
 Filial de  <b>Pequiven</b> <small>Petroquímica de Venezuela, S.A.</small>	Technical specifications Requirements for Goods and Services
MAINTENANCE MANAGEMENT	2024

This document is only a courtesy translation into English of the document written in Spanish with Reference "Anexo 1A. Especificaciones técnicas CEMS". Therefore, in the event of any difference between the two versions, the Spanish version shall prevail.

## 1 INTRODUCTION.

**MONÓMEROS COLOMBO VENEZOLANOS S.A.** hereinafter "**Monómeros**" or "**MCV**", wishes to **quote budgetary** under the context of a market study, the supply of a continuous N<sub>2</sub>O emissions monitoring system (CEMS) for the Nitric Acid production plant of the Simón Bolívar Complex, according to the detailed specifications described in the scope of this document.

The technical specifications described in this document are part of a **market research phase** in which suppliers of this type of technology, hereinafter "**interested suppliers**", will be invited to validate whether the requested equipment and services are available in the market and to establish an estimated cost for them.

In any case, it should be noted that, for the purposes of this market study phase, **interested suppliers** will be allowed to suggest, within the budget quotation, all equipment and services not mentioned in this document and which, at their discretion, are required to guarantee the total execution of the scope requested by Monómeros.

## 2. PURPOSE.

This Annex has been prepared specifically to enable **interested suppliers** to successfully understand Monómeros' requirements and submit their **quote**.

This document is not intended to specify all technical requirements, nor to specify requirements already covered by applicable codes and standards. The vendor/OEM (Original Equipment Manufacturer) that results in the bid for which this market study is launched shall apply sound engineering and manufacturing practices and include all equipment and services not mentioned to deliver a unit suitable for the required functionality, which conforms to current industry standards.

### **3. REQUIRED EQUIPMENT.**

#### **3.1 Stack gas flow meter.**

Annubar type stack gas flow meter to be installed in the plant's stack in order to measure the volumetric flow of the flue gases; in addition, measure the static pressure and temperature of the gases to make the necessary compensations, according to the detailed specifications of Annex 1B.

#### **3.2 Concentration gas analyzer.**

To measure the concentration of  $N_2O(g)$ ,  $O_2(g)$  in the stack gas stream, according to Annex 1C specifications with high precision and accuracy, with response time less than 200 seconds and long term stability, automatic, semi-automatic and manual calibration capability with both calibration gases and certified calibration cuvettes, adjustment, logging and data storage capabilities for further analysis.

##### **3.2.1 Sample extraction, transport and conditioning system:**

Robust and reliable design to guarantee a representative sample extraction. It must contemplate adequate filters and traps to remove impurities and avoid cross contamination.

Automatic and programmable sampling system with the necessary protection systems to guarantee the reliability of the measurement and the performance of the analysis equipment. Compliance with safety standards and proper handling of hazardous samples.

##### **3.2.2 Cabinet and Electrical System:**

Rugged, watertight cabinet with adequate dimensions to house all system components.

The cabinet must have an integrated air conditioning system to maintain an internal temperature of less than 24°C.

Reliable and safe electrical power distribution system, proper installation of cables and electrical connections for system components and lighting.

### **3.3.3 Outputs and Additional Functionalities:**

Signal retransmission outputs for the concentration of the gas analyzed in standard current from 4 to 20 mA.

Discrete outputs to report the status of the analysis modules and the system in general. Possibility of communication in industrial protocol for the reading of the important variables of the system.

Intuitive user interface and real-time data visualization capability.

## **4. REFERENCE DOCUMENTS.**

The following is a reference to the international codes and standards that Monómeros considers must be complied with by the supplier that is awarded the contract in the subsequent bidding process for which this market study is launched. It is clarified that in case of conflict between standard codes and standards or between standard codes/standards and this specification, the successful supplier shall notify Monómeros, who will determine the application.

The codes and standards are described below:

- R.E.T.I.E. Technical Regulation of Electrical Installations of Colombia.
- NTC 2050 Colombian Electrical Code.
- NEC 2005 NATIONAL ELECTRICAL CODE HANDBOOK.
- NFPA-497 Recommended Practice for the Classification of Flammable Liquids, Gases or Vapors and of hazardous (Classified) Locations for Electrical Installations in Chemical Process areas.
- API RP 500 - Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2.
- CEMS performance shall comply with the Industrial Emissions Directive (IED), EPA 40 CFR 60, "New Source Performance Standards (NSPS)" and EPA 40 CFR 75, "Acid Deposition Control (Acid Rain)".
- EN 14181, "Stationary source emissions - Quality assurance of automated measuring systems", shall apply to installed CEMS systems.

