



**SECTOR STUDY - INTERNATIONAL OPEN TENDER
SUPPLY OF CONTINUOUS MONITORING SYSTEM OF NITROUS OXIDE
EMISSIONS (N₂O)**

SECTOR STUDY

**INTERNATIONAL OPEN TENDER
MONÓMEROS 002-2024**

PURPOSE OF THE SELECTION PROCESS:

Contract the “Supply of a Continuous Emissions Monitoring System (CEMS) of nitrous oxide (N₂O), for the Monómeros nitric acid plant, located in the Special, Industrial and Port District of Barranquilla , Department of Atlántico – Colombia, in the context of the Nitric Acid Climate Action Group (NACAG) initiative.”

**Barranquilla – Atlántico, Colombia, 2024
August**

1. INTRODUCTION.

In compliance with the provisions of Decree 1082 of 2015 Article 2.2.1.1.1.6.1 of the Colombian public procurement regime, buyers have the duty to carry out, during the planning stage, the necessary analysis to know the sector related to the object of the contract. Hiring Process from the legal, commercial, financial, organizational, technical, and Risk analysis perspective.

The objective of this document is to carry out an analysis to understand the sector related to the object of the contracting process for the *Contract the "Supply of Continuous Emissions Monitoring Technology (CEMS) of nitrous oxide (N₂O), for the Monómeros nitric acid plant, located in the Special, Industrial and Port District of Barranquilla, Department of Atlántico – Colombia, in the context of the Nitric Acid Climate Action Group (NACAG) initiative"*, which will be carried out through an International Open Bidding.

Monómeros Colombo Venezolanos SA is a commercial company with 56 years in the petrochemical industry, a subsidiary of the Venezuelan state company, Petrochemical de Venezuela SA (Pequiven), located near the mouth of the Magdalena River in the city of Barranquilla, Colombia, being a producer of varied products such as simple and complex fertilizers, tricalcium phosphate for livestock feed and other industrial products, such as nitric acid. In 2018 it received the " *Best Company in Social Responsibility Simón Bolívar* " award. Monómeros is the second agroindustrial company in Colombia producing fertilizers, covering 40% of the national market.

Monómeros has a nitric acid plant with a production capacity of 280 MTPD, which is an important product for the agrochemical industry, as it is used for the production of nitrogen-based inorganic fertilizers. However, the nitric acid manufacturing process emits N₂O, which is a greenhouse gas with a global warming potential 273 times greater than that of carbon dioxide (CO₂)¹.

Monómeros has a budget authorized by the *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)* , which it will use to finance the eventual Contract for which this tender is issued. This grant is framed in the context of the [NACAG](#) (Nitric Acid Climate Action Group) initiative, which is a project funded by the *German Federal Ministry for Economic Affairs and Climate Action (BMWK)* and for whose global implementation the GIZ has been designated. The NACAG initiative advocates for the gradual elimination of global N₂O emissions in nitric acid production and provides all governments and plant operators with assistance on

¹ <https://www.nitricacidaction.org/>

technological and regulatory issues related to the mitigation of N₂O emissions produced in this production. industry. NACAG also offers financial support for the purchase and installation of emissions reduction technology and monitoring equipment at those plants that are eligible under certain criteria defined by the initiative. In this way, within the framework of the NACAG initiative, GIZ is providing financial support to the Monómeros company for the acquisition of N₂O Monitoring technology.

In accordance with the above, the Monómeros company is interested in contracting the “Supply of Continuous Emissions Monitoring Technology (CEMS) of nitrous oxide (N₂O), for the nitric acid from Monómeros, located in the Special, Industrial and Port District of Barranquilla, Department of Atlántico – Colombia, in accordance with the detail and technical specifications related in Annex 1A, which is an integral part of the present selection process and the future contract.

2. GENERAL ASPECTS OF THE MARKET

On an international scale, nitric acid production represents a considerable source of greenhouse gas (GHG) emissions, especially a source of nitrous oxide (N₂O) emissions, which is the third most significant greenhouse gas released to the atmosphere and highly destructive of the ozone layer². The global warming potential (GWP) of N₂O is 273 times that of CO₂³.

N₂O is formed in the production of nitric acid during the ammonia combustion stage as an unwanted byproduct. Once formed, this gas passes unreacted through the plant and is not affected by the operating conditions in the absorption stage or any other equipment⁴.

Global emissions from nitric acid production are estimated at 350,000 tons of N₂O per year, corresponding to about 100 million tons of carbon dioxide (CO₂-eq), which represents about 24% of emissions from nitric acid. greenhouse gases other than CO₂ from key industrial processes⁵.

For nitric acid production plants, there are three main technologies at the forefront in terms of reducing N₂O emissions, which are feasible to install in a wide range of plants. There is experience of numerous success stories of implementing such technologies in the context of

²IPCC, « Assessment Climate Change Report 2013: The physical Science Basis », 2013.

³GG Protocol, « Global Warming Potential Values . h https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-PotentialValues%20%28Feb%2016%202016%29_1.pdf.

