



LONGPATH
TECHNOLOGIES

Supporting Documentation: Publicly Facing Documents

Request for Alternative Test Method

Methane Detection Technology

§60.5398b(b) Periodic Screening

The Environmental Protection Agency

Emission Measurement Center

<https://www.epa.gov/emc/oil-and-gas-alternative-test-methods>

LongPath Technologies

<https://www.longpathtech.com>

This document does not contain Confidential Business Information.



This supporting documentation provides externally-facing materials and collateral that support external stakeholder understanding of the LongPath measurement system. This supporting documentation includes white papers, technical slide decks and informational brochures that help to describe the technology and method.

The LongPath webpage is an excellent resource for stakeholders wishing to better understand and connect with LongPath's continuous monitoring offerings:

www.LongPathTech.com

The LongPath Resources Library includes video explainers of the technology and white paper guides to critical concepts and ideas.

www.LongPathTech.com/resources

The following pages contain other important outward-facing documents that aid in stakeholder understanding and engagement with LongPath Technologies.

LONGPATH TECHNOLOGIES OVERVIEW

COVER YOUR ASSETS WITH RELIABLY
ACCURATE METHANE EMISSIONS
QUANTIFICATION AND LOCALIZATION.

2024

Upstream Monitoring



Midstream Monitoring



Networked Monitoring



Contact

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LongPath laser fenceline (yellow lines) extend between the node (outside image top) to passive mirrors to bracket selected facilities and capture 2-12 readings per day, per site for valid quantification and emissions threshold alarms.

METHANE PERFORMANCE

- Know where the leaks are so you understand equipment malfunctions and design flaws
- Keeping your gas in the pipes all the way to market vs. evaporating in the atmosphere
- OGMP Level 4 & 5 attainment
- MiQ and Low Methane Rating data
- Digital gas trading data (registries)
- Low-carbon barrels (inc. LNG)
- Sustainability Goals
- Advanced operational control
- Quantified methane inventory

1. Reliable Data: Precision at Your Fingertips

LongPath's technology transforms methane emissions data with reliable continuous monitoring, localization and valid quantification capabilities. By integrating quantitative analytics, the system ensures that data is not only trustworthy but also actionable. This empowers operators with the clarity needed to make informed decisions quickly, enhancing the utility of data across the entire value chain.

2. Forever Compliant: Future-Proof

After 10 years of R&D, ARPA-E and DOE investments, LongPath's innovative approach is designed to be future-proof, meeting the compliance standards of every regulatory jurisdiction today and in the years to come. By proactively adapting to evolving regulations, LongPath ensures that your operations are always ahead of compliance requirements, securing your enterprise against future regulatory shifts and reporting demands.

