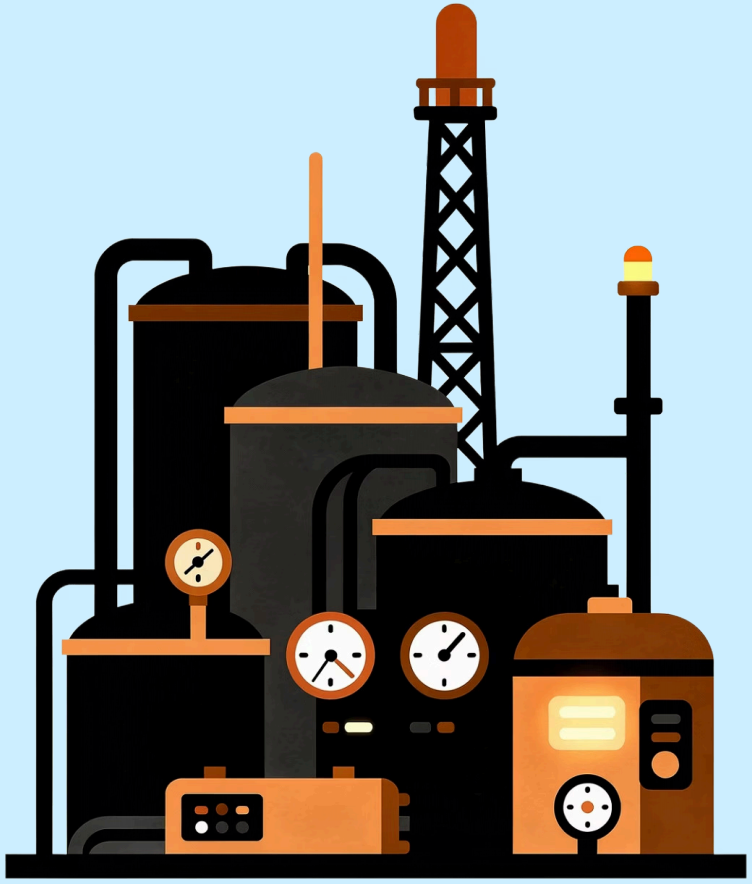


The Calibration Shield

SWAM Safety & Calibration Hub — Nexus Energy Technologies

A professional calibration checklist framework engineered for oil & gas equipment integrity. This document establishes the authoritative procedures for pressure gauge, temperature sensor, and flow meter calibration — ensuring every measurement is accurate, traceable, and compliant.

CALIBRATION CHECKLIST

NEXUS ENERGY TECHNOLOGIES

The Hidden Risk

In the oil and gas industry, equipment drift is a silent adversary — one that accumulates gradually, erodes measurement accuracy, and ultimately compromises site safety, regulatory standing, and operational efficiency. A gauge that reads just 2% off can translate into thousands of dollars of product giveaway per shift, and a sensor that drifts beyond tolerance can trigger a cascade of safety events that no operator wants to manage.

Why Calibration Matters

Calibration is not a bureaucratic exercise — it is the foundational act of ensuring that every pressure reading, every temperature signal, and every flow measurement is a genuine "single source of truth." Without it, operators are making decisions based on data they cannot trust.

- Equipment drift causes inefficiency, unplanned downtime, and product loss
- Uncalibrated instruments expose facilities to regulatory non-compliance penalties
- Accurate measurements are the bedrock of safe process control decisions
- Calibration records serve as legal protection during incident investigations

The Cost of Inaction

Industry studies consistently show that facilities with rigorous calibration programs report significantly fewer process upsets, lower maintenance costs, and stronger audit outcomes. SWAM Safety & Calibration Hub exists precisely to close this gap — providing systematic, traceable, and compliant calibration procedures that protect people, assets, and the environment across every site served by Nexus Energy Technologies.

⚠ Uncalibrated equipment is not merely an operational inconvenience — it is a safety hazard and a compliance liability that can result in regulatory shutdown, financial penalties, and reputational damage.

Section 1: Pressure Gauge Calibration

CALIBRATION PROCEDURE | 8 STEPS

Pressure gauges are among the most critical instruments on any oil and gas facility. Incorrect pressure readings can lead to over-pressurization events, relief valve failures, or unsafe operating conditions. The following eight-step procedure ensures that every gauge is verified, adjusted if necessary, and documented to full traceability standards before being returned to service.

