
 Filial de  Pequiven <small>Petroquímica de Venezuela, S.A.</small>	Technical specifications for the supply of a CEMS Environmental Emissions Monitoring System for the Monómeros nitric acid plant
MAINTENANCE MANAGEMENT	YEAR 2024

Notice: This document is only a courtesy translation into English of the document written in Spanish with Reference "Anexo 1A - Especificaciones Técnicas - Requisitos de los Bienes". Therefore, in the event of any difference between the two versions, the Spanish version shall prevail.

ANNEX 1A "TECHNICAL SPECIFICATIONS - REQUIREMENTS OF GOODS".

1 INTRODUCTION.

MONÓMEROS COLOMBO VENEZOLANOS SA hereinafter "**Monómeros**" or **MONÓMEROS** is in an international bidding process to acquire a continuous emissions monitoring system of N_2O (CEMS), which will be installed in the Nitric Acid production plant of the Simón Bolívar Complex, according to the detailed specifications described in the scope of this document.

Monómeros requires from interested bidders a detailed proposal for continuous monitoring equipment, with factory acceptance tests (FAT) and on site (SAT), associated sample extraction and conditioning systems, cabinet with electrical installations and necessary control systems, a stack gas flow meter and a PC-based data acquisition and management system for continuous emissions monitoring (CEM-DAS/DASH).

2. PURPOSE.

This document, annexed to the specifications, has been prepared so that interested bidders can successfully understand the requirements and minimum requirements for the supply and can submit their offers.

This document determines the minimum requirements that will be demanded of interested bidders. The offeror / OEM (Original Equipment Manufacturer) who is the winner of this tender must apply sound engineering and manufacturing practices and include all equipment and services not mentioned to deliver a unit appropriate for the required functionality, which conforms to current industry standards.

3. PROJECT LOCATION.

The equipment described in this document must be delivered to the facilities of Monómeros, Vía 40, Las Flores, Barranquilla, Atlántico (Colombia). To be installed by Monómeros personnel in the nitric acid plant.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **INTERESTED SUPPLIERS** exclusively for the preparation of the corresponding offers.

PROPOSERS must express any questions or clarifications through the website before submitting their offer.

4. REQUIRED EQUIPMENT.

4.1 Chimney gas flow meter:

Annubar type chimney gas flow meter to be installed in the plant chimney in order to measure the volumetric flow of the exhaust 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**.

4.2 Gas Analyzer:

To measure the concentration of N_2O (mg/Nm^3) in the gas stream of the chimney, according to the specifications of **Annex 1C**, with response time less than 200 seconds and long-term stability, automatic, semi-automatic calibration capacity and manual with both calibration gases and certified calibration cuvettes, adjustment, recording and data storage capabilities for subsequent analysis.

4.3 Data acquisition system for continuous monitoring of CEM-DAS/DAHS emissions:

Complete network system (hardware and software) for the recording and evaluation of data in real time, of the emissions reported by the CEMS system in accordance with the EN-17255 standard.

4.4 Sample extraction, transportation and conditioning system:

With a robust and reliable design to guarantee a representative sample extraction. You must consider adequate filters and traps to eliminate 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 dangerous samples.

4.5 Cabinet and Electrical System:

Resistant and airtight cabinet with adequate dimensions to house all system components. The cabinet must have an integrated air conditioning system to maintain an internal temperature no higher than 24°C . It must also include a reliable and safe electrical power distribution system, proper installation of cables and electrical connections for the system components and for Lighting.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROponentes**, exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimientomoneros.com.co before submitting their offer.

4.6 Additional Outputs and Functionalities:

Signal retransmission outputs for the concentration of the analyzed gas at standard current of 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 reading important system variables.

Intuitive user interface and real-time data visualization capability.

5. PRESENTATION OF THE PROPOSAL:

You are requested to provide a detailed proposal that includes the following:

- Description of the proposed equipment and components, including complete and detailed technical specifications of the manufacturer.
- Detail of the sample extraction and conditioning system, including the methods and components used.
- Description of the proposed cabinet, including dimensions, air conditioning features and details of electrical installations.
- Information on after-sales service capabilities, including warranty, technical support and spare parts availability.
- Documentation to support staff training and experience.
- Recent success stories with similar equipment.
- Proposed schedule for delivery and start-up of the system.
- Detail the associated costs, including equipment, FAT testing and any other additional costs, as well as annual preventive maintenance costs.