3. Scalable: Streamlined Efficiency for Growth

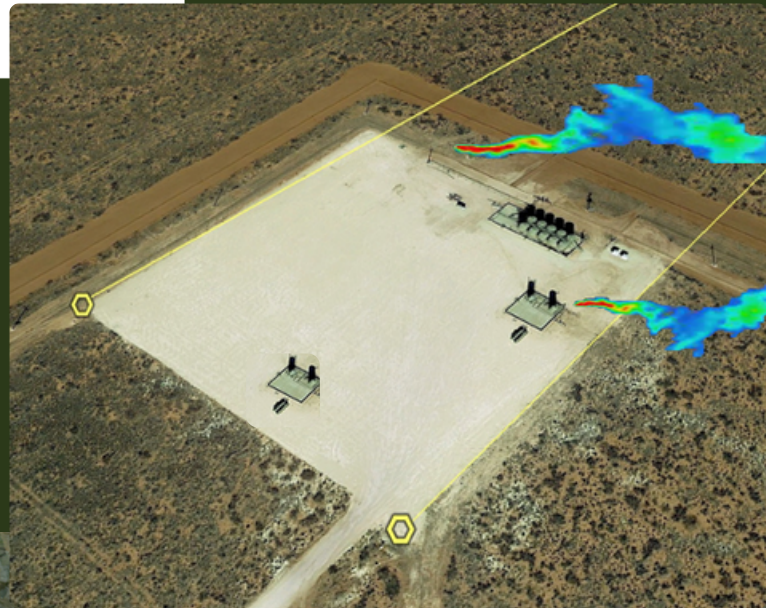
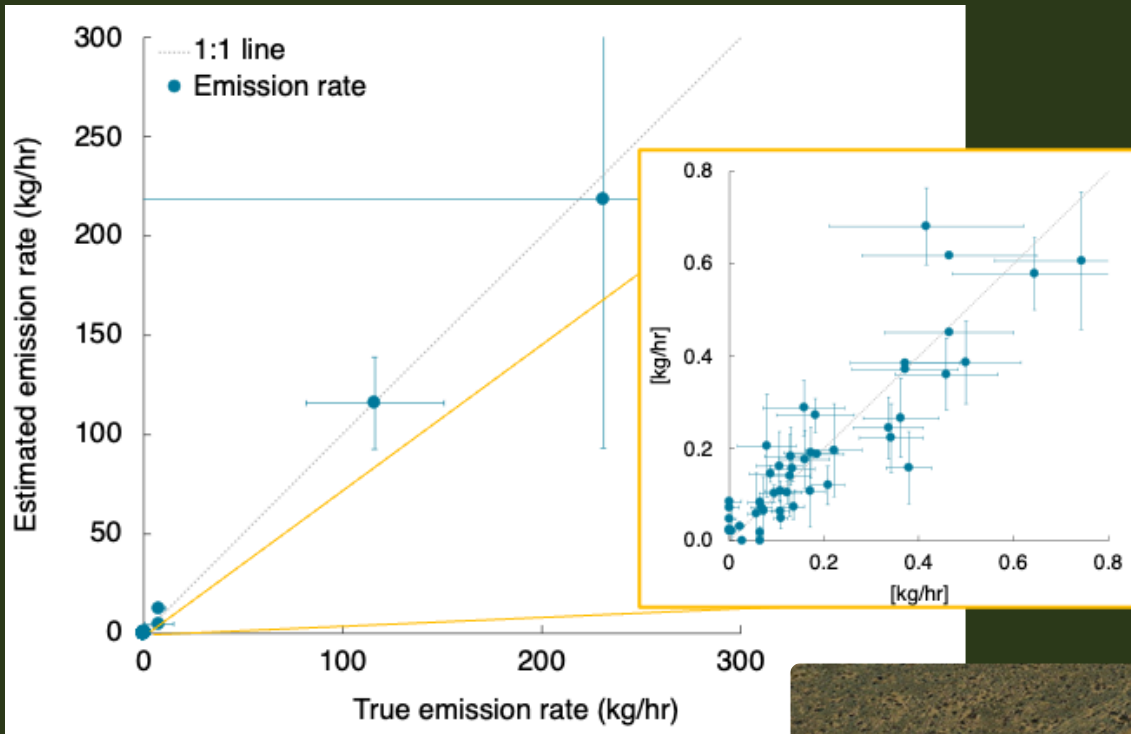
With an emphasis on scalability, LongPath's solutions are low-cost and designed to pay for themselves over time. The system is maintenance-free, offering a turnkey solution that integrates seamlessly into existing operations. Its flexible and agile nature makes it easy to work with, ensuring that as your business grows, LongPath's technology scales alongside it without additional burdens.

LongPath advanced methane emissions monitoring and data helps the oil and gas industry achieve unprecedented efficiency, compliance, and growth, ready for today's demands and tomorrow's challenges.

UNMATCHED QUANTIFICATION



BLIND TEST

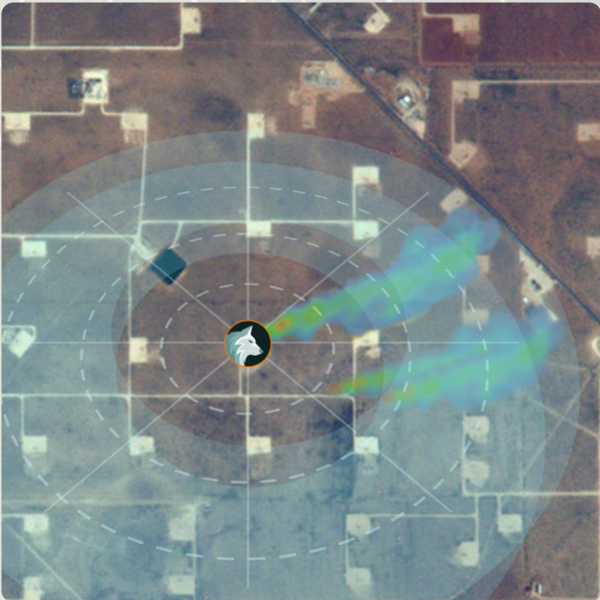


TECHNOLOGY AT-A-GLANCE

All leak types, one alerting system tuned to your specs:

