For non-Part 75 sources, check your state for guidance
  - Substituting 14.0% dry $O_2$ for 20% yields 0.65 lb/MMBtu

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# Examples – Erroneous Data

- Incorrectly including data when
  - CEMS in repair or maintenance
  - Daily calibration checks
  - Out-of-span parameter, e.g. wet $O_2$ > dry $O_2$
  - A given hour fails the data validity check per 40 CFR 60.13(h)(2)
    - At least one data point from each quadrant

# How to QA Your DAHS

- Assistance from DAHS Vendor
  - Request summary of data validation rules, equations, averages, and reports
  - Examine each logarithm and data source in the DAHS database
- External Review
  - Manually calculate values in spreadsheets and compare against DAHS

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# Discussion & Questions

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