6. REFERENCE DOCUMENTS.

The international codes and standards that Monómeros considers must be complied with by the supplier that is awarded the tender are referenced below. It is clarified that, in the

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomonmeros.com.co before submitting their offer.

event of a conflict between standard codes and standards or between standard codes/standards and this specification, the awarded supplier must notify Monómeros who will determine the application.

The codes and standards are described below.

- RETIE 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)".
- The EN 14181 standard, "Stationary source emissions – Quality assurance of automated measuring systems", will apply to the CEMS systems installed.
- The quality and uncertainty assurance of the CEMS automated measurement system must comply with standard EN 13284, "Stationary source emissions – Determination of low range mass concentration of dust".
- The secure Location and accessibility of the CEMS to generate a sample homogeneous and representative, it must be in accordance with standards 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 data acquisition and processing systems (DAHS) will comply with the standard EN 17255, "Stationary source emissions - Data acquisition and handling systems" and to the EU regulation on monitoring and reporting.
- The digital interface/data transmission must follow the recommendations established in VDI 4201, "Digital Communication for Emission Monitoring Systems at Regulated Sources".
- The QAL1 certification must comply with the EN 15267 standard, "Air quality – Certification of automated measuring systems" and to the EN 14181 standard.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROponentes**, exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimiento@monomeros.com.co before submitting their offer.

- The supplier must 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 will 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 (NOx) - reference method: chemiluminescence".
- Oxide nitrous: EN ISO 21258, "Stationary source emissions – Determination of the mass concentration of dinitrogen monoxide (N₂O) - 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, "Environmental Air Quality Surveillance."
- BS6739: Code of practice for instrumentation in process control systems.

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

7. SCOPE OF SUPPLY.

7.1 As indicated in this document, the awarded Supplier must provide a complete continuous emissions monitoring system for N₂O and O₂, a stack gas flow transmitter and a DAHS data acquisition system, including the detailed engineering, purchases, acquisitions, transportation to the plant, elements and goods (sensors, chimney gas tubes, couplings, hardware, software, connectors, cables, fiber optics, drains, vents (if applicable) and other necessary elements) required to monitor, analyze and track plant emissions.

The analysis system must be provided to continuously measure the concentration of the requested components, whose gas phase sample will be extracted from the line that leads to the chimney of the nitric acid production plant in accordance with the parameters indicated by Monómeros on the sheet data from **Annex 1C**.

The SUPPLIER that is awarded must supply the nitrous oxide analyzer, which incorporates the measurement of O₂ and must have at least the following components:

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

The equipment for monitoring N₂O must have QAL1 certification for both the continuous analyzer and the stack gas flow meter, both equipment will undergo a QAL2 test shortly after installation. The QAL2 test will be carried out by accredited laboratories according to ISO/IEC 17021 contracted to perform the calibration of the equipment and verify its correct installation. This will apply only to equipment and measurement parameters for determining N₂O emissions.

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

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

The stack gas flow meter must be certified EN 14181 QAL1; Installed according to EN 15259 standard and include the installation flange to the chimney for measurement of:

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimiento@monomeros.com.co before submitting their offer.

- Chimney gas flow.
- Chimney gas temperature.
- Chimney gas pressure.

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

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

The electronic unit of the analyzer and the cabinet that contains it must comply with the area classification described in **Annex 1C**.

The analyzer must have accessories for installation and assembly; they must be installed visibly to the operator and their maintenance must be facilitated.

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

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

The SUPPLIER that is awarded must provide a diagram indicating the components that make up the system without any omission.

The SUPPLIER that is awarded must supply the equipment considering the design, safety, protection, assembly and communication in accordance with the MONÓMEROS requirements indicated in the data sheet of **Annex 1C** of this specification.

The system must be composed of standardized products from the supplier (hardware, software and system firmware, etc.) which can be configured to meet the established 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.

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomoneros.com.co before submitting their offer.

The SUPPLIER that is awarded must include the most current technology that exists on the market for the sensor, digital signal processing and “software” programming as required by the technology of the acquired analyzer, the electronic unit must be made up of 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 that is awarded 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. It must also have short circuit protection.

7.2 Cabinet.

The cabinet that will house the analyzer components must comply with the type of cabinet and area classification indicated by MONÓMEROS in **Annex 1C**.

The cabinet must have an integrated air conditioning system to maintain an internal temperature of no more than 24 °C.

The dimensions must be adequate to allow easy access to its components, and avoid overheating of the internal components. These dimensions must be sent by the SUPPLIER in the proposal to be submitted for review, in addition, it must have sufficient space for the future installation of at least two analysis modules (19-inch rack).

