2026 ONYX LN2 Gaseous Delivery Monitoring

System Strategy: Vaporization Phase Auditing & Compliance

I. Scope of Monitoring

This report concerns the monitoring of **Gaseous Nitrogen (GN2)** supplied to the laboratory infrastructure. While the bulk tank also serves a liquid dewar-filling station for researchers, that liquid usage is *excluded* from this specific metering circuit.

> **Hardware Stack:**
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> - **Thermal Instrument 9500P:** Measures mass flow of vaporized gas exiting the heat exchanger.
> - **Monarch Track-It™ Logger:** Captures time-series data via the 4-20mA loop.
> - **Current Flow (Baseline):** ~350 SCFH (Standard Cubic Feet per Hour).
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> **2026 Initialization Status:**
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> - **Gas Totalizer:** Successfully zeroed at 3:30 PM on 12/31/2025 via internal board reset (SW4).
> - **Logger Schedule:** Configured for a "Hard Start" at 11:59 PM, 12/31/2025.

II. The "March 31" Data Retrieval Deadline

Because the Monarch Logger has been set to a granular **120-second (2-minute)** sample interval to ensure high-fidelity records of lab demand, its memory capacity (~64,000 samples) is subject to a strict time limit.

Operational Limit: The internal memory will reach 100% capacity in approximately **88.8 days**. If the logger is not manually read and cleared, the recording of 2026 gas consumption will cease.

Add March 31 Retrieval Alert to Calendar

III. Understanding the Audit Logic: Dashboard Analogies

Effective management of gaseous delivery requires an implicit understanding of the "Odometer" vs. the "Dash Cam."

The 9500P Gas Meter

The Odometer: Total Volume Account

The Totalizer on the 9500P faceplate is your billing "Ground Truth." Just like a car's odometer, it provides the cumulative total of every cubic foot of gas that has entered the lab line. Because we zeroed this at 3:30 PM today, this value represents the exact gaseous delivery for the 2026 fiscal year. This allows us to reconcile the **Bulk Tank Level Drop** vs. **Known Gas Usage**.

The Monarch Track-It

The Dashboard Cam: Operational Behavior

The Logger provides the "footage" of how that gas was used. It records flow rates every 120 seconds. It doesn't just tell you *how much* was used, but *when*. This is critical for determining lab demand cycles and detecting leaks. If the Dash Cam shows a steady 150 SCFH flow at 3:00 AM on a Sunday, it is an implicit indicator of a gas leak or a valve left open in a lab, even if the "Odometer" (Totalizer) looks normal.

IV. Vendor-Integrated Auditing Strategy

To keep an eye on the totalizer between the 90-day logger downloads, we propose leveraging the regular LN2 refill schedule. Since the vendor already visits the tank to reset fill readouts, they are perfectly positioned to provide a "Secondary Audit."

Proposed Workflow: Mobile-First Vendor Log

We recommend creating a **QR-based reporting tool** (using Google Forms, Microsoft Forms, or an Excel-integrated Power App) and placing the QR code near the tank's fill manifold.

- **Vendor Action:** Upon completing the liquid fill, the tech scans the QR code.
- **Data Entry:** The tech enters the current **Totalizer** value from the 9500P display.
- **Implicit Audit:** This provides a time-stamped "Snapshot" of gas usage that correlates exactly with a liquid refill event.
- **Cloud Integration:**
  - **Google Forms:** Instantly populates a shared spreadsheet for management.
  - **Microsoft Forms/Outlook:** Can trigger an automated email to the lab manager: "*Refill Complete: Gas Totalizer at XXXXX.*"

V. Future Roadmap: Real-Time LoRa Mesh Telemetry

To eliminate the manual "March 31" download requirement, the facility is well-positioned for a **DIY LoRa Mesh (Meshtastic)** upgrade.

The "Live Data" Concept:

- **The Node:** An ESP32-based LoRa module (e.g., Meshnology) is installed at the tank.
- **The Bridge:** A 4-20mA to Voltage converter (or a 150Ω precision resistor) bridges the 9500P signal to the LoRa ADC pin.
- **The Mesh:** Data "hops" across the campus via low-power 915MHz radio, requiring no Wi-Fi at the tank.

- **The i-Gate:** A central node in the main office receives the signal and pushes it to a live dashboard (Grafana/MQTT).

Benefit: This would transform the "Dash Cam" from a 90-day historical tool into a **Real-Time Alert System**.