1

Verify Tag Number & Model

Confirm the instrument tag number and model against the site calibration database and P&ID documentation. Ensure the correct calibration range and tolerance are referenced before any work begins.

☐ **Completed** Date: _____ Tech: _____

2

Secure LOTO & Permit-to-Work

Implement full Lock-Out/Tag-Out (LOTO) procedures in accordance with site safety protocols. Obtain and display a valid Permit-to-Work (PTW) before isolating the instrument from the live process.

☐ **Completed** Date: _____ Tech: _____

3

Isolate & Safely Vent Process Fluid

Close isolation valves, bleed down the gauge to zero, and confirm depressurization using a secondary pressure indicator. Verify that all process fluid has been safely vented per site environmental procedures.

☐ **Completed** Date: _____ Tech: _____

4

Record As-Found Readings (5-Point)

Apply reference pressure at 0%, 25%, 50%, 75%, and 100% of the gauge's calibrated range using a certified deadweight tester or precision pressure calibrator. Record all As-Found readings prior to any adjustment.

☐ **Completed** Date: _____ Tech: _____

1

Compare Against Tolerance

Evaluate each As-Found reading against the instrument's required accuracy specification (typically ±0.25% to ±1.0% of full scale). Flag any reading that falls outside the accepted tolerance band as requiring adjustment.

☐ **Completed** Date: _____ Tech: _____

2

Perform Adjustment if Out of Spec

Adjust the zero and span of the gauge or transmitter as required using manufacturer-approved procedures. Re-apply reference pressures after each adjustment to confirm the correction has been effective.

☐ **Completed** Date: _____ Tech: _____

3

Document As-Left Performance (5-Point)

Repeat the full 5-point calibration sweep and record all As-Left readings. Confirm that all data points now fall within the specified tolerance. Retain all raw data for traceability purposes.

☐ **Completed** Date: _____ Tech: _____

4

Sign-Off & Update Calibration Status

Technician signs and dates the calibration record. Update the instrument's calibration status in the CMMS or calibration management system. Attach calibration certificate and set the next due date.

☐ **Pass** ☐ **Fail** Tech Signature: _____ Date: _____

Section 2: Temperature Sensor Calibration

CALIBRATION PROCEDURE | 8 STEPS

Temperature sensors — including thermocouples and RTDs — are critical to process control, personnel safety, and equipment protection in oil and gas operations. Drift in temperature measurement can affect product quality, trigger false alarms, or mask dangerous overheating conditions. This eight-step procedure ensures all temperature instruments are verified against national standards with full documentary traceability.

1 Verify Sensor Health

Perform an initial health check on the sensor element by measuring its resistance (for RTDs, typically 100Ω at 0°C) or millivolt output (for thermocouples). Compare readings against published reference tables. Flag any open circuit, short circuit, or abnormal reading for replacement before proceeding.

☐ **Completed** Date: _____ Technician: _____

2 Ensure Test Equipment Certification

Confirm that the reference calibrator (dry-block calibrator, temperature bath, or documenting process calibrator) has a valid calibration certificate traceable to NIST or the relevant national metrology institute. Verify the certificate is current and the accuracy ratio meets the 4:1 test uncertainty ratio (TUR) requirement.

☐ **Completed** Date: _____ Technician: _____

3 Disconnect Sensor Input

Safely disconnect the sensor from the transmitter input terminals. Record all wiring configurations before disconnection to ensure correct re-termination. Where applicable, install temporary isolation barriers to protect associated control systems from spurious signals during calibration.

☐ **Completed** Date: _____ Technician: _____

4 Simulate Input Using Calibrator

Using a certified dry-block calibrator or precision signal simulator, inject known temperature signals (or equivalent resistance/mV values) at a minimum of five points across the sensor's operating range. Allow adequate stabilization time at each point before recording the transmitter's indicated output.

☐ **Completed** Date: _____ Technician: _____

5 Record As-Found Data

Document the transmitter output at each test point against the reference input value. Calculate the error at each point in both engineering units and as a percentage of span. Retain all raw As-Found data — this constitutes the pre-adjustment condition of the instrument and is a mandatory record.

