Pipeline Monitoring
Services and expertise that improve operability, efficiency, and certainty
Schlumberger is the world’s leading provider of pipeline monitoring using fiber-optic technologies. We design, deliver, and support pipeline surveillance solutions for operators and plants around the world.

Sensa® fiber-optic monitoring systems deliver industry-specific solutions to protect our customers’ investments through real-time measurement interpretation and provision.

Throughout the process, we ensure that customers’ needs are met through operator training, presite surveys, project management and execution, customer support, in-house graphical user interface (GUI) development, and service and maintenance provision.

Balancing innovation with quality enables us to manage and implement the most commercially viable solutions. In addition, our inherent partnership culture enhances our ability to deliver solutions on time and within budget constraints.

APPLICATIONS
- Transmission pipelines
- Infield production flowlines
- Gas reinjection facilities
- Hazardous chemical pipelines
- LNG tanks and pipelines
- Subsea interconnector power cables
- Subsea flexible risers and umbilicals
- Subsea integrated production bundles

ADVANTAGES
- Enables swift preventive action
- Improves operability through minimized false alarms
- Achieves best-in-class measurement profile
- Fosters seamless data connectivity
- Maximizes hardware scope with long optical range
- Simplifies installation and does not require operational maintenance of in-field equipment
- Detects, identifies, and locates multiple simultaneous disturbances in real time
- Facilitates adjustable detection sensitivity along the asset relative to the local environment
- Requires no infield electrical power supply
Leak Detection Solutions

Leaking pipelines can pose safety risks of product ignition, and exposure leaks can result in damage to the environment, leading to the incursion of substantial cleanup costs, regulatory fines, and damage to corporate reputation.

Comprising a suite of systems developed in house and multiple technologies, Schlumberger leak detection solutions enable monitoring the entire length of pipelines in real time, delivering notification of a leak, intervention, or unwanted activity directly to the control room.

With this real-time insight, pipeline activity can be immediately reported and remediated, thereby minimizing the potential impact of theft, breach, or production slack. This enables operators to focus repair activities on minimizing potential environmental effects, the cost of repair, and downtime.

By linking the Schlumberger surveillance system to the plant distributed control system, personnel can be alerted by an alarm if any anomalies are identified at any point along the pipeline.
1. Identify monitoring requirements
2. Characterize physical phenomena
3. Define target measurement
4. Acquire and interpret data
5. Consider installation parameters
6. Deliver performance summary
A variety of requirements is placed on leak detection systems. Schlumberger has the technology and expertise to help you select appropriate detection methods depending on your application.

1. **Identify monitoring requirements** — The first step involves evaluating the monitoring requirements for the job. Schlumberger uses three methods of identifying such requirements.
   - Distributed temperature signature (DTS) is used to seek and report temperature differences brought about by leaking product. A localized change differentiating from normal is considered a leak by various mechanisms. Escaping gas generates a low-temperature signature because of the thermodynamic effect of adiabatic expansion, also known as the Joule-Thomson effect, and escaping oil in a heated line generally causes a local increase — both of which are suited for temperature sensing.
   - Distributed acoustic signature is used to seek audible events such as walking, digging, and driving, thereby providing an early warning of sabotage. The leaking product is evident in several measurable ways — audible hissing from a breach, a transient impulse, or a simple standing wave.
   - Real-time transient method blends computational leakage detection with industry-recognized standards, including API Spec 1130.

2. **Characterize physical phenomena** — A pipeline leak is defined by a combination of factors divided into three general categories: leak physics and mechanics, pipeline fluid type and operating conditions, and environmental conditions. These factors help determine the resulting physical phenomena that any leak detection system aims to resolve. In cases of marginal operating conditions or unusual fluid compositions, modeling may be necessary for providing a clear picture.

3. **Define target measurement** — Spatial extent and amplitude are the primary characteristics to consider. This stage determines the performance required to reliably detect the generated physical feature, including spatial and temperature resolution and measurement duration.

4. **Acquire and interpret data** — Schlumberger then generates a short list of applicable technologies that meet the initial performance requirements.

5. **Consider installation parameters** — Additional specifications, such as pipeline length, availability of hardware locations, and cost and installation practicalities, are also considered.

6. **Deliver performance summary** — The conclusion of the design process is a short list of design options that enables the operator to make well-informed decisions.
Schlumberger expertise and industry experience covers a wide range of measurement systems, applications, and domains—from the development and deployment of industry-spanning technology to postinstallation support, operator training, data analysis, remote communications, and data visualization.

We invest a high proportion of revenue on an annual basis into new product and existing product development and testing. Leak detection expertise has been developed through computational modeling, large-scale trials, and real-world application experience.

