

# **SAMPLE SPECIFICATIONS CONTINUOUS EMISSION MONITORING SYSTEM**

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## **PART 1 - GENERAL REQUIREMENTS**

### **A. PURPOSE OF THIS SPECIFICATION**

To define a continuous emission monitoring system (CEMS) for measuring NO<sub>x</sub>, CO, and O<sub>2</sub> which meets federal and state regulatory monitoring requirements for installation at

### **B. RELATED DOCUMENTS (To Be Attached)**

1. State, and local requirements as applicable.
2. Operating Permit
3. Installation site drawings

### **C. SUMMARY OF SPECIFICATION**

1. Part 2 of this Specification includes a description of the plant, process, and installation site conditions including composition of gas to be measured.
2. Part 3 of this section of the Specification contains the technical and performance requirements of the continuous emission monitoring system.
3. Part 4 of this section contains the requirements for services to be provided for each individual CEMS system. This includes but is not limited to:
  - a) Services to be provided by CEMS supplier
  - b) Work and material by others:

### **D. SUPPLIER QUALIFICATIONS**

1. All suppliers of equipment supplied by this specification shall have an acceptable history of supplying satisfactory reliable systems in use for a period of at least five years.
2. Acceptable bidders must be analyzer manufactures as well as system suppliers.
3. Acceptable bidders must have ISO 900:2008 quality certification.
4. Acceptable bidders must be financially solvent and be able to show upon demand a net worth of at least ten times the value of the bid for this system.
5. Acceptable bidders must provide 24 hour telephone access to technical support personnel skilled with this instrumentation.

**E. DELIVERY**

The supplier shall deliver equipment to the project site in accordance with manufacturer's shipping requirements. Project schedule requirements include:

Drawing delivery \_\_\_\_\_  
Hardware delivery to site: \_\_\_\_\_  
Installation supervision; \_\_\_\_\_  
Startup of CEMS \_\_\_\_\_  
Certification of CEMS: \_\_\_\_\_

**PART 2- PROCESS AND APPLICATION CONDITIONS**

A. PLANT

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B. PROCESS AND FUEL(S)

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C. EMISSION CONTROL EQUIPMENT

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D. CEMS INSTALLATION SITE

Probe location \_\_\_\_\_

Analyzer cabinet \_\_\_\_\_

Sample line  
length \_\_\_\_\_

**E. GAS CONDITIONS AT INSTALLATION SITE**

1. Gases to be measured and measurement ranges

NOx: typical concentration\_\_\_\_\_, maximum concentration\_\_\_\_\_, measurement range\_\_\_\_\_

CO: typical concentration\_\_\_\_\_, maximum concentration\_\_\_\_\_, measurement range\_\_\_\_\_

O2: typical concentration\_\_\_\_\_, maximum concentration\_\_\_\_\_, measurement range\_\_\_\_\_

2. Coexisting gases and concentrations

H2O: typical concentration\_\_\_\_\_, max concentration \_\_\_\_\_

CO2: typical concentration\_\_\_\_\_, max concentration \_\_\_\_\_

SO2: typical concentration\_\_\_\_\_, max concentration \_\_\_\_\_

Other \_\_\_\_\_: typical concentration\_\_\_\_\_, max concentration \_\_\_\_\_

3. Physical gas conditions

Gas temperature: \_\_\_\_\_

Gas pressure: \_\_\_\_\_

4. CONTACT

Name \_\_\_\_\_

Telephone \_\_\_\_\_

**PART 3 - CEMS SPECIFICATIONS**

**1. FEDERAL REGULATORY REQUIREMENTS**

1. The CEMS shall comply with US EPA 40CFR60, Appendix B, Performance Specification 2 for O2/CO2, Performance Specification 3 for NOx and Performance Specification 4 for CO. It shall also meet the QA/QC requirements of 40CFR60, Appendix F. Calculation of emission rate in lbs/mbtu shall be in conformance with 40CFR60, Appendix A, Reference Method 19.

