CEMS INSTALLATION AND SETUP

R. SEAN WARDEN

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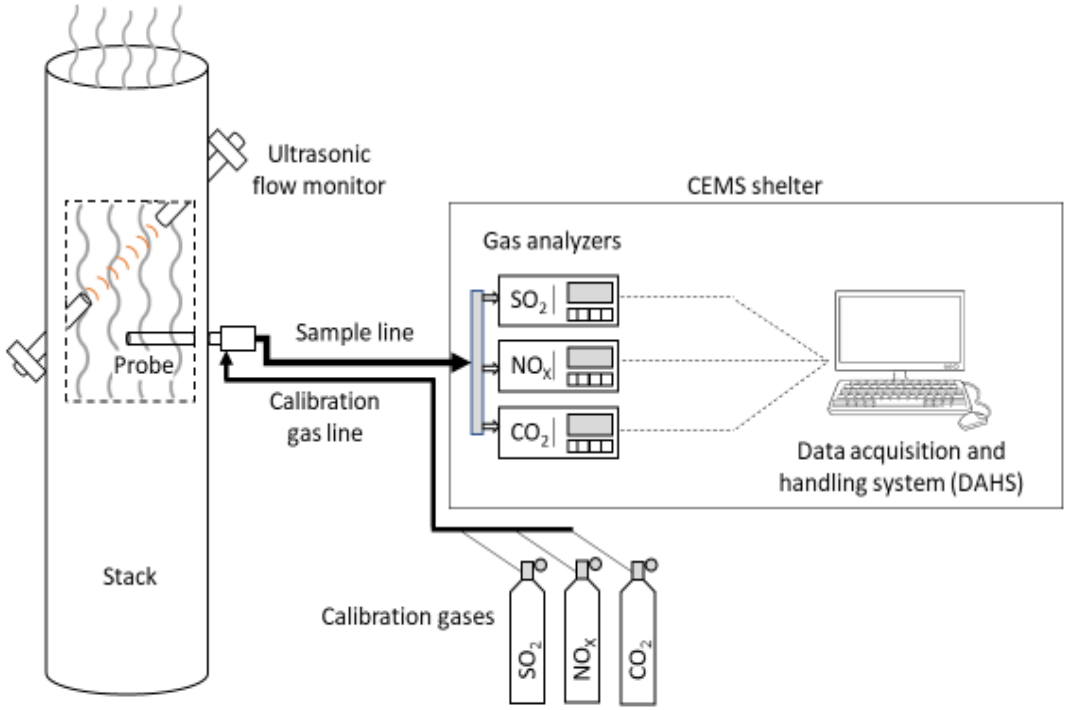
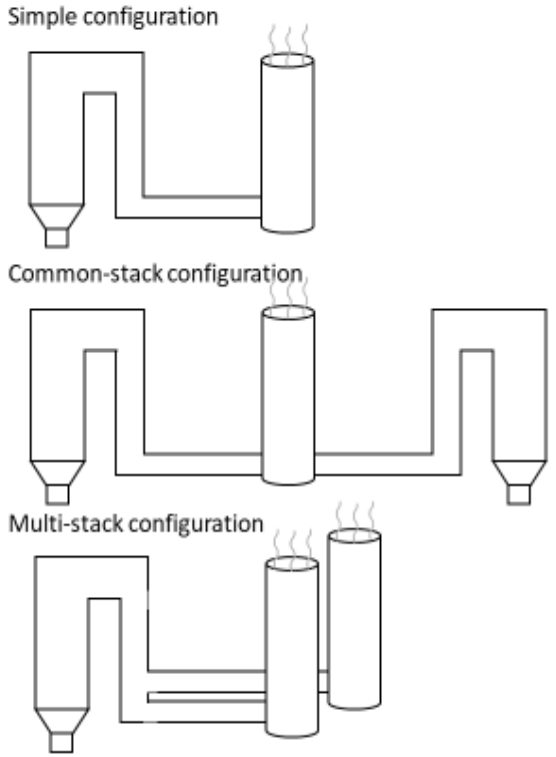
INTERNATIONAL CENTRE FOR
SUSTAINABLE CARBON

USEPA APPROACHES TO MONITORING

- All coal-fired boilers and integrated gas-fired combined cycle (IGCC) combustion turbines must use CEMS to monitor gas concentrations and stack gas flow rates to determine SO_2, NO_X and CO_2 emissions and heat input
- Gas and oil-fired boilers and turbines typically use a CEM NO_X-diluent system (consisting of a NO_x monitor and either a CO_2 or O_2 monitor) to measure NO_X emission rate (lb/mmBtu)(ng/J)
- Gas and oil-fired boilers and combustion turbines typically use hourly data from a NO_X-diluent system together with heat input rates from Appendix D to determine NO_X mass emission rates
  - Heat rates are based on fuel analysis and certified fuel flow meters

