



COMPREHENSIVE SAFETY MONITORING SOLUTION FOR CRITICAL INFRASTRUCTURE

Distributed Fiber Optic Sensing Technology

VTI-GL-100C



Challenges in Temperature Monitoring for Critical Infrastructure



- Large-scale infrastructures including oil and gas pipelines, industrial tanks, power cable tunnels, and highway tunnels are constantly exposed to risks caused by abnormal temperature changes.
- Conventional temperature monitoring solutions are limited to discrete measurement points, resulting in blind zones and the lack of continuous, holistic temperature visibility.
- Delayed fault detection can lead to catastrophic consequences, including fires and explosions, chemical leaks, production downtime, and severe economic losses.

Invisible Risks: Limitations of Traditional Solutions



Point-Based Monitoring

Provides temperature data only at discrete locations, potentially missing hot spots located between sensors..



Slow Response

Delays in fault detection can result in severe damage.



Electromagnetic Interference (EMI)

Electronic sensors are susceptible to interference in industrial environments, leading to false alarms or missed incidents.



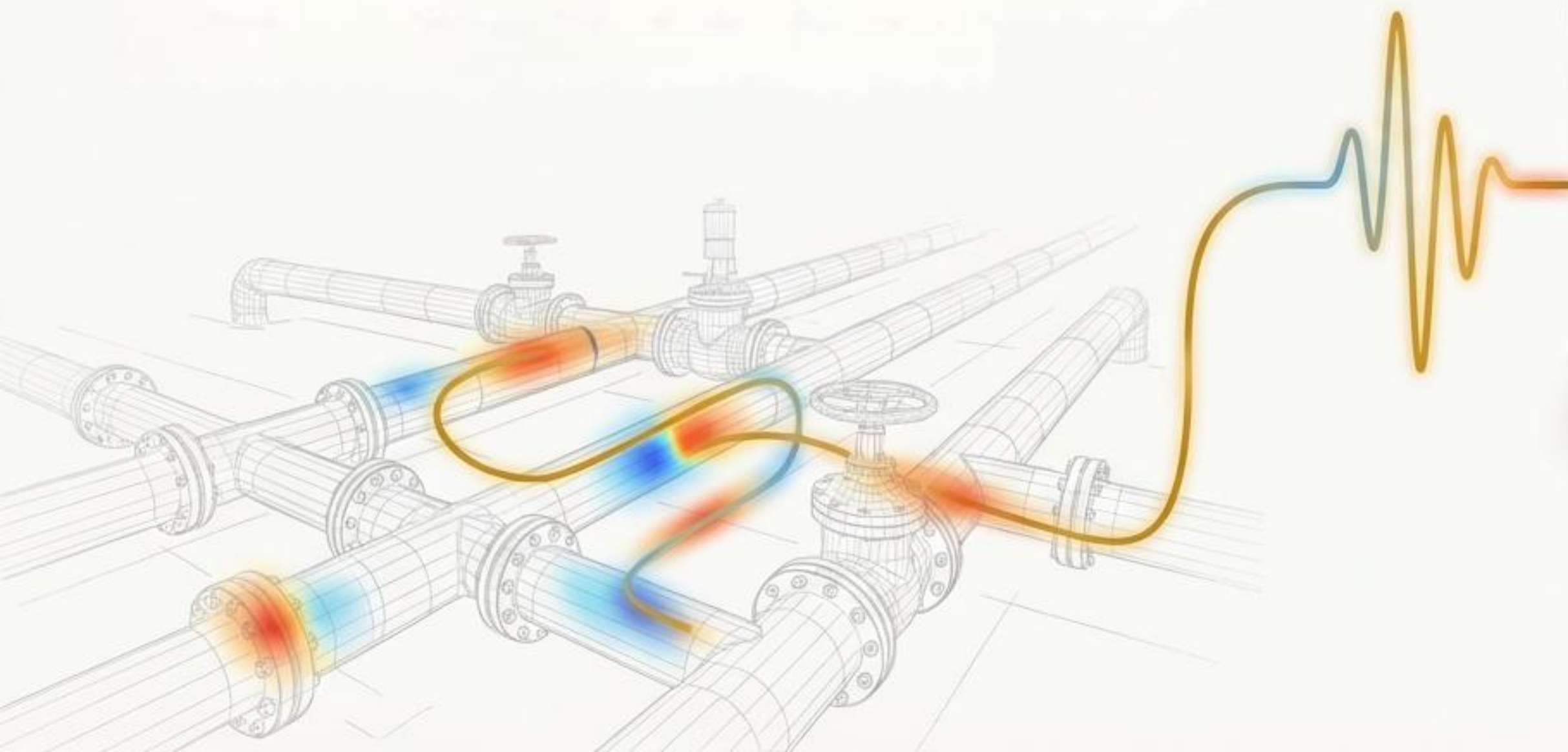
Complex and Costly

Requires power supply and periodic maintenance for hundreds or thousands of individual sensors.

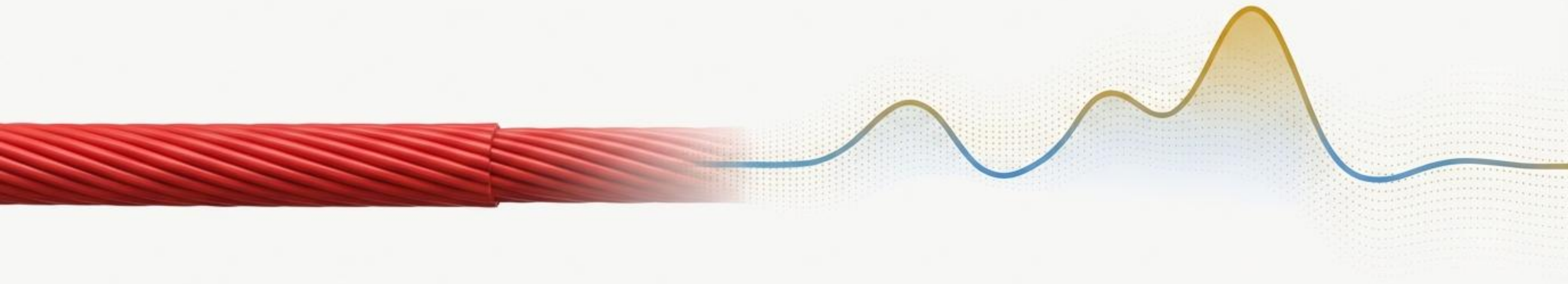


COMPREHENSIVE TEMPERATURE MONITORING SOLUTION USING DISTRIBUTED FIBER OPTIC SENSING

Introduction to the VTI-GL-100C System



A New Era: Transforming the Entire Optical Fiber into an Intelligent Sensor



- ✓ Advanced technology that uses the optical fiber itself as thousands of passive temperature sensing points.
- ✓ Provides uninterrupted monitoring along the entire fiber route over distances of up to tens of kilometers.
- ✓ Real-time temperature monitoring with $\pm 1^{\circ}\text{C}$ accuracy and precise meter-level localization.