**2. GENERAL**

A. The Continuous Emissions Monitoring System (CEMS) shall be of the conventional extractive type, which includes a sampling probe and filter, heated sample line, gas cooler/drier with sample pump, and analyzers.

The analyzers shall be controlled by a system controller which provides a means for calibration of the analyzers, periodically checking the calibration of the system, control and/or correction for temperature and pressure as applicable and transmission of data to the Data Acquisition System. A DAS (data acquisition system) shall be provided to acquire CEMS and process measurement information so as to prepare reports required by the regulatory agencies.

- B. Calibration checks of the system, both zero and span shall verify calibration at the sample probe, which checks the entire measurement system.
- C. Pollutant gas measurement techniques using Fourier Transform Infrared spectroscopy (FTIR), electrochemical analysis, or systems which transport and measure gases in a hot wet state are specifically excluded as being non-responsive to this specification.
- D. Gas cooler/dryers shall be of the thermoelectric type.
- E. The CEMS shall be designed and installed to ensure reliable operation with a minimum frequency and duration of system outages for maintenance and repair. The system shall provide 95% data availability when maintained according to factory recommended procedures and with factory trained personnel who have access to an adequate supply of spare parts.
- F. All system components shall be industrial quality and suitable for the type of plant environmental conditions to be encountered.
- G. All necessary signal cables requiring special connectors shall be supplied with the system.
- H. Complete engineering documentation of the system, as built, shall be supplied with the system.

### **3. INPUT/OUTPUTS**

The CEMS shall provide one linear isolated 4-20 ma dc output for each measured parameter and each of the calculated values listed below. The outputs shall represent zero to full scale reading for each parameter. These outputs will be for the owners use in addition to any required for CEMS operation. Outputs from either the analyzer(s) or the DAS are acceptable. ( Note: Ethernet connection to the DCS may meet the owners requirements for this section at a cost savings)

- A. Nitrogen Oxides (NO<sub>x</sub>) in ppmdb, v/v (parts per million by volume dry basis)

- B. Carbon Monoxide (CO) in ppmdb, v/v (parts per million by volume dry basis)
- C. Oxygen (O<sub>2</sub>) in percent (by volume dry basis)
- D. Nitrogen Oxide (NO<sub>x</sub>) Emission rate in pounds per million BTU.

#### 4. GAS ANALYZERS

##### A. Nitric Oxide (NO<sub>x</sub>) Analyzer

1. Measurement Method: Microprocessor controlled Chemiluminescence
2. Must have an operating temperature range of 5-40°C.
3. Must have fold down front and rear panels for ease of maintenance.
4. Ranges shall be user selectable from 0 -50 ppb to 0 - 20 ppm in increments of 1 ppb, user
5. Analyzer shall have auto range capability
6. Minimum Detectable Limit: <0.4 ppb. (RMS)
7. Zero Noise: <0.2 ppb. (RMS)
8. Span Noise: 0.5% of Reading (RMS) above 50 ppb
9. Precision: 0.5% of Reading
10. Linearity: 1% of Full Scale
11. Zero Drift: <0.5 ppb/24 hrs <1 ppb/7 days
12. Span Drift: <0.5%/24 hours, <1%/7 days
13. Rise and Fall time (to 95%): <60 seconds
14. Sample flow rate shall be less than or equal to 0.5 LPM.
15. Analyzer shall use a high capacity ozone generator internal to the instrument