☐ **Completed** Date: _____ Technician: _____

6 Adjust Transmitter Zero & Span

Where As-Found errors exceed the instrument's tolerance specification, adjust the transmitter's zero and span parameters using the manufacturer's approved configuration tool or adjustment procedure. Perform iterative adjustments as necessary, verifying the effect of each change before proceeding to the next.

☐ **Completed** Date: _____ Technician: _____

7 Verify As-Left Accuracy

Repeat the full multi-point simulation sweep after all adjustments have been completed. Compare As-Left readings against national standards accuracy requirements and the instrument's specified tolerance. All points must fall within the accepted band before the instrument can be returned to service.

☐ **Completed** Date: _____ Technician: _____

8 Final Sign-Off & Pass/Fail Recording

Technician completes and signs the calibration record. Record the definitive Pass or Fail result. Update the instrument's calibration label, CMMS record, and the site calibration register. If the instrument fails and cannot be adjusted within tolerance, initiate the site's instrument rejection and replacement procedure.

☐ **Pass** ☐ **Fail** Tech Signature: _____ Date: _____

Section 3: Flow Meter Calibration

CALIBRATION PROCEDURE | 8 STEPS

Flow meters are the fiscal and operational heartbeat of oil and gas processing — used for custody transfer, mass balance, and safety system actuation. Errors in flow measurement directly impact revenue, regulatory reporting, and process safety system integrity. This eight-step procedure covers the complete calibration cycle for both electronic and mechanical flow meter types, from initial access and isolation through to final compliance sign-off.

Step 1 — Confirm Accessibility & Isolation

Verify that the flow meter is safely accessible and that process isolation can be achieved without affecting upstream or downstream safety-critical systems. Confirm the isolation boundary with the control room and obtain all necessary work authorizations. Apply LOTO as required by site procedures.

☐ **Completed** Date: _____ Technician: _____

Step 2 — Verify Calibration Standard Accuracy Ratio

Confirm that the reference standard being used for calibration achieves a minimum 4:1 Test Uncertainty Ratio (TUR) relative to the flow meter's specified accuracy. Review the reference standard's current calibration certificate and ensure it is traceable to NIST or an equivalent national metrology body.

☐ **Completed** Date: _____ Technician: _____

Step 3 — Check Bypass Requirements

Determine whether a bypass line is required to maintain process continuity or safety system function during calibration. Where safety systems (ESD, F&G) rely on this flow meter for actuation, coordinate with the safety team and control room before isolating the instrument. Document the bypass configuration used.

☐ **Completed** Date: _____ Technician: _____

Step 4 — Perform Initial Diagnostic & Flow Simulation

Run onboard diagnostics where available (e.g., Coriolis meter self-check, ultrasonic meter signal quality assessment). Introduce a known, stable reference flow rate using a certified master meter or prover loop. Allow the system to stabilize before commencing data collection.

☐ **Completed** Date: _____ Technician: _____

Step 5 — Record As-Found Deviation Data

Measure and record the flow meter's indicated output against the reference standard at a minimum of three flow rates (low, mid, and high within the operating range). Calculate the percentage deviation at each point. Retain all As-Found data as a mandatory pre-adjustment record.

☐ **Completed** Date: _____ Technician: _____

Step 6 — Calibrate Electronics & Mechanical Components

Adjust the flow meter's K-factor, meter factor, or transmitter configuration parameters as required to bring all readings within the specified accuracy band. For mechanical meters, inspect and service all moving parts per manufacturer guidance. Verify that all electronic adjustments are performed using the manufacturer's approved configuration tool.

☐ **Completed** Date: _____ Technician: _____

Step 7 — Document As-Left Repeatability Test

Repeat the multi-point flow simulation after all adjustments. Record As-Left readings and calculate the meter's repeatability — the consistency of its output under identical conditions. Both accuracy and repeatability must meet the specified performance criteria before the meter is returned to service.

☐ **Completed** Date: _____ Technician: _____

Step 8 — Technician Signature & Final Compliance Check

Technician signs and dates the completed calibration record. Confirm that all data entries are legible, all fields are completed, and the Pass/Fail determination is clearly recorded. Update the CMMS, calibration register, and instrument label. Submit all documentation to the site calibration authority for review and filing.