Schlumberger employs a number of software options to ensure the delivery of relevant data streams to the control room. Multiple levels of functionality are used to ensure the most appropriate data and monitoring levels are available for individual asset monitoring requirements.
Schlumberger leak detection software consolidates multiple instrument data streams, presenting the operator with a single harmonized user interface. The operator-facing software forms a key part of the pipeline integrity management operating procedure. The data delivered to the control room enables analysis and interpretation of potential leak events, thereby supporting the decision-making process. Alarms are directly delivered from the software to the pipeline or plant process control system via industry-standard protocols.

The software consists of two fundamental elements—a powerful multistream data management architecture and an easy-to-use GUI. The data management architecture ensures that every event is received from the connected data acquisition instruments, handled appropriately, processed, and presented to the operator in line with operational procedures. Alarm management can be tailored for each system depending on requirements.

Benefits

- Dynamic geopositioned satellite map of complete asset
- Ability to zoom from the high-level overview down to a resolution of a few meters anywhere
- Precise location of events and alarms
- View of five recent unacknowledged alarms on all screens and links to all other interfaces
- Detailed information for all events and alarms with the ability to open the relevant live data stream centered on the selected event
- Deep-dive interpretation of the characteristics of an event of interest
- Simultaneous visualization of multiple data streams from different locations
- Connectivity and data acquisition status information presented on system health screen
Fiber-optics-distributed sensors are based on optical time domain reflectometry (OTDR), a proven technique that has been widely used across the industry for many years. In OTDR, pulsed laser light is emitted into an optical fiber. As the light propagates, the imperfections of the glass lattice scatters a proportion of the light backward, creating a normal baseline. External influences, such as temperature, vibration, and strain, induce changes in the glass's structure, causing proportional changes in the backscatter signal. The instrument is configured to analyze specific wavelengths of backscatter light. This variation is used to analyze temperature, strain, vibration, and acoustic measurement.
Project Management, Installation, and Commissioning

Project management teams draw on strengths from within the company to provide a single customer interface throughout and beyond the installation and commissioning process. Proven management and organizational processes ensure project delivery to detailed specification using method statements, risk assessments, and QHSE requirements.

Our bespoke database system reinforces existing controls to manage workflow for project awards of all sizes. From the moment your contract is placed, the Schlumberger project management team ensures smooth progress from purchase order to project handover and acceptance testing.

Each project is assigned a dedicated project manager, who serves as a single point of contact and manages delivery of
- factory acceptance testing (FAT)
- site acceptance testing (SAT)
- field splicing
- project documentation
- site supervision
- all other elements of the project to bring it to a successful conclusion.

Dedicated installation teams are highly skilled in the deployment of fiber-optic sensors and commissioning of our instrumentation and associated software applications.

Experience and a proven approach ensure minimal disruption to operations throughout the installation process. All installation and commissioning services are undertaken to required QHSE standards and can be supported by onsite personnel. Schlumberger also offers remote operator training programs to ensure familiarity with the solution and software capabilities.

The solution can be configured and integrated with existing systems, and an acceptance test will confirm communication with the SCADA system. Remote monitoring facilities provide additional customer asset analysis, and a remote diagnostics capability enables limited reconfiguration and diagnostic adjustment to be carried without the need for a site visit.
Our range of distributed fiber-optic sensors are designed and manufactured at the Schlumberger Fiber Optics Technology Center in the UK.

**Short-range fiber-optic temperature sensor**
- Real-time asset monitoring optimized for short-range duties to 4 mi [6 km]
- High-performance DTS system aimed at localized monitoring with remote communications

**Standard-range fiber temperature sensor**
- Real-time asset monitoring
- High-speed and accurate temperature measurements over ranges up to 9 mi [15 km]
- Up to 12 independent channels

**Long-range distributed temperature sensor**
- Accurate, single-ended temperature measurements for ranges up to 31 mi [50 km] using multiple laser interrogation techniques with dynamic optical loss correction along the length of fiber

**Long-range dual-channel fiber-optic temperature sensor**
- Long-range interrogator optimized for real-time pipeline surveillance
- Delivery of primary measurements of both temperature and strain from single-mode fiber
- Linear distances up to 62 mi [100 km]

**Real-time intelligent fiber-optic vibration sensor**
- Real-time vibration and acoustic monitoring that enables detection, identification, and location of multiple simultaneous disturbances over ranges up to 24 mi [40 km]
- Use of artificial intelligence to recognize different asset threat types
The real-time intelligent vibration sensor can recognize different asset threats over a range of up to 24 mi (40 km).

The short-range fiber-optic temperature sensor offers multiple temperature duties to 4 mi (6 km).

The long-range sensor enables measurement up to 31 mi (50 km) in a single-ended configuration.
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