- The quality assurance and uncertainty of the automated CEMS measurement system shall be in accordance with EN 13284, "Stationary source emissions - Determination of low range mass concentration of dust".
- The location and safe accessibility of the CEMS to generate a homogeneous and representative sample shall be in accordance with EN 13284, "Stationary source emissions - Determination of low range mass concentration of dust" and 15259, "Stationary source emissions - Requirements for the measurement sections and sites and for the measurement objective, plan and report".
- The digital interface/data transmission shall follow the recommendations set forth in VDI 4201, "Digital Communication for Emission Monitoring Systems at Regulated Sources".
- The QAL1 certification shall be in accordance with EN 15267, "Air quality - Certification of automated measuring systems" and EN 14181.
- The supplier, OEM and subcontractor shall be certified according to the international standard ISO 9001, "Quality management systems - Requirements" and ISO 14001, "Environmental management systems - Requirements with guidance for use".
- The test gases shall be certified according to ISO 6142, "Gas analysis - Preparation of calibration gas mixtures".
- ISO 9169:2006: "Air quality - Definition and determination of performance characteristics of an automatic measuring system".
- ISO 10396: "Stationary source emissions - sampling for the automated determination of gas emission concentrations for permanently installed monitoring systems".
- ISO/CD 10849: "Stationary source emissions - Determination of the mass concentration of nitrogen oxides - Performance characteristics of automated measuring systems".
- EN ISO 14956: "Air quality - Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty".
- EN ISO 16911: "Stationary source emissions - Manual and automatic de-termination of velocity and volume flow rate in ducts" and CEN/TR 17078, "Stationary source emissions - Guidance on the application of EN ISO 16911".
- Nitrogen oxides: EN 14792, "Stationary source emissions - Determination of mass concentration of nitrogen oxides (NO<sub>x</sub>) - reference method: chemiluminescence".
- Nitrous oxide: EN ISO 21258, "Stationary source emissions - Determination of the mass concentration of dinitrogen monoxide (N<sub>2</sub>O) - reference method: Non-dispersive infrared method".

- Humidity, water vapor: EN 14790, "Stationary source emissions - Determination of the water vapor in ducts".
- 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards (including Federal Reference Methods)".
- 40 CFR 53, "Ambient Air Monitoring Reference and Equivalent Methods".
- 40 CFR Part 58, "Ambient Air Quality Surveillance".
- BS6739: Code of practice for instrumentation in process control systems

The latest editions of the codes and standards shall be used. In case of discrepancy or conflict between the standards and codes and the requirements set forth in this document, the more stringent requirement shall apply.

## **5. SCOPE.**

### **General.**

As directed herein, the market research is launched for a complete continuous emissions monitoring system for N<sub>2</sub>O and O<sub>2</sub> and an on-line flow transmitter, including the detailed engineering, procurement, purchases, transportation to the plant, elements and goods (sensors, couplings, hardware, software, connectors, cables, fiber optics, drains, vents (if applicable) and other necessary items) required to monitor, analyze and track plant emissions.

The analysis system must continuously measure the concentration of the requested components, whose gas-phase sample will be extracted from the line leading to the stack of the nitric acid production plant according to the parameters indicated by Monómeros in the data sheet in Annex 1C.

The nitrous oxide analyzer, which incorporates the measurement of O<sub>2</sub>, must have the following components:

- a) Cabinet.
- b) Probe unit.
- c) Sampling line.
- d) Sample conditioning system.
- e) Analysis Modules.
- f) Electronic Unit.

Equipment for N<sub>2</sub>O monitoring shall be QAL1 certified for both the continuous analyzer and the stack gas flowmeter, both equipment shall undergo a QAL2 test shortly after installation. The QAL2 test will be performed by accredited laboratories according to ISO/IEC 17021 contracted to perform the calibration of the equipment and verify its correct installation. It shall apply only to equipment and measurement parameters for the determination of N<sub>2</sub>O emissions.

The OEM will assist the independent and authorized body in the first certification of the analysis system in accordance with QAL2.

