SPECIFICATIONS FOR STANDARD DILUTION
CONTINUOUS EMISSION MONITORING SYSTEM

PART 1 - GENERAL

A.   REQUIRED PURCHASER DOCUMENTS

    1.   Federal, state and local agency requirements as applicable.

    2.   Attached Operating Permit

    3.   Attached Drawings of Installation Site

    4.   Complete description of gas measurement conditions including gas composition, concentrations, measurement ranges, gas temp., gas pressure, and facility operational conditions including fuel(s), emission control equipment, and environmental considerations.

B.   CEMS REQUIREMENTS

    1.   Provide a Continuous Emission Monitoring System (CEMS) as specified below. The system must meet all the requirements of 40 CFR 75, 40 CFR 60, and all applicable Local Requirements as required by attached operating permit.

    2.   Part 2 of this section of the specification contains the technical and performance requirements of the CEMS and DAS. The configuration as specified includes, but is not limited to:

        a.   Individual component accuracy.
        b.   Performance of the analyzers.
        c.   Performance of the data acquisition and reporting system.
        d.   Performance of the system controller.
        e.   Standard shelter specifications to fit the environment required for the system.

    3.   Part 3 of this section contains the requirements of services to be provided for each individual CEMS. This includes, but is not limited to:

        a.   Provide on-site instruction and guidance to the contractor installing the equipment.

      b.   Provide on-site and factory training to the customers personnel on the operation and maintenance of the equipment.

      c.   Perform inspection and initial startup of the equipment.

      d.   Field Certification to U.S. Federal Register 40 CFR 60, 40 CFR 75, State and Local Regulations.

4.   Part 4 of this specification contains the requirements for Drawings and Documentation which are supplied as a part of this CEMS.

5.   Part 5 of this specification contains the criteria for purchaser acceptance of the equipment and services purchased hereunder.

6.   Work and materials provided by buyer:

      a.   Setting and leveling any analyzer shelters furnished by this contract.

      b.   Installation of equipment and components, where final installed location is external to any analyzer shelter furnished under this contract.

      c.   Installation of all access ways, platforms, and elevators. Easy access to all installed components is required to ensure maintainability and availability.

      d.   Installation of all stack and duct connections to be used as attachments for equipment furnished by this contract.

      e.   Installation of all cable and conduit exterior to any analyzer shelter furnished by this contract.

      f.   Calibration gases for initial certification and performance testing, quarterly audits and daily operation will be provided by the owner.

      g.   Suitable installation sites for the gas sampling probe, opacity transceiver and reflector, and gas velocity sensor(s) as required to provide representative measurements of concentration and flow rate consistent with regulatory requirements.

7.   Utilities provided by buyer:

      a.   AC Power - 230 VAC, single phase, 60 Hz, up to 25 kVA.

      b.   Instrument air - -40° F, oil free, 80-100 psi.

C.   EXPERIENCE / QUALITY

All suppliers or equipment supplied by this specification shall have an acceptable history of supplying satisfactory, reliable systems in use for a period of at least five (5) years. Successful supplier shall be certified to the ISO 9001: 2008 quality standard.

D.   DELIVERY

Deliver equipment to the project site in accordance with customers shipping requirements.

PART 2 - SYSTEM FUNCTIONALITY

A.   GENERAL

1.   The CEMS shall incorporate a sampling system which uses a dilution extractive type measurement technique with the dilution occurring external to the stack or duct. Pollutant gas measurement techniques using Fourier Transform Infrared (FTIR) spectroscopy, wet electrochemical analysis, or extractive techniques where the gas sample is extracted and transported in a hot and wet condition are specifically excluded as being non-responsive to this specification.

2.   The system controller (PLC) shall be able to provide compliant data collection and storage for all parameters, to provide display capabilities for measured and calculated values, to provide a means for controlling the analyzer system to provide all alarm and analog outputs for continued plant operation, and to provide the capabilities for proper maintenance of data during any Data Acquisition System (DAS) failure lasting up to seven (7) days.