16. Zero drift shall be corrected by a periodic Auto Zero routine, which physically routes the sample from the reaction cell
17. Particulate filter shall be front panel accessible with ability to view filter condition without disassembly.
18. Other than filters, analyzer shall have no scheduled maintenance for a period of six months.
19. Analyzer shall have US EPA approval, automatically adjusting time constant for optimal time response
20. High capacity pump shall be external to the analyzer. Pump maintenance period shall be at least one year.
21. Sample and ozone flow rates shall be controlled by critical orifices and be displayed using front panel display
22. Measurement shall be temperature and pressure compensated.
23. Warranty shall be two years, parts and labor.
24. Shall contain internal data logging capability with capacity to log a minimum of 900,000 data values including up to five years worth of 5 minute averages for NO, NO<sub>2</sub> and NO<sub>x</sub> along with calibration factors, flow and pressure data.
25. Shall provide Diagnostic warning messages in case of out of tolerance of at least the following key parameters:
  - Analog Output Calibration
  - Auto Zero Out of Range
  - Box Temperature
  - Dynamic Span
  - Dynamic Zero
  - Configuration Erased
  - Converter Temperature
  - DAS Data Erased
  - PMT Power Supply
  - IZS Temperature
  - Ozone Flow
  - Ozone Generator
  - PMT Temperature
  - Reaction Cell Pressure
  - Reaction Cell Temperature
  - Mother Board Communication
  - Relay Board Communication
  - Sample Flow
  - System Reset

26. Analyzer shall have ability to connect to an Ethernet and shall support a unique IP address for access from anywhere on the network. Full analyzer control shall be available via RS232 or Ethernet.

B. **Carbon Monoxide (CO) Analyzer**

1. Measurement Method: Microprocessor controlled IR absorption using Gas filter Correlation.
2. Must have an operating temperature range of 5-40°C
3. Must be U.S. EPA or TUV certified over 10-40°C temperature range
4. Minimum Detectable Limit: <0 .04 ppm. (RMS)
5. Zero Noise: <0.02 ppm. (RMS)
6. Span Noise: 0.5% of Reading (RMS) above 5 ppm
7. Precision: 0.5% of Reading
8. Linearity: 1% of Full Scale
9. Zero Drift: <0.1 ppm/24 hrs  
<0.2 ppm/7 days
10. Span Drift: <1%/7 days
11. Rise and Fall time (to 95%): <60 seconds
12. Sample flow rate shall be less than 1 LPM.
13. Field and objective mirrors shall be monolithic. Adjustment screws shall not be required and adjustment shall not be required even after cleaning.
14. GFC wheel shall be temperature stabilized and have a 5 year warranty against leaks.

15. Particulate filter shall be front panel accessible with ability to view filter condition without disassembly.
16. Measurement shall be temperature and pressure compensated.
17. Shall contain internal data logging capability with capacity to log a minimum of 900,000 data values including up to five years worth of 5 minute averages for NO, NO<sub>2</sub> and NO<sub>x</sub> along with calibration factors, flow and pressure data.
18. Shall provide Diagnostic warning messages in case of out of tolerance of at least the following key parameters:
  - System Reset
  - RAM Initialized
  - Source Warning
  - Bench Temp Shutdown
  - Mirror Temp Shutdown
  - Sample Flow Warning
  - Sample Pressure Warning
  - Sample Temp Warning
  - Box Temp Warning
  - Bench Temp Warning
  - Cannot DYN Zero
  - Cannot DYN Span
19. Analyzer shall have ability to connect to an Ethernet and shall support a unique IP address for access from anywhere on the network. Full analyzer control shall be available via RS232 or Ethernet.
20. Warranty shall be two years. Manufacturer shall guarantee gas filter correlation wheel and CPU for a period of five years.

C. **Oxygen Analyzer**

1. The measurement principle shall be paramagnetic.
2. Range: 0-25% O<sub>2</sub> full scale
3. Zero Drift: 24 hours - Less than 0.5% O<sub>2</sub>
4. Span Drift: 24 hours - Less than 0.5% O<sub>2</sub>
5. Cal Error: 0.5% O<sub>2</sub>

6. Relative accuracy: 20%
7. Oxygen Sensor may be incorporated into the NOx instrument for economy and diagnostic purposes

D. **SYSTEM CONTROLLER**

1. The analyzer controller shall be microprocessor based PLC.
2. Proprietary Data Logger type systems are specifically excluded as being non-responsive to this specification.
3. The PLC shall include a HMI for interface with the PLC
4. Controller shall include means for:
  5. Activating either manual or automatic timed calibration
  6. Calibration with or without automatic zero/span correction.
  7. Correction for gas pressure and temperature as needed.
  8. Detection of analyzer system faults (faults invalidate emission measurements).
  9. Detection of analyzer alarms (alarms do not necessarily invalidate emission measurements, they do indicate a need for maintenance).
  10. Detection of pollutant level alarms.
  11. Performing self diagnostics and indicating alarms/faults.
  12. Detecting failure of gas cooler/drier.
  13. Detecting failure of sample flow control system.
  14. Displaying concentration of each pollutant.
  15. Displaying alarms and faults.
  16. Ethernet communication of all above information to DAS.