A Complete, Integrated Monitoring Ecosystem



Fiber Optic Signal Controller
The 'brain' of the system.



Distributed Sensing Cable
The 'nervous system' that senses temperature.



Gateway Signal Receiver
The data acquisition and communication hub.



AI Platform Software
The intelligent interface for monitoring and analysis.

The VTI-GL-100C Signal Controller: The Heart of the System



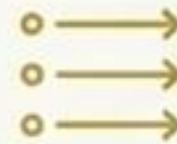
- Integrates high-frequency laser pulse technology, wavelength multiplexing, and Optical Time-Domain Reflectometry (OTDR).



- Provides 24/7 real-time, continuous monitoring across the entire sensor length.



- Delivers high accuracy of $\pm 1^{\circ}\text{C}$ with a spatial resolution of 0.5m over 20km.



- Features 4 channels, each supporting up to 5km, for a total measurement distance of 20km.



- Enables rapid alarm tracking and incident localization.



- Equipped with a 10.4-inch touchscreen and versatile communication interfaces (Ethernet / Modbus / RS-485) for easy SCADA integration.

VTI-GL-100C Controller: Technical Specifications

Specification	Value
Number of Channels	4
Max Distance per Channel	5km
Total Measurement Distance	20km
Standard Alarm Length	1m
Temperature Range	-40°C to +120°C (depending on cable)
Temperature Accuracy	±1°C
Temperature Resolution	0.1°C
Sampling Frequency	3 samples/sec/channel
Relay Outputs	16 Relays (250VAC/3A)
Communication Interface	1x RS485 (Modbus RTU), 1x RS232, 1x RJ45
Optical Connector	FC/APC Standard
Power Supply	DC 24V, 50W
Operating Temperature	-10°C to +50°C
Storage Temperature	-20°C to +60°C
Humidity	0% ~ 95% RH (non-condensing)
Dimensions (WxHxD)	420mm x 182mm x 580mm

The Sensing Cable: A Resilient, Continuous Sensor



- Functions as both the signal transmission medium and a continuous sensor array.



- Built with a reinforced, armored structure for high tensile, compression, and bending strength.



- Measures temperature along the entire route with $\pm 1^{\circ}\text{C}$ accuracy.



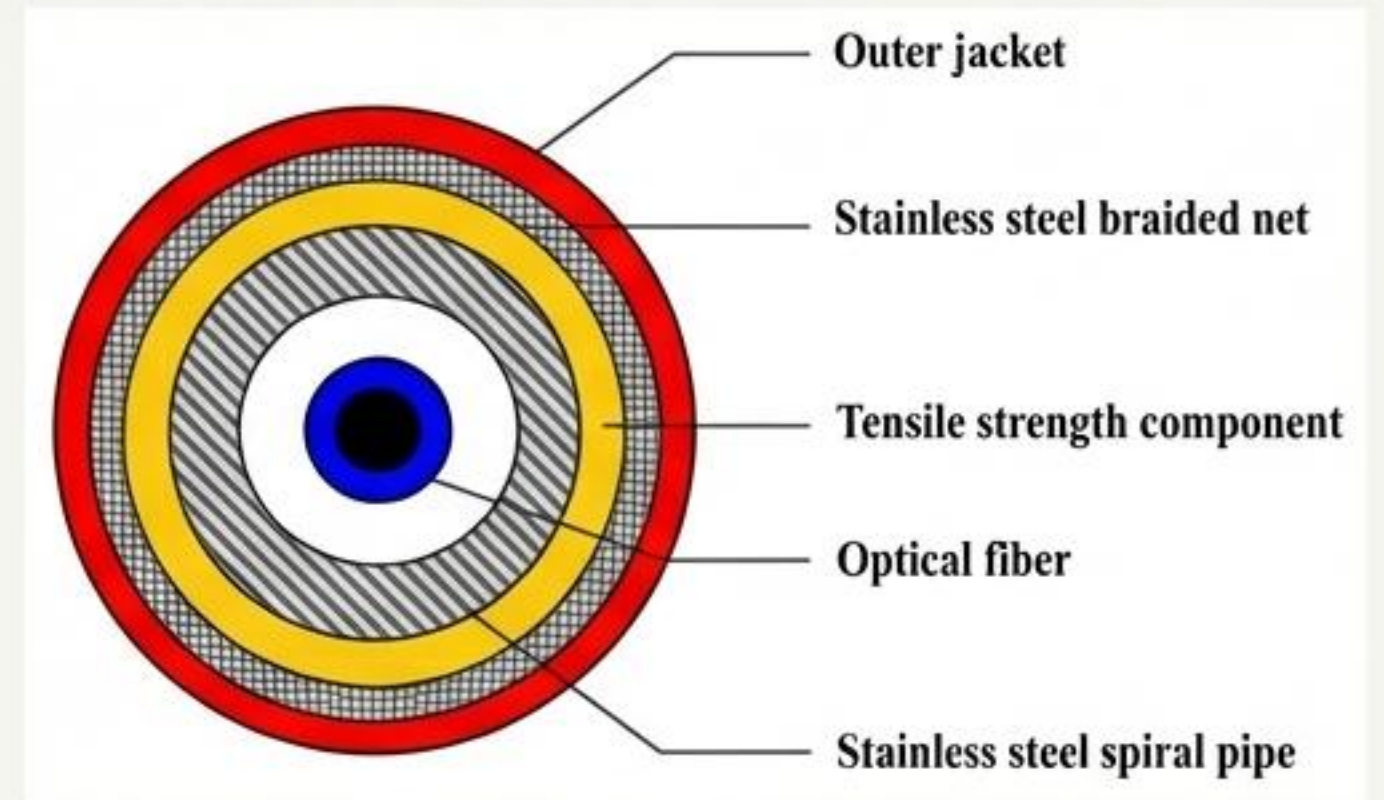
- Completely immune to electromagnetic interference (EMI).