The CEMS shall have facilities to allow for in-plant testing and QAL 2 after installation, as well as facilities to allow for periodic maintenance and calibration.

The stack gas flowmeter must be certified EN 14181 QAL1, be installed according to EN 15259 and include the installation flange to the stack for measurement of:

- Stack gas flow (volume).
- Stack gas temperature.
- Stack gas pressure.

The monitoring equipment will be installed and operated according to the requirements of EN14181 (latest version), including periodic maintenance and calibration. Monómeros will operate the monitoring equipment in accordance with QAL3 level of quality assurance.

The operation of the analyzer should be optimal during normal and start/stop conditions of the process. The characteristics of the sample under these conditions are given in Annex 1C.

The analyzer electronics unit and the cabinet containing them must comply with the area classification described in Annex 1C.

The analyzer must have the accessories for installation and assembly, must be installed in a visible way to the operator and must be easy to maintain.

The SUPPLIER who is awarded the contract will be responsible for providing the probe and sampling line for connection to the process, taking into account a distance between the sampling and the analyzer of at least 25 meters.

The SUPPLIER that is awarded the contract shall supply the attachments and accessories required for the calibration of the analyzers locally, manually, semi-automatically and automatically when applicable.

The awarded SUPPLIER shall provide a schematic indicating the components of the system without any omission.

The successful SUPPLIER shall supply the equipment considering the design, safety, security, protection, assembly and communication in accordance with the MCV requirements indicated in the data sheet in Annex 1C of this specification.

The system shall consist of standardized vendor products (hardware, software and system firmware, etc.) which can be configured to meet the stated requirements. Standardized products are defined as those products that have a part number assigned by the supplier, product bulletins exist and installation documents and user manuals are available.

It must include the most current technology available in the market for the sensor, digital signal processing and software programming as required by the technology of the analyzer acquired, the electronic unit must be based on microprocessors and its function must be to indicate, alarm and transmit the information received from the analyzer with standard communication signals as specified in Annex 1C.

The SUPPLIER who is awarded the contract must indicate the operating limits of the instrument, such as: pressure, flow, temperature and humidity, and the electronic unit must have devices to eliminate interference produced by radio frequency and electromagnetic signals. Likewise, it must have short circuit protection.

#### **Cabinet.**

The cabinet housing the analyzer components shall comply with the cabinet type and area classification indicated by MCV in Annex 1C of these specifications.

The cabinet must have an integrated air conditioning system to maintain an internal temperature of not more than 24°C.

The dimensions must be adequate to allow easy access to its components, and to avoid overheating of internal components.

The successful SUPPLIER must specify the list of auxiliary services (electricity, instrument air, nitrogen, etc.) required for the operation of the analyzer.

### **Probe unit.**

The insertion length of the probe should be half the diameter of the process pipe and allow the gas to reach the sensor in order to measure the concentrations of the gas of interest in the sample.

The installation flange and a ¼ turn full bore block valve must be included, as well as a particle filter and heating to avoid condensation.

The material of the outer sheath of the probe must have the mechanical resistance and chemical compatibility for the required service, considering the length of the probe, the composition and temperature of the fluid.

The sampling system must provide the analyzer with a representative sample of the process stream, which must be transported, conditioned and introduced to the analysis modules.

### **Sampling line.**

It must be made of a mechanically resistant material and chemically compatible with the sample and include all the accessories for its installation (pipe fittings, terminal blocks, etc.).

The successful SUPPLIER must determine if insulation or heating of the line is required and is responsible for the selection and supply of components for these requirements, respecting the area classification and the maximum temperature to which the sample can be subjected.

No recirculation of the sample gas back into the stack is necessary.

### **Sample conditioning system.**

The awarded SUPPLIER must provide the sample conditioning system fully assembled to supply the sample to the conditions required by analysis modules.

The awarded SUPPLIER must ensure that the sample meets the following conditions upon arrival at the sample conditioning system:

- a. That the composition and physical properties are representative of the process.
- b. Homogeneous.
- c. That it is in a single phase.



A sample conditioning system should be provided that allows for the following:

- a. The separation of solid and liquid particles or other harmful components from the sample.
- b. Removal of contaminants from the reference stream.
- c. Adequate sample flow for the analysis module to operate under safe conditions and within the required measurement parameters.
- d. Adjust the sample pressure to the conditions required by the analysis modules, if required.
- e. Sample cooling to adjust the temperature and remove humidity, with the objective of sending a dry sample to the analysis modules.
- f. It must have an internal protection system that, in spite of abnormal conditions in the process or in the sample conditioning, does not allow the entrainment of liquid particles to the analysis modules.