5. **DATA ACQUISITION SYSTEM (DAS)**

- A. The DAS shall provide for automatic data acquisition, data processing, report generation, graphical display of data, printing or storing reports in electronic format, archival storage of data, and providing remote access to the system via Internet/modem.
- B. The system shall use a Microsoft® Windows Server® Operating system.
- C. Software and operating system requirements: The system shall:
- D. Facilitate system control through operator selectable menus.
- E. Offer password protection on multiple levels.
- F. Allow the operator to edit data, reason codes, and corrective actions.
- G. Allow the operator to log out of service, out of control, and off line CEMS status.
- H. Allow the operator to archive data on a variety of media.
- I. Prepare unlimited graphical operator interface screens.
- J. Report program shall be browser based.
- K. Allow remote access to all system functions via modem/ internet.
- L. Allow easy expansion to accommodate revised regulations and/or
- M. Measurement /calculation requirements.
- N. Allow reporting and alarms via email.
- O. System hardware: The contractor shall provide a complete system using a Server computer with the following minimum components:
  - 1) Pentium 2Ghz CPU or higher with at least 2 GB of RAM.
  - 2) 4 Hard Drives: 100 gigabyte or greater.
  - 3) DVD Drive.
  - 4) USB External Hard Drive (for data backup).
  - 5) Printer.
  - 6) Color Flat Panel Monitor, 19" Larger.
- P. Performance:
  - 1) The contractor will guarantee the DAS/software will meet the permit reporting requirements.
  - 2) The supplier shall have successfully installed at least 50 DAS systems for EPA compliance reporting.

## **PART 4 - SERVICES**

### **6. SERVICES TO BE PROVIDED BY CEMS SUPPLIER**

- A. Installation Verification and Start-up
  - 1) Provide instruction and guidance to the installing contractor for the equipment supplied under this specification.
  - 2) Inspect the installed CEMS equipment after the installation is complete.
  - 3) Provide the owner with confirmation that the equipment is properly installed and is ready for energization.
  - 4) Perform start up and verify correct operation of all equipment supplied under this specification.
  
- B. Certification Testing:
  - 1) Perform initial certification testing including Drift, Response, and Relative Accuracy testing as required.
  - 2) Notify owner prior to scheduling any testing.
  - 3) Prepare Certification Report suitable for submission to regulatory bodies.
  - 4) The Owner will supply all necessary calibration gases.
  - 5) The Owner shall provide all necessary plant operating conditions to complete the specified certification procedures.

## **7. Maintenance Services**

- A. Provide a 1 year maintenance contract to commence upon successful completion of the certification testing including:
  - 1) Performance of 4 quarterly scheduled maintenance visits.
  - 2) Provision for up to 4 emergency site visits.
  - 3) Provide 24/7/365 telephone /modem support.
  
- B. Training Services:
  - 1) Provide on-site classroom training and instruction for operations and maintenance personnel for each plant site.
  - 2) Provide factory training for ( ) of the owners technicians. Training shall be for a minimum of 24 classroom hours and cover the operation and maintenance of all components furnished.

## **8. WORK AND MATERIAL BY OTHERS**

1. Installation of equipment and components.
2. Installation of all access ways, platforms, and elevators.
3. Installation of all stack and duct connections to be used as attachments for equipment furnished by this contract.
4. Installation of all cable and conduit exterior to any analyzer/cabinet furnished by this contract.
5. Calibration gases for initial operation, certification and performance testing, quarterly audits and daily operation will be provided by the owner.