3.   The CEMS shall employ automatic and continuous means for determining the actual dilution ratio including, but not limited to, a mass flow measurement of the dilution air supply and a continuous dilution probe orifice pressure measurement used to compensate for pressure effects in the sample dilution ratio.

4.   The CEMS shall be designed and installed to ensure maximum system availability which shall be 95% at a minimum. System availability evaluation and field certification testing will be conducted according to 40 CFR 75.

5.   System shall incorporate Ethernet connectivity which will allow for the remote access to the DAS, PLC and Analyzers to ensure the highest level of remote system support.

6.   All system components shall be industrial quality and suitable for the type of plant environmental conditions to be encountered. Such conditions will include range of temperatures, humidity, dust and corrosive gas concentrations, and effects of wind and vibration.

7. Provide all necessary bolts, mounting plates, prefabricated tubing, valves, flanges, purge blower systems, relays, cabinets, junction boxes, and special tools and accessories for a complete and properly operating system.

8. Provide all necessary prefabricated signal cables requiring special connectors.

9 The CEMS shall include a programmable logic controller (PLC) or equivalent means to control gas calibration cycles, monitor diagnostic information, and provide communications with the DAS.

10. If required, the PLC shall accept a gas velocity input and shall provide contact closures to activate calibration and/or diagnostic cycles.

11. The CEMS shall provide one linear, isolated 4-20mA dc output for each measured parameter and each of the calculated values listed below. The outputs shall be scaled for the specified zero to full scale range for the parameter. These outputs will be for the owners as required for plant operation and backup reporting.

   a. Sulfur dioxide (SO_2) emission rate in pounds per hour.
   b. Sulfur dioxide (SO_2) emission rate in pounds per million Btu.
   c. Nitrogen oxide (NO_x) emission rate in pounds per million Btu.
   d. Carbon dioxide (CO_2) emission rate in tons per hour.

12 For each measured parameter the system shall provide one (1) dry contact closure to alarm for limit exceedence. In addition, the following dry contacts are output from the CEMS:

   a. Common CEMS fault.
   b. Common CEMS in calibration.
   c. Common CEMS in maintenance mode.
   d. Opacity in calibration.
   e. Stack flow monitor in calibration.
   f. CEMS in backflush.
   g. Common calibration error alarm.

   All contacts shall be rated at 0.5 Amp at 24-125 VDC/120-240 VAC.

13. Gas sensing devices shall show no significant interference (less than 2% of FS change) by a two order-of-magnitude concentration change in any of the trace species or a factor of two for the major components including CO_2, O_2, and H_2O. The sensor shall respond to a minimum of one percent (1%) of full scale change in the gas of interest.

B. GAS ANALYZERS

1. General

   a. All gas analyzers shall have internal data storage for up to 1 million records.
   b. All pollutant gas analyzers shall be multi-tasking, microprocessor based systems with Ethernet and RS-232 interfaces available to the system controller.
   c. All gas analyzers must have an auto-ranging capability selecting the optimum measurement range for display, printer, and RS232 outputs.
   d. All gas analyzers shall have a full range of status and predictive diagnostic capabilities such that if an operating parameter is out of limit, a message appears on the display as well as being sent to communications ports. Operating parameters must be saved for at least one hundred days making the prediction of failures possible.
   e. Analyzers Particulate filter shall be front panel accessible with ability to view filter condition without disassembly.
   f. Analyzers shall come with interface software allowing for remote access to analyzer data and diagnostics.
   g. Analyzers shall be equipped with a Ethernet and RS232 communication ports and be capable of multi-drop communications.
   h. Warranty shall be two years, parts and labor.

2. Sulfur Dioxide (SO_2) Analyzer

   A. The measurement principal shall be compatible with the requirements of 40 CFR 75. Acceptable methods is UV Fluorescence.

