



MOBILE LABORATORY · ENERGY SECTOR

LAB BIO MAX: The Laboratory That Went to the Field

When the pandemic threatened Colombia's energy production, NINOX built a mobile biomolecular laboratory to bring PCR testing directly to Ecopetrol's oil fields.

CLIENT

Ecopetrol

LOCATION

Colombia

YEAR

December 2020

ninoxcorp.com

CLIENT

Ecopetrol

ECOPETROL

COVID-19

LABORATORY

BIOMOLECULAR

PCR

PANDEMIC

MOBILE-UNIT

In December 2020, as the world braced for a second wave of COVID-19, Colombia's oil industry was fighting a quiet battle of its own: how to keep production running without turning remote field operations into outbreak sites. Ecopetrol, the state oil company, operated facilities deep in the Magdalena Medio region — including the country's largest refinery in Barrancabermeja — where thousands of workers rotated through shifts that made access to urban diagnostic centers completely impractical. The response could not wait. Every day without reliable testing was both a human and an operational risk. Ecopetrol needed on-site PCR diagnosis — results in hours, not days — in facilities that met the strictest biosafety standards, and that could be deployed wherever the need was greatest, independent of any hospital infrastructure. It was a challenge of engineering, of logistics, and above all, of will. That is when NINOX, a Colombian company specializing in the design and fabrication of specialized mobile units, received the commission to build something that did not yet exist in Colombia: a fully self-contained COVID-19 biomolecular diagnostic laboratory mounted on a mobile module. The result was the LAB BIO MAX — a unit that moved from drawing board to oil field in a matter of weeks, and permanently changed how Colombia responds to public health emergencies in remote territories.

A Pandemic at the Wellhead

Oil fields are closed worlds: temporary communities of hundreds or thousands of workers sharing dormitories, dining halls, and shift schedules — operating critical machinery that cannot be stopped without severe economic consequences. When SARS-CoV-2 began circulating in 2020, these environments became extreme epidemiological risk zones. A single undetected positive case could spark an outbreak capable of shutting down operations essential to the national economy.

The standard protocol — sending samples to urban laboratories and waiting 48 to 72 hours for results — was operationally unsustainable for Ecopetrol. The distances between the Magdalena Medio fields and cities with PCR diagnostic capacity meant not just lost time, but the impossibility of keeping workers in effective isolation while awaiting results. A paradigm shift was required: bring the laboratory to the worker, not the worker to the laboratory.

The urgency was absolute. Colombia had declared a health emergency, global oil prices were under historic pressure, and Ecopetrol bore responsibility for protecting both its workforce and the country's energy continuity. The brief to NINOX was direct: build a solution that could be certified, deployed, and operated under the most stringent biosafety standards — in the shortest possible time.

Engineering Biosafety on Wheels

Designing a molecular diagnostic laboratory is not the same as outfitting a rolling clinic. International standards for biosafety level 2 laboratories — the minimum required for handling COVID-19 samples — impose very specific conditions: controlled negative pressure, seamless washable surfaces without open joints, HEPA-filtered ventilation, germicidal UV lighting, and physical separation between the dirty zone for sample reception and the clean zone for analysis. Achieving all of this within a module that fits on a commercial chassis is an exercise in extreme precision.

The NINOX team started from the chassis and built inward. The interior walls of the LAB BIO MAX were clad in continuous-surface gelcoat polyester panels — no exposed seams where pathogens could accumulate — finished in high-reflectance sanitary white. The floor, seamless and jointless, permits full wet cleaning. The ceiling integrates high-efficiency circular LED panels and a broad-spectrum germicidal UV tube for decontamination cycles between shifts. Stainless-steel storage cabinets with lever-lock closures sit flush against the walls, eliminating hard-to-clean corners.

The access zone features a transition airlock where personnel don their required PPE before entering the analysis area: safety goggles, high-filtration face masks, double-layered gloves, and a protective suit. A pass-through window — the most subtle and perhaps most critical design element — allows samples and reagents to be transferred between compartments without breaking the biosafe barrier. A dedicated generator, housed in a separate compartment, ensures full electrical autonomy: the laboratory can operate in facilities with no grid power for extended shifts.



Interior module view: flush-mounted circular LED panels, germicidal UV tube, and industrial lever-lock storage cabinets. The clean geometry eliminates surfaces that are difficult to decontaminate.



Mandatory PPE protocol panel at the airlock entrance to the analysis area: safety goggles, face mask, safety gloves, and protective suit. Signage is an integral part of the biosafe design.

The Laboratory That Reached Barrancabermeja

The LAB BIO MAX left the NINOX facility in December 2020, certified and ready to operate. On board: a real-time PCR thermocycler for nucleic acid amplification, a Class II A2 biosafety cabinet for sample preparation, cold-chain refrigeration for reagent and sample storage, and the full complement of consumables, PPE, and hazardous waste management infrastructure required by a molecular diagnostic protocol. The unit connected in minutes to any point across Ecopetrol's facility network — no civil works, no space retrofits required.

Results arrived within hours. Workers who had previously waited two or three days — in uncertainty, in provisional quarantine, away from their families — could receive a diagnosis the same day their sample was taken. Positive cases were isolated promptly. Negative cases returned to their duties. The operational continuity of critical facilities was maintained without sacrificing the health of those who kept them running. The LAB BIO MAX was not just a laboratory: it was the difference between sanitary chaos and the orderly management of an unprecedented crisis.



Interior of the LAB BIO MAX biological waste management area: red hazardous waste container, social distancing signage, and sample pass-through window between zones. Every element answers to a specific biosafety requirement.

A Model for Emergency Response

The LAB BIO MAX demonstrated that diagnostic capacity does not have to be anchored to hospital geography. In a country like Colombia — where vast regions producing strategic resources lie hours from the nearest urban center — mobile diagnostics are a matter of health sovereignty and economic continuity. What NINOX built for Ecopetrol in 2020 set a precedent: it is possible to deploy certified laboratory infrastructure, with real molecular capacity, at any point in the national territory.

The project also confirmed something NINOX had been developing for years: that specialization in complex mobile units is not a lesser variant of conventional construction, but an engineering discipline in its own right — one where every centimeter of space, every system, and every material decision has direct consequences for functionality and safety. The LAB BIO MAX was delivered not as a standard product awkwardly adapted, but as a solution engineered from the ground up for a specific need — and that distinction made all the difference at the most critical moment.



Biosafe zone detail: the combination of biological hazard signage, hazardous waste container, and sample transfer window defines the rigor of a Class 2 molecular diagnostic laboratory.

“Some projects are measured in square meters; others are measured in lives. The LAB BIO MAX was the latter. In a year that taught the world that public health cannot depend solely on fixed infrastructure, Colombia was fortunate to have teams capable of imagining — and of building — responses that go where the need calls them. That is the true legacy of this unit: not the steel it is made of, but the certainty that in the next critical moment, the laboratory can be there, in the field, ready to work.”

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