⁴J. Pérez-Ramírez, F. Kapteijn, K. Schöffel and J. Moulijn, « Formation and control of N₂O in nitric acid production . Where do we stand today ?,» Applied Catalysis B: Environmental, vol. 44, p. 117–151, 2003.

⁵ IPCC, «5th Assessment Report, "Climate Change 2014",» 2014

CDM and JI projects⁶, emissions trading schemes and other emissions regulations around the world.

After an evaluation of which system is most convenient to install in its nitric acid plant located in Barranquilla, Monómeros selected secondary abatement technology. Secondary abatement consists of the mitigation of N₂O emissions directly after its formation in the ammonia oxidation reactor, this is carried out through a catalytic decomposition reaction that takes place in a catalyst bed (also called secondary catalyst) installed under the primary gauze inside the oxidation reactor.

i. TECHNICAL ASPECT

The goods and services to be contracted will have the following scope (for more information see Annex 1A - Technical specifications):

As indicated in this document, the awarded Supplier must provide a complete continuous emissions monitoring system for N₂O, a stack gas flow transmitter and a DAHS data acquisition system, including 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 monitor 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

⁶ CDM stands for Clean Development Mechanism and CA stands for Joint Implementation. Both are part of the so-called flexible mechanisms of the Kyoto Protocol.

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:

- 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.

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.

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.

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.

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.

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 allow 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.

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.

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.

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**.

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.

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.

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.

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.

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.

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.

UNSPSC Classification.

According to the Colombian regulations defined by the Colombian Public Procurement Agency, the UNSPSC classification or coding was identified following the Guide for the coding of goods and services in accordance with the United Nations standard code of products and services. Below, the classification of the goods and services that could satisfy the need to be contracted is presented, clarifying that since Monómeros is a company belonging to the private regime, it will not require each of the bidders to classify any experience, given the complexity of the project to be developed and the characteristics of the possible suppliers.

SEGMENT	FAMILY	CLASS	PRODUCT
410000000 Laboratory, measurement, observation and testing equipment and supplies	410000000 Measurement, observation and testing instruments	411113100 Gas analyzers and monitors	N/a
770000000 Environmental Services	7710000 Environmental Management	77101500 Environmental Impact Assessment	77101505 Environmental Monitoring
770000000 Environmental Services	7710000 Environmental Management	77101800 Environmental Audit	77101804 Environmental audit services for specific activities
770000000 Environmental Services	7710000 Environmental Management	77101800 Environmental Audit	77101805 Environmental quality control services

ii. REGULATORY ASPECT

The current contractual process is adjusted within the legal framework applicable in Colombia and the Subsidy Contract signed between Monómeros and GIZ. In this sense, it is expected that the legal framework contains the minimum requirements that potential bidders must meet to be part of the selection of the successful bidder and future contractor, which must be objective and generally in compliance with the contracting principles.

The standards included in the contracting process are defined in the previous studies, the procedure to be followed will be governed by the principles of the Public Contracting Regime in Colombia, in Law 80 of 1993 *“By which the General Contracting Statute is issued. Public Administration; Regulated by Decree 1082 of 2015 and other regulations on the matter; The process and the proposals presented in its development are subject to public procurement regulations. Article 2 of Law 1150 of 2007, Law 1474 of 2011, Article 94 of Law 1474 of 2011, Decree Law 019 of 2012, in accordance with Decree 1082 of 2015, commercial and civil regulations insofar as they are applicable and other relevant regulations and other current regulations that are presumed to be known by all bidders participating in this selection process...”*

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 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 II, 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”.
- Location and accessibility secure 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.
- 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 (NO_x) - 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.

iii. BEHAVIOR OF HISTORICAL EXPENDITURE.

There is no public information available regarding costs/expenses in similar contracting processes (through open international bidding) carried out by other national or international entities.

iv. STUDY OF THE OFFER.

This process will be carried out with the Legal Entities, Temporary Union or Consortium that accredits what is established in the specifications, as well as the experience and suitability, to carry out the analysis that supports the estimated value of the contract that is intended to be carried out.

The economic conditions were established based on market quotes. According to the responses obtained in the market analysis, there are possible suppliers in the local and/or national market and the international field, which state that they can fully comply with all goods and services according to the requirements of Monómeros.

However, it is clarified that any supplier that meets the conditions established in the tender document may submit an offer to compete in the international open tender, regardless of whether or not the supplier participated in the market research carried out in 2023.

v. STUDY OF THE DEMAND.

The need is the supply of Nitrous Oxide (N₂O) Monitoring technology for the nitric acid production plant of Monómeros Colombo Venezolanos SA, located in the Special, Industrial and Port District of Barranquilla, Department of Atlántico. - Colombia. Below is the general description of the **scope of the activities** that will be covered by the contract in question (see Technical aspect Annex 1A):

vi. RISK ANALYSIS.

During the development of the contract, unforeseen events and other aspects related to the previous studies of this contractual process must be considered as potential risks. For more details see Risk Matrix Annex.