



Sentinel AI™

Structural Monitoring using AI-Driven Sensing for LNG Terminals

PRODUCT SPECIFICATION

Reduce Risk of Structural Failures with Automated SHM

StructureIQ's AI-driven SHM Service

LNG terminals operate under some of the most extreme and unforgiving structural conditions in the energy sector — cryogenic thermal cycling across liquefaction and regasification systems, stress corrosion in high-exposure marine and coastal environments, vibration from BOG compressors and high-pressure pumping systems, and seismic loads that periodic manual inspection routinely misses. For operators managing aging import and export infrastructure, the consequences of undetected structural deterioration are severe: unplanned outages cost an estimated \$20 million to \$50 million per event in lost throughput, ship demurrage, and emergency repairs, while safety and environmental incidents at high-density cryogenic facilities carry consequences that extend well beyond direct financial loss.

StructureIQ deploys wireless Xnode sensors across every critical terminal structure, liquefaction train support frames, LNG storage tank foundations, marine jetty and trestle systems, cryogenic pipe racks, compressor foundations, and marine loading arms, delivering continuous, real-time structural condition intelligence through Sentinel AI, its secure cloud-based SaaS dashboard.

Sentinel AI™



Key Highlights:

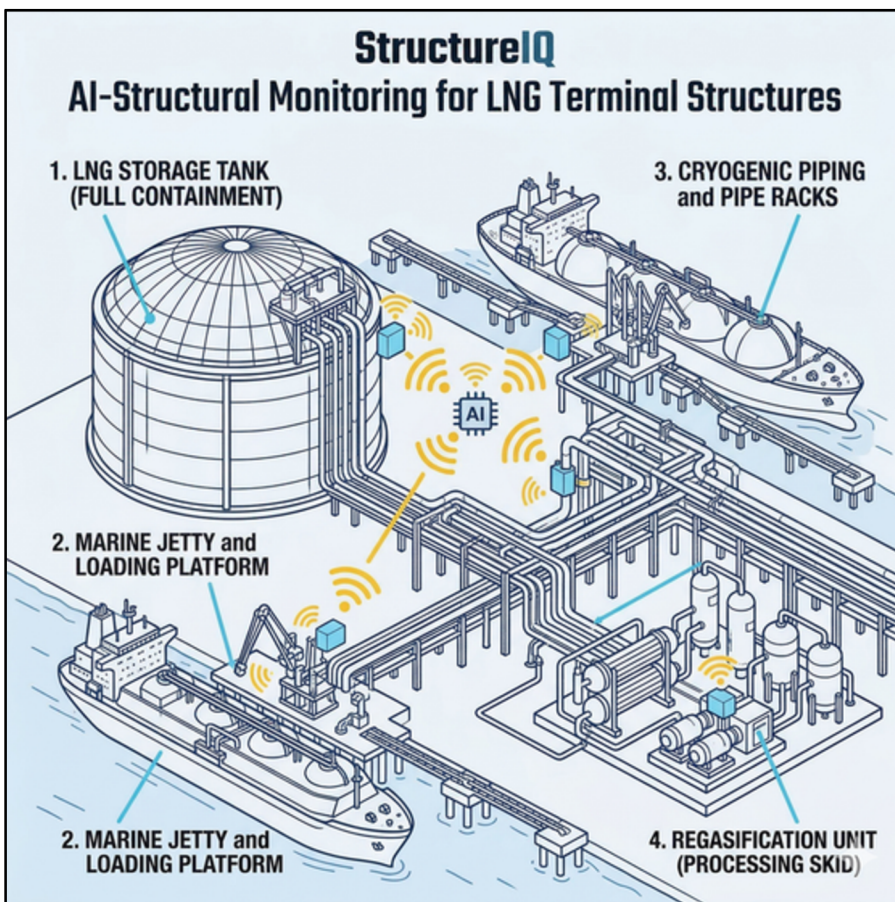
- **Continuous Structural Performance Monitoring:** Ongoing measurement of structural response in various settings under real operating and cryogenic loads.
- **AI-Enabled Fatigue & Anomaly Detection:** Automated identification of issues like fatigue and degradation that traditional inspections may miss.
- **Event Notification:** Immediate insights after seismic events or impacts on structures.
- **Shutdown Cost Avoidance:** Early warnings enable proactive maintenance, reducing costs linked to unplanned downtimes.
- **Rapid Post-Event Assessment:** Quick decisions on returning to operations after incidents using objective performance data to prevent unnecessary shutdowns.

PRODUCT SPECIFICATION: StructureIQ AI powered SHM Service

LNG export terminals operate under extreme structural stress. Cryogenic thermal cycling, accelerated marine corrosion, high-frequency vibration from large rotating compressors, and seismic loads on soft coastal foundations all degrade asset integrity in ways that manual, periodic inspections routinely miss. For terminal operators bound by take-or-pay cargo commitments, undetected deterioration carries severe consequences: unplanned production outages costing \$20 million to \$50 million per event, environmental incidents in high-consequence coastal zones, and FERC and PHMSA compliance exposure in an increasingly scrutinized regulatory environment.

Continuous Structural Health Monitoring (SHM) provides LNG terminal operators with a real-time, high-fidelity view of structural condition across every critical asset — from liquefaction train support structures and LNG storage tank foundations to marine jetty and trestle systems, pipe racks, and compressor foundations. By moving beyond "point-in-time" manual checks and scheduled underwater inspection campaigns, StructureIQ enables: Predictive Maintenance, Targeted Inspections, Life Extension, and Rapid Recovery. For terminals under construction or in commissioning, Xnode deployment at first-fill establishes the structural baseline that underpins all future condition trending — eliminating the data gap that operators face when SHM is retrofitted after years of operation.