- Process emissions
- Intermittent emissions
- Persistent Fugitive Emissions Alerts
- Super-Emitter Alerts
- Customized Rapid Alerting thresholds

With LongPath, operators can pursue low carbon barrels, differentiated gas, CO2e reporting, keep product in the pipes, reduce methane emissions, and reduce operational costs by quantitatively monitoring all assets in survey or continuous monitoring modes (e.g., sub-daily for facilities with large emission rate potential and daily-to-monthly for facilities with lower emission rate potential) with smart alerting.



Technology Type	Continuous line sensor, laser
Quantification	Emission rate quantification proven in 3rd party blind testing
Site Coverage	All equipment, including tanks and flares
Work Practices	Real-time alerts, super-emitter alerts, intermittent alerts, customizable alerts
Minimum Detection Limit	0.06 kg/hr
Quantification Accuracy	0% mean bias across full range of emission sizes (verified by 3rd party, blind testing)
Detection Accuracy	No false positives as determined by 3rd party blind tests.
Investment Partners	Conoco-Phillips, Williams, ARPA-E, DOE

COVER YOUR ASSETS.

10X DETECTION CAPABILITIES.

3X COVERAGE VS POINT SENSORS.

*BCG Methane Technology Report 2022



LONGPATH
TECHNOLOGIES

THE ONLY EMISSIONS MANAGEMENT SYSTEM WITH ACTIVE OVERWATCH.

LongPath Technologies offers cutting-edge software solutions with exceptional equipment-level localization accuracy (~90%). Low error rates minimize operator windshield & on-site time, while maximizing trust in newly deployed sensors.

Standardized test results showcase a remarkably low error rate with zero false positives and the only continuous monitor that can catch tanks and flares.

Experience real-time data processing and minimal latency, setting our solutions apart from all others. The LongPath emissions system has the ability to scale basin-wide and potential for deployments across multiple terrains, assets, and regions.

Redefine your emissions performance strategy and protect your business with LongPath Technologies. Guaranteed Protection, only from the LongPath Active Overwatch Emissions System.

LONGPATHTECH.COM
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LONGPATH

CONTINUOUS Methane Monitoring.
PRECISE Measurement.
QUANTITATIVE Emission Rate Data.

SUMMARY

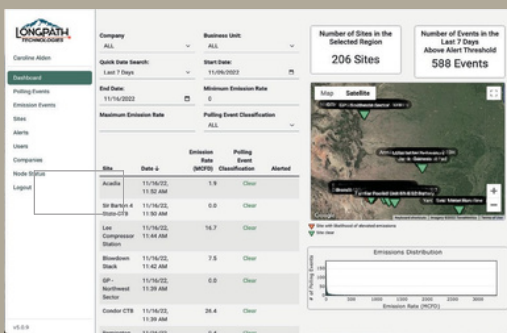
1. Dashboard: Interactive application for data & customization.
2. Email Alerts: Real-time alerts on emissions that require action.
3. REST API: Integrate LongPath data to your company's SCADA.
4. MQTT: Low-latency, real-time messaging for emission readings.

1

DASHBOARD

- Time history of emission rate information (MCFD or Kg/hr).
- Visual Mapping of on-pad location of emission sources.
- Emission Event Tracking
- Customizable alerts, time zones, rates, and settings.

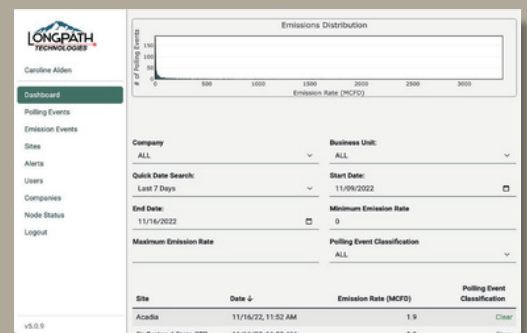
EMISSIONS DATA AT A GLANCE



View all historical emissions -related activities.

Prioritize the most significant emission sources.