   Performance Requirements:
   1. Range: Ranges shall be user selectable from 0 -50 ppb to 0 - 20 PPM in increments of 1 ppb, user selectable. With any two independent ranges simultaneously, auto range capability.
   2. Noise: .2pbb RMS.
   3. Lower Detectable Limit: .4 ppb RMS.
   4. Zero Drift: 24 hours - < 0.5 ppb.
   5. Span Drift: 24 hours - < 0.5%.
   6. Temperature Range: 0 - 40 $^{\circ}$C.

   B. The SO_2 analyzer shall have a method of removing hydrocarbons from the sample to prevent interference.

C. The analyzer shall be certified by the EPA as an equivalent method for ambient air monitoring.
D. Sample flow rate shall be less than 1 LPM.
E. UV Lamp power supply shall be high-frequency switching type.
F. Must use a Zinc UV lamp with an emission line at 214 nm.
G. UV source shall require no stabilization or feedback circuitry.
H. Zero drift shall be corrected by an Auto Zero routine, which physically removes the lamp light from the fluorescence chamber.
I. Flow rate through the analyzer controlled by critical orifice and be displayed using front panel display.
J. Measurement shall be temperature and pressure compensated.

3. Nitric Oxide (NO_x) Analyzer

A. The measurement principle shall be compatible with the requirements of 40 CFR 75. The acceptable method is chemiluminescence.
B. Performance Requirements:
   1) Ranges shall be user selectable from 0 -50 ppb to 0 - 20 ppm in increments of 1 ppb, user selectable. NO, NO2, and NOx ranges shall be independent. Analyzer shall have auto range capability.
   2) Noise: .2ppb (RMS)
   3) Lower Detectable Limit: .4ppb
   4) Zero Drift: 24 hours - .5ppb; 7 days - 1ppb
   5) Span Drift: <.5% of full scale
   6) Temperature Range: 5-40°C
C. The analyzer shall be certified by the EPA as an equivalent method for ambient air monitoring.
i. Sample flow rate shall be less than or equal to 0.5 LPM.
j. Ozone shall be scrubbed from the instrument without the use of charcoal or other expendables.

4. Carbon Dioxide (CO_2) Analyzer

a. The measurement principle shall be compatible with the requirements of 40 CFR 75. Acceptable methods are Gas Filter Correlation or Infrared.
b. Performance Requirements:
   1. Range: 0-2000 ppm (auto-ranging)
   2. Temperature Range: 5-40°C
   3. Minimum Detectable Limit: <0.4 ppm. (RMS).
   4. Zero Noise: <0.2 ppm. (RMS)

5. Span Noise: <1.0% of Reading (RMS) above 20 ppm.
6. Precision: 0.5% of Reading
7. Linearity: 1% of Full Scale
8. Zero Drift: <0.5 ppm/24 hrs
9. <1.0 ppm/7 days
10. Span Drift: <1% of reading/7 days.
11. Rise and Fall time (to 95%): <60 seconds.

    c.   If the part of the analyzer measuring beam exposed to the ambient air is a significant fraction of the gas measurement path length, the CO_2 analyzers case should be purged with dilution air.

5. Flow Monitor

    a.   The flow monitor shall meet all the requirements of 40 CFR 75 (and 40 CFR 60). This includes, but is not limited to the following:
1) The requirements of Appendices A and B of 40 CFR 75.
2) Capable of daily calibration error tests.
3) Coordinated and controlled by the CEMS controller, such that all daily calibration and drift checks are done automatically.
4) Suitable for continuous operation in the full ambient conditions to be expected.

    b.   Acceptable techniques for flow measurements:
1) Ultrasonic Time of Flight

    c.   Ultrasonic flow systems shall have the following features:
1) The flow must be of ultrasonic design, operating with transducer frequency greater than 20kHz.
2) Ultrasonic signals must be digitally generated and received.
3) Response time must be programmable from 1sec – 720 seconds.
4) Single or dual TEFC (totally enclosed fan-cooled) 42-110CFM blowers shall be provided to provide purge air to the transducers.
5) The stack electronics must be capable of supporting up to four transducers.
6) If 50kHz transducers are used they must be electro-static design.
7) If 20kHz transducers are used they must be piezo-ceramic design.