The awarded SUPPLIER must install the facilities for the final disposal of the gaseous sample and condensate, in order to take them back to the plant process.

#### **Analysis modules.**

The accuracy of the analyzer shall comply with Annex 1C. The measuring principle shall be non-dispersive infrared NDIR for N<sub>2</sub>O measurement and electrochemical for oxygen O<sub>2</sub> measurement.

It must include the most current technology available on the market for the sensor and analysis unit.

#### **Electronic Unit.**

It must include the most current technology available on the market, digital signal processing and software programming as required by the technology of the analyzer purchased.

The electronic unit must be based on microprocessors and its function must be to indicate, alarm and transmit the information received from each analyzer by means of standard communication signals specified in Annex 1C, and the descriptive messages must be available in English and Spanish.

Have a power supply and amplification circuit. All electronic components of this unit must be able to withstand the temperature and relative humidity conditions prevailing at the installation site.

The electronic unit must include an integrated digital type indicator with a linear scale and it must also detect the range automatically. Likewise, it must have indication for general failure of the analyzer and for maintenance requirements. The operations must be performed by means of keyboard and remote access through communication protocols.

The electronic system must have software security levels for monitoring, maintenance and programming by means of passwords. Include the necessary software licenses for configuration and maintenance.

The electronic unit must have devices to eliminate interference produced by radio frequency and electromagnetic signals. Likewise, it must have short-circuit protection.

The power supply must be as indicated in the data sheet in Annex 1C.

Systems must be provided with levels of on-line self-testing, routine testing and off-line self-testing. This on-line self-diagnosis must be applied to the following concepts:

- a. Circuits and functions.
- b. Devices and interfaces.
- c. Configuration and communications interface.
- d. Library programs.
- e. Special programs.

The electronic unit must satisfy the performance conditions, such as range, accuracy, repeatability, among others, indicated in the data sheet in Annex 1C.

### **Materials.**

The awarded SUPPLIER together with the manufacturer must supply the materials required for each of the parts that make up the system.

The manufacturer through the awarded SUPPLIER must issue the criteria for choosing the selected material as indicated in Annex 1C of these specifications, for the sampling, the wetted parts of the sample conditioning system and the analysis modules.

The successful SUPPLIER together with the manufacturer must select the analyzer materials, which must be compatible with the chemical composition of the sample and meet the application requirements requested by Monómeros in Annex 1C of these specifications.

### **Manufacturing.**

The manufacturing of the analyzers must comply with the requirements outlined in these specifications.

The analyzer electronics unit must have an identification plate, permanently attached to the instrument, containing at least the following information:

- a. Identification number (Tag) and service.
- b. Brand, model y serial number.
- c. Manufacturer.
- d. Service contact.
- e. Date manufacture.
- f. Power supply.
- g. Instrument certifications.

The SUPPLIER that is awarded the contract must indicate the list of national, foreign and international standards that comply with the manufacture of the system.

All hardware, software and firmware of the system supplied must have been field tested prior to order placement in similar industries. Field tested is defined as a satisfactory operation of an assembled system for one (1) year or more in the Petrochemical or similar industries indicating the applications and companies in which it has been installed and supported by the awarded SUPPLIER. There must be the possibility for Monómeros to verify the status of the system tested in the field.

### **Calibration.**

The analyzer must be capable of performing calibration in automatic, semi-automatic and manual modes with certified calibration gases and certified calibration standards.

The SUPPLIER that is awarded the contract must indicate the available calibration methods for the analyzer and the necessary requirements, as well as include electric and/or manual

valves, pressure reducers, etc., necessary for the entry of the calibration gases into the system.

Zero gas and O<sub>2</sub> and N<sub>2</sub>O calibration spam gas with certificate of analysis from an ISO IEC 17025 accredited laboratory.

Rack for calibration gas cylinders.

### **Spare parts.**

The awarded supplier shall be responsible for providing detailed information on the parts that make up the system with their respective part numbers from both the analyzer manufacturer and the original manufacturer.

Supply spare parts for 3 years of regular maintenance, a list with specifications of standard spare parts and a list of critical spare parts for proper operation will also be provided.

### **Reliability and Availability.**

The system must be designed in such a way that any faults can be quickly identified and diagnosed.