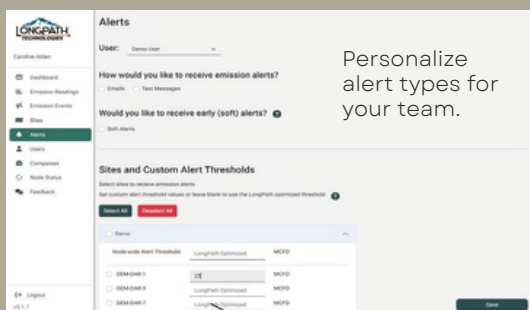
CUSTOMIZABLE INTERFACE & ALERTS



Single out events from specific business units and time spans.

Sort emissions rates with a single click.

PRIORITIZE EMISSIONS ACTIONS SEAMLESSLY



Prioritize critical emissions events and history.

Customize emissions alert levels across, or within, assets.

LOCATE LEAKS AND TRACK THROUGH TIME



Rapidly Identify emissions patterns and changes through time.

Zoom Into locations with problematic emissions.

LongPathTech.com

Only LongPath delivers reliably accurate real-time, localized detection for quick repair of any leak on the well pad while maximizing operator safety.



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CONTINUOUS Methane Monitoring.
PRECISE Measurement.
QUANTITATIVE Emission Rate Data.

EMAIL ALERTS

2

- Detailed information on emission event onset, duration, rate, intermittency, related meteorological conditions and more.
- Customized alerting tiers, from persistent leaks only to rapid alerting on all emissions or real-time alerting on Super-Emitter event onset.



Longpath Public API 1.0 OA30

Public API for clients of Longpath.

Authorize

v1

- GET /api/v1/emission/search Get collection of emissions from your company.
- GET /api/v1/site/search Get collection of sites from your company.
- GET /api/v1/emission_event/search Get collection of emission events from your company.

API

3

- Simple and powerful token-based REST API to integrate your emission and site data with your own application.
- Correlate existing SCADA (line pressures, flow rates, run times, etc.) with LongPath data.

MQTT

4

- MQTT provides real-time updated messages for emission readings.
- Subscribe to the emissions channel and receive messages whenever a new emission reading is processed.
- Efficient and lower-latency updates

You can receive your MQTT credentials by emailing support@longpathtech.com

Once you have received your credentials, real-time emission updates for LongPath Technologies will be available from the MQTT broker hosted at app.longpathtech.com on port 1883 via the `lpt/emissions` topic.

Below is an example of using the `mosquitto_sub` MQTT subscriber to subscribe to the `lpt/emissions` topic.

```
mosquitto_sub -h app.longpathtech.com -p 1883 -u <your_username> -P <your_password> -t lpt/emissions
```

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CONTINUOUS Methane Monitoring.
PRECISE Measurement.
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Laser Fence Line Continuous Methane Monitoring

PERFORMANCE SPECIFICATIONS

- Continuous, real-time detection. 10x detection capabilities vs. point sensors.
- Highly accurate quantification suitable for both reporting and prioritization.
- Industry-leading detection capability 10x better than closest competitor.
- All leak types, one alerting system tuned to your specs: Rapid Alerts, Persistent Emissions Alerts, Super-Emitter Alerts, and, Custom Alerts.
- Algorithmic localization to equipment-level with ~90% accuracy.
- Complete well-pad coverage, 2-3x coverage vs. point sensors.

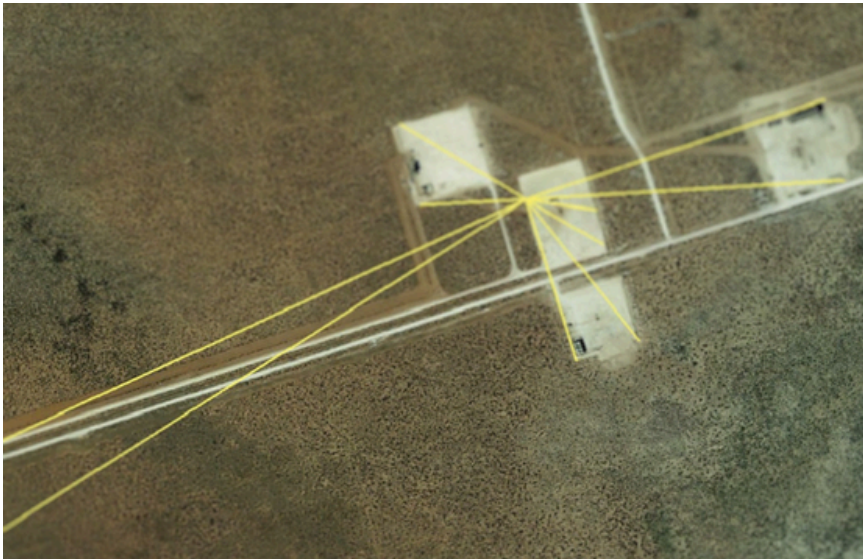
Minimum Detection Limit	0.06 kg/hr
Quantification Accuracy	0% mean bias across full range of emission sizes in blind testing
Detection Accuracy	No false positives for single, steady emission sources in blind 3rd party testing.