8) Transducers nozzle assemblies must have Teflon nose pieces for protection from acidic condensation.
9) Purge blowers must be supplied with weatherhood enclosures.

10) Transducers nozzles must have quick connect/disconnect latches for ease of withdrawal and insertion.
11) Stack electronics must be able to support two paths.
12) RS232 serial port must be available from the stack electronics to support a laptop interface.
13) A Modbus software interface package must be supplied to initialize parameters, download measured values, upload parameter values, etc.
14) All stack electronics must be housed in a stainless steel stack enclosure.
15) A barometric pressure transducer shall be located with the stack electronics enclosure.
16) The stack electronics must be capable to accepting both a temperature and pressure analog input.
17) Only a single twisted pair of wire will be necessary for communication from the stack to a control room mounted remote panel.
18) The remote display shall include at least four analog outputs; eight isolated digital inputs; and eight dry contacts.
19) The remote display shall have RS232C, RS422 and RS485 serial communication capability, all operating in a "polled" and "broadcast" mode and share be capable or enabling remote initiation of calibration.
20) The remote display shall be able to graph at least six measured variables and at least 100 discrete readings of each variable.
21) The remote display shall include software that has both alarm and fault event logs. The logs shall be capable of archiving at least the last one hundred alarms and faults complete with a time stamp, error code and current status indicator.
22) The stack electronics box and the enhanced remote panel shall both have security protection via passwords or key lock systems.
23) The remote display shall be a standard 19" rack mount display with a height less than 8" to permit easy installation into existing rack mounts.
24) The remote panel must have the ability to provide a 5th degree polynomial correlation curve or 3-point look-up table to correlate the flow monitor to Method 2.
25) The remote panel must have a 3-point look-up panel to determine internal temperature calculations.
26) Operator must be able to view both "raw" and corrected flow velocities.

27) The remote panel must have an RJ-45 Ethernet port with an internally mounted web server. The server shall be DHCP compatible and be accessible via any web browser.
28) The web server shall be capable of supporting two masters on the same LAN.
29) The web browser interface shall permit viewing of variables as well as changing of variable values.
30) The web server shall also have the capability to communicate via Modbus TCP.
31) Internal firmware within the server shall be capable of remote upgrade.

6. Opacity Monitor

a. Double-pass transmissometer complete with the following features:
   1) Purge blower system.
   2) All mounting hardware, brackets, manifolds, air hoses, motor and accessories for a fully functional and U.S. EPA certifiable opacity monitoring system.
   3) Fully enclosed and gasketed weather enclosures.
   4) Single Green light emitting diode (LED) light source.
   5) Shall meet the requirements of 40 CFR 60, Appendix B Performance Specification 1 and all applicable revisions and additions.
   6) Provide automatic zero compensation for dirt accumulation on exposed optical surfaces and provide an alarm when such compensation exceeds 4% opacity.
   7) Peak and mean spectral response must occur between 500nm and 600nm.
   8) Total angle of view and angle of projection shall each be less than 4 degrees.
   9) Provide remote calibration check capabilities, both manual and automatic.
   10) Provide a differential pressure switch to alarm when the filters are dirty.
   11) The control unit shall be microprocessor-based with full self-diagnostics and alarm capability.
   12) Zero cal reflector to check complete electronic and optic systems and provide direct simulation of clear stack light level.
   13) Internally computed zero and span drift for testing against EPA performance limits with automatic alarms for maintenance and out-of-control conditions.
   14) Automatic correction for zero and span drift.