All equipment supplied must be based on proven hardware and software. Special hardware and software will be acceptable when absolutely necessary for the application.

### **RFI & EMI considerations.**

The successful Supplier shall provide MCV with analyzer specifications related to radio frequency interference (RFI) and electromagnetic interference (EMI) considerations for all equipment included in this project.

The successful Supplier must specify any precautions, interference or restrictions, in the use of hand-held radio frequency communicators in the vicinity of the equipment.

## **6. INSTALLATION AND FUNCTIONAL TESTS.**

This section details the requirements for factory acceptance testing, site acceptance testing, installation and field acceptance of the system.

Based on the purchase specification, the successful supplier must submit its own testing, installation and acceptance procedures for hardware and software. Acceptance tests must be mutually agreed upon and approved by Monómeros.

### **Installation.**

The supplier must offer the supervision service for installation and start-up of the equipment in the plant.

Consideration should be given to the classification of the installation area, the protection of the environment, the effects of variation in ambient temperature and the ease of availability for maintenance.

The following considerations should be taken into account:

- a. Accessibility for cleaning and maintenance.
- b. The distance from the conveyor line should be minimal, thus achieving a shorter delay time.
- c. Consideration should be given to the recommendation of the manufacturer or SUPPLIER that is awarded the contract; for the installation of the analyzer in order to avoid security problems in classified areas within the MCV facilities.

During the execution of the system installation and integration work, the awarded SUPPLIER must comply with the following requirements:

- a. Submit the assembly procedure(s) and system installation maneuvers for approval by MCV safety personnel, which must be obtained prior to applying such procedures in the execution of the work.
- b. Each analyzer should be installed according to the manufacturer's installation recommendations.
- c. The installation and connection of the elements that make up each analyzer must be carried out as described in the manufacturing catalogs and operation manuals.
- d. Calibration tests specified by the manufacturer must be performed.

- e. The activities carried out must be performed safely within the Monómeros' Facilities, minimizing the possibility of risk.
- f. All the parts that make up each analyzer must be inspected and visually reviewed, checking that they are complete and correspond to what is requested by MCV in this specification.
- g. Calibration and integration to the oxygen analyzer control system must be performed by qualified personnel certified by the manufacturer. A calibration report must be submitted.
- h. The auxiliary services required for testing, calibration, isolation and maintenance of the analyzer at its installation site must be specified.

#### **Technical assistance.**

The awarded SUPPLIER must provide the supervision services for the installation, and carry out the configuration, field testing, commissioning, start-up and training of the personnel designated by Monómeros.

The awarded SUPPLIER through the manufacturer must provide training courses to Monómeros designated personnel at the location where Monómeros indicates, the scope must cover the aspects of configuration, operation and maintenance of the analyzer.

The awarded SUPPLIER shall perform annual maintenance of the complete analyzer system and data logging system for 3 years (remotely).

#### **Testing and acceptance.**

The successful SUPPLIER shall prepare the test protocol document indicating the tests to be performed for acceptance of the analyzer. The tests, as indicated, must be performed under the supervision of Monómeros designated personnel.

The tests to be considered are as follows:

- a. Testing of the system, its equipment and accessories.
- b. Tests of the communication interface with the existing Control System of the installation.

The awarded SUPPLIER must prepare a test protocol, which must be submitted for review, comments and approval; it must be sent to Monómeros at least 30 days prior to the scheduled date of acceptance testing.

The protocol for the development of these tests should include, at a minimum, the following:

- a. Table of contents of the document.
- b. Identification, function and description of system components.
- c. Detailed description for each type of test indicating the objective and the way in which the test is to be performed.
- d. Identification of simulators and test equipment.
- e. Activities to be performed.
- f. Elements or components on which it has an effect.
- g. Expected results.
- h. Format for acceptance or rejection of the test.
- i. Space for comments.

Likewise, the personnel designated by Monómeros must be allowed to participate in the acceptance tests, giving all the facilities for their participation in these tests.

The tests that require the approval of Monómeros, according to the requirements indicated in this specification, to proceed with the acceptance of the analyzers are: Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT).

#### **Factory Acceptance Test (FAT).**

The awarded SUPPLIER must test and demonstrate the functional integrity of the system hardware and software. No material shall be shipped to the site until all required testing is satisfactorily completed and a certification is made indicating its readiness for shipment to Monómeros.