CONTINUOUS Methane Monitoring.
PRECISE Measurement.
QUANTITATIVE Emission Rate Data.

ABOUT

- Line sensor with 2-3x more coverage (inc. tanks and flares) vs. point sensors.
- 10x detection capability.
- High quality, accurate data 24/7 at the fidelity you need to confidently run your business.
- Allows operators to catch emission events quickly.
- Minimize emissions.
- Maximize returns.
- Execute sustainability goals.



Laser Fence Line Continuous Methane Monitoring

PERFORMANCE SPECIFICATIONS

Technology Type	Continuous line sensor, laser
Quantification	Emission rate quantification proven in blind testing
Site Coverage	All equipment, including tanks and flares
Work Practices	Real-time alerts, super-emitter alerts, custom alerts
Minimum Detection Limit	0.06 kg/hr
Quantification Accuracy	0% mean bias across full range of emission sizes in blind testing
Detection Accuracy	No false positives for single, steady emission sources in blind 3rd party testing.



LONGPATH

Zero-Bias Quantification
Reliable Detection
Actionable Localization

- Laser-based methane monitoring.
- 10x detection capabilities vs. all other sensors.
- Data as a service at low monthly cost.
- LongPath performs all installation, maintenance, and upgrades.
 - Light footprint solution.
 - Solar power with reflectors
 - Up to 30 facilities per laser tower
 - Discrete location hosts 30-50 ft tall laser tower
- Alternative 240V/50A option for grid power.
- 10 years of R&D. 12 Patents. 5 peer-reviewed studies.

LONGPATH BLIND TEST RESULTS

METEC R1 (Round 1) Blind Test Protocol

- 18 blind tests of single, steady emission rates 0 to 11 g/min (0 to 35 scfh).
- 100% true positive rate, 0% false positive or negative rate.
- 100% accuracy in localization to pad or equipment group.
- 85% accuracy in identifying equipment.
- $\pm 27\%$ quantification accuracy with zero bias.

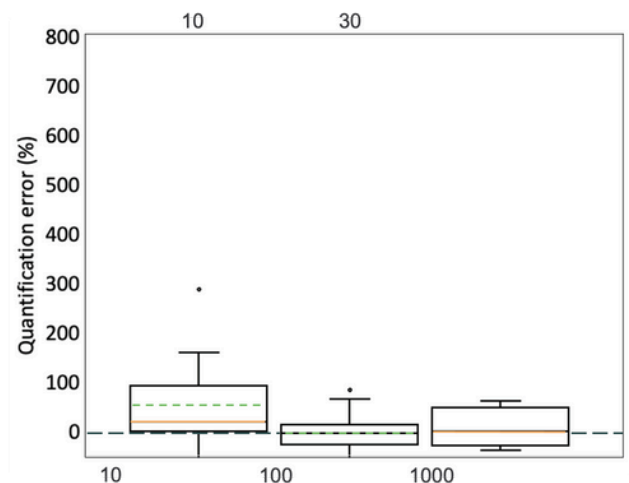
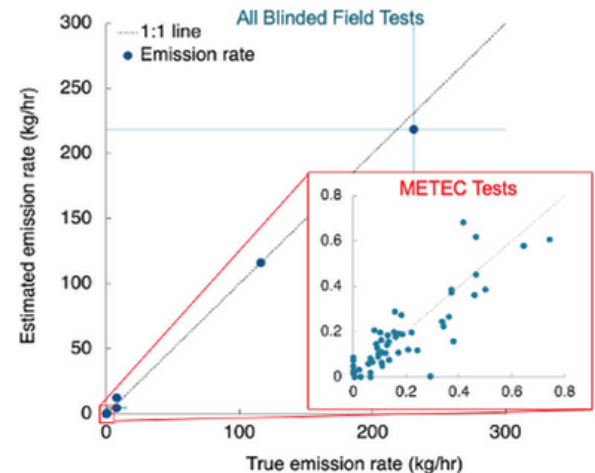
METEC R2 (Round 2) Blind Test Protocol