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

7.3 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-flow blocking valve must be included, in addition, a particle filter and heating must be incorporated to avoid condensation.

The material of the outer cover of the probe must have the mechanical resistance and chemical compatibility for the required service, considering its length, 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.

7.4 Sampling line.

The sampling line must be made of a material that is mechanically resistant and chemically compatible with the sample and includes all accessories for its installation (pipe connectors, terminal blocks, etc.).

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

7.5 Sample conditioning system.

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

The SUPPLIER who is awarded the contract 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) That it be homogeneous.
- c) That it is in a single phase.

A sample conditioning system must be provided that allows the following:

- d) The separation of solid and liquid particles or some other harmful component of the sample.
- e) Removal of contaminants from the reference stream.
- f) Adjust the sample flow so that the analysis module operates under safe conditions and within the required measurement parameters.
- g) Adjust the sample pressure to the conditions required by the analysis modules, if required.
- h) Cooling of the sample to adjust the temperature and remove humidity, with the aim of sending a dry sample to the analysis modules.
- i) It must have an internal protection system that, despite abnormal conditions in the process or sample conditioning, does not allow liquid particles to be carried into the analysis modules.

The SUPPLIER that is awarded must install the facilities for the final disposal of the gas sample and condensate.

7.6 Analysis modules.

The accuracy of the analyzer must comply with what is specified in **Annex 1C**. The measurement principle must be non-dispersive infrared NDIR for the measurement of N₂O and **electrochemical** for the measurement of oxygen.

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

7.7 Electronic unit.

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

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

Possess a power supply and an amplification circuit. All electronic components of this unit must have the capacity to withstand the temperature and relative humidity conditions prevailing at the installation site.

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

The electronic system must have software security levels for monitoring, maintenance and programming using access codes. Include the software licenses necessary for configuration and maintenance

The electronic unit must have devices to eliminate interference produced by radio frequency and electromagnetic signals. It must also have short circuit protection.

The electrical power supply must be as indicated in the data sheet in Annex 1C of these specifications.

Systems shall be provided with levels of online self-diagnosis, routine testing and offline self-diagnosis. This online self-diagnosis must be applied to the following concepts:

- a) Circuits and functions.
- b) Devices and interface
- c) Communications configuration and interface.
- d) Library programs.
- e) Special programs.

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

7.8 Materials.

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

The SUPPLIER must issue the criteria to choose the selected material in accordance with what is indicated in **Annex 1C** for sample collection, the wet parts of the sample conditioning system and the analysis modules.

The SUPPLIER must select the analyzer materials, which must be compatible with the chemical composition of the sample and comply with the application requirements requested by MONÓMEROS in **Annex 1C**.

7.9 Manufacturing.

The manufacture of the analyzers must comply with the requirements indicated in these specifications.

The electronic unit of the analyzer must have an identification plate, permanently secured to the instrument, containing at least the following information:

- a) Identification number (Tag) and service.
- b) Brand, model and serial number.
- c) Name of the manufacturer.
- d) Service contact.
- e) Manufacturing date.
- f) Electrical supply.
- g) Instrument certifications.

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimiento@monomeros.com.co before submitting their offer.

The SUPPLIER that is awarded must indicate the list of national, foreign and international standards that the manufacturing of the system complies with.

All supplied system hardware, software and firmware shall have been field tested prior to order placement in similar industries. Field tested is defined as a satisfactory operation of a system installed for one (2) year or more in the Petrochemical industry or with similar characteristics, indicating the applications and companies in which it has been installed and supported by the SUPPLIER. There must be the possibility for Monómeros to verify the status of the system tested in the field.

7.10 Calibration.

The analyzer must have the ability to perform calibration in automatic, semi-automatic and manual mode with certified calibration gases and certified calibration cuvettes.

The SUPPLIER must indicate the available calibration methods for the analyzer and the necessary requirements, in addition, include electric and/or manual valves, pressure reducers, etc., necessary for the entry of calibration gases into the system.

Zero gas N₂ and O₂ and N₂O calibration spam gas with certificate of analysis from an ISO IEC 17025 accredited laboratory.

Calibration gas bottles must be included in the proposal.

7.11 Spare parts.

The Supplier will 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 at no additional cost a set of spare parts for 1 year 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.

7.12 Reliability and Availability.

The system must be designed in such a way that any failure 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.