Monómeros shall advise that acceptance of any equipment or exception to inspection or testing shall in no way relieve the successful SUPPLIER of the responsibility for delivery of the equipment in such a manner as to meet all requirements.

During the test the awarded SUPPLIER must prepare a maintenance log in which the following items must be recorded: Failed components, effect of failure, cause of failure, and the length of service of the component prior to failure. The test must be suspended upon failure of any component. The SUPPLIER must replace the component to repair the system, but if the action is not satisfactory, the successful SUPPLIER must provide a fully functional replacement subsystem to restart the test.

Monómeros reserves the right to restart the FAT from the beginning if major subsystems fail or if multiple individual components fail. During the initial stages of the detailed engineering phase, the awarded SUPPLIER must define this limit of failed components, obtain approval from Monómeros.

FAT tests to be included, but not limited to the following:

- a. Visual inspection to verify that the systems are manufactured in strict compliance with the technical and normative specifications, as well as the scopes established in the corresponding contract.
- b. Testing of the equipment (hardware), with all components fully integrated, assembled and interconnected.
- c. Programming tests (software).
- d. Self-diagnostic tests (including failures).
- e. Tests to analog and discrete inputs and outputs.
- f. Additional tests requested in the bidding conditions.

The awarded SUPPLIER must deliver to Monómeros the technical report generated during this stage of tests carried out, indicating the result of the same, as well as the compliance or non-compliance with the objectives and technical and functional requirements. The test report shall include, among other items, the following:

- a. References to applicable international standards.
- b. Complete identification of the sample and calibration gases: quality, concentration, uncertainties.
- c. Circumstances in which the tests were carried out: locations, conditions...
- d. Scheduling of the sample: date and time.
- e. Test results: calibration, lower limit of detection, precision, zero and span deviation (including the effect of temperature), linearity, effect of interferences on the determinant, response time, standard deviations and systematic errors and a statement of compliance with this specification.

### **Site Acceptance Test (SAT).**

This test shall verify that the analyzers, including their installation accessories, operate in accordance with the requirements specified in Annex 1C.



On-site acceptance testing should be performed once the equipment is fully connected and installed on site.

These tests should consider the same points as those performed in the factory acceptance tests, including the following points:

- a. Before proceeding with any testing, the awarded SUPPLIER must ensure that all components are complete, identified and properly assembled and connected in order to comprehensively test the entire system, any deviation from this point must be notified in writing to Monomers to decide the start of the tests.
- b. The awarded SUPPLIER must deliver, prior to the start of the on-site acceptance tests, the factory acceptance test approval report and the on-site acceptance test protocol for review and approval by Monómeros. As part of the on-site acceptance tests, the commissioning of the system must be considered, until stable operation in the process is achieved.
- c. Verification of analyzer operation on site.
- d. Verification of the operation of the analyzer interface with the digital control system of the installation.
- e. The awarded SUPPLIER must deliver to Monómeros the technical report generated during this testing stage, indicating the results of the tests, as well as the compliance or non-compliance with the objectives and technical and functional requirements.

Once the analyzer has been put into operation under stable conditions, the awarded SUPPLIER must provide the corresponding delivery report to Monómeros.

## **7. DOCUMENTATION.**

The awarded SUPPLIER in connection with the analyzer shall provide the following documents to Monómeros.

All project deliverables and information will be prepared and provided in Spanish language.

All technical and non-technical documents, as well as the text of alarms and warning signs, shall be provided in the Spanish language.

The documentation shall be delivered according to the supplier's document list in at least one hard copy and in electronic format. As for the final documentation, the electronic files shall be in MS Office compatible format and the installation specific diagrams shall be in AUTOCAD or similar, as agreed with Monómeros:

- Electrical wiring diagrams.
- Instrument loop diagrams.
- Data communication interface diagrams.
- Dimensional drawings of the assembly.
- Sampling line piping diagrams.
- Calibration piping diagrams.
- Flow charts.
- CEMS regulatory mandates and description.
- CEMS Operating Manual.
- Calibration curve.
- Certificates, calibration and test documents shall be paper originals and scanned copies.
- Functional testing procedures and activities to be performed by Monomers to ensure that the CEMS meets the criteria for accuracy, precision, availability and representativeness upon successful completion of the initial performance specification test.
- Maintenance Strategy.