- 15 blind tests of mixed intermittent, single, multiple and single leaks, emission rates 1.5 to 9 g/min (5 to 28 scfh)
- 88% accuracy in localization to pad or equipment group.
- $\pm 40\%$ quantification accuracy with zero bias, including for multiple and intermittent emissions.

Field Testing in Operating Assets

Excellence in quantification, localization, detection across full array of asset types and operating conditions.

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Compare LongPath
Results to Recent METEC
Study for Point Sensors
and Cameras:





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CONTINUOUS Methane Monitoring.
PRECISE Measurement.
QUANTITATIVE Emission Rate Data.

- Laser-based line sensor for methane monitoring.
- Data as a service at a low monthly recurring cost.
- LongPath performs all installation, maintenance, and upgrades.
- Light footprint solution
 - One solar-powered node can handle up to 30 sites.
- Solution is solar powered with alternative 240V/50A option for grid power.
- Reliable solution with 10 year R&D, 12 Patents, and 5 peer-reviewed studies.

ENVIRONMENTAL OPERATING CONDITIONS

Wind Speed	Quantification requires wind speed > 1m / s
Temperature	- 15 deg * C to 44 deg * C (5°F to 111 deg * F)
Precipitation/Weather	No effects of weather
Ground Cover	No effects of ground cover
Topography/Vegetation	Solutions exist for all topographies and vegetation zones

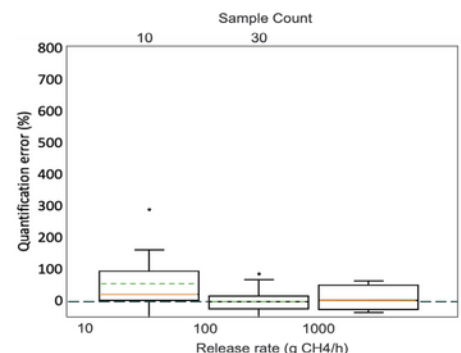
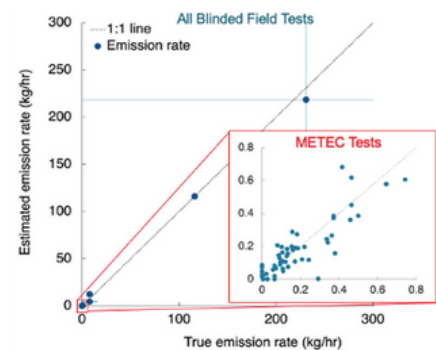
BLIND TEST RESULTS

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- 1.5 to 9 g/min (5 to 28 scfh)
- 88% accuracy in localization to pad or equipment group
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- Field Testing in Operating Assets
- Excellence in quantification, localization, detection across full array of asset types and operating conditions



Compare LongPath
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REAL-WORLD BLIND TESTING RESULTS

CASE STUDY

Blind, customer-conducted continuous emissions monitoring technology test at Haynesville location. Eight releases with rates between 20-40 MCFD, mirroring typical real-world leaks from upstream oil and gas equipment.

November 2023

Contact

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TESTING PROCEDURE

Nadel and Gussman tested LongPath vs. point sensors and flyovers. LongPath is a new breed of CEM, or ground-based surveys, which is a fundamentally different approach to emissions localization and quantification versus point sensors and flyovers because of its full fenceline open path laser technology and multi-pad reach. They conducted the blind technology evaluation in a forested real-world setting at an upstream oil and gas site featuring separators, flares, and two tank batteries (image below). Over two weeks, they initiated controlled methane releases from different equipment sets, conducting a total of eight (8) tests.

All tests were performed discreetly (blind) to the technology teams, including LongPath, without revealing the exact timing or equipment locations. Moreover, they introduced an off-pad emission event to validate effectiveness with outside interference.