☐ **Pass** ☐ **Fail** Tech Signature: _____ Date: _____

Critical Documentation Standards

A calibration is only as good as its documentation. In oil and gas operations, incomplete or non-traceable records can invalidate an entire calibration event — exposing the facility to regulatory findings, insurance liability, and loss of ISO 17025 certification. SWAM Safety & Calibration Hub enforces the following non-negotiable documentation standards across all calibration activities.

NIST Traceability

All calibration data must be traceable to NIST (National Institute of Standards and Technology) or the applicable national metrology institute. Every reference standard used must have a current, valid calibration certificate that establishes an unbroken chain of traceability back to SI units. Certificates must be available for review at any time during an audit.

Technician Signature & Date

Every entry in a calibration record — including As-Found data, adjustment notes, As-Left data, and the final Pass/Fail determination — must bear the hand-written or electronically authenticated signature of the performing technician, together with the date and time of entry. Unsigned or undated records are considered incomplete and non-conforming.

ISO 17025 Protocol Alignment

All Pass/Fail determinations must be made in strict accordance with ISO/IEC 17025:2017 requirements, including the correct application of measurement uncertainty. Where a result falls within the guard band of the tolerance limit, expanded uncertainty must be calculated and documented before a Pass determination can be recorded.

Required Fields — Every Calibration Record

- Instrument tag number, description, and location
- Calibration date and next calibration due date
- Reference standard ID numbers and certificate expiry dates
- As-Found and As-Left data tables with engineering units
- Adjustment description (if applicable)
- Pass/Fail determination with tolerance reference
- Performing technician name, signature, and qualification level
- Reviewing authority signature (where required by site procedures)

All calibration records generated under the SWAM Safety & Calibration Hub program are retained for a minimum of 10 years in both physical and electronic formats, in compliance with API RP 554, IEC 61511, and site-specific regulatory requirements. Digital records are stored in a secure, access-controlled calibration management system with full audit trail functionality.

Any calibration record with missing signatures, absent traceability references, or incomplete As-Found data must be immediately escalated to the Calibration Supervisor. Do not return an instrument to service on the basis of an incomplete record.

Visualizing Our Commitment

The Language of Color in Safety-Critical Operations

In safety-critical industries, color is never arbitrary — it is a communication tool that must be applied with precision and consistency. The SWAM Safety & Calibration Hub visual identity has been deliberately designed to reflect the values and operational priorities of Nexus Energy Technologies at every level of interaction.

Dark Navy — Depth & Reliability

Navy is the color of precision engineering, technical authority, and unwavering reliability. In the context of SWAM Safety & Calibration Hub, dark navy represents the depth of our systems, the rigor of our procedures, and the stability that Nexus Energy Technologies' clients depend on. It communicates that our processes are grounded in science, validated by data, and trusted at the highest levels of operational management. When technicians see this color on a calibration document or signage, they understand it carries the full weight of the SWAM quality system behind it.

Orange — Vigilance & Alert Status

Orange is universally recognized as the color of attention, caution, and active safety awareness. In the SWAM color system, orange signals the dynamic, human-facing dimension of our safety culture — the constant vigilance, the active monitoring, and the immediate response readiness that defines world-class HSE performance. Orange on a calibration checklist or facility marking means: this matters, pay attention, act with care. It is the visual reminder that behind every instrument reading is a human decision, and that human must be fully alert and engaged at all times.

Consistent Color Coding — Rapid Recognition

Consistent application of the SWAM color system across all calibration documentation, instrument labels, status tags, and facility markings enables rapid visual inspection and immediate status recognition. A technician approaching any instrument on a Nexus Energy Technologies site should be able to determine calibration status, next due date, and compliance standing within seconds — without consulting a database. This visual fluency reduces human error, accelerates turnaround, and reinforces the culture of precision that defines the SWAM Safety & Calibration Hub program.

The Nexus Difference

Why Precision Calibration Is a Strategic Business Advantage

Calibration is often perceived as a compliance cost — a necessary but unremarkable operational expense. At Nexus Energy Technologies, we challenge that framing entirely. Precision calibration, delivered systematically through the SWAM Safety & Calibration Hub, is one of the highest-return investments a facility can make. Here is why.