7.13 RFI & EMI considerations.

The Supplier must provide MONÓMEROS with the analyzer specifications, related to radio frequency interference (RFI) and electromagnetic interference (EMI) considerations for all equipment included in this project.

The Supplier must specify any precautions, interference or restrictions in the use of manual radio frequency communicators that are located near the equipment.

8. INSTALLATION AND OPERATIONAL TESTS.

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

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

8.1 Installation.

The supplier that is awarded must present the assembly procedure(s) and installation maneuvers of the system, which must be obtained before applying such procedures in the execution of the work.

Monómeros will carry out the installation of the equipment. However, the awarded supplier will be responsible for **verifying that the installation complies** with the installation recommendations of the equipment manufacturer and in case of deviation will issue the recommendations for MONÓMEROS to execute.

The classification of the installation area, environmental protection, the effects of variation in ambient temperature and ease of availability for maintenance must be considered.

The following considerations should be taken into account:

- a) Have accessibility for cleaning and maintenance.
- b) The distance from the transport line should be minimal, thus achieving a shorter delay time.
- c) The recommendation of the manufacturer or SUPPLIER must be considered; for the installation of the analyzer in order to avoid security problems in classified areas within the Monómeros facilities.

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomonómeros.com.co before submitting their offer.

8.2 Testing and acceptance (Test Protocol).

The SUPPLIER must prepare the test protocol document in which the tests to be carried out for the acceptance of the analyzer must be indicated. The tests, as indicated, must be carried out with the supervision of personnel designated by Monómeros.

The tests that should be considered are the following:

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

The SUPPLIER must prepare a testing protocol, which must be subject to review, comments and approval; this protocol must be sent to Monómeros at least **30 days before** the date on which the acceptance tests are scheduled to be carried out.

The protocol for the development of these tests must include at least the following:

- a) Index of document contents.
- b) Identification, function and description of system components.
- c) Detailed description for each type of test, indicating the objective and the way in which said test should be carried out.
- d) Identification of simulators and test equipment.
- e) Activities to do.
- 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 intervention and participation of personnel designated by Monómeros in the acceptance tests must be allowed.

The tests that require approval by Monómeros, in accordance with the requirements indicated in **Annex 1C** are: factory acceptance tests (FAT) and on-site acceptance tests (SAT).

8.2.1 Factory Acceptance Test (FAT).

The SUPPLIER must test and demonstrate the functional integrity of the system hardware and software in the presence of a Monómeros official. No material should be sent to the site until all required tests are satisfactorily completed and a certification is made indicating its ready status for shipment to Monómeros.

Monómeros must notify that the acceptance of any equipment or the exception of the inspection or test will in no way relieve the SUPPLIER of the responsibility for the delivery of the equipment, in such a way that it meets all the requirements.

During the test, the SUPPLIER must prepare a maintenance record in which the following items must be recorded: Components with failures, effect of the failure, cause of the failure and the duration of service of the component before the failure. The test must be suspended if any component fails. SUPPLIER shall replace the component to repair the system, but if the action is not satisfactory, SUPPLIER shall provide a fully functional replacement subsystem to restart the test.

MONOMEROS 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 SUPPLIER must define this limit of failed components, obtain approval from MONÓMEROS.

The FAT tests that must be included, but will not be limited to the following:

- a) Visual inspection to verify that the systems are manufactured in strict compliance with the technical and regulatory specifications, as well as the scope established in the corresponding contract.
- b) Equipment (hardware) testing, with all components fully integrated, assembled and interconnected.
- c) Programming tests (software).
- d) Self-diagnostic tests (includes faults).
- e) Testing analog and discrete inputs and outputs.
- f) The additional tests that are requested in the bidding rules.

The SUPPLIER that is awarded must deliver to Monómeros the **technical report generated** during this stage of tests carried out, indicating their results, as well as compliance or non-compliance with the technical and functional objectives and requirements.

The test report must include, among other items, the following:

- References to applicable international standards.
- Complete identification of the sample and calibration gases: quality, concentration, uncertainties.
- Circumstances in which the tests have been carried out: places, conditions...
- Sample programming: date and time.
- 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 declaration of conformity with this specification.