INSTALLATION AND SETTING





CEMS LOCATION

- Placement of the sampling probe:
  - 40 CFR Part 75 Appendix A references 40 CFR Part 60, Appendix B, Performance Specification 2 (PS-2)
    - PS-2 §8.1.1 States:
    - For Gas Monitors
      - "install the pollutant concentration monitor or monitoring system at a location where the pollutant concentration and emission rate measurements are directly representative of the total emission from the effected unit."
      - Select a representative point or path for the monitor probe(s) will pass a relative accuracy test.
    - For Point Monitors
      - Locate the measurement point (1) within the centroidal area of the stack or duct cross section, or (2) no less that 1.0 meter from the stack or duct wall.
    - Another consideration is PS-2 §8.1.2 States:
      - It is suggested that the measurement location be (1) at least two equivalent diameters downstream from the nearest control device, the nearest point of pollution generation or other point at which a change in the pollution concentration or emission rate may occur and (2) at least 0.5 equivalent diameter upstream from the effluent exhaust or control device.

CONTINUOUS OPACITY INSTALLATION

- Install COMS at a location where the opacity measurements are representative of the total emissions from the affected source:
- 4 duct diameters downstream from any disturbance
- 2 duct diameters upstream from any disturbance
- Condensed H_2O vapor is not present
- Additionally, installed COMS must be accessible for maintenance.

UPSTREAM DOWNSTREAM DISTANCES

- Equivalent Diameters for rectangular stacks or ducts are calculated using USEPA Method 1 equation 1-1.