The result is increased uptime, lower O&M costs, and the operational confidence that comes from knowing the structural condition of your terminal assets at all times — not just at the last turnaround or dive inspection cycle.



1. LNG Storage Tank

- Monitors integrity of concrete outer shell.
- AI detects displacements, cracking, or foundation settlement.

1. Marine Jetty and Loading Platform

- Measures impact forces and dynamic load during ship docking.
- Sensors track stress distribution to identify fatigue or damage.

1. Cryogenic Piping and Pipe Racks

- Detects vibration and movement in high-pressure lines.
- Tracks displacement, and vibrations to prevent failures.

1. Regasification Unit

- Monitors high-frequency vibrations from pumps and compressors.
- AI analyzes vibration patterns to identify mechanical faults or structural issues.



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Sentinel AI - SaaS Architecture

Xnode Wireless Smart Sensors

StructureIQ's wireless smart sensors provide real-time structural health monitoring by precisely measuring vibration and tilt. These ruggedized devices utilize onboard edge AI to filter raw data, identifying critical events. Data is transmitted via low-power protocols to a wireless gateway, eliminating the need for invasive and costly cabling across infrastructure.

Gateway and Cellular data

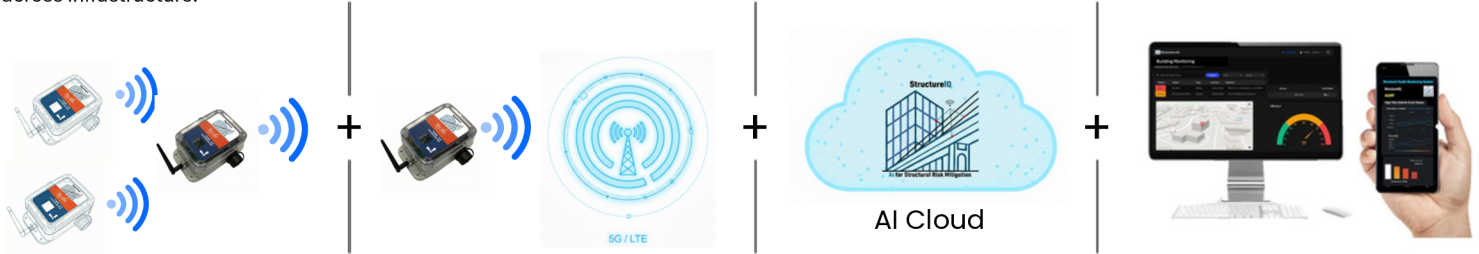
The StructureIQ Gateway acts as a secure bridge, collecting high-precision vibration and tilt data from wireless sensors via low-power protocols. After local verification and edge buffering, the gateway utilizes an encrypted 4G LTE/5G cellular uplink to transmit data through a private APN, ensuring cybersecurity.

AI Cloud & SHM Data Analysis

In the StructureIQ Data Cloud, AI algorithms de-serialize and normalize this time-series data. The engine then performs automated feature extraction to distinguish routine environmental noise from critical structural anomalies.

SHM data SaaS delivery

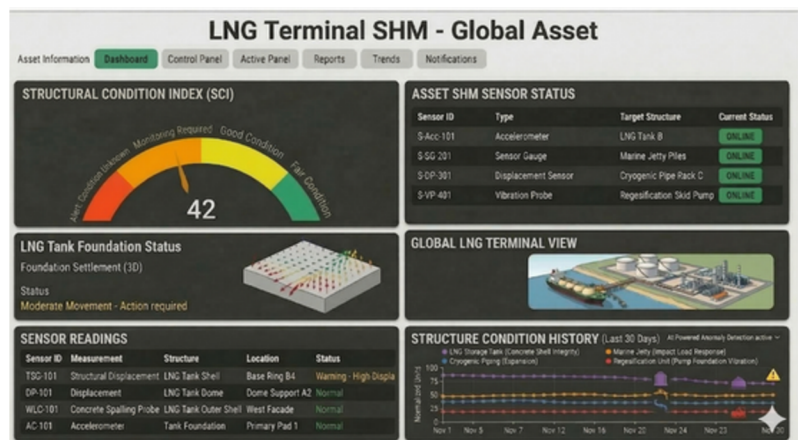
Insights generate real-time risk profiles and alerts delivered directly to the secure Sentinel AI SaaS dashboard for engineering and insurance assessment. The Structural Condition Index (SCI) score provides a single composite health metric per asset.



Core Capabilities

- Wireless smart sensor deployment – Rapid installation with minimal disruption
- Automated anomaly detection – Identifies deviations from established baselines
- Post-event structural assessment – Faster safety and occupancy decisions
- Secure cloud-based dashboard – Remote visibility anytime
- Secure SaaS delivery (no client IT infrastructure required)
- Scalable from single building to enterprise portfolio
- Subscription-based SaaS service model

Asset Dashboard



Sensor configurations shown are illustrative of monitored parameters; actual deployment specifications are tailored to each facility.

What Gets Monitored

- Vibration (Acceleration), Temperature
- Tilt – Settlement, drift, structural movement
- Impact Detection – Ship/Vehicle strikes
- Long-Term Trends – Deterioration and performance shifts

SaaS Features

- Real-time alerts (SMS, email, dashboard)
- Automated event reports
- Structural health scoring
- Multi-asset portfolio dashboard

Note: Cost and performance figures represent cross-industry benchmarks; terminal-specific performance data will be developed through initial pilot deployments.

Engineering dashboard



Management overview