8.2.2 Site Acceptance Test (SAT).

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

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

These tests must consider the same points as those carried out in the factory acceptance tests, including the following points:

- a) Before proceeding to carry out any test, the SUPPLIER must guarantee that all components are complete, identified and correctly assembled and connected in order to comprehensively test the entire system. Any deviation from this point must be notified in writing to Monómeros to decide the start of the tests.
- b) The SUPPLIER must deliver, prior to the start of the on-site acceptance tests, the approval certificate of the factory acceptance tests, and the on-site acceptance testing protocol for review and approval by Monómeros. As part of the on-site acceptance tests, the commissioning of the system must be considered until its stable operation is achieved in the process.
- c) Verification of the operation of the analyzer on site.

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomonómeros.com.co before submitting their offer.

- d) Verification of the operation of the analyzer interface with the facility's digital control system.
- e) The SUPPLIER that is awarded must deliver to Monómeros the technical report generated during this stage of tests carried out, indicating the results of the tests, as well as the fulfillment or non-compliance of the technical and functional objectives and requirements.

Once the analyzer is put into operation in stable conditions, the SUPPLIER who is awarded the contract must provide the corresponding delivery certificate to Monómeros.

9. DOCUMENTATION.

The SUPPLIER who is awarded the contract in relation to the analyzer must provide the following documents to Monómeros.

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

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

The documentation will be delivered according to the list of documents of the SUPPLIER that is awarded in at least one printed copy and in electronic format. Regarding the final documentation, the electronic files will be in a format compatible with MS Office and the specific installation diagrams will be in AUTOCAD or similar, as agreed with Monómeros:

- Electrical wiring diagrams.
- Instrument loop diagrams.
- Data communication interface diagrams.
- Dimensional plans of the set.
- Sampling line piping diagrams.
- Calibration piping diagrams.
- Flowcharts.
- CEMS – DAS/DASH regulatory mandates and description.
- CEMS – DAS/DASH operating manual.
- Calibration curve.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROponentes** , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimientomonmeros.com.co before submitting their offer.

- Certificates, calibration and test documents will be paper originals and scanned copies.
- Functional testing procedures and activities to be performed by Monómeros to ensure that the CEMS meets the criteria for accuracy, precision, availability and representativeness following successful completion of the initial performance specification test.

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

Procedures will also be included to verify the validity of the mathematical procedures used to correct or adjust the monitoring data.

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

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

- Where the gases are introduced into the measurement system.
- How the correct flow rate and pressure for gas injections are determined and maintained.
- The duration of gas injection.
- The data display device or devices used to determine monitor response.
- Any procedure necessary for the interpretation of the data.
- The criteria for deciding whether adjustments to the monitoring system are necessary.
- The actions that will be taken when adjustments are necessary.

These procedures shall include the OEM specification 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 precision tests.
- Quality control procedures including daily and periodic checks of system or component performance, preventive maintenance procedures, spare parts inventory.
- Procedure for identifying outliers.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROponentes**, exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimiento@monomeros.com.co before submitting their offer.

- Performance test tabulation and plots of Standard Reference Methods (SRM) data versus CEMS data.
- Raw SRM data will be expressed under the same conditions as 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.
- Data backup procedures.
- A list of spare parts for commissioning and spare parts for three years of operation will be presented based on the OEM recommendation.
- Instrument air quality and consumption requirements.
- A list of diagnostic functions.
- A list of consumables will be presented, if necessary.
- A list of special tools will be presented, if necessary.
- Documentation of software licenses implemented in the project
- The SUPPLIER that is awarded must present a summary of the life cycle costs (CAPEX and OPEX).

9.1 Documentation that the bidder must submit with his proposal:

- The technical proposal of the analysis system.
- Schedule, showing all detailed activities, beginning with verification of analyzer specifications and continuing through field review and final acceptance of the system.
- Provide references with similar installed applications (with names and contact numbers).
- Field assistance plan with response times and personnel availability.
- List of personnel trained to provide support to the analyzer and attach factory training certificates.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROPONENTES** , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimiento@monomeros.com.co before submitting their offer.

9.2 The SUPPLIER who is awarded the contract must provide it after the purchase order has been placed.

Three complete copies (physical and magnetic media) of the following documentation for each analyzer:

- Drawings showing dimensions with assembly details and weight, specifications of the equipment components. The construction materials in contact with the gas sample must be indicated.
- Block diagram indicating the parts that make up the system: Sample collection, sample conditioning system, sensor/analysis unit and the electronic control unit; entrances and exits. Manufacturer's drawings indicating all assembly and installation details.
- Wiring diagrams and electrical interconnection of instruments.
- Memory maps of the electronic units of the analyzers required to integrate the information into a digital system of the facility.
- Documentation of protocols, reports and acceptance minutes of factory acceptance tests (FAT) and on site (SAT).
- Loop diagrams.
- Complete description of operation of the analyzers.
- Operation manuals for the equipment and components that make up the system.
- System maintenance manual.
- Installation, startup, operation, repair, configuration and maintenance manuals for each analyzed.
- The list of recommended replacement parts, including procedures and replacement schedule for each of them.
- Complete parts list with their respective part numbers from both the analyzer manufacturer and the original manufacturer of the spare part.
- The list of auxiliary services that are required for the operation of the system (instrument air, water, steam, among others).