-40°C
+120°C

- Wide operating temperature range: -40°C to +120°C.



- Enables monitoring over distances from several kilometers to tens of kilometers.



Sensing Cable: Technical Specifications

Specification Group	Detail	Value
Optical Fiber Core	Core Diameter	62.5μm
	Cladding Diameter	125μm
	Type	Single-mode, Multi-mode
Overall Outer Diameter		Φ3mm
Outer Sheath Material		Anti-static, flame retardant, low smoke, halogen-free
Tensile Strength	Installation	≤500N
	In-use	≤300N
Crush Resistance	Short-term	≤5000N/10cm
	Long-term	≤3000N/10cm
Temperature Range		-40°C ~ +120°C
Minimum Bending Radius		≥60mm



The Gatewave Receiver: Flexible Data Acquisition & Connectivity



- Collects data from fiber optic sensors using license-free 2.4Ghz wireless technology.



- Supports multiple communication protocols, including Modbus TCP/RTU.



- Provides detailed object identification based on monitoring location.



- Flexible connectivity options: Ethernet, 4G, and Wi-Fi.

Feature	Details
Interfaces	Ethernet (RJ45), Wi-Fi (2.4GHz 5dbm), 4G (Micro SIM), RS485 (Modbus RTU)
Connected Sensors	Unlimited by hardware (license-dependent), 32 sensors by default
Dimensions	93 x 84 x 24 (mm)
Weight	200g

AI Platform: Visualize, Analyze, and Respond



Real-time Temperature Mapping:

Displays a real-time heat map along the monitored route.



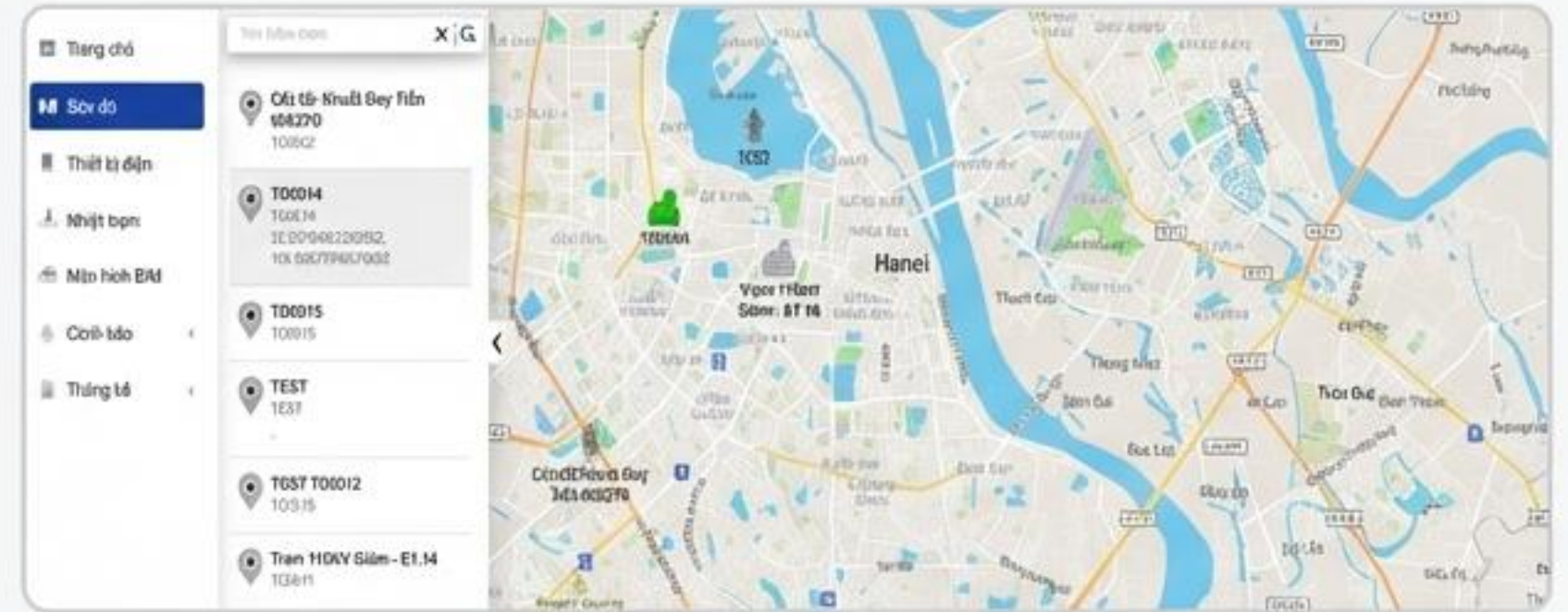
Historical Trend Analysis: Track temperature trends over time with interactive charts.



Geospatial Location: Pinpoint and retrieve coordinates/locations of monitoring stations on a map.