$000s

Saved Per Shift

Accurate flow and pressure measurement eliminates product giveaway — the unintentional over-delivery of product that occurs when instruments read low. Facilities with calibrated flow meters routinely recover thousands of dollars per operational shift in product that would otherwise be lost to measurement error.

100%

Audit Readiness

A fully documented calibration program means that every regulatory or client audit can be met with confidence. Complete, traceable, ISO 17025-aligned records demonstrate systemic compliance — not just point-in-time conformance — transforming audits from anxiety-inducing events into opportunities to showcase operational excellence.

Zero

Unplanned Downtime

Instruments that are calibrated on schedule and maintained within tolerance do not fail unexpectedly. Planned calibration intervals, executed rigorously, dramatically reduce the probability of instrument-related process upsets — protecting production continuity and eliminating the enormous costs associated with emergency shutdowns and unplanned maintenance mobilizations.

> Reliability is not an accident. It is the cumulative result of thousands of precise, disciplined calibration acts performed by professionals who understand that their work is the difference between a safe shift and a crisis. That is the Nexus difference.

Operational Readiness

From Checkbox to Confidence — How SWAM Transforms Risk into Reliability

The act of completing a calibration checklist is more than an administrative requirement — it is the physical manifestation of a safety culture in action. Every checkbox that a SWAM-certified technician marks as complete represents a deliberate, informed decision that a specific risk has been identified, evaluated, and controlled. In aggregate, these individual acts of precision create a facility that is genuinely operationally ready — not just paperwork-ready.

Every Checkbox Is a Risk Mitigated

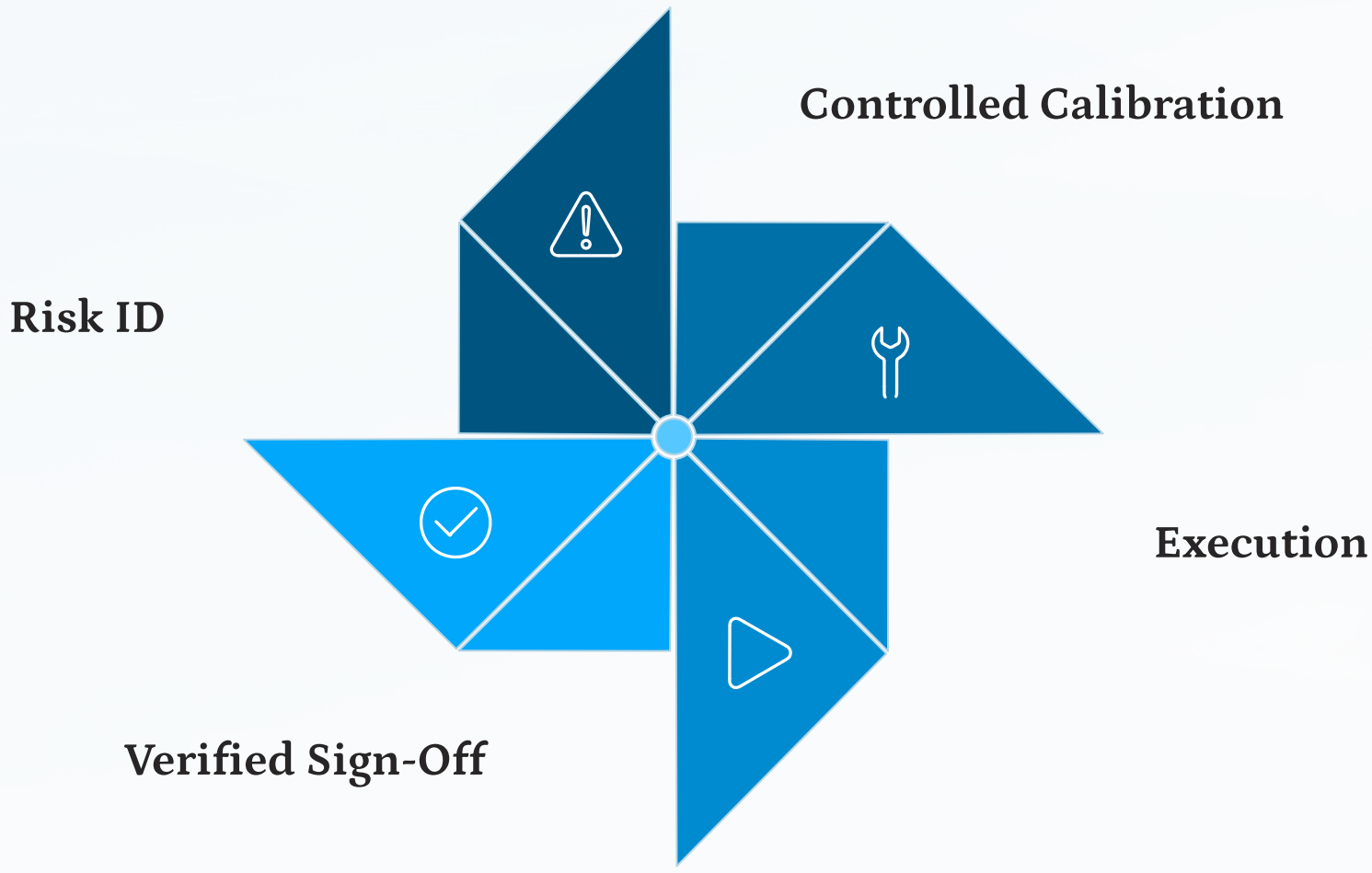
Risk in oil and gas is not theoretical — it has names, histories, and consequences. The eight checkboxes in each calibration section of this document correspond to eight distinct failure modes that have caused real incidents at real facilities. Completing each step closes a potential pathway to equipment failure, process upset, or personnel harm. The checklist is, in the most literal sense, a risk register being systematically cleared.