NOTE 1: The SUPPLIER that is awarded must be responsible for providing any manufacturer documentation that is necessary for sub-suppliers of those equipment that are part of the system, but that are manufactured by other companies, ensuring that the information meets the requirements of this specification.

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROponentes** , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimientomoneros.com.co before submitting their offer.

NOTE 2: The SUPPLIER that is awarded must deliver the certificate, report or calibration opinion of the analyzers and sample conditioning system issued by an accredited laboratory.

9.3 Documentation that the SUPPLIER that is awarded must provide after starting the system.

The SUPPLIER that is awarded must deliver the plans, manuals and general documentation described in point 9.2 updated according to the modifications that the system has had during installation and start-up.

10. REQUIREMENTS OF THE COMMISSIONING.

The contractor must provide training for the supplied equipment. The type of personnel to be trained is divided into two groups. These are:

- Operations.
- Engineering and maintenance.

The training requirements of these groups are as follows:

- Operation personnel will require training in the operation of the system.
- Maintenance and engineering personnel will require training in operation, maintenance, troubleshooting, configuration and programming of the analyzers and electronic systems.
- The number of attendees to the training course is 6 people, the training will be after the installation of the system and during its startup and the location is the Monómeros facilities.

11. QUALITY ASSURANCE.

The SUPPLIER that is awarded the contract will provide the documents that describe its quality procedures demanded by Monómeros.

12. PREPARATION FOR PACKAGING.

THE SUPPLIER that is awarded must provide appropriate packaging and cover the system inlets in order to prevent the entry of contaminants into the equipment during transportation and storage until installation.

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomonómeros.com.co before submitting their offer.

13. WARRANTY AND TECHNICAL SUPPORT.

13.1 Performance Guarantee (Operation Test).

The parameters and specifications provided by Monómeros will be guaranteed. Limits and tolerance ranges must be declared and established.

The performance test will be carried out after installation, the system shall meet the **performance test for 60 hours of continuous operation**. Once the performance test is completed, commissioning will be completed and the system will be officially declared operational. If the SUPPLIER that is awarded is not successful due to failures or deficiencies that are revealed during the test, the supplier must correct everything as soon as possible at no expense to Monómeros and then perform a new warranty test.

13.2 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 working condition.

Correct procurement, machining, heat treatment, welding, corrosion protection and accessories has to be guaranteed, as a mechanical/electrical guarantee, by the seller.

Any defect, of those described here, that occurs during the warranty period, will give rise to the application of the requirements indicated in the particular and general commercial conditions.

13.3 The Guarantees described in sections **13.1** and **13.2** above make up the “Guarantee of Liability for hidden defects and defects” that must remain in force for 1 year (one year) from the date of delivery of the Goods to the facilities. . The other years of warranty offered by the SUPPLIER that is awarded will be covered by the standard warranty of the manufacturer or supplier without the need for a bank guarantee.

THE CONTRACTOR must include a minimum 2-year warranty for the equipment. During this period, THE CONTRACTOR must provide specialized technical support to diagnose and correct errors that may arise in the systems.

13.4 Monómeros will provide:

- Electricity and air in predetermined positions.
- Air supply (according to the supplier's quality, pressure and flow requirements).

All information contained in this document is the property of MONÓMEROS and is delivered to PROPONENTES , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by PROPOSERS via email: licitacionabatimientomonómeros.com.co before submitting their offer.

- All civil works to support the equipment, the supplier must deliver the appropriate anchoring according to the engineering and all documents required for construction.
- Installation of equipment according to the supplier's instructions and under the supplier's supervision.

Brayaham Villa

BRAYAHAM VILLA

All information contained in this document is the property of **MONÓMEROS** and is delivered to **PROPONENTES** , exclusively for the preparation of the corresponding offers.

Any questions or clarifications must be expressed by **PROPOSERS** via email: licitacionabatimiento@monomeros.com.co before submitting their offer.