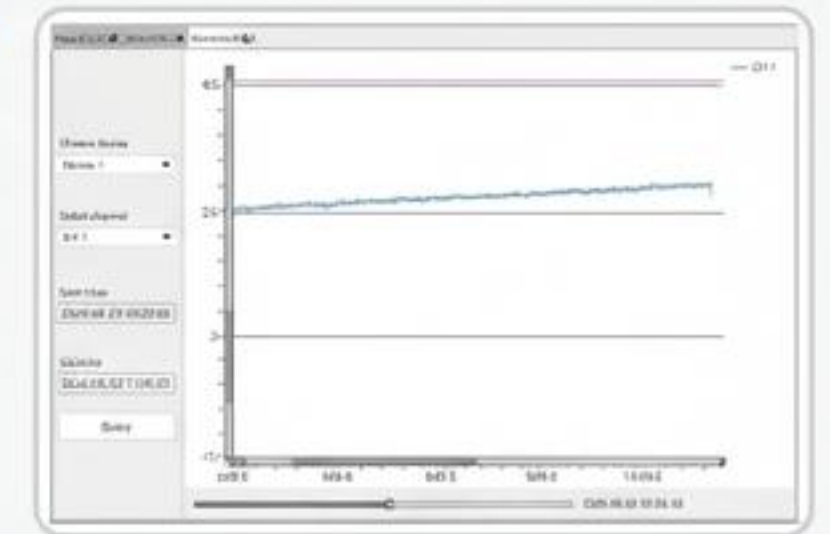
Configurable Alarms: Easily query alarm information, configure alert settings, and set custom alarm thresholds.



Geospatial Location



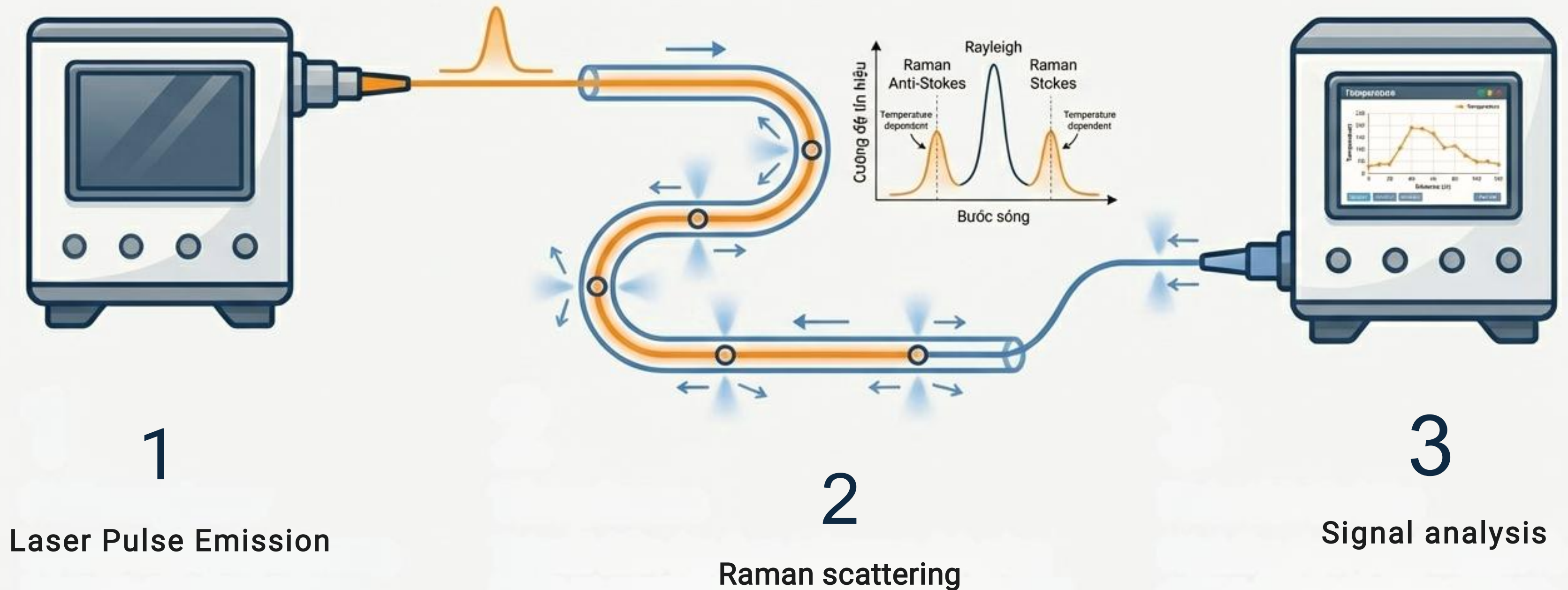
Historical Trend Analysis



Configurable Alarms

Technology Principle: Transforming Optical Fiber into Thousands of Sensors

The system operates based on the Raman scattering effect and the Optical Time-Domain Reflectometry (OTDR) method.



Operating Principle: Raman Light Scattering Technology

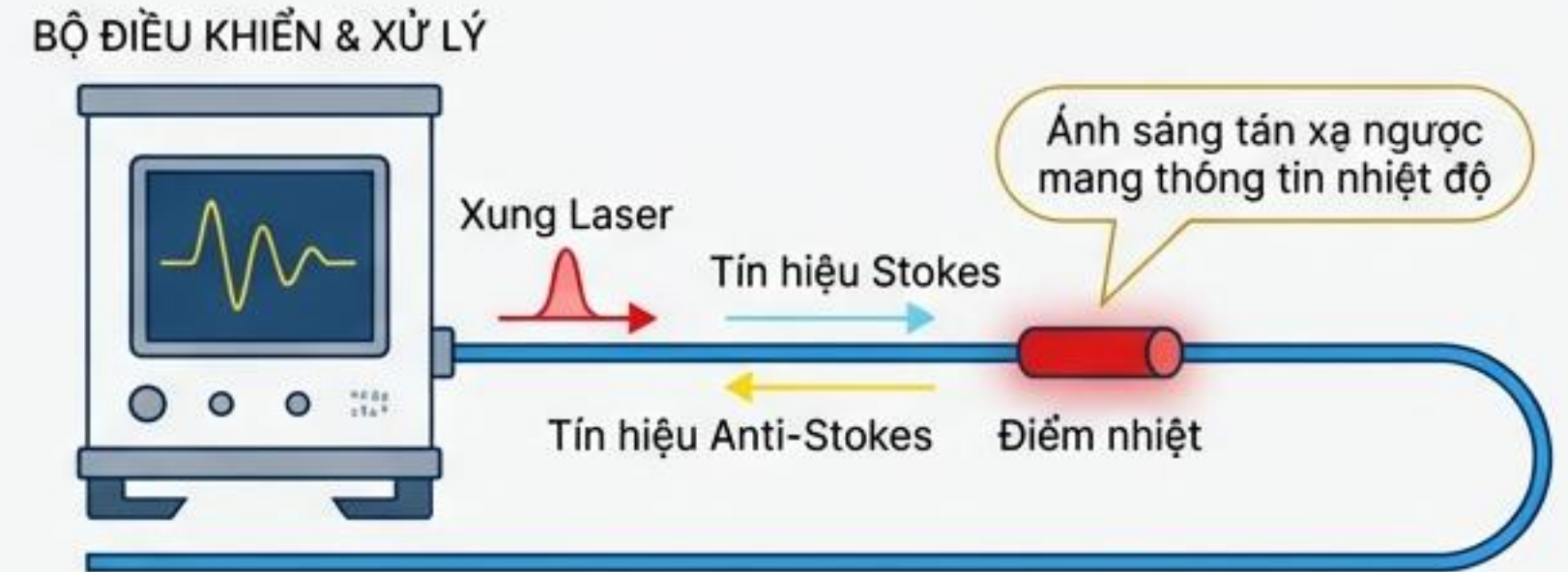
1. Laser Pulse Emission: A high-frequency laser pulse is launched into the optical fiber.