- Unchecked tag verification leads to wrong-instrument calibration events
- Skipped LOTO steps have caused serious injury during live-instrument work
- Missing As-Found data destroys the audit trail for failure investigations
- Absent sign-offs invalidate calibration records in legal proceedings

Predictable Success Replaces Potential Failure

The SWAM procedures documented in this checklist are not hypothetical best practices — they are proven operational protocols refined through years of field experience across multiple oil and gas asset classes. When followed consistently, they transform the probabilistic nature of equipment failure into a predictable, manageable maintenance cycle. Technicians who follow these procedures are not merely completing tasks — they are actively engineering the reliability of the systems that power Nexus Energy Technologies' clients.

SWAM Safety & Calibration Hub: Protecting the operational backbone of Nexus Energy Technologies — one calibration at a time. Every procedure followed is a step toward a facility that is safer, more efficient, and more competitive.



This cycle repeats at every calibration interval — quarterly, semi-annually, or annually depending on instrument criticality classification — ensuring that operational readiness is continuously maintained rather than periodically achieved.

Built for Excellence

SWAM Safety & Calibration Hub — A Commitment to Zero-Defect Operations

The procedures contained in this calibration checklist are not minimum standards — they are the expression of a commitment to operational excellence that goes beyond regulatory compliance. SWAM Safety & Calibration Hub was built on the conviction that in safety-critical industries, "good enough" is never good enough. Every calibration performed under this program is an act of professional pride and a contribution to the safety culture that Nexus Energy Technologies works to embed across every site, every shift, and every instrument in the network.

Zero-Defect Operations

Perform every step of every checklist with the same attention and care — whether it is the first calibration of the day or the last. Zero-defect operations are not achieved by working harder in isolated moments; they are built through the consistent application of disciplined procedures across every interaction with every instrument.

Your Precision Is the Guardian

Every technician who signs a calibration record under the SWAM program is personally affirming that the work was performed correctly, that the data is accurate, and that the instrument can be trusted by operators, engineers, and safety systems that may depend on it. That signature is a statement of professional accountability and the ultimate expression of safety culture in action.

Calibrate for a Safer Tomorrow

The work done today — the gauge verified, the sensor adjusted, the flow meter documented — is the foundation of the safe operations that Nexus Energy Technologies will deliver tomorrow, next month, and next year. Begin your next calibration cycle with the full weight of that understanding. Your precision is not just a technical act. It is a promise to everyone who works on this facility.

> SWAM Safety & Calibration Hub — Precision. Traceability. Trust.
> Nexus Energy Technologies: Powering the Energy Sector with Confidence.