$$D_e = \frac{2(L)(W)}{L+W} \qquad Eq.\ 1\text{-}1$$

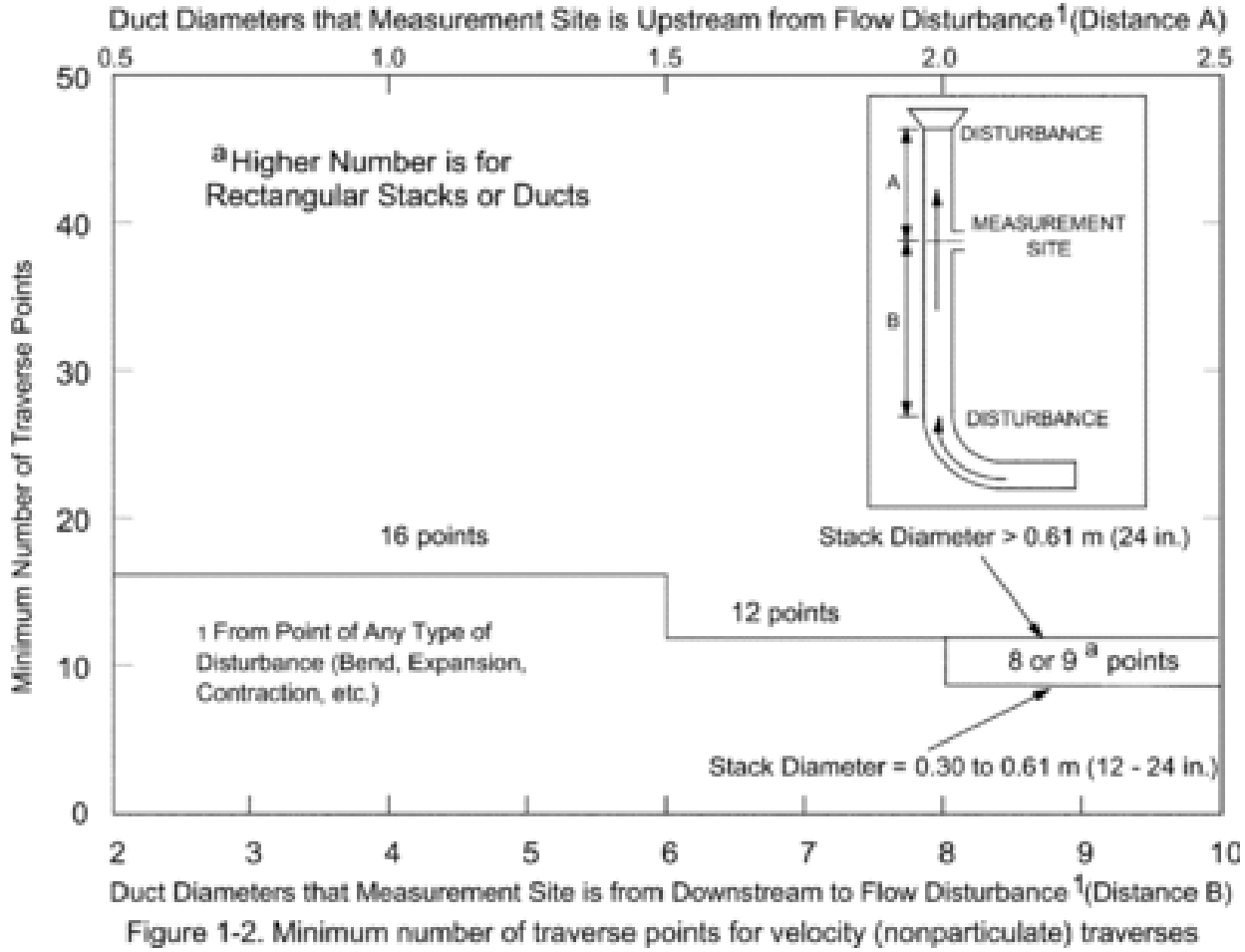


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses

USEPA METHOD 1 – NONPARTICULATE TRAVERSE

MONITORING RANGE AND SPAN

- MPC – Maximum Potential Concentration
  - Applies to SO_2, NO_X, CO_2 and O_2
  - Can be determined by
    - Equations using fuel analysis (SO_2)
    - CEMS historical data (uncontrolled)
    - Table values (NO_X)
- The MPC is used to determine the span and range of a CEM gas analyzer and, when required, is used as a "worst case" substitute data value

MONITOR RANGE AND SPAN

- MEC – Maximum Expected Concentration
  - Applies to units with add-on SO_2 or NO_X emission controls
  - Represents the maximum "controlled" value (SO_2 and NO_X ppm)
  - Initial MEC determination is based on an expected average design removal efficiency
  - Certified CEM data (720 hours or more) downstream of the control device may also be used to determine the MEC provided the unit and the controls are both operating "normally"
- MER – Maximum potential NO_X Emission Rate
  - Used for substitute data, as required
  - Calculated using NO_X MPC and a minimum CO_2 or maximum O_2 concentration
- MPV – Maximum Potential Velocity
  - Used to calculate the maximum potential stack flow rate
- MPF – Maximum Potential Flow rate
  - Calculated using the MPV and stack cross-sectional area

MONITOR RANGE AND SPAN

- "High" span values are determined based on a multiple (1.0 - 1.25) of the maximum potential values (i.e. MPC, MPF)
- Dual span and range (high and low) are typically required for units with emission controls, and the low span value is derived from the MEC
- The full-scale range must be equal to or greater than span value
- Range exceedances *may* require a readjustment of the analyzer

