A Senstar Corporation White Paper

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Pipeline Security

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Abstract

Forty percent of the world's oil is moved by pipeline. Producers are currently using half a million miles of pipeline in the US alone to transport oil, natural gas and hazardous liquids. At present there are 112,000 miles of pipeline planned or under construction worldwide, of which over 28,000 miles will be in the US and Canada.

Projections by Virginia-based ICF International suggest that 4,600 miles of pipeline will be laid in Alaska and Canada between 2013 and 2030. By 2020 China plans to create a 1,970-mile pipeline in Guangdong Province with the aim of supplying gas to 21 cities. The cost of laying down an oil or gas pipeline is currently estimated at $US1M per mile.

Threats

Damage in the form of terrorist sabotage or tapping by thieves is by far the largest cause of worldwide pipeline failures. (Tapping is rare in the Middle East, but common in south-east Asia, Africa and Latin America.) Terrain that is both politically unstable and prone to climatic upheaval is likely to suffer the worst levels of supply disruption, with Colombia, Ecuador, Chile and Nigeria having experienced problems on both fronts recently. In North America, inadvertent 3rd party damage is the biggest threat.

Attacks on pipelines have long been identified by Al Qaeda as an objective though, with the exception of the 'apostate' economy of Saudi Arabia, the targets lie outside the Middle East. In addition to those from terrorist groups, threats can come from military adversaries, organized oil smugglers and armed rebels.

Colombia's Ministry of Defense reported 67 major pipeline attacks by guerillas in the country between January and June 2012. Attacks in

Yemen during 2012 by small groups of separatists cost $US15m per day. In 2006, the Abule Egba pipeline explosion in Nigeria killed hundreds of people. Recent 'lone wolf' attacks have seen a 40-year-old Caucasian male with no known terrorist connections confess to placing an IED under a natural gas pipeline in the US state of Oklahoma. In addition to sabotage, pipeline operation can be compromised by accidental manmade threats such as seismic disturbances caused by legitimate civil engineering works in the area, or even by farming activity.

Pipeline safety and security necessarily involve federal agencies, oil and gas pipeline associations, pipeline operators and local communities. Leading suppliers of pipeline protection solutions such as Senstar are accustomed to working with a range of parties both singly and in groups when implementing products.

Impractical solutions

Many perimeter intrusion protection methods that have been successful in other environments have proved impractical for pipelines. The requirements for pipeline protection include very long protection sites, the need to be concealed, and most times sensors must have EMI immunity. As a result of these unique requirements, the solution needs to be similarly unique.

A consensus practical solution

In view of limiting factors experienced with other technologies, the industry consensus is that for remote sections of oil and gas pipelines, fiber optic-based distributed sensors are a very cost-effective means of protection. In urban areas, seismic sensors are a more practical application. For the fiber optic approach, the sensing fiber is dielectric meaning that electric charges do not flow through it as they would in a conductor, but instead shift only slightly from their average equilibrium positions causing dielectric polarization.

The main benefit for a perimeter intrusion system is that performance of the fiber is unaffected by the EMI and lightning frequently encountered in open spaces. Vibratory signals can be transmitted across longer distances and as such processing units can be fewer and farther apart. Installations will be cheaper and will have reduced carbon footprint, a crucial consideration for oil and gas companies as they face ever more stringent scrutiny from environmentalists. In rural areas, having electronics/processors exposed every few kilometers makes a system vulnerable for theft or damage; therefore the requirement is to have a small storage container or vault every few tens of kilometers with the electronics inside. An additional benefit is that installations of this kind are in no way restricted by line of sight.

To reduce costs and effort associated with installation, fiber optic sensors can be installed at the same time as the pipeline itself.

The prime requirement for pipeline usage is a high probability of detection (PD), with sensors working to fine thresholds but ignoring background 'noise' in the environment. Such a threshold might be sensitive to a level at which the seismic disturbance caused by a human being or an animal of a comparable weight crossing a buried pipeline does not trigger an alarm but a meaningful intrusion such as the use of any kind of digging tools does.

At remote sections of a pipeline in difficult territory with few treated roads suitable for vehicles, it can be extremely difficult to inspect the location of a possible pipeline breach except by air. Users therefore insist on a minimal nuisance alarm rate (NAR), the ability to locate

an incident precisely and fine-tuning of parameters including duration threshold, disturbance life and event life. Incorporating buried and fence-mounted sensing fiber in different locations for the same project is common practice and the desired parameters will vary according to the type of usage.