15) Automatic measurement and correction for window dirt accumulation.
16) RS-232 interface to computer based data acquisition system or printer.
17) The remote panel must have an RJ-45 Ethernet port with an internally mounted web server.
18) The server shall be DHCP compatible and be accessible via any web browser.
19) The web server shall be capable of supporting two masters on the same LAN.
20) The web browser interface shall permit viewing of variables as well as changing of variable values.
21) The web server shall also have the capability to communicate via Modbus TCP.
22) Internal firmware within the server shall be capable of remote upgrade.
23) Maintain separate values for original PLCF and current working PLCF which are output in Aux. Perf. Parameters and over serial data link.
24) Rugged cast aluminum transceiver housing. Modular plug-in components.
25) Through-the-lens optical alignment verification system.

C.   DILUTION AIR SUPPLY-CONDITIONING SYSTEM

1.   The system shall condition instrument air supplied at -40°F, oil free, and 80-100 psi sufficiently for dilution. It shall include:

   a.   A dual tower, regenerative, heatless CO_2/H_2O absorber.
   b.   A coalescing filter with automatic high pressure drain.
   c.   Chemical scrubbing to remove back ground levels of SO_2 and NO_2,(when necessary).
   d.   A ballast tank to dampen the effects of pressure variations in the instrument air supply.
   e.   A post filter to protect dilution air from desiccant dusts.
   f.   Reduction in dewpoint to -100°F at full capacity.
   g.   Reduction in CO_2 to less than 2 ppm; SO_2, NO_x, and CO to trace amounts.
   h.   CO scrubber, if necessary.

D.   DILUTION PROBE

1.   Provide a complete probe system with external eductor bypass, dilution orifice, filters, probe heater, all extensions, bolts, washers and assembly materials necessary for connection to the stack or duct.

   a.   Acceptable materials for the probe are: 317LMN, 316L, Inconel, and Hastelloy.
   b.   Critical orifice material shall be glass or sapphire crystal.
   c.   Furnish the probe with a filter upstream of the critical orifice.
   d.   Provide a probe heater assembly; heater shall heat the portion of the probe that surrounds the critical orifice. Heater shall come complete with: temperature controller, interconnecting wiring assembly with junction box, and probe heater failure alarm contacts.
   e.   Probe length shall be sized to meet all applicable regulations.
   f.   Calibration gases shall be introduced upstream of all filters such that any build-up of "scrubbing" material will be visible in both the calibration and stack gas measurements.

E.   FLUE GAS TRANSPORT LINE

1.   Provide flue gas sample tubing between the probe and the analyzer shelter. The tubing shall be a multi-tube bundle with dilution air, calibration gases, flue gas sample and pressure sensing lines inside a polyethylene jacket.

   a.   Furnish flue gas transport line with low wattage, self-regulating, heat tracing (freeze protection).

   b.   Sample lines shall be heated if/as necessary to keep the diluted sample from condensing out water under worst case operating conditions.

F.   SYSTEM CONTROLLER

1.   Provide a programmed PLC to perform all control within the CEMS.

   Proprietary Data Logger type systems are specifically excluded as being

   non-responsive to this specification. It shall have the following features:

      a)   Control the calibration cycles.
      b)   Monitor system for faults.
      c)   Provide a minimum of 7 days of data storage in the event communication is lost to the Data Acquisition System (DAS).
      d)   Time and date stamp all data.

  e) Local PLC Interface. An alpha-numeric display with function keys to provide a user interface with the PLC.

  f) Continuously monitor and correct for changes in the dilution ratio.

 2. Input/Output

  a) Provide analog 4-20mA dc outputs.

  b) Provide digital outputs for alarms.

  c) Provide 8 analog inputs.

  d) Provide 16 digital inputs for system status monitoring.

  e) Provide 16 simulator switches for manual system control.

  f) Provide serial communications for CEMS analyzers.

  g) Provide Ethernet communications to DAS and DCS.