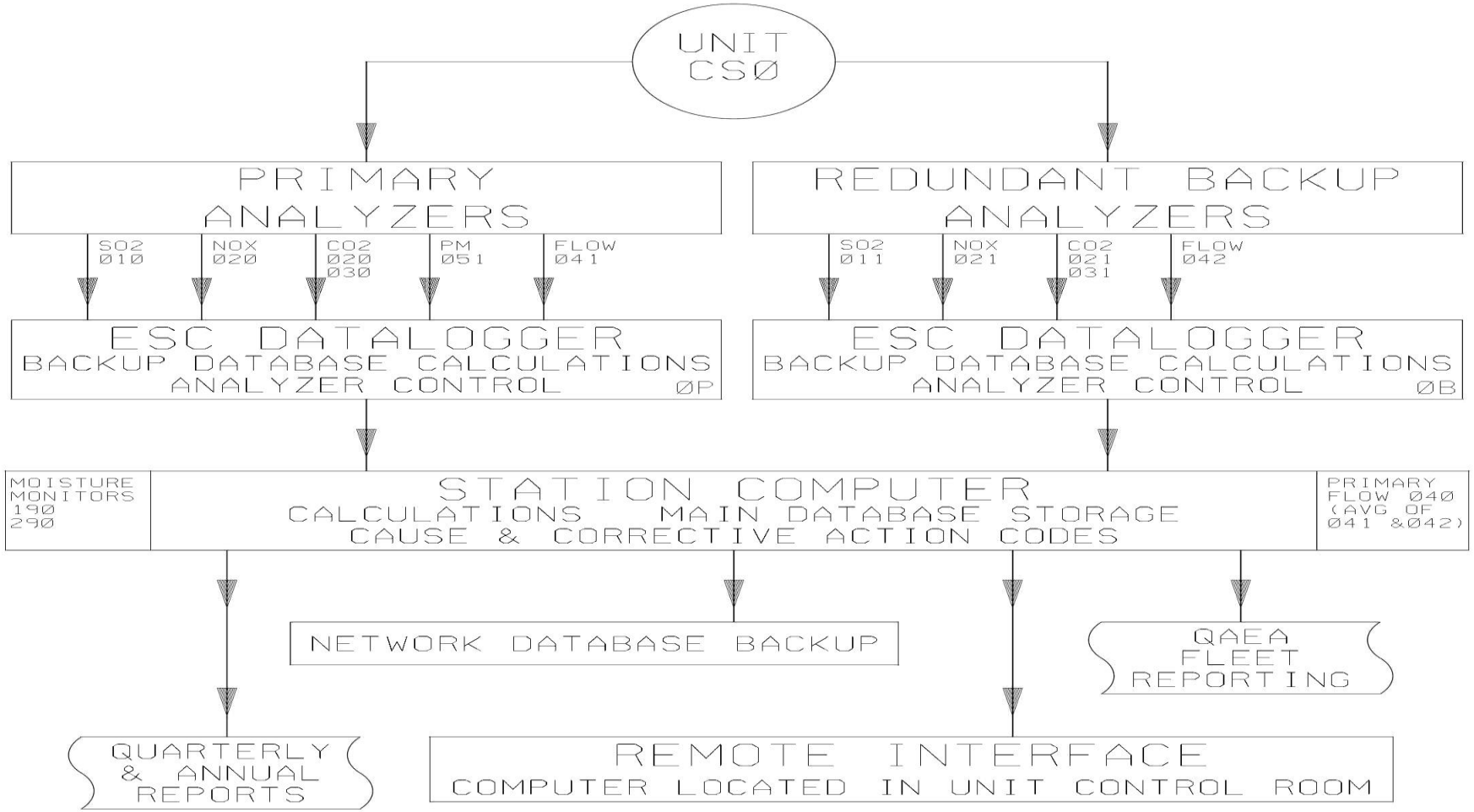
CERTIFICATION PROCESS

- Submit an initial monitoring plan and notification of initial CEM certification testing 21 days prior to starting certification testing (§75.61 & §75.62)
- Conduct all required testing for the CEM system(s) to be certified (See 75.20(c))
  - 7-day Calibration Error Test
  - Linearity Check
  - Cycle Time Test
  - RATA & Bias Test
  - DAHS Verification

CERTIFICATION PROCESS (CONT.)

- Initial certification must be completed within 180 days after a new Acid Rain Program (ARP) unit "commences commercial operation" (see §75.4(b))
- For a newly-affected ARP unit, testing must be completed within 180 days after the date that the unit becomes affected (see §75.4(c))
- For non-ARP units subject to Part 75 testing must be completed by the date specified in the applicable regulation
- Upon successful completion of all certification tests, the monitoring system(s) are provisionally certified
- A certification application must be submitted within 45 days after completing all certification tests
- The Administrator has 120 days after receipt of a complete certification application to review the application and approve or disapprove certification

CEMS DATA FLOW



DATA PROCESSING AND CALCULATIONS

- Units with SO_2 CEMS (wet basis) calculate SO_2 mass emission rate (lb/hr) as follows:

$$E_h = K\ C_h\ Q_h \qquad \text{(Eq. F-1)}$$

Where:

- E_h = Hourly SO_2 mass emission rate during unit operation, lb/hr.
- $K = 1.660 \times 10^{-7}$ for SO_2, (lb/scf)/ppm.
- C_h = Hourly average SO_2 concentration during unit operation, stack moisture basis, ppm.
- Q_h = Hourly average volumetric flow rate during unit operation, stack moisture basis, scfh

DATA PROCESSING AND CALCULATIONS

- Nearly all units with NO_x-*diluent* CEMS calculate NO_x emission rate (lb/mmBtu) using either Equation F-5 or F-6:

$$E = K\ C_h\ F\ [20.9/(20.9 - \%O_2)\ ] \qquad \text{(Eq. F-5)}$$

or

$$E = K\ C_h\ F_c\ 100/\%CO_2 \qquad \text{(Eq. F-6)}$$

Where:

  - K = 1.194×10^{-7} (lb/dscf)/ppm NO_X
  - C_h = Hourly average NO_x concentration during unit operation, ppm.
  - $\%O_2$, $\%CO_2$ = Oxygen or carbon dioxide concentration during unit operation
  - F, F_c = Fuel specific dry-basis or carbon-based F-factor (CO_2) (see Table 1 in App F)

DATA CAPTURE AND REPORTING OF HOURLY AVERAGES

- Hourly averages are computed using at least one data point (normally a 1-minute average) in each fifteen-minute quadrant of an hour in which fuel is combusted
- If a unit operates in more than one 15-minute quadrant of an hour and some of the emissions data are unavailable as a result of QA/QC or maintenance activities during that hour, an hourly average may still be computed if there are at least two valid data points separated by a minimum of 15 minutes
- The owner or operator must use all valid data recorded during an hour to calculate the hourly average
- All data points collected during an hour must, to the extent practicable, be evenly spaced over the hour

MISSING DATA

- For any operating hour(s) in which quality-assured data are unavailable due to maintenance, QA tests or out of control periods, substitute data must be reported, in accordance with §§75.30 - 75.37
- For CEMS, substitute data values become more conservative (i.e., tending to increase reported emissions) as the percent monitor data availability (PMA) decreases
  - PMA is the ratio of the number of quality-assured hours to the number of operating hours, over a specified period of time, expressed as a percentage.
  - When 8,760 unit or stack operating hours have been accumulated after initial certification, the PMA is calculated by the DAHS on an 8,760 hour "rolling" basis, updated hourly.

INCIDENTS THAT MAY RESULT IN MISSING DATA

- Monitoring system malfunction (e.g., critical component failure)
- Monitoring system out-of-control due to a failed QA test (e.g., daily calibration, linearity check or RATA)
- Required QA test not performed by the deadline
- Monitoring system off-line for routine maintenance or required QA/QC activities
- Improper application of the Part 75 regulation or associated policy guidance

ELECTRONIC REPORTING

- "ECMPS" stands for EPA's Emissions Collection and Monitoring Plan System
- ECMPS is a desktop application
- Affected sources are required to use the ECMPS Client Tool to make three types of submissions:
  - Monitoring Plan information
  - Certification, Recertification, and QA test results
  - Quarterly emissions reports

ELECTRONIC REPORTING

- Monitoring Plan Data Includes:
  - Monitoring location(s) and relationships
  - Unit information (maximum rated heat input, applicable programs, monitoring methods, fuel type(s), and emission controls)
  - Monitoring system makes, models, and **serial numbers**
  - CEMS MPC, MEC, MER, MPF values, spans and ranges
  - Formulas
  - Monitoring default values
  - Qualification records (e.g. for peaking units)

ELECTRONIC REPORTING

- Certification, Recertification, and QA Test Data
  - Submitted separately, either prior to or concurrent with the relevant quarterly emissions report
  - The results of RATAs, linearity checks, flow monitor leak checks, flow to load ratio tests, 7-day calibration error tests, and cycle time tests must be reported
  - The results of Appendix D fuel flowmeter accuracy tests and primary element inspections are also reported
  - Test Extensions and Exemption records
  - "Event" records, with conditional data validation claims

ELECTRONIC REPORTING

- Emissions Data---Quarterly Reports Include:
  - Daily Calibration Error Tests and (if applicable) flow monitor interference checks
  - Weekly Tests (Hg, only)
  - Hourly operating data---Operating times, Load, Load "bins", Heat input rates
  - Hourly records of CO_2, NO_x, SO_2, and Hg emissions, fuel flow rate, stack gas flow rate, as applicable to the monitoring methods used. All hourly records include monitoring component and/or system IDs. Hourly CEMS records also include:
    - Unadjusted and Bias-adjusted Emissions Values
    - Method of Determination Codes (MODC)
    - Percent Monitor Availability (PMA)

ELECTRONIC REPORTING

- Data Quality Assurance
  - The ECMPS Client Tool performs thousands of checks and recalculations of reported data
  - The Client Tool checks monitoring plan information, QA and certification test results, and emissions data
  - The data must meet certain criteria before it will be accepted into the EPA database
  - Note, however, that the QA checks performed by ECMPS have their limitations
- Monitoring plan and QA data may be submitted at any time. Emissions data reports must be submitted within 30 days after the end of each quarter.

INTERNATIONAL CENTRE FOR
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THANK YOU FOR LISTENING

ANY QUESTIONS?

Your name
your email@icscarbon.org