2. Scattering Analysis: Raman scattering occurs due to molecular vibrations, generating Stokes signals (constant intensity) and Anti-Stokes signals (temperature-dependent intensity), which carry temperature information at every 0.5-meter point along the optical fiber.

3. Temperature Determination: The controller analyzes the intensity ratio between the Stokes and Anti-Stokes signals to accurately determine the temperature.

4. Fault Localization: The location of the temperature point is precisely determined using the Optical Time-Domain Reflectometry (OTDR) method.

5. Result Visualization: The results are displayed in the software as temperature–position–time graphs.



Unmatched Advantages for Critical Monitoring



Real-Time, Long-Range, High-Precision

Monitors tens of kilometers in real-time with $\pm 1^{\circ}\text{C}$ accuracy.



Rapid & Precise Localization

Pinpoints fault locations down to the meter.



No Field Power Required

The passive fiber optic cable requires no power along the monitoring route.



Flexible & Durable

The small, flexible cable is easy to install and maintain.



Intrinsically Safe

Immune to EMI and safe for use in flammable, explosive, and hazardous environments.



Seamless Integration

Easily connects to SCADA, DCS, and IoT platforms for remote management.

VTI-GL-100C vs. Traditional Point Sensors (RTD/Thermocouple)

Feature	VTI-GL-100C System	Point Sensors (RTD/Thermocouple)
Monitoring Scope	Continuous along the entire fiber length	Localized, only at discrete points
Resolution / Accuracy	1 m / $\pm 1^{\circ}\text{C}$	1 point / $\pm 2\text{--}3^{\circ}\text{C}$
Field Power Supply	None required (optical signal)	Power required for each individual sensor
Installation Environment	Safe for hazardous and explosive areas	Restricted in hazardous areas
Electromagnetic Noise	Completely immune	Susceptible to interference
Maintenance	No power supply needed, long lifespan	Requires periodic recalibration
System Integration	Easy integration with SCADA/DCS/PCCC/IoT	Limited, complex point-to-point connections

How We Compare to Other Sensing Technologies

Solution	Principle & Scope	Key Advantage	Limitation
Distributed Fiber Optic (VTI-GL-100C)	Continuous temperature measurement along the fiber	 Total route monitoring, no field power, intrinsically safe, easy SCADA integration  	Higher initial investment cost
Point Sensors (RTD/Thermocouple)	Measures at single, discrete points	Low cost, easy to replace	Not continuous, high maintenance, limited range
Linear Heat Detection (LHD Cable)	Heat-sensitive cable, electrical principle	Zone-based temperature alarms	Low accuracy, hard to locate hot spots, prone to aging
Wireless Sensors	Temperature sensing, RF signal transmission	Fast deployment, no wiring	Limited range, potential for RF interference, battery or power needed
IR Monitoring Camera	Remote thermal image analysis	Detects surface hot spots	Measures surface only, not durable in harsh environments, affected by dust/light

Application: Oil & Gas Pipeline Leak and Anomaly Detection



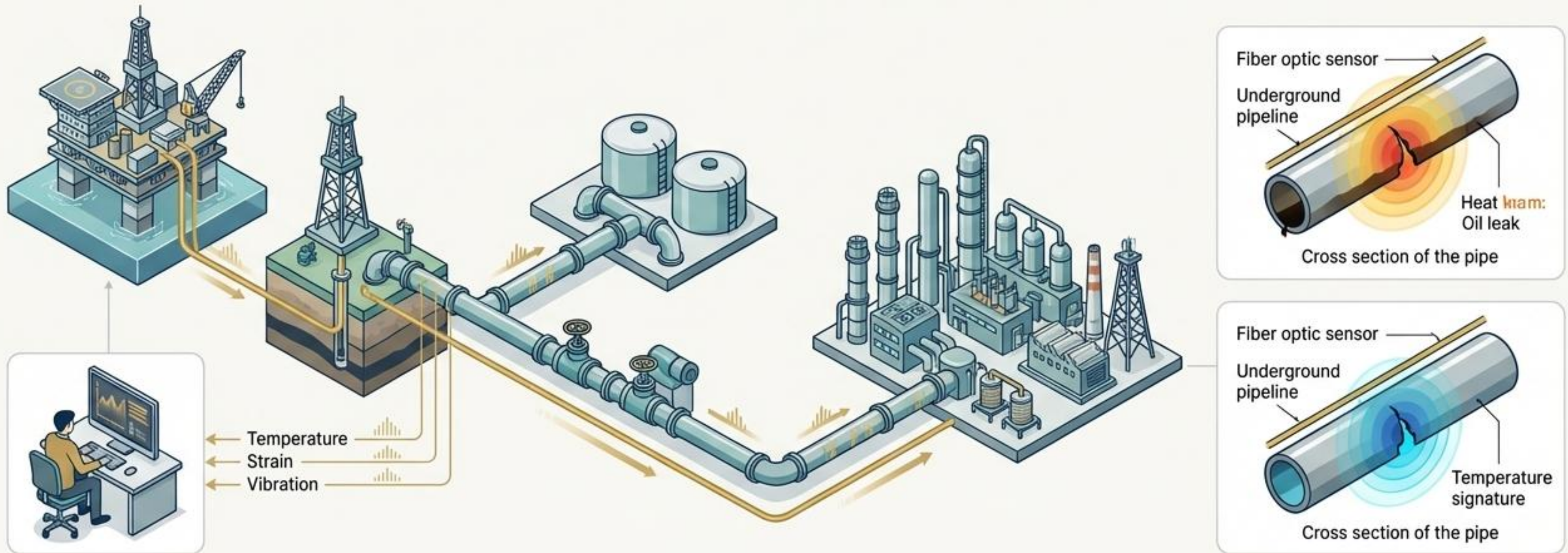
Problem Solved:

Leaks, blockages, and hot spots in pipelines pose significant environmental and safety risks. Early detection is critical.