**GOAL: Leak Rate Accuracy, Localization, Valid Quantification
LongPath Laser vs. Point Sensors vs. Flyovers**

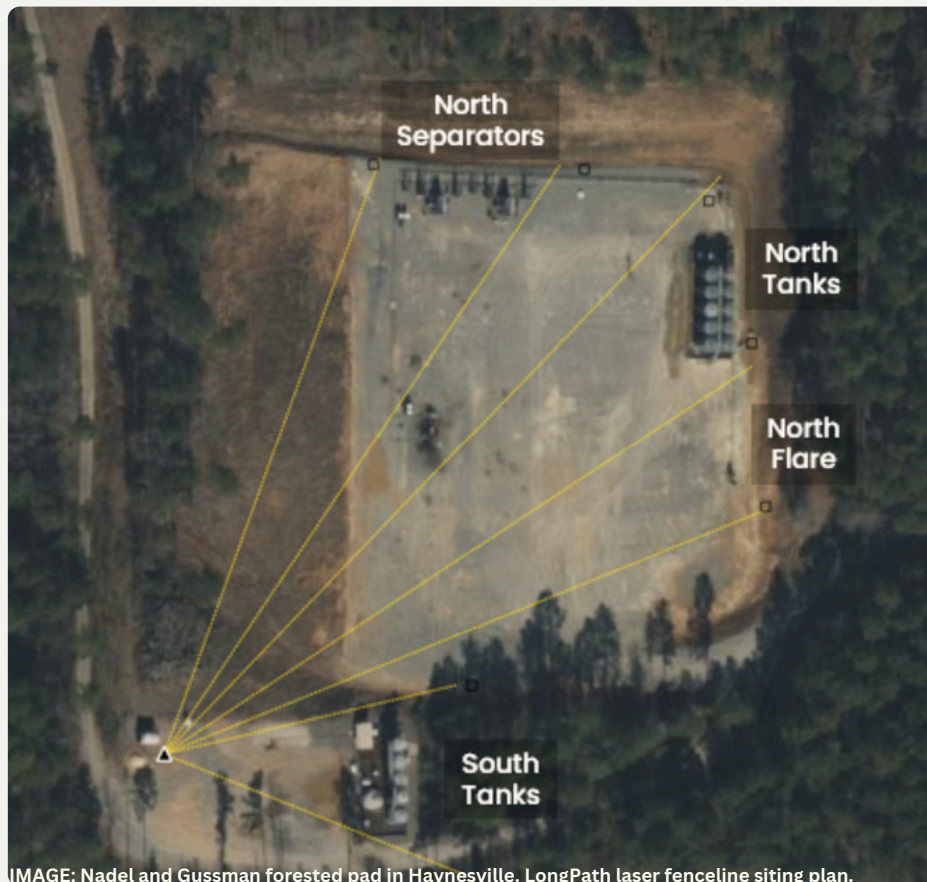


IMAGE: Nadel and Gussman forested pad in Haynesville. LongPath laser fenceline siting plan.

TESTING RESULTS

Impressive Results That Speak Volumes

The release rates were maintained between 20-40 MCFD, mirroring typical leaks from upstream oil and gas equipment. They varied the leak locations within the equipment groups to further challenge the LongPath system's location sensitivity.

- **In all the tests conducted, each emission was promptly detected and correctly localized with 100% accuracy.**
- When they introduced off-pad interference, the LongPath system excelled by rightly categorizing it as a non-actionable event.

Event	LongPath Correctly Detected	LongPath Equipment Localization	Event Details
Blind Test 1	Yes	North Tank	20-40 MCFD Rate - North Tanks
Blind Test 2	Yes	Separators	20-40 MCFD Rate - Flow Line at Separators
Blind Test 3	Yes	Separators	20-40 MCFD Rate - Sales Meter at Separators
Blind Test 4	Yes	North Tanks	20-40 MCFD Rate - Top of North Tanks
Blind Test 5	Yes	North Tanks	20-40 MCFD Rate - Meter at Tanks
Blind Test 6	Yes	North Tanks	20-40 MCFD Rate - Top of North Tanks
Blind Test 7	Yes	Separators	20-40 MCFD Rate - North Separator
Off-Pad 1	Yes	Not Flagged for Action. Off-Pad. Correct ID	20-40 MCFD Rate - Off-Pad Wellhead