The procedures will address the calibration of both components and the overall measurement system. They will also identify the assumed parameters (a parameter report with line sizes, temperature and flow ranges, conversion factors, etc.) that are important for the calibration of the monitoring equipment.

It will also include procedures to verify the validity of the mathematical procedures used to correct or adjust the monitoring data.

Procedures used for routine (daily) zero and upper scale calibration checks and criteria for adjustment of the CEMS in case of excessive deviation.

In the case of the use of calibration gases for checks, these procedures shall describe:

- Where the gases are introduced into the measuring system.
- How the correct flow rate and pressure for gas injections are determined and maintained.

- The duration of gas injection.
- The data display device(s) used to determine monitor response.
- Any procedure necessary for the interpretation of the data.
- Criteria for deciding whether adjustments to the monitoring system are necessary.
- Actions to be taken when adjustments are necessary.

These procedures should include specification of the OEM and type of calibration materials used for daily calibration checks and the method used to establish the concentration values of these materials.

- Procedures used for standard gas audits (linearity tests) and relative accuracy tests.
- Quality control procedures including daily and periodic system or component performance checks, preventive maintenance procedures, spare parts inventory.
- Procedure for the identification of outliers.
- Performance test tabulation and plots of Standard Reference Method (SRM) data versus CEMS data.
- The SRM raw data shall be expressed under the same conditions as the CEMS data (e.g., dry or wet, temperature and pressure compensated).
- Corrective action procedures for repair, adjustment or replacement of the CEMS or its components.
- A schedule of recurring maintenance and adjustment operations will be provided to ensure quality assurance.
- Data backup procedures.
- A list of spare parts for commissioning and spare parts for three years of operation shall be submitted based on OEM recommendation. For each type of CEMS, a definitive list shall be submitted with all tag numbers for the project in question, indicating their interchangeability.
- Consumption and instrument air quality requirements.
- A list of diagnostic functions.
- A list of consumables, if needed, will be provided.
- A list of special tools, if needed, will be presented.
- The supplier shall submit a summary of life cycle costs (CAPEX and OPEX).

## **8. QUALITY ASSURANCE.**

The manufacturer shall be in accordance with the quality assurance standards. The awarded SUPPLIER shall provide the documents describing its quality procedures required by Monómeros.

## **9. PREPARATION FOR PACKAGING.**

THE SUPPLIER who is awarded the contract must provide appropriate packaging and cover the system inlets in order to prevent contaminants from entering the equipment during transportation and storage until installation.

## **10. WARRANTY AND TECHNICAL SUPPORT.**

### **10.1 Performance guarantee.**

Parameters and specifications provided by Monómeros shall be guaranteed. Tolerance limits and ranges shall be declared and established.

The performance test shall be conducted after installation, the system shall meet the performance test for 60 hours of continuous operation. Upon completion of the performance test, commissioning shall be completed and the system shall be officially declared operational.

If the supplier is unsuccessful due to faults or deficiencies revealed during the test, the supplier shall correct everything as soon as possible without expense to Monómeros and then perform a new warranty test.

### **10.2 Mechanical/Electrical/Electronic Warranty.**

The equipment shall be warranted against any defects in design, material, welding, and workmanship or otherwise, for all components of the equipment in operating condition.

The correct procurement, machining, heat treatment, welding, corrosion protection and accessories have to be guaranteed, as mechanical/electrical warranty, by the awarded supplier.

Any defect, as described herein, occurring during the warranty period, shall give rise to the application of the requirements indicated in the particular and general commercial conditions.

The Warranties described in items 10.1. And 10.2. Comprise the "Liability Warranty for Defects and Hidden Defects" which shall remain in force for 1 year (one year) from the date of delivery of the Goods at the Monómeros' facilities. The remaining years of warranty offered by the awarded supplier shall be covered by the standard manufacturers' or awarded supplier's warranty without the need for a bank guarantee.

The awarded supplier must include a minimum warranty of 3 years for the equipment. During this period, the awarded supplier must provide specialized technical support to diagnose and correct any errors that may occur in the cabling systems attributable to a deficient installation.

### **10.3 Monómeros will provide:**

- Electricity and air in predetermined positions.
- Air supply (according to quality, pressure and flow requirements of the supplier).
- All civil works to support the equipment, the supplier must deliver the appropriate anchorage according to the engineering and all the documents required for the construction.
- Installation of the equipment according to the supplier's instructions and under the supplier's supervision.