Our Solution:

Provides 24/7 temperature monitoring along the entire pipeline route, instantly detects and locates temperature anomalies caused by leaks, and delivers precise location data for rapid response.



Application: Oil & Gas Storage Tank Fire and Leak Prevention



Problem Solved:

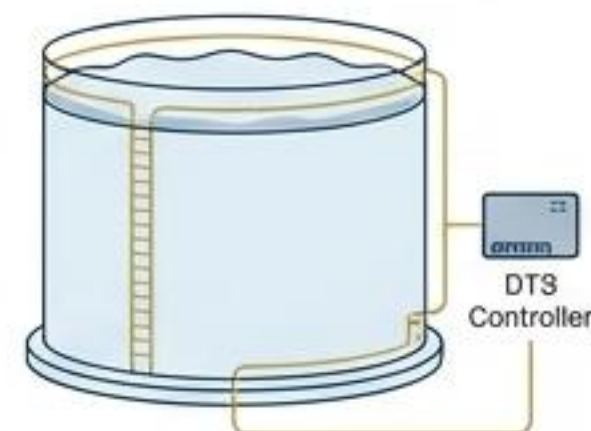
Hot spots, smoldering fires, and vapor leaks in large storage tanks are difficult to detect with traditional methods until it's too late.



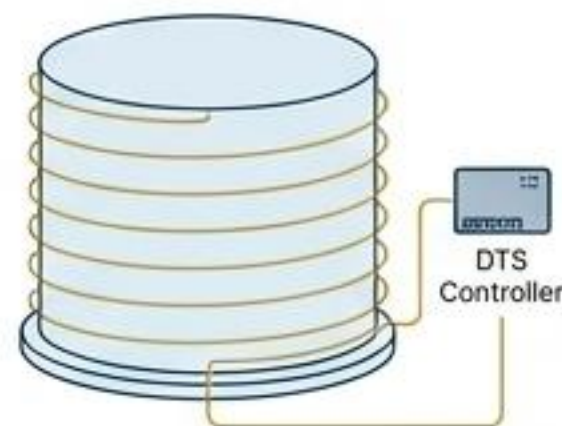
Our Solution:

- Sensor cables are deployed around the tank shell, base, and on floating roofs for comprehensive 3D coverage.
- Detects hot spots, vapor leaks, and incipient fires with high precision.
- Can automatically trigger fire suppression systems for immediate response.
- A single system can monitor multiple tanks simultaneously on one platform.