 3. The PLC shall be packaged as part of the CEMS.

 4. PLC shall be a Allen Bradley Control Logix PLC. (Allen Bradley SLC 500 Series; Allen Bradley Series 5 PLC; GE Funac 90/30 PLC]

G. DATA ACQUISITION SYSTEM

 1. Provide a complete and functioning IBM Pentium compatible computer system with the following, minimum capabilities:

  a. The DAS system shall use Microsoft® Windows® Server operating system. The system shall allow for access to current or past data for trending, report generation or data transfer, while continuously collecting data from the CEMS.

  b. Software and operating system requirements. The system shall be:

   1) Menu driven.

   2) Password protected on multiple levels.

   3) Able to view data in tabular or graphical formats.

   4) Capable of allowing data, reason codes or constants to be edited.

   5) Be capable of remote contractor support and trouble shooting via modem or internet (VPN).

   6) Be provided with all required reports, and allow for user modification of reports.

   7) Provide a real time prompt for alarm acknowledgement.

   8) Be capable of sending alarms and/or reports via email.

   9) The Report program must be browser based for easy access throughout the network.

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10) User must be capable of designing unlimited User Interface screens.

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c. System architecture. The contractor shall design a system using the following hardware as a minimum:

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1) Quad Core Intel® Xeon® Processor
2) 2 GB RAM
3) 4 hot-swappable hard drives
4) DVD R/W Drive
5) External Hard Drive (for Back-ups)
6) Sound Card
7) 21" flat screen monitor
8) Laser printer
9) UPS
10) Microsoft Windows 2000 operating system

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H. <u>SHELTER</u>

1. The System(s) provided shall be integrated into a fully-assembled, environmentally controlled, enclosure designed to house electronic monitoring systems and similar equipment in a secure and controlled environment. It shall be thermally efficient and feature designs and materials which control climate penetration through the walls, floor, and ceiling. The Shelter shall provide protection against falling rain, sleet and ice formation consistent with the NEMA 3R or optimally NEMA 4x requirements.

PART 3 - FIELD SERVICE AND PERFORMANCE TESTING

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. Provide owner with confirmation that the equipment is properly installed and is ready for energization.

   3.   Perform start-up and verify correct operation of all equipment supplied under this specification.

B.   CERTIFICATION TESTING

   1.   Perform initial certification testing. Notify owner prior to starting any testing.

      a.   The owner will supply all necessary calibration gases.

      b.   The owner will provide all coordination of testing schedules with appropriate regulatory agencies.

      c.   The owner will provide plant operating conditions consistent with regulatory requirements.

C.   MAINTENANCE SERVICES

   1.   Provide a one-year maintenance contract to commence upon successful completion of the certification testing.

      a.   Perform four (4) quarterly scheduled maintenance visits.
      b.   Provide four (2) emergency site visits. The contractor's personnel shall be on-site in less than 40 hours from the time the owner contacts the contractor.
      c.   Provide unlimited telephone and modem support.

D.   TRAINING SERVICES

   1.   Provide a minimum of 40 hours of on-site classroom training and instruction for operations and maintenance personnel for each plant site.

   2.   Provide factory training for up to 6 of the owners' technicians. Training shall be for a minimum of 24 classroom hours and cover the operation and maintenance of all components furnished.

PART 4 - DRAWINGS AND DOCUMENTATION

   1.   A Quality Assurance manual shall be provided which meets regulatory requirements and is specifically written to address the maintenance, operation, and calibration of this CEMS.

   2.   Operating and maintenance manuals shall be supplied for each analyzer, computer, PLC, computer peripheral, or other major component of the system.

   3.   System drawings shall be supplied which detail the pneumatic and electrical interconnections of the system. A system schematic shall also be required which provides an overview of the CEMS implementation. Drawings shall be revised to incorporate any as-built or installed modifications before project completion.

PART 5 - CUSTOMER ACCEPTANCE CRITERIA

   1.   The customer shall accept the CEMS herein supplied at the time the certification testing has been completed and a report prepared which demonstrates performance consistent with 40 CFR 75 requirements, or at the time when all the above equipment, services, and documentation has been delivered, whichever is later.