These complex requirements have seen Senstar offer FiberLR which can protect up to 48 km of pipeline in a single processor and detect the location of intruders within 30 meters of accuracy. This is of extreme importance, as in a 48 km configuration, first responders must have a clear area to investigate, otherwise the time taken to find the point of intrusion could render their efforts meaningless.

Other important benefits of FiberLR

- Environment, temperature resiliency
- Simultaneous intrusion detection
- Integration to Physical Security Information Management (PSIM) system

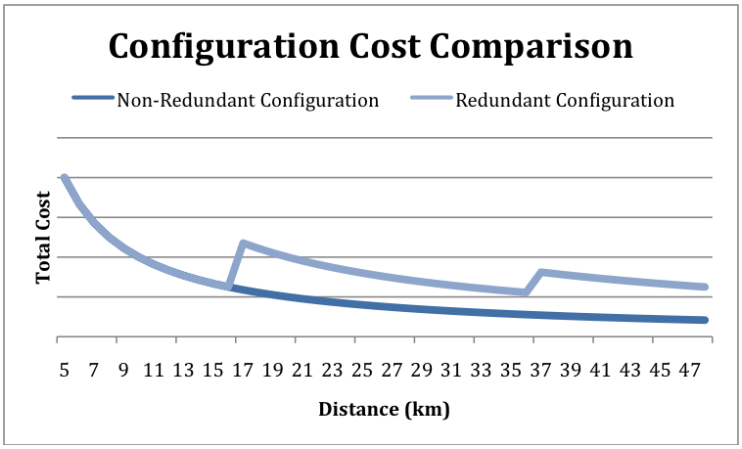
Long-term cost of ownership and return on investment (ROI) must be considered in terms of durability and ease of installation. Climatic conditions are also a factor and it should be noted that FiberLR can be used in a temperature range of -40°C - +70°C with no restriction on humidity.

Price concerns

The new FiberLR processor and technology is not cheap. Fortunately since pipelines are very long the cost of the processor is amortized on the full length.

If we also take into consideration the ease of installation, support and full cost of ownership then the Return on Investment (ROI) would even be greater.

Consultants should also insist on a product that can detect multiple simultaneous disturbances along an entire pipeline and the ability of fiber optic sensor equipment to integrate with PSIM systems in order to streamline the response by security officers or law enforcement agencies is a prerequisite. FiberLR can be offered in a redundant configuration for pipeline applications; however, installing in this manner would reduce the coverage capabilities drastically.



Integrated approach

Senstar's field experience has shown how effective real-world solutions which perform successfully and inspire user-confidence often require a variety of products to be integrated seamlessly. Long-range fiber optic distributed sensing devices such as FiberLR have become a default choice when securing remote stretches of pipeline.

However, buried pipelines are one component of the overall energy supply chain; protection of associated plants such as pumping stations, refineries and wells at locations with a communications infrastructure and where pipeline tends to be over ground may require other products from the Senstar suite such as the

FlexPS™ microphonic fence-mounted sensor which detects attempts to cut, climb or lift a fence fabric. There may also be a need for complementary approaches from Senstar's technology partners such as CCTV (including thermal imaging cameras), video analytics, intruder alarm and access control. With the luxury of infrastructure, fiber optic is not the only method and there may be the possibility of a tiered or 'onion skin' approach to perimeter protection.

Summary

Pipeline protection must be part of a coherent overall strategy for securing assets. With the largest suite of products in the perimeter protection sector, Senstar is able to offer a comprehensive choice of multi-layer intrusion detection systems that can be tailored to achieve a balance between minimizing NAR without compromising sensitivity and probability of detection (PD.) During implementation of a pipeline system, Senstar engineers collaborate with the client using proprietary algorithms to create context-specific event classifications which can achieve this balance and build confidence levels among staff at the site such that they wish to 'own' the system and will work to optimize it.

As a result of massive electrical power grid failures in 2012 (often resulting from floods) and the 2011 nuclear disaster at Fukushima, oil demand across the US, Japan and India has spiked in recent months. Take-up of alternative energy sources in the US has been slower than expected and OPEC is predicting steady worldwide oil demand in 2013 at 89.52 million barrels per day and 104 million barrels per day by 2030. Growth in long-distance road haulage of oil is unlikely. The pipeline oil transportation industry has no choice but to accommodate increased demand and the requirement for fine-tunable, reliable and environmentally-responsible pipeline protection will grow apace.