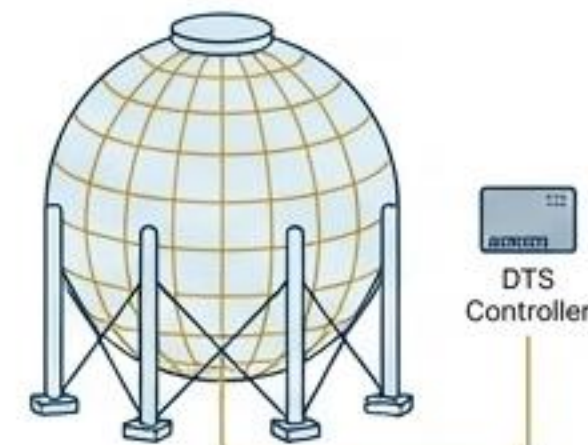
Floating Roof Tank Installation



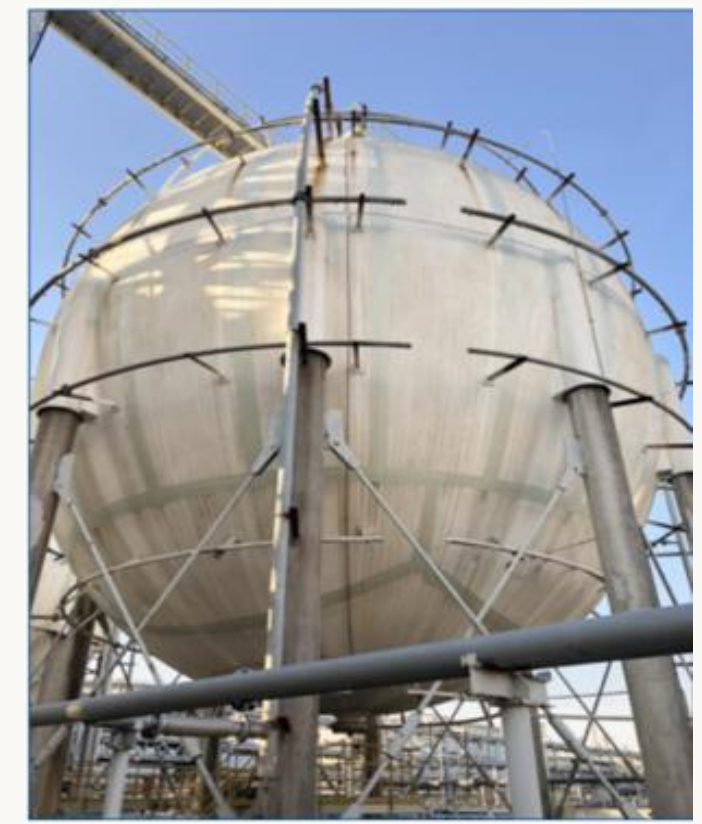
Vertical Storage Tank Installation

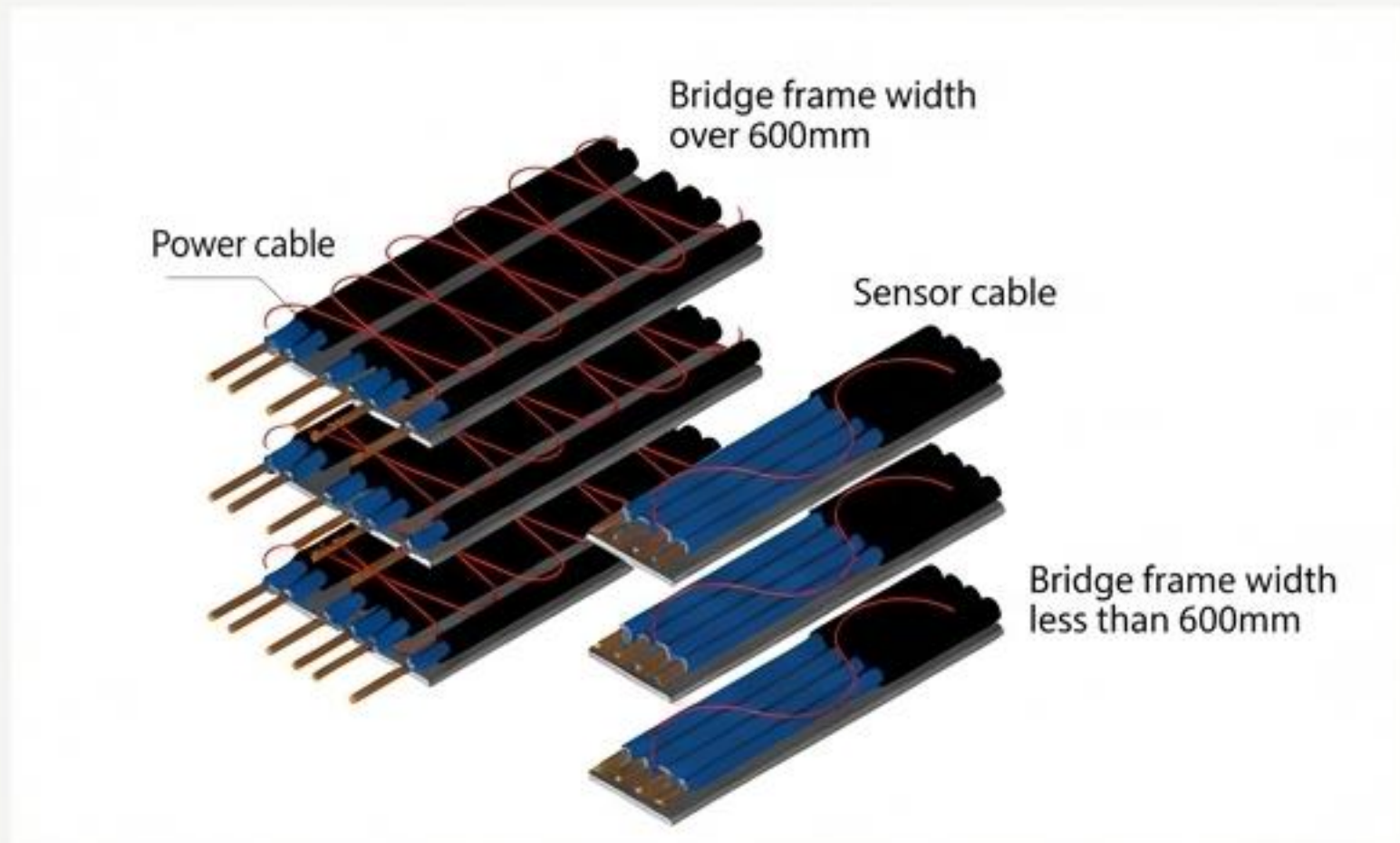


Spherical Storage Tank Installation



Real-World Deployment





Application: Power Cable Tray & Tunnel Overheating Detection



Problem Solved:

Overheating power cables in confined trays and tunnels can lead to insulation failure and devastating fires, causing major service disruptions.



Our Solution:

- The sensor cable is installed along the length of the cable tray or tunnel.
- Detects overheating, short circuits, and fire ignition points in real-time.
- Provides the exact location of the fault (by meter) for rapid isolation and repair.
- Operates reliably in enclosed, humid, and high-temperature environments.

Application: Conveyor Belt Fire Prevention



Problem Solved:

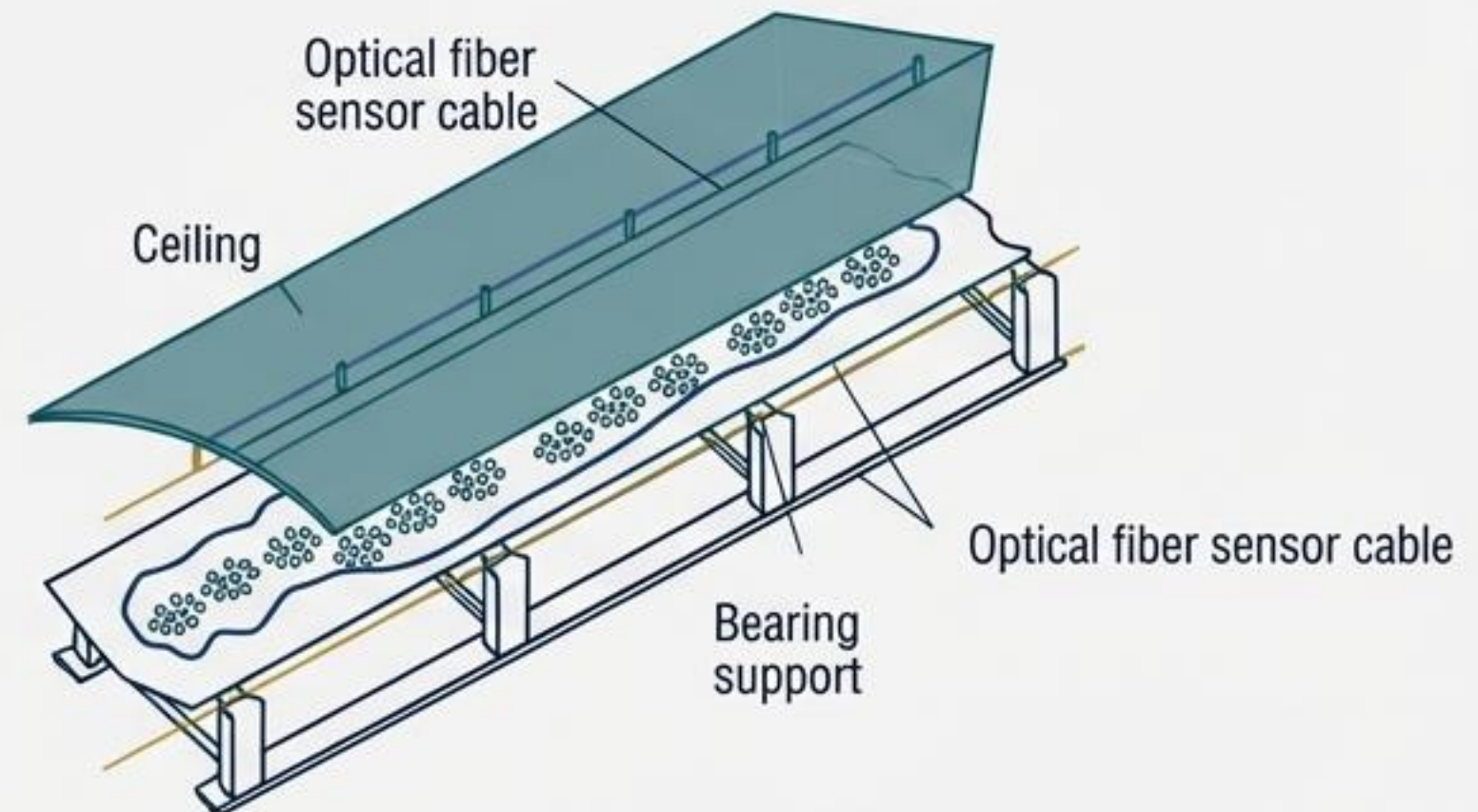
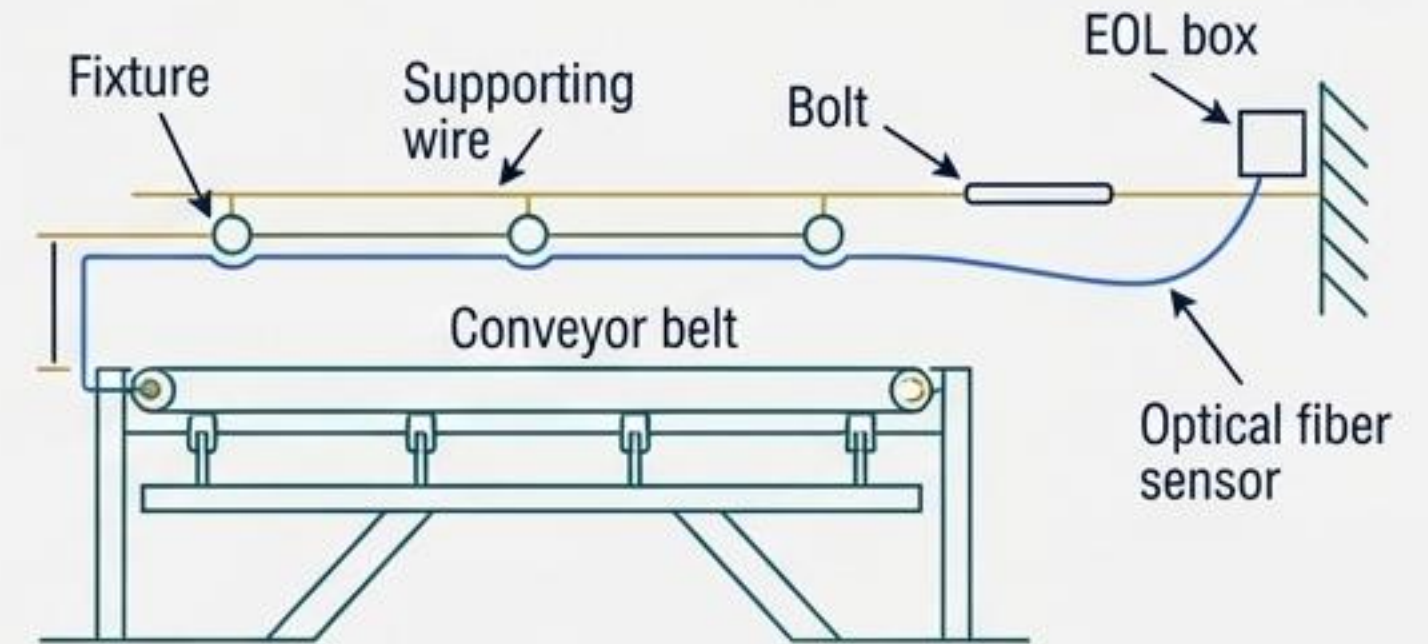
Friction from bearings or smoldering materials (like coal) on long conveyor belts can cause fires that spread quickly, leading to catastrophic damage and shutdowns.



Our Solution:

- Continuously monitors the temperature along the entire conveyor belt system.
- Detects hot spots caused by bearing friction or burning materials.
- Provides early warning to prevent fire, explosions, and costly equipment downtime.
- Ideal for power plants, coal mines, cement factories, and shipping ports.

Coal transport trestle temperature monitoring



Application: Highway & Utility Tunnel Fire Safety



Problem Solved: Fires in tunnels are extremely dangerous. Early detection and precise location are essential for effective emergency response and evacuation.



Our Solution:

- Sensor cables are arranged along the ceiling or walls of the tunnel, often above cable trays.
- Provides early detection of fires, hot spots from electrical faults, or other thermal anomalies.
- Reports the exact location of the incident to emergency management systems.



Real-World Deployment





VTI Corp: A Trusted Partner for High-Tech Monitoring Solutions

With the VTI-GL-100C system, we deliver not just a product, but a comprehensive solution that protects assets, optimizes